CRANFIELD UNIVERSITY

PAULINA ANGUIANO ARREOLA

A study of obesity drivers in Mexico using alternative future scenarios to define policy

SCHOOL OF WATER, ENERGY AND ENVIRONMENT

PhD
Academic Year: 2017 - 2022

Supervisor: Professor Tim Hess
Associate Supervisor: Dr Kenisha Garnett
February 2022

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ABSTRACT

In the last four decades, Mexico has experienced a rise in the prevalence of obesity among urban households, increasing the risks of comorbidities and premature deaths. This PhD thesis examines what is driving obesity in urban Mexican households to develop a systemic understanding of consumers' eating choices and health behaviours and how these drivers interact and change eating choices and dietary behaviours under alternative future scenarios. This analysis leads to a discussion about potential policy implications to encourage healthier eating choices and improve dietary patterns.

The largely qualitative research comprised:
1. A broad literature review to identify drivers of obesity, using a Social, Technological, Economic, Environmental, Political, Legal and Ethical (STEEPLE) framework to identify a broader range of external drivers influencing individuals' eating choices in Mexico.

2. A theoretical framework that combines the Theory of Planned Behaviour (TBP) and Social Cognitive Theory (SCT) to encompass the impact of external and internal factors that influence eating choices.
3. A survey to understand individuals' eating behaviours and the impact on nutrition from a selected sample of the population in Mexico.
4. The development of scenarios to deliver plausible futures in the context of consumer's behaviour, eating choices and impact on obesity in Mexico.

The results showed the importance of multidisciplinary collaboration within the system that can breach the pre-existing gaps between the education, health, and food production sectors. In addition, the findings confirmed the influence of eating choices associated with food insecurity, driven in part by social inequalities and political and legal agreements, which influence internal behaviours and impact health.

In addition, scenario development results suggested the need to support community/regional food production projects, re-evaluation of current initiatives, integration of multiple sectors to enhance collaborations, higher transparency in the developed initiatives. The measures can a) increase economic, education, and employment opportunities; b) improve sociodemographic equality; c) improve health literacy; and d) promote food security.

Main contribution of this research was a more holistic and improved perspective of consumers' eating choices and health behaviours through the visualisation of a systemic understanding, derived from selected methods of literature, theoretical framework, consumer survey and scenarios to set the connections between external and internal drivers.

Keywords:

STEEPLE, cognitive dissonance/value-action gaps, eating choices, sociodemographic inequality, food policy.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

A^3	Availability, Affordability, Accessibility
BMI	Body Mass Index
CVD	Cardiovascular Disease
DM2	Diabetes Mellitus type 2
ENSANUT	National Health and nutrition survey
ENEQ	Normal School from the State of Queretaro Campus Jalpan
FDA	U.S Food and Drugs Administration
FDI	Foreign Direct Investment
GNKQ	General Nutritional Knowledge Questionnaire
IMSS	Mexican Social Security Institute
ITQ	Technological Institute of Queretaro
GDA	Guideline Daily Allowance
GDP	Gross Domestic Product
NAFTA	North America Free Trade Agreement
NGO	Non-Governmental Organisation
O	Obesity
OECD	Organisation for Economic Cooperation and Development
OW	Overweight
S	Stage
SCT	Social Cognitive Theory

SES   Socioeconomic sector

SCFI   Secretariat for Trade and Industrial Development

SSA   Health services

SSB   Sugar Sweetened Beverages

STEEPLE   Social, Technological, Economic, Environmental, Political, Legal,
           Ethical.

TPB   Theory of Planned Behaviour

UN   United Nations

UAQ   Autonomous University of Queretaro

USMCA   United States, Mexico, Canada Agreement

W/H   Waist/Hip

WHO   World Health Organisation

Chapter 1 Introduction

1.1 Obesity in Mexico

Obesity has profoundly affected the world over the past 40 years and the number of prevalence has tripled since 1975 (WHO, 2020). Globally in 2016, 1.9 billion adults were overweight, and 650 million were diagnosed with obesity (WHO, 2020). More than 200 diseases are linked to people who are overweight and obese, and deaths from both conditions are associated with cardiovascular diseases, Diabetes Mellitus type 2 (DM2) and many forms of cancer (The Council of the Obesity Society, 2008; De Lorenzo et al., 2019). Obesity is responsible for about 5% of global mortality each year (Dobbs et al., 2014). Since 2013, incidences of obesity in G-20 countries have grown by 0.5 to 1.5 percentage points (Dobbs et al., 2014). It is anticipated that, despite healthcare interventions and health awareness campaigns, the number of people who are obese worldwide will continue to grow (De Lorenzo et al., 2019). The economic cost of global obesity in 2014 was over $2 trillion, or 2.8% of global GDP (Dobbs et al., 2014; Tremmel et al., 2017).

The prevalence of obesity in Mexico is driven by changes in social, economic, and geopolitical situations. In the last 30 years, the number of people aged 15-75 who were overweight and/or obese in Mexico increased by 42.2% (Dommarco et al., 2018; Barquera and Rivera, 2020). Increasing levels of people with overweight and obese place a burden on the medical system because of the increase in the number of comorbidities such as DM2, hypertension and cardiovascular diseases. Obesity has been estimated by the Organization for Economic Cooperation and Development (OECD) to have reduced life expectancy in Mexico by 4.2 years, compared to 2.7 years on average in the remaining block nations (OECD, 2019). This has had a significant impact at a national level, where the estimated loss associated with premature deaths and/or work absenteeism is 5.3% of GDP (OECD, 2019). Combined figures from the National Health and Nutrition Survey (ENSANUT, 2012) indicate that, between 1988 and 2012, the number of people who were obese and overweight increased by 8.7% in men and 36% in women. Researchers found that the death rate in Mexico associated with DM2 rose nearly 47% from 1980 to 2000 and that DM2 was the ninth leading cause of death in 1980 but the third leading cause of death by 1997 (Barquera et al., 2003, 2013). In 2016, DM2 in Mexico ranked as the primary cause of death for women and second for men (Bello-Chavolla et al., 2017; Gutiérrez-León et al., 2022). Additionally, in 2019, Mexico became the sixth country

worldwide with the highest level of expenditure to treat the disease, valued at 17 billion USD (Gutiérrez-León et al., 2022).

In developed countries such as the US or countries in Europe, men tend to have higher rates of obesity than women (Kanter and Caballero, 2012). The exceptions in Europe where obesity is found more in women than in men are the Netherlands, Lithuania, Turkey and Iceland (OECD, 2022a). Similarly to the exceptions in Europe, in developing countries such as Mexico, classified as an upper middle-income developing country (OECD, 2022b), the prevalence of obesity in women is greater than in men (Kanter and Caballero, 2012).

In G20 countries, 24% of women were obese, compared to 19% of men (OECD, 2019). A possible explanation can be linked to cultural perceptions and social norms: In some developing countries, specific demographic groups continue to associate the larger female body size with a higher level of fertility, health and wealth (Kanter and Caballero, 2012).

The national prevalence of people who were overweight and obese in Mexico between 2018-2019 was found to be 77% in women and 74% in men (Shamah-Levy et al., 2020). Women were 37% more likely to be overweight and 40% more likely to be obese, whereas men were 43% more likely to be overweight and 31% more likely to be obese (Shamah-Levy et al., 2020). From 2012 to 2018, the prevalence of obesity in women rose from 38% to 40%, and in men it rose from 27% to 31% (Shamah-Levy et al., 2020). For both genders, the highest level of obesity occurred between ages 40 and 49 (Shamah-Levy et al., 2020).

Cardiovascular events, DM2, and cancer remained Mexico's top three causes of death in 2019 (INEGI, 2019). The causes of mortality reflect the severity of Mexico's epidemiological emergency and the crisis in the nation's health system. Gaps in the healthcare system's management need to be recognised, particularly those that can better engage with people and the transmitted messages of eating choices and health recommendations.

1.2 Nutritional transition in Mexico

Changes to the socioeconomic, political, and environmental landscape in Mexico led to the transition from traditional to poorer quality diets. The nutritional transition is a major change in the sequence of both diets and physical activity that occurs across human lifestyles (Popkin, 2015). Popkin (2003) explained that changes in diets and physical activity are driven by a wide range of factors such as urbanisation, economic growth and change in culture and technology.

The three stages associated with the nutritional transition proposed by Popkin (2002, 2003) are:

Stage 1) Diets characterised by starchy and low variety foods, low fat, and high fibre.

Stage 2) Increased consumption of fatty, sugar-processed foods, adoption of sedentary lifestyles.

Stage 3) Behavioural change - reducing consumption of fatty foods, expanding fruit, vegetables, and fibre consumption, and increasing physical activity.

The Mexican traditional diets reflect the characteristics in stage 1 and 2 above with an increase in the production and consumption of processed foods that are high in saturated fats, salt, and sugar. This is possibly attributed to the Mexican food system, which is predominantly controlled by wealthy transnational corporations that decrease the production of fresh produce from rural farms due to the increase of mixed, industrialised, and processed production (Rivera *et al.*, 2002; Denham and Gladstone, 2020).

The Mexican diet consists of a mix of several carbohydrates, including legumes (pulses), traditional vegetables, and some fruits, with moderate amounts of animal food, which also includes more complete proteins (Casanueva et al., 2008). The Mexican diet is based on maize, beans, and chilli, with the addition of other foods dependent on cost and availability (Casanueva et al., 2008) (See Appendix A -Table 1 explains in detail the different food groups and delivers culinary examples of each one). Historically, food products like meat, eggs, fruits, vegetables, dairy, cheese, and processed products are integrated into the diet in favourable economic conditions. In general, food products such as legumes, seafood, fruit, vegetables, and dairy are estimated to account for between 1–23% of the total energy intake (Casanueva et al., 2008; Rivera et al., 2016). Unfortunately, the processed food group (high in saturated fats and added sugars) showed a higher figure accounted for 26% of the population's energy intake (Rivera et al., 2016).

In addition, the Mexican diet was stigmatised as there was an increase in the tendency to follow diets with a predominance of refined foods, rich in energy, saturated fats, and preservatives such as sugars and salts, and low in fibre (Casanueva et al., 2008). Despite the vast food variety, Mexico has been affected by global changes that have many facets of society and health behaviours, including eating choices. Among these changes was the impact on daily consumption and transition of dietary choices due to the dynamics of the food system (Herforth

3

and Ahmed, 2015). From 2000 to 2013 daily food energy purchased by the Mexican adult population decreased from 2,428 to 1,875 kcals (Marrón-Ponce et al., 2019). However, the decrease focused mainly on unprocessed food such as fresh fruits and vegetables (-69.8%), and pulses (-61.4%) whilst energy from processed food, such as 'ready to eat meals' (+5.7%) and sugar-sweetened beverages (+6.5%) increased (Marrón-Ponce et al., 2019). Consumption outside the home has also been increasing (ENIGHT, 2018).

FAO (2019) reported that, from 1970 to 2013, the energy supply by food groups in Mexico suggested a constant rise in the consumption of animal food origin, such as milk (+0.4%) and meat (+5.1%). The energy supplied from sugars (+1.3%) and fats (+5%) was further increased. In contrast, there was a marginal increase in the energy supplied by fruits (+0.1%) and vegetables (+0.6%). In the case of pulses, there has been a decrease (-3.6%).

Between 1992-2016, the National Household Income and Expenditure Survey (ENIGH) reported in 2018 a decrease in fruits and vegetables expenditure, from 3.6% to 3.4% and from 9.5% to 7.4% respectively (Colchero et al., 2019). The same survey showed that expenditure on products with a high caloric value (e.g. snacks, crisps, desserts, chocolates, puddings, ice-cream) rose from 4.3% to 5.2%; sugar-sweetened beverages rose from 4.7% to 5.6%; whilst milk expenditure decreased from 7.5% to 4.8% (Colchero et al., 2019). Consumption outside the home also increased (ENIGHT, 2018).

1.2.1 Dietary differences between rural and urban areas in Mexico

In the last census (INEGI, 2020), the population in Mexico was estimated at 126 million inhabitants, of whom 78% reside in urban areas and 22% in rural areas. There are structural challenges related to poverty that mainly affect people living in rural areas (FAO, 2019b). The percentage of food consumption between 2016 and 2019 in rural and urban levels highlights differences in almost all food groups, with the exception of sugar sweetened beverages (SSB) (ENSANUT, 2016; 2018-19).

In 2019, the National Dietary survey (ENSANUT) showed the pattern of consumption by food groups. The report from data collected in 2016 showed that consumption of vegetables and fruits in rural areas dropped by 4% and 3%, respectively; Legumes dropped by 14% and meat by 32%; Egg and dairy products dropped by 20% and 15%, respectively; Fast food or Mexican street food vending remained the same at 13%; snacks, sweet and desserts decreased by 3%;

sweet cereals dropped by 15%; lastly, sugar sweetened beverages (SSB) consumption increased by 1%.

In contrast, in the urban zones the vegetable consumption increased by 3% whilst fruits consumption dropped by 2%; Legumes dropped by 16% and the meat dropped by 20%; Egg and dairy products dropped by 18% and 15%, respectively; Fast food or Mexican street food increased +2%; snacks, sweets and desserts dropped by 4%; sweet cereals by 11%; Finally, SSB consumption remained constant at 85%.

The notable and worrying reduction happened in the consumption of pulses and the differences in the percentage consumption of vegetables, which reflects the lack of support for "sustainable" "self-sufficient" production, particularly in marginal rural regions (Barquera et al., 2001).

1.2.2 Mexican dietary guidelines

The Mexican dietary guidelines are outlined in the Official Mexican Standard norm -043-SSA2-2012 "Basic health services. Promotion and education for health in food: Criteria for Guidance" (Health Secretariat, 2013). As of 2005, these guidelines, released by the Health Secretariat, established the nutrition standards for Mexican diets with the last modifications and improvements made in 2012 and 2013 (SEGOB, 2021). The main intended audience for these guidelines was care providers such as nutritionists, dietitians, physicians, nurses, and community health workers (FAO, 2021).

The *Plato del Bien Comer* or "well-eating plate" (Figure 1.1) sets the base of a balanced diet established in the official Mexican norm, where it identifies the main food groups that individuals should be including in their diet. The norm focuses mainly on fruit and vegetables, cereals, and tubers, and lastly on legumes and animal food proteins (including dairy, meat, poultry, and fish). The guideline recommends combining cereals and pulses to provide the necessary amino-acids, equivalent to an animal food product (Iqbal et al., 2006).

Figure 1.1. Mexican Dietary Guideline (Source: Health Secretariat, Norm-043).

The main messages of the guidelines are: include one food from each of the three groups and vary the foods in the groups and the preparations; eat plenty of the green group, raw and shelled food, to reduce the energy density of the diet; consume wholegrain cereals without added sugars and combine with legumes; promote the consumption of pulses; moderate consumption of food of animal origin and, if consuming meat, choose white meat with low fat preparation, and semi-skimmed dairy products; emphasise the importance of combining and varying food; recommend three mealtimes with one food from each food group and two snacks; mention the importance of food moderation in terms of frequency of consumption and portion size; drink plenty of plain water as a primary source of hydration; consume as little as possible processed food and foods with added sweeteners; do not engage in other activities when eating, but do so in the company of the family and enjoy the meal; consume food according to individual needs; handle food hygienically; engage in at least 30 minutes of physical activity per day; maintain a healthy weight and follow it with a medical check-up; select indigenous and regional foods with local preparation; preferably use vegetable oils (Health Secretariat, 2005; López Talavera, 2021).

The guidelines in the "Well-eating plate" promote consumption using labels that are not precise in the quantity they apply. For example, the use of words such as "Too Much," "Enough," "Combine" and "Too little" is not specific and does not provide sufficient guidance on the quantity of different food groups to be consumed. Additionally, the well-plate features a traffic light colour scheme that allows consumers to associate it with the daily recommended amounts for each food group. Indeed, research by López-Olmedo et al. (2020) has shown that dietary

guidelines are not effective in promoting healthy behaviours as reflected in the low adherence from the adult population.

As discussed in Section 1.2.1 the current diet in Mexico demonstrates that the public does not adhere to the dietary guidelines. Despite the efforts of the guidelines and the recommendations, a study by Batis et al. (2016) found that among the adult population the adherence to the recommendation was only visible in red meat consumption at a high rate of >75%, while the level of adherence to the other food groups was very low <25%., This could be due to the distribution of convoluted and difficult-to-understand health information to the intended audience. Another cause could be the lower utilisation of public health services such as medical and nutritional counselling/orientation. Hence, there is a need to understand and expand on the factors that contribute to the Mexican population's failure to adhere to recommended nutritional practices.

1.2.3 Sugar sweetened tax in Mexico and other countries

Mexico is one of the countries where individuals drink the most sugar-sweetened beverages (SSB) (e.g., fizzy drinks). The daily recommendation is that added sugars, including SSB, should not exceed 10% of the total daily energy intake. However, SSB consumption in Mexico accounted for 20-23% of the daily total energy recommendation for added sugars (Barquera et al., 2008; Barquera et al., 2010; Barquera et al., 2013). Mexico dominated Latin America's retail consumption in 2013 with 184.9 litres per capita/ per year (LPC), followed by Chile 170 litres per capita per year and Argentina 156 litres per capita per year (Carriedo et al., 2021).

To implement a strategy on nutrition, in 2014 the Mexican government added a 10% tax on sugar-sweetened beverages or 1 MXN per litre (£0.040 GBP) (Colchero et al., 2017). The figure is controversial, as the tax recommended by the United Nations and the scientific community was ≥20% tax (Pedraza et al., 2018). Other Latin American countries that implemented the sugar-sweetened beverages (SSB) tax were Chile, Dominican Republic, and Colombia in 2015, Ecuador 2016, Peru 2018 (WHO, 2017a; Carriedo et al., 2021). Chile was another country where the health fiscal strategy for the reduction of SSB consumption was set at 18%, less than the WHO recommended (≥20% tax). The last SSB tax was increased from 13% to 18% (+ 5%) for high sugar drinks and reduced from 13% to 10% (-3%) tax in low sugar drinks (Cuadrado et al., 2020). These controversial figures can be linked to the fact that, in Mexico and Chile, companies would either absorb the tax and not include it in the final price and/or would promote the purchase of larger package sizes to avoid major price changes

associated with the smaller package sizes (Colchero et al., 2015; Vall-Castello, 2018; Cuadrado et al., 2020). In the United Kingdom, SSB tax was established at two tiers: the first tier is 0.24 GBP (6 MXN) with an 8g total sugar content per 100mL and the second tier is 0.18 GBP (4.50 MXN) with a 5g to 8g total sugar content per 100mL (Pell et al., 2021). Compared to the United Kingdom, the Mexican regulation lacks more specific sugar content requirements.

Despite not complying with the WHO recommendation, and the differences in the strategy there are positive effects in Mexico and Colombia, particularly among consumers from a lower socioeconomic sector (SES), which must be highlighted (Barrientos-Gutierrez et al., 2017; Vecino-Ortiz and Arroyo-Ariza, 2018). Taxes on SSB have decreased SSB consumption in Mexico, where the daily consumption of a taxed sweetened beverage decreased on average by 6% (-12 ml/capita/d) (WHO, 2017b; Vecino-Ortiz and Arroyo-Ariza, 2018; Colchero et al., 2019). The decrease in SSB consumption among the low-socioeconomic groups was estimated to be between 9% and 17% (Carriedo et al., 2021).

The UN have defined food security as, people, at all times, having physical, social, and economic access to sufficient, safe, and nutritious food to lead a healthy life (IFPRI, 2020). The criteria for food security include the following four dimensions: availability (i.e. production, stock level and commerce); accessibility (i.e. income, affordability, market and price); utilization (i.e. sufficient for the nutritional requirements, diversified diet); and stability (i.e. the level of security) (FAO, 2008).

Associated with poverty, food insecurity has been found to directly impact dietary patterns and the state of nutrition of individuals (Walls et al., 2018). Among the most common effects is malnutrition with deficiencies of macro and micronutrients (Bhutta and Salam, 2012; Walls et al., 2018). Thus, the relationship between food insecurity and obesity is paradoxical (Franklin et al., 2012). The paradox is the result of an increase in poor-quality diets with an excessive intake (Finney et al., 2012). The poor quality diets result from an increase in the availability, access and affordability of this type of food in the last four decades (Via, 2012). However, there is a need to further understand the links between food insecurity and the nutritional transition (Tapsell, 2017) to identify the factors influencing individual eating choices.

1.2.4 Mexican food production system

There is an ongoing challenge in Mexico to guarantee access to basic food to all social group levels. It is necessary to emphasise that Mexico's population growth is not concomitant with

increasing agricultural land. From 1980 to 2015, the population increased by 67%, while the land available for agricultural practices decreased by 31% (Baldivia and Ibarra, 2017). Between 2006 and 2012, the Mexican government's actions to increase the productivity of the agricultural sector increased the GDP by only 2% (Rivera et al., 2015). For the period 2012-2018, the GDP of the agricultural sector increased by 3.3% (Canales et al., 2019). In contrast, the production of processed products was estimated at 3.6% of GDP and represented 22.5% of GDP from food manufacturing, particularly in the bakery, tortilla, meat, and dairy industries (CEDRESSA, 2018). There are some concerns that this strategy does not support healthier diets, particularly where unprocessed fresh food products are deviated to ultra-processed products (i.e., high in salt, saturated fat and/or added sugars) and offered to consumers. On the other hand, those processed foods can offer a high value formulated product to contribute to malnutrition and micronutrient deficiencies.

From 2006 to 2012 there has been profound changes in the production, export and import of basic products such as corn, wheat, beans, sugar, sorghum, and soya beans in Mexico (Rivera et al., 2015). The 2006-12 indicators showed a high level of imports and a decrease in local crop production at the national level, leading to a significant economic deficit (Rivera et al., 2015). Both the deficit and the decline in national production have had an impact on food security and sovereignty (Rivera et al., 2015). At the same time, there was an inadequate Mexican food system that could not provide enough nutrition for the population, widening the gap between consumers and traditional diets, reflected in the nutritional transition (Popkin, 2003) and the prevalence of obesity and those overweight.

Furthermore, the private food processing industry in 2015 was forced within the official national standard Norm- 051 (General labelling specifications for pre-packaged food and non-alcoholic beverages) to display their developed nutritional label based on the Daily Dietary Guidelines (GDA) (Tolentino-Mayo et al., 2020). The GDA displayed on the product contains information about saturated fat, other fats, total sugars, sodium, and energy (Federal Commission for the Protection against Health Risks, 2016). However, there were many factors for not supporting this nutritional labelling. These factors included: daily diet of 2000 kcals (overestimating the caloric intake of children); low comprehension by the general population as it required nutritional knowledge and mathematical skills; reduced propensity of the general public to make a choice, based on the provided information (Tolentino-Mayo et al., 2020). Thus, understanding the impact of the food system on individuals' eating choices and health should be further studied.

1.2.5 Food insecurity in Mexico

The 2018 National Health and Nutrition Survey (ENSANUT) reported on Mexican food security status. At a national level, the proportion of food insecurity was estimated at 45% (ENSANUT, 2018). The households with food-insecurity accounted for 56% in 2018 (ENSANUT, 2018). Considering the three categories of food insecurity in ENSANUT in 2018 mild insecurity was estimated at 33%, moderate insecurity 14% and severe insecurity 9%.

In 2018, food insecurity was estimated at 70% in rural households (mild insecurity 41%, moderate insecurity 18% and severe insecurity 11%) (ENSANUT, 2018). In urban areas food insecurity was 51% (mild insecurity 30%, moderate insecurity 13%, severe insecurity 8%) (ENSANUT, 2018). Several factors contributing to food insecurity in Mexico have now been proven to be problematic. These include the increase in food prices, rapid population growth, pollution, soil degradation, environmental threats, oligopolistic and segregated agricultural food production systems, diversion and improper use of agriculture and livestock for non-food production, and financial and energy issues (Martínez, 2016).

The Basic Food Basket (*Canasta Basica*) instrument has been in use in Mexico since 1982 and was implemented by the National Council for the Evaluation of Social Development Policy (CONEVAL) in 2009 (Ruiz-Becerra and Sandoval-Godoy, 2018). It is a useful and practical tool that measures the level of food affordability (Ruiz-Becerra and Sandoval-Godoy, 2018). In Mexico, the affordability of food is a key factor restricting access to the basic food basket products, which has affected food security. It has been observed that the level of purchasing power is insufficient to cover the essential daily food basket, linked to the low wages in Mexico. One problem which reflects the above is that, since 2005, only 77-81% of the basic food basket is covered by a minimum wage (Toledo, 2014; Valadez-Martínez et al., 2018). In 2020, the minimum wage was 123 MXN per day (£4.2GDP per day), whilst the Basic Food Basket for an average home (3.6 members) cost 862 MXN per day (£30 GDP per day), representing a lag of 739 MXN per day (£25.3 GDP per day) (Bandala-Jimenez et al., 2021). Therefore, there is a need to understand how factors such as income levels affect consumers' eating choices and their overall effect on dietary habits and health.

1.2.6 Health initiatives to reduce malnutrition and overnutrition in Mexico

Over the last two decades, Mexico has worked to improve health, education, and agriculture in order to reduce malnutrition and overnutrition among its population (Barquera et al., 2001). Mexican health policies have followed worldwide initiatives, with development strategies

beginning with institutional aid and progressing to comprehensive inter-sectoral coordination programmes (Barquera et al., 2001). To reduce nutritional problems in Mexico, health initiatives follow a model that synchronizes three elements: health, social development, and economic development (Barquera et al., 2001).

- One of the first initiatives, which began in 1944 and continues today, was to produce and distribute milk branded as *Liconsa* which was fortified with iron, zinc, folic acid, vitamins A, C, D, B2 and B12. The primary purpose of the initiative was to reduce the problem of anaemia in children and the elderly population. The national dietary survey showed that the high consumption of *Liconsa* milk was associated with a lower risk of anaemia compared to those that did not consume it (De la Cruz-Góngora et al., 2019).

- The *PROGRESA* (progress) programme developed in 1997, currently known as *Prospera*, (prosper) was another important project, which aimed to integrate health with food production and education systems. The programme focused mainly on low socioeconomic sectors (SES) in urban and rural areas. Results from the programme showed a lower level of stunting in toddlers aged 24 to 29 months (+1.1 cm in the age-length) and a decrease of 10% in the number of cases of anaemia in rural infants (Rivera et al., 2004). In food production, the results were marginal with a growth of only 0.4% in the rural agriculture sector (Maldonado et al., 2016). In terms of education the impact was an average of 0.7 years of extra school enrolment, especially in girls at the secondary level (Skoufias and McClafferty, 2001).

- The *Diconsa* programme was designed to increase access of highly nutritious food, guaranteeing its distribution and affordability in remote areas with low SES population. Results have shown that just 33.3% of DICONSA stores are able to provide every product specified in the Basic Basket (ENSANUT, 2012). Furthermore, the poverty rate is around 45.2%, and nearly 23% of the people still face food insecurity (CONEVAL, 2015; Shamah-Levy et al., 2017).

- The community kitchen programme, which currently has more than 5,000 kitchens throughout the country, was set up in 2009 (Campuzano-Martínez, 2017). The programme has targeted people living in remote, vulnerable areas with extreme poverty. Its objective is to increase access to nutritious and adequate food (CONEVAL, 2016). A study by Balam-Gómez et al. (2013) showed the program has face challenges such as the lack of infrastructure and insufficient primary resources. The National Crusade Commission against Hunger was a strategy set up to target extreme poverty in remote,

vulnerable areas during the previous term of the presidential administration (2012 - 2018) (Casanueva et al., 2008). The programme focused on four primary objectives; to: 1) improve child nutrition; 2) increase monetary income and food production for rural farmers; 3) minimise food loss during transportation and 4) promote farming skills and activities (Casanueva et al., 2008). The results were visible in the National Dietary Survey. In 2018, the figures of those who were overweight and obese among severely food insecure infants had decreased by 35% compared with the levels in 2012 (Shamah-Levy et al., 2020). In adults obesity increased by 10% with moderate food insecurity between 2012 and 2018 (Shamah-Levy et al., 2020). The delivered cash of 310MXN (GBP 10.6) per month did not cover the monthly value of the Basic Basket 897MXN (GBP 31.49) in rural areas (INEGI, 2019).

- PROCAMPO is a government strategy that was implemented in 1993 and targets small food producers in rural communities. The strategy is to help rural Mexican producers meet their economic needs as well as contributing to the country's overall economic growth. Additionally, it encourages the production of legal crops providing monetary aid in return. There was mixed support for these programmes as they promote technological innovation that was not accessible for rural farmers nor appropriate for their environment (Barquera et al., 2001). On the other hand, the economic crises (e.g. 1987, 1994) and the trade agreements negotiated at that time increased the deficit and food insecurity (Barquera et al., 2001).

- Since 2000, the Mexican government's role in attempting to manage diabetes and obesity has included the development of health promotion programmes to: increase people's understanding of what is a healthy and nutritionally adequate diet and the role of physical activity to maintain good health; regulate highly processed/low nutritional value foods in Mexican primary schools; run educational campaigns for self-care of DM2; combine dietary guidelines with diagnosis and treatment of DM2; institute support groups for DM2 patients; improve knowledge and training for healthcare workers; and develop a National Health Card for adults to prioritise continuous evaluation of weight, blood sugar, blood pressure and cholesterol/lipids tests (Hernández-Romieu et al., 2011; Barquera et al., 2013).

Mexican health projects are in part constrained by their design in terms of evaluation, risk assessment, and accountability (OECD, 2018). One issue is that the food industry's regulations and policymakers' lack of cohesive protocols and standards that would ensure

positive eating choices (Poder S.C- Consumer's Power, 2019). Additionally, in Mexico, health education and the public health system have been working within a scheme of disease treatment rather than disease prevention.

1.3 Synthesis of the obesity crisis in Mexico

In summary, when trying to understand "what is driving obesity in Mexico?" there are important factors to consider. It is essential that the research takes into consideration and poses the additional question of "what leads to increased food insecurity and what is the impact of the nutritional transition in Mexico"? Then to further determine what drives obesity. The gaps that contribute to food insecurity and shape the environment of eating choices and changing dietary behaviours need to be further understood. Furthermore, the prevalence of people who are overweight and obese in Mexico reflects a lack of effectiveness in the Mexican Health guidelines (López-Talavera, 2021), suggesting there is a need to identify how these can be improved in order to support positive and healthy food choices and ultimately the transition to more healthy lifestyles.

Figure 1.2 summarises the factors that have contributed to obesity in Mexico
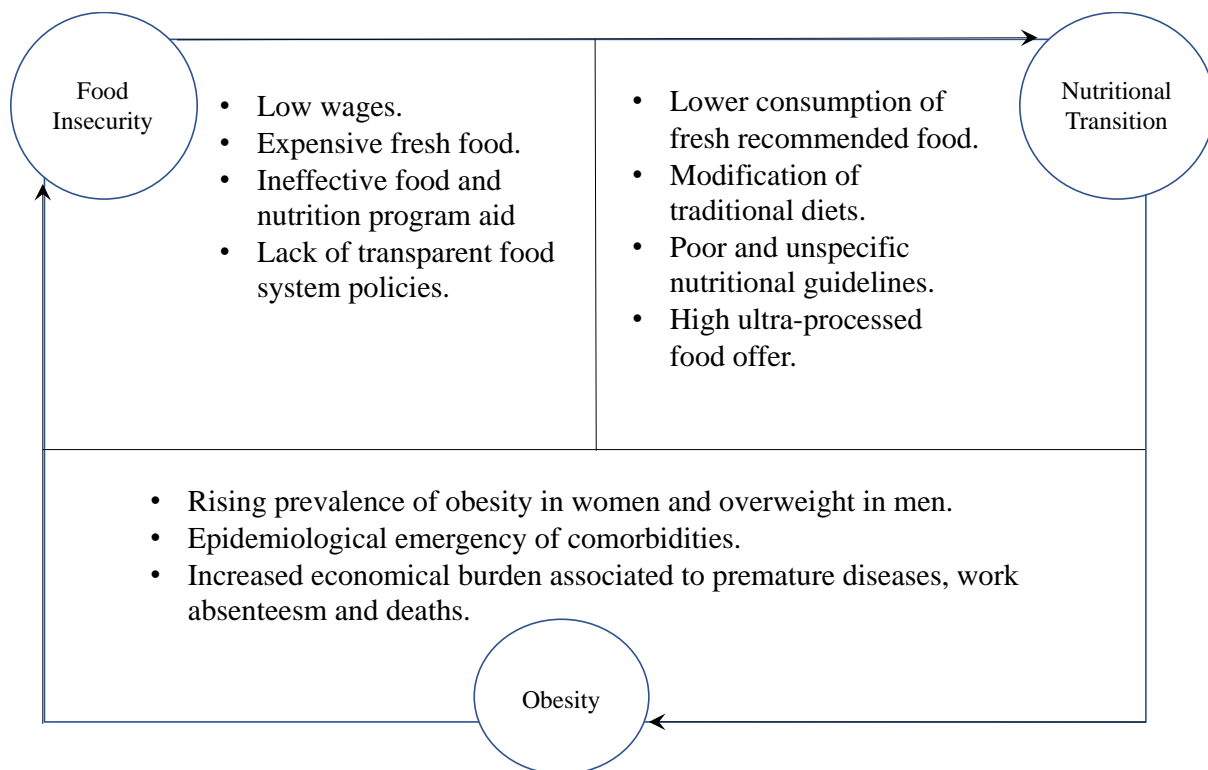
Figure 1.2 Summary of factors that have led to obesity in Mexico.

1.4 Aim and objectives

From this introductory chapter, several gaps can be identified –

- There is a need to identify the factors that increase food insecurity and the strategies that can be developed to reduce it.
- There is a need to identify the general behavioural responses to food insecurity and their impact on the nutritional transition.
- There is a need to understand and identify the key sociodemographic factors which affect consumers' eating choices and influence their health.
- There is a need to identify the factors that play a role in making a difference in the prevalence of obesity between women and men.
- There is a need to examine Mexican's health guidelines and what alternatives can be set to increase individuals' adherence to healthier behaviours (i.e., making a healthier eating choice).

It is, therefore, important to understand what pushes consumers' choices towards food products with a low nutritional value and leads to a gradual abandonment of healthier eating choices and a move to unhealthy behaviours. Hence, the aim of this thesis is to develop a systemic understanding of consumers' behaviours and the impact on obesity within the context of urban Mexican households and to recommend policy interventions needed to improve dietary patterns.

Identifying what influences eating choices and health behaviours requires an understanding from an environmental perspective, from which the STEEPLE framework can identify, through a broader scope, what drives individuals' eating choices. Moreover, the theoretical behavioural framework enables an understanding of the internal context of the individual to outline the path of decision. Additionally, the survey enables the observation and exploration of behavioural responses and their impact on health and nutrition using a conveniently selected sample. The scenarios can incorporate the data and provide plausible expected futures of eating choices and health behaviours.

The research proposed the following objectives:

1. To determine a range of external drivers that affect health-related behaviour and can lead to obesity.

2. To identify the behavioural factors leading to obesity, considering both internal and external drivers of change that influence eating choices and health behaviours and impact on nutrition in Mexico.

3. To develop alternative scenarios that explore future changes in diets, eating choices and health behaviours and the implications for policy interventions to address obesity in Mexico.

4. To inform policy makers of suggestions that support and provide advice on how to minimise and/or prevent obesity in Mexico.

1.5 Thesis Structure

The thesis is presented in seven chapters with five different stages as outlined below. Figure 1.3 shows the five different stages (abbreviated as S plus the stage number), the selected methods and data analysis for each stage.
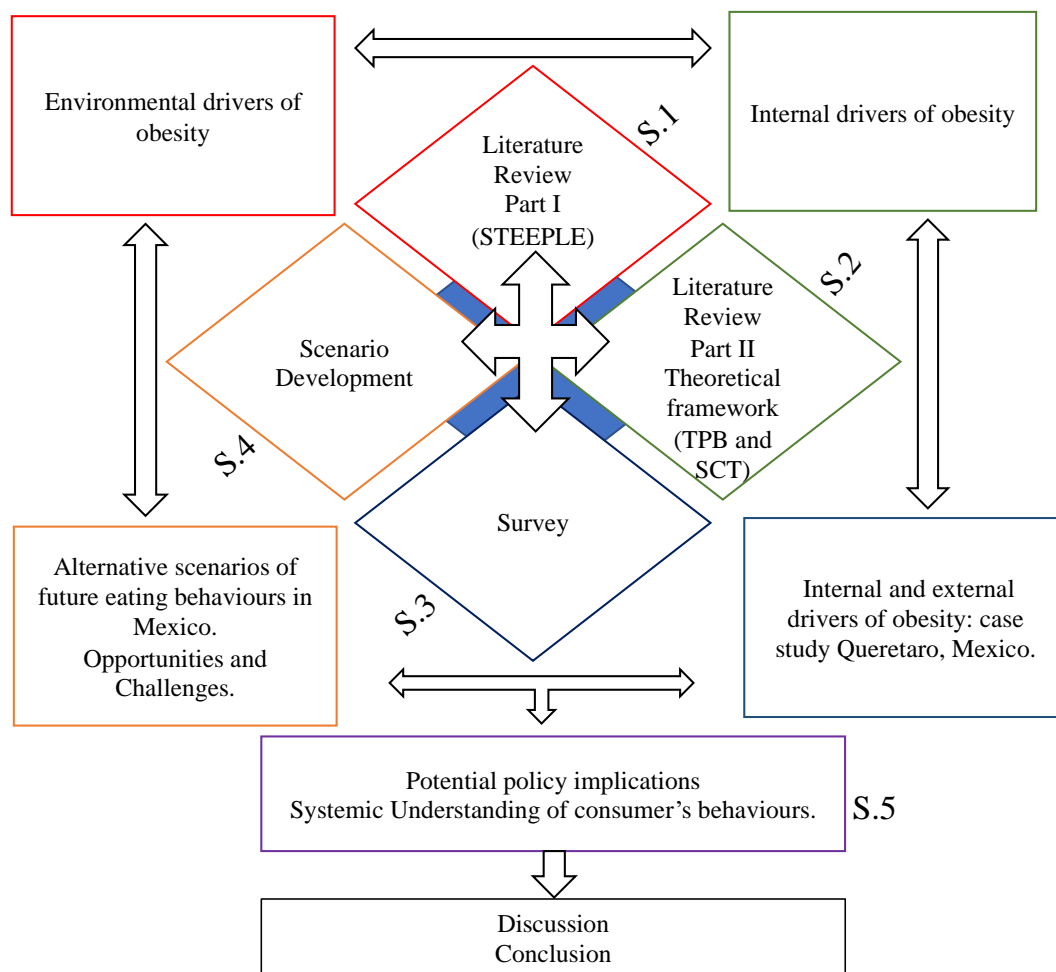
Figure 1.3 Stages of research, methods, data collection and analysis.

Chapter 1: Introduction

The introduction sets out the context for the research, including the main issue, and identifies the research gaps, the aim, and the objectives of the thesis. Finally, it describes the contribution to knowledge.

Chapter 2: Drivers of obesity in Mexico

The literature review highlights drivers linked to changes in nutrition and diets from individuals' environments that are important in the influence of eating choices and healthy behaviours, which may contribute to an increase in the incidence of obesity in Mexico. The STEEPLE framework was used to collect and analyse data on the influence of each of its components (social, technological, environmental, economic, political, legal, and ethical) on eating choices and health behaviours. The identified environmental factors linked to obesity provide a causal/consequence approach for understanding in-depth drivers and outcomes.

Chapter 3: Theories of Health-Behaviour Change

This chapter describes the integration of two social behavioural theories to create a conceptual framework that provides a perspective on what behaviours are essential for understanding and recognising essential internal behaviours that influence eating choices. The framework is represented as the second stage from which the built theoretical framework (Literature Review Part II) determines the behavioural components that influence an individual's eating choices, which can help to develop strategies for healthier food choices (McDermott et al., 2015). The drivers found to impact behaviours were incorporated into the scenario development and narratives to redefine the expected future in terms of individuals' eating choices and health. In addition, the behavioural framework used to align and set a path to develop a systemic understanding of consumers' eating choices and health behaviours.

Chapter 4: Drivers of eating choices and health behaviours. A case study in Queretaro State, Mexico.

A survey was developed and administered to identify factors that influence individuals' eating choices and health behaviours and their association with nutritional status. The chapter discusses the third step of the research, which involved developing and implementing a survey to collect data from a selected study case and location to analyse individuals' eating habits, their

internal drivers such as attitudes and perceptions, and their implications for health and nutritional status. The survey's findings were aligned with the obtained drivers from the literature to be used for the scenario exercise. The findings provided evidence to support and develop a customised systemic understanding of eating decisions to make policy and health/nutrition recommendations.

Chapter 5: Future scenarios of eating choices and health behaviours.

Alternative scenarios were developed that explore future changes in eating choices and health behaviours and the implications for policy interventions to address obesity in Mexico. The chapter represents the fourth stage of the research from which the scenario narratives and analysis aided thinking about how to influence eating choices and the impact on obesity in Mexico. The analysis of the scenarios identified opportunities and challenges associated with the individuals' environment and their internal drivers that can be expected to conduct eating choices in Mexico, offering insight for policy recommendations.

Chapter 6: Discussion

The discussion presents the findings and a systemic understanding of eating choices, considering all acquired data to provide potential policy recommendations. The chapter discusses the research and makes policy recommendations based on triangulating the findings from the scenarios, survey, behavioural theories, and literature. Throughout the framework, essential elements were identified to develop final recommendations that address the thesis's final objective of understanding eating choices and health behaviours that can mitigate and prevent obesity. The policy recommendations accompanied by critical characteristics of their implementation, advantages and disadvantages from a sociodemographic, stakeholder, sector, organization, and institutional context.

Chapter 7: Synthesis and Conclusion.

The chapter summarises the research's key themes and suggestions. Additionally, the chapter discusses all empirical and methodological contributions to knowledge. At the conclusion of the chapter, it discusses the chapters' limitations and future work.

Chapter 2 Drivers of obesity in Mexico

2.1 Introduction

The aim of this chapter is to identify a broad range of drivers influencing diets and health-related behaviour, which can lead to an increase in the prevalence of obesity. It provides an analysis of literature and secondary data using Social, Technological, Environmental, Economic, Political, Legal and Ethical (STEEPLE) analysis (Mokhtar and Deng, 2015). The purpose of STEEPLE is to identify the range of opportunities or threats which can influence and shape an issue or sector. The STEEPLE framework has previously been used by multiple firms and sectors to achieve their objectives through the assessment, understanding and elaboration of macro-environmental factors (Mokhtar and Deng, 2015). An example of how the STEEPLE framework has been previously used to explore changes in the food production system was in Zhao and Dou (2019), where the objective was to identify how production/management changes in the organic food markets could impact dietary choices in Great Britain.

2.2 Method

The STEEPLE framework is frequently used by organisations to identify critical macro-environmental factors that can influence decision making (Bouzid, 2020). Its main objective is to bring information, evidence and stakeholder perspectives to better understand external factors influencing the organisation's present situation and possible future (CIPD, 2022).

STEEPLE was chosen to conduct a literature review and identify current indicators of the relationship between environmental factors (e.g., heatwaves and increased consumption of sugar-sweetened beverages) and social factors (e.g., urbanisation and its impact on social inequality) to gain a better understanding of the eating habits and health behaviours that lead to obesity in Mexico. The STEEPLE analysis consists of three steps: the selection of keywords, the search for relevant literature, and the analysis of that literature. The current factors that affect and increase the prevalence of obesity have been identified through selected keywords from the research literature. As a result, the collection and synthesis of data delivered the discussion and qualitative analysis, assigning them to each of the STEEPLE elements. The analysis and discussion included a description of how and why the output drivers impacted Mexican eating choices and their consequences on the state of nutrition and health behaviours.

The output "drivers," will be related to the analysis of a survey to aid scenario development in the fourth stage of the method selected for this thesis.

2.2.1 Selection of keywords

The selected keywords were related to macroenvironmental factors characterised by their impossibility of being controlled by individuals that can lead to and/or are associated with obesity as guided by each of the STEEPLE elements. Figure 2.1 shows the chosen keywords for each of the STEEPLE elements used as the primary source to generate multiple themes that reveal potential gaps within the sectors of health, food production, economy, policies, technology, and environment. The themes are linked to the proposed research question: "what drives obesity in Mexico", which is operationalised to examine the influences on individuals' lifestyles and dietary patterns. For example, the themes are linked to factors such as- food insecurity that may lead to nutritional transition and obesity. Food insecurity and nutritional transition are linked to a variety of changes in nutrient status and intakes, raising the possibility of diet-related chronic diseases (Egeland et al., 2011).

Social	Urbanisation; Nutritional Transition; Neoliberal; Health; Reform; Macro-Environmental; Development System; Dietary Change; Gender; Mexico.
Technological	Television; Viewing; Obesity; Physical Activity; Digital obesity; Gadgets; Predictors; Sedentary; Systematic, Screen.
Environmental	Environmental; Warming; Climate Change; Water; Global; Systematic; Food Security; Obesity; Beverage; Gender; Intake; Mexico.
Economic	Households; Economic Intake; Logistics; Socioeconomic; Transition; Education; Nutrition; Security; Rural; Environment; Foreign Direct Investment.
Political	NAFTA; Trade policy; Food industry; Public policy; Development; Economy; Political Agriculture; Food Security; Sovereignty; Migration; Integration System; Regional.
Legal	Diabetes; Food; Front-of-package; Management; Labelling; Obesity; Security; Costs; Sugar-Sweetened Beverages; Consumers.
Ethical	Consumers; Developing; Ethics; Food-Marketing; Choice; Obesity; Countries; Public;Obesity.

Figure 2.1. Keywords used for the STEEPLE analysis grouped by themes.

2.2.2 Literature search

Search engines included Scopus, Web of Science, Elsevier, and Google Scholar. The search was through advanced search which included titles and abstract related to the keywords. A

screening method was employed - if a paper showed only a single word from a two-word or more keyword, it was excluded. The overall number of sources were 215; among those were 142 journal scientific papers, 66 reports, 6 book sections, 2 national surveys, 3 websites, 1 scientific magazine, 2 newspapers and 1 factsheet. From the 215 references, 199 were considered as literature review and/or secondary data sources. Sources that did not provide any kind of argument or contribute to the narrative of each of the STEEPLE elements were excluded.

The collected data was taken from journal papers both in English and Spanish and reports from official organisation websites such as CGIAR, FAO, WHO, U.S. Department of Agriculture (USDA), U.S. Trade Representative (USTR), Secretariat of Agriculture and Rural Development (SAGARPA), Prosecutor for the Consumer (PROFECO), and Social Development Secretariat (SEDESO). Moreover, secondary data to understand the state of nutrition was obtained from the National Nutritional Survey (ENSANUT). Secondary data on individuals' food choices was obtained from the National Household Income and Expenditure Survey (ENIGH). Food price data were gathered from the National Market Information and Integration System of Mexico (SNIIM), PROFECO and the Agri-food and Fisheries Information Service (SIAP).

2.3 Results and discussion

The outputs of the literature review are summarised, using the STEEPLE framework to highlight what has impacted individuals' eating choices and health behaviours.

2.3.1 Social

The neoliberal system and the neglected agricultural industry had a critical impact on obesity in Mexico. More than three decades have passed in which sociodemographic changes in Mexico shifted as the country was driven towards a neoliberal system shaping its economic growth and development (Laurell, 2015). One outcome of this neoliberal change was industrialisation, which brought an increase in urbanisation (Brenner and Theodore, 2012). The newly adopted neoliberal system neglected the agricultural industry (UNCTAD, 2013). The resulting neoliberal system shifted local crop productivity to "cheap" imports in order to "reduce" food prices (Fitting, 2011; Jones et al., 2017). The political changes endangered the agrarian individuals' work, ideas, and rights, radically transforming their lives (Jones et al., 2017).

The failing agriculture sector and the lack of economic investment in agriculture's productivity reduced subsidies and support for farmers resulting in fewer job opportunities. Additionally, the Mexican government's failure to support agriculture led to production methods that were not sustainable, which caused social problems and posed risks to the environment and people's health (Ibarrola-Rivas and Galicia, 2017a). Between 1993 and 2010, the lack of production due to a critical reduction in the Mexican government's economic investment in the agriculture sector caused a 28% decrease in labour opportunities (UNCTAD, 2013). Agriculture workers were compelled to seek work outside rural areas and, in some cases, outside the country. That would include an increase of crossing illegally into the United States of America (Labonté et al., 2019).

Moreover, the lack of support for small producers compared to large-scale producers enhanced inequalities and imbalances of opportunities across the sector (Ibarrola-Rivas and Galicia, 2017a). The shortage of opportunities increased financial difficulties for Mexicans due to reduced employment opportunities and low salaries. These financial difficulties led to detrimental effects on individuals' well-being and health attributed to economic and food insecurity. The result of the neglected agricultural sector led to socioeconomic changes, which forced Mexican farmers and small-scale producers to migrate from rural communities towards urban areas seeking labour opportunities and better lifestyles in the *maquiladoras* or the manufacturing sector (Clark et al., 2012).

Urbanization and socio-demographic inequalities pose challenges in daily life, influencing dietary choices. Migration to urban areas was accompanied by significant lifestyle changes, including a shift in dietary choices. One reason was that urban areas made it easier for them to obtain and consume imported goods such as SSB, rapidly increasing a nutritional transition (Barquera et al., 2003; Bermudez and Tucker, 2003; McGranahan and Satterthwaite, 2014; Popkin, 2015). In addition, sociodemographic disadvantages were persistent within urban areas. In some cases, people who migrated to urban areas were affected by poverty, social inequality, and limited employment and low educational opportunities. The new reality took a detrimental effect on people's lifestyles, health, and nutrition, strongly linked to food insecurity (Mercado et al., 2007; Patrick et al., 2016). Urban poverty would translate into an informal type of work without any social security, low and non-fixed salaries, and precarious housing, usually in the peripheries of the cities (Ziccardi, 2014). The main reason was the lack of efforts by the Mexican authorities to increase labour and income opportunities for the agrarian

individuals who recently migrated to urban areas, thereby increasing social inequalities and disclosing gaps within the system (Davis et al., 2002; Ziccardi, 2014).

Another critical sociodemographic change was the increment of sedentary lifestyles in urban areas (Jones et al., 2003). One of the reasons was that mobility in rural areas was usually done by walking and cycling, but the distance needed by many to travel to urban zones meant that this was no longer viable and cars and public transportation were needed, which decreased physical activity. Ojiambo et al. (2012) found significant differences in sedentary times in Kenya by comparing the amounts of physical activity of individuals in rural and urban areas and finding a significant reduction in the latter. The reduction of physical activity of those who migrated from rural to urban areas similarly affected Mexican society. Other authors also showed a higher level of sedentary behaviour in adolescents living in urban areas, compared to their peers in rural zones (Omran, 1971; Prista et al., 2009). Hence, it seems reasonable to imply that evidence suggests sedentary lifestyles to be an influencing factor in obesity in urban areas, linked to reduced physical activity.

As previously stated, individuals moving from rural to urban areas in Mexico face social inequities and a constant daily struggle to cope with financial issues (Ziccardi, 2014). One of the most noticeable social differences for the population arriving in cities was that they were at a significant disadvantage in terms of socioeconomic, cognitive, and intellectual factors when compared to individuals born and raised in cities. The 2002 Employment Survey in Mexico showed that 14% of the population employed in the agriculture sector in rural areas did not have formal education, compared to 3% of the population in urban areas that did not receive schooling (Gameren and Hinojosa, 2004). The association between the level of education and food security has a specific role in the individual's internal behaviours (Dover and Lambert, 2016). The low or non-educational level of the population that moved to cities was a critical factor that affected internal behavioural factors such as a lack of control and a decrease in empowered decision-making due to a low purchasing power level (Mirowsky and Ross, 2005; Cohen et al., 2013). The high susceptibility and influence of the obesogenic environment (i.e., greater availability and affordability of low-nutritional value food products) increased the likelihood of a nutritional transition.

Pérez-Ferrer et al. (2018) found a negative association between the level of obesity and the level of education, specifically among women in Mexico. Obesity reached 50% in women who had not completed primary education (i.e., basic education level), compared to 32% of women

who had finished basic education or had a higher education level (Pérez-Ferrer et al., 2018). For the male population from rural areas Pérez-Ferrer et al. (2018) found a positive association between the level of education and obesity (i.e., high level of education led to a high level of obesity). Authors did not find any type of association between the level of education and obesity among the male population living in urban areas (Pérez-Ferrer et al., 2018).

The urban areas' changing individuals' dietary patterns were attributed to the growth of obesogenic environments. Aceves-Martins et al. (2016) found that people who moved from rural to urban areas decreased their consumption of vegetables and cereals in favour of processed foods. Thus, the obesogenic environment would play a major role in urban areas, as it would trigger and influence the nutritional transition of the population (Corsica and Hood, 2011; Swinburn et al., 2011; Yayan and Çelebioğlu, 2018). In other words, the obesogenic environmental circumstances in urban regions strongly influenced the eating habits of the rural migrants.

When considering the social conditions that contributed to Mexico's obesogenic environment, the following can be considered: inadequate and poor healthy food options in schools, increased adoption of sedentary lifestyle due to the lack of security outdoors, misperceptions and traditional mistaken beliefs about health and nutrition, high exposure of TV marketing of food items that can lead to obesity, easy access to low nutritional food value products (Aceves-Martins et al., 2016). The ease of access to ultra-processed, low nutritional value food products enhances palatability, dependency, and higher preference consumption of calories, added sugars, sodium, and saturated fats (Piernas and Popkin, 2011; Swinburn et al., 2011; Zlatevska et al., 2014; Llewellyn and Wardle, 2015).

The access to ultra-processed products in Mexico City included established venues and mobile vendors in strategic geographic points. The ease of access to ultra-processed products is reflected in the study by Long-Solís (2007); Bañuelos-Barrera et al. (2016), showing approximately 246 food mobile vendors close to 60 public schools; 85% of those vendors sell unhealthy street food as a result of stocking and reselling products such as sugar-sweetened beverages (SSB), industrially processed products, and packaged snacks.

The obesogenic environment influences individuals' food choices, especially for those living in a constant state of food insecurity, thereby increasing the prevalence of obesity in the population (Naylor et al., 2010; Townshend and Lake, 2016). The rising obesity issues also brought a malnutrition diagnosis, with micro and macronutrient imbalances affecting

metabolism due to critical modulations, for example, in hormone production such as insulin (Love, 1986; Rajamanickam et al., 2020). These metabolic unbalances can lead to the development of overweight, obesity and chronic diseases (e.g., DM2) (Via, 2012).

Obesity prevalence is expected to be significantly higher in both genders by 2050, with the male population (57%) slightly outnumbering the female population (54%) (Rtveladze et al., 2014; Esposito et al., 2020).

2.3.2 Technological

The increased sales and distribution of technological gadgets have had a critical role in the obesity problem. People in urban areas increase television viewing time, making them less active and raising the risk of obesity and other health issues associated with inactivity. A previous study by Colditz et al. (2002) of children aged between 9 to 16 years old in Mexico showed a direct association between television time exposure and the prevalence of obesity. The children that adopted sedentary lifestyles had a higher risk of developing obesity. These children were more likely to remain obese towards adulthood, increasing their risk of developing premature comorbidities such as Diabetes Mellitus Type 2 (DM2), cardiovascular diseases, hypertension among others (Parsons et al., 1999; Eisenberg et al., 2013). Additionally, among the Mexican population, the excessive use of technology such as computers/internet, electronic tablets, mobile phones and social media has led to drastic changes in conduct that favour sedentary lifestyles and the growth of medium- and long-term cardiovascular diseases (Rivera et al., 2018).

The increase of sedentary lifestyles have led researchers to study the effects of technological gadgets in behaviours that can lead to nutritional and health issues. The term "digital obesity" was first defined by Sieberg (2011) for dependence on new technologies (people whose anxiety rises without their mobile devices or the internet). Additionally, videogames particularly among children have been shown to be one of the most frequent reasons for not doing physical activities (Yamamoto et al., 2013).

A study by Rivera et al. (2018) showed that among a total of 206 Mexican undergraduates between 18 and 28 years old, women would spend more time between 6 and 10 hours/week on the use of technology (i.e., television, computers, tablets, mobile phones, the internet, and social media), while male students spent more of their time in moderate and intensive physical activity (>6 hours/week) (Rivera et al., 2018).

Simultaneously, technology can play a beneficial role in human health. In Mexico, information technology professionals, marketers, and nutritionists collaborated to create an interactive social tool that sent daily messages to participants containing health and nutrition-related information, encouraging them to make healthy positive eating choices (Sepulveda et al., 2017). The tool's design considered participants' food and beverage choice behaviours, which proved to be closely related to their cognitive, emotional, and physical behaviour (Sepulveda et al., 2017). The messages were consistent and were displayed in the participant's working area. Its evaluation received positive feedback for being simple to remember, easy to learn, and appealing. The tool evoked attitudes that went much further than a simple navigation tool and tap to get the next or previous message. The prototype demonstrated positive behaviour from users, who would adhere to the healthy messages and incorporate them into their everyday lifestyles. The tool demonstrated sufficient effectiveness at transmitting and enhancing positive and healthy food eating and drinking choices (Sepulveda et al., 2017). The evidence shows that any technological effort with a positive impact on individuals' behaviours and their diets can help lower the rate of obesity.

2.3.3 Economic

The combination of social inequality and low levels of education reduces daily lifestyle factors such as purchasing power (Bashir et al., 2012; Mutisya et al., 2016). Several studies (Corvalán, 2006; Hawkes, 2006; Kimoto et al., 2014) have shown that low socioeconomic levels in Latin America, as in Mexico, are more exposed to the effects of the obesogenic influence due to low purchasing power. The low socioeconomic group spends more than half of their incomes (i.e., 60–70%) on the purchase of food products (FAO, 2019). Their low income and a restricted supply of affordable and available nutritional goods increase their health risks (i.e., a double health burden of malnutrition and obesity). In addition, the obesogenic climate enhances the ease of access and availability of energy-dense food products.

In Mexico, low-income households rely on traditional retailers (i.e., public markets, mobile street vending) for the majority of their foods and beverages. In contrast, middle and upper socioeconomic sector (SES) households primarily purchased foods from supermarkets and beverages from traditional retailers (Pedraza et al., 2018). Low-socioeconomic sector (SES) households shop at supermarkets for more processed food only once per week, representing 58% of their food calories (Pedraza et al., 2018). For their weekly basic groceries, such as corn

tortillas, chilli, beans, milk, bread, and SSB, they shop at traditional local stores at least three times per week (Pedraza et al., 2018).

Street mobile food vending (61%), diners (8%), and public markets (7%) have all seen an increase in demand for cheap ready-to-eat food and urban snacks in Mexico (PROFECO, 2013). Between 2016 and 2018, consumption outside the home increased by 10.2%, compared to 4.2% for eating at home (ENIGH, 2018). Street food vending generates 10% of GDP in Mexico and employs 28% of the total workforce (Alvi and Mendoza, 2017).

Tamales (corn cakes) and *"tamales baguette"* were the most popular foods (20.5%); followed by *"Mexican antojitos"* (traditional food) (18.7%); sandwiches/baguettes (12%); tacos (fried or grilled) (11.7%); *"tortas"* (Mexican sandwich) (9.4%); economic food (2-3 courses) (6.4%); cookies or salty snacks (4.7%); fruit (4.7%); restaurant (2-3 courses) (4.1%); salads (1.8%); fast food (1.2%); "nutritional" shakes (1.2%); nothing (1.2%); others (2.4%) (PROFECO, 2013).

As for the most consumed beverages, soda and fizzy drinks were the most popular (24%); followed by "not drinking anything" (24%); *"atole"* (warm cornflour drink) (18.1%); coffee (15.2%); fruit juice (9.9%); bottled water (4.1%); no-industrialized fruit water (2.9%); milkshake (1.2%); Other (yogurt) (0.6%).

The frequency of eating out, particularly in the morning for breakfast, was five times per week (24%); four times per week (7%); three times per week (24%); twice per week (20.5%); once per week (18.7%); once every 15 days (2.3%); once a month (2.3%); other (1.2%) (PROFECO, 2013).

Using the previous data, if eating a tamal/baguette and drinking a soda for breakfast five times a week, the calories for these two options are as follows: According to the Mexican system of equivalents one tamal (corn flour, lard, chicken, chilli sauce) is approximately 510 kcals; 1 wheat bun 134 kcals; 1 soda (355 ml) 152 kcals giving roughly a total of 796 kcals (Perez-Lizaur et al., 2008). The calorific recommendation for the Mexican population for breakfast is approximately 480 kcals (Mexican-Health-Secretariat, 2010). This estimation gives the most preferred option of the Mexican population for breakfast an additional +316 kcals (Perez-Lizaur et. al., 2008). If the frequency of consumption sums the five times per week, +1580 kcals extra are consumed only for breakfast.

The Mexican Health Secretariat recommends a daily calorie intake of 1600-1800 kcals for females with normal weight (body mass index between 18.5-24.9 kg/m^2) and 1800-2000 kcals for males with normal weight (body mass index between 18.5-24.9 kg/m^2) (Mexican-Health-Secretariat, 2010). However, the results of the most recent Mexican nutritional survey indicated that the median daily energy intake of women was 1800 kcals and men was 2000 kcals (Gaona-Pineda et al., 2018). The evidence shows that the extra calories consumed and the increase in sedentary lifestyles can be two of the many factors that have led to the increase and prevalence of obesity in Mexico. Therefore, it may imply that individuals need health and nutritional guidance to learn how to balance their diets.

Previous studies (Drewnowski and Eichelsdoerfer, 2009; Drewnowski, 2010; Colchero et al., 2019) showed that, in Mexico, ready-to eat products and snacks consumption represented a more affordable option, compared to a nutritional quality and healthy food product (Colchero et al. 2019).

The difference in cost between eating out and preparing food at home is minimal. For example, the price of an outdoor breakfast choice (sandwich or tamales) sold in street food is around 25MXN (equivalent to £0.89GBP), whereas the total price of a healthy balanced breakfast done at home (following a recommended 480 kcals) is around 22MXN (equivalent to £0.78GBP) (own calculations). However, eating out can also be convenient as individuals find it accessible while waiting for public transportation. 73.7% of those who did not prepare breakfast at home cited lack of time as the main reason (PROFECO, 2013).

Food price volatility, particularly in fresh food products such as fruits and vegetables, has not been an exception in Mexico. In 2017, the food price difference was reflected in a variety of fresh products such as cauliflower, guava, grapefruits, chickpeas, sardines, potatoes, eggs, sugar cane, and cow's milk, for which prices increased in 2018 (PROFECO, 2019). In contrast, avocados, nuts, apples, strawberries, broccoli, zucchini, beef, and poultry were among the food products whose prices fell in 2018 compared to 2017 (PROFECO, 2019). Furthermore, maize, amaranth, cucumber, edible cactus, and beans were food products with a stable price both in 2017 and 2018 (PROFECO, 2019). The fact that food products with lower prices in 2018 are still considered expensive foodstuffs is an important factor to emphasise. In addition, compared to those food products that have increased or decreased in price, the number of those with stable prices is minimal.

Price ranges for fruits and vegetables can vary and might depend on whether the products were locally produced or imported. However, there will be exceptions where prices would be high even when locally produced. That was the case for red plums, garlic, beetroot, parsley, mushrooms, peppers, green bean, and *"epazote"* (herb/condiment). Fruit and vegetable wholesalers buy directly from farmers and then deliver goods to retailers (Ortiz-González, 2016). Commercialization channels of fruits and vegetables are 11% for "*tianguis*" (outdoor markets), 47% for public markets, 7% for local fruit shops, 4% grocery shops, 21% transnational supermarkets (Schwentesius and Gómez, 2002). The fruit was found at the lowest price in outdoor markets, with an estimated cost of 82.5MXN (2.88GBP), while public market prices increased by 13% and in supermarkets the price would rise by 17% to 50%. The lowest price for vegetables was also found in outdoor markets at 164MXN (5.73GBP), while in public markets the price would rise by 36%, and in supermarkets the price would increase from 34% to 81% (SEDECO, 2014).

Economic crises and inflation must be considered as they generally translate into an increase in the prices of foods with a high nutritional content (Barquera et al., 2001; Ortiz-Hernández, 2006). Commercial agreements, such as the North America Free Trade Agreement (NAFTA) between the United States, Canada, and Mexico, should also be considered when understanding food prices. About 80% of Mexico's exports go to the U.S., and 47% of Mexican imports come from the U.S. (Ansari and Babu, 2018). The impact of exporting more than 50% of local production can be beneficial in increasing the sector's GDP. However, the benefits may be marginal due to a lack of economic support for small local farmers, worsening food insecurity, as they depend on its production for their consumption and sale. Moreover, agriculture's GDP in Mexico has not increased and has remained stable at 3% since 2000 (OECD, 2020). GDP stagnation has resulted in a 4% drop in the labour force from 2000 to 2018 (OECD, 2020). Investments and support for small-scale local producers are therefore an opportunity to increase GDP and to prevent/reduce the food security of vulnerable populations.

In late 2006, the association between food prices and food security difference between developed and developing country was demonstrated, when there was a global food price crisis, which automatically raised food prices in Mexico. Meanwhile, the food price crisis did not reach, or have a negative impact on the other two NAFTA countries (i.e., US and Canada) (Otero, 2011). Food insecurity can recur in Mexico if food production is unable to keep up with the annual increase in domestic demand.

The current import-export food trade between Mexico and the U.S. can raise concerns about what is left accessible and affordable for the domestic demand of fresh and raw, high nutritional value food. This means that most of the food supply from the United States is processed before it is exported to Mexico. In contrast, the exported goods from Mexico to the U.S. could be considered fresh, unprocessed and are directly offered as a primary food source to the American consumers. The food products that usually enter from the U.S. to Mexico are corn, dairy products, pork, and beef (USTR, 2021). Mexico's 95% corn demand and consumption depends on the US corn imports (UNCTAD, 2013; SAGARPA, 2016). The example shows a higher level of dependency and vulnerability in terms of food security, especially if the US faced an economic recession and/or productivity issues (Velut, 2011).

Other imported products, such as pork, are frequently high-sodium processed meats such as sausages and ham. Processed meats aggravate health issues such as hypertension and obesity (Farquhar et al., 2015; Wu et al., 2015). The large consumption of sodium in the Mexican population has been primarily attributed to processed meat, followed by savoury bread and sweet bakery goods (Colin-Ramirez et al., 2017).

Currently 41% of imported goods from Mexico to the United States are unprocessed and go directly to the final consumer, while only 8% of imported goods from the United States to Mexico go directly to the final consumer (OECD, 2020). The percentage difference of processed food between the two countries can be explained by the fact that high nutritional value food products, such as fresh vegetables and frozen fruits and vegetables, are among Mexico's primary exports to the United States (USTR, 2021). Hence, it can be claimed that Mexico needs to elevate the demand standards of food products, particularly those processed, for which reformulation can contribute to a higher nutritional quality. However, this can represent a challenge not only for the Mexican government but also for the U.S. producers. Hence, these changes would need to be set as part of a globalised food system that aims to improve and elevate nutritional standards.

Mexico's economic development scheme in which the Foreign Direct Investment (FDI) was boosted by the government set policies, was one of the reasons why the obesogenic environment extended in the country. The FDI is defined as "an enterprise resident in one economy and in which an investor resident in another economy owns, either directly or indirectly" (OECD, 2014, p.7) (e.g. McDonald's, Coca-Cola, Burger King, KFC). The result was a strategy that provided some economic growth while also confirming Mexico's nutritional

transition (Hawkes, 2005). FDI brought an increase of industrialised food systems specifically from imports from the US including snacks, salty food, processed meat and investments in beverages company producers (soft sweetened beverages) and fast-food chains (Clark et al., 2012). The FDI partially and gradually led to a nutritional transition, clearly proving an association with obesity and the development of chronic diseases (Cuevas et al., 2019). In other words, the agreement on bringing ultra-processed products and expanding fast food chains into Mexico facilitated the availability of low nutritional value foods, which altered traditions and dietary habits (Gálvez, 2018).

In Mexico convenience stores (mostly owned by multinational food companies) sell processed food and sugar beverages with promotions such as "2x1" or discounts promoting unhealthy dietary patterns, resulting in the increase and prevalence of overweight/obesity and comorbidities (Tester et al., 2010; Gordon-Larsen, 2014). As a result, both multinational food corporations and FDI companies "subtly" promote the terms "available," "convenient," "affordable," and "addictive." Businesses generate sufficient revenues to subsidize advertising (marketing) and develop strategic geographical points of sale (e.g., convenience stores) (Ministry of Public Education, 2015; Dommarco et al., 2018).

Factors that increase the nation's economy and growth through food supply chains, regardless of quality and nutritional value, dispel and divert attention from the fundamental aim of genuine investment in food security. Obesity, dietary changes, and public health pressures are likely to remain if the constant support to allow food businesses with unhealthy, ultra-processed food/beverage products, added sugars and, saturated fats prevails and expands in the nation (Hawkes, 2005).

2.3.4 Environmental

Transformation of the food system is required not only to prevent and diminish the obesity issues and the current public health burden. Nowadays, most people globally are exposed to three types of epidemic: malnutrition, obesity, and climate change which delivers co-existent epidemics (Swinburn et al., 2019). The interlinked epidemics are the most serious health problems of the twenty-first century, wreaking havoc on humans, the environment, and the entire planet (Swinburn et al., 2019). Hence, the need to understand and align common actions that can guarantee diminishing what drives and increases obesity, malnutrition, and climate change.

Climate conditions such as constant heatwaves can increase the likelihood of people decreasing their physical activity and adopting a sedentary lifestyle (An et al., 2018; Swinburn et al., 2019). Seasonality and rising weather temperatures have also been linked to a rise in sugar-sweetened soda consumption (e.g., fizzy drinks) in Mexico. In contrast to the winter season, there was a higher prevalence of consumption in the summer (Colchero et al., 2016). Hence, the risk of developing a higher consumption due to changes in climate and prolonged dry-hot weather seasons.

Droughts and other climate-related food production shocks can result in food shortages and price spikes, leading to food insecurity (Verschuur et al., 2021). In other words, climate change not only impacts crops and harvests but also affects small producers and small-scale rural farmers, exacerbating food insecurity.

In the last 30 years, climate change has had consequences for Mexico including a decrease in precipitation episodes and rising annual temperatures (Conde et al., 2000; Cubasch, and Meehl, 2001; Liverman, 2001; Bee, 2014). Climate and food shocks disproportionately affect areas where individuals are socially and economically disadvantaged and vulnerable (Liverman, 1990; Bee, 2014). Previous studies (e.g., Liverman 1990, 2001; Magana et al., 1997; Conde et al., 2000; Bee, 2014) suggested that climate change in Mexico and environmental phenomena such as ENSO[1] negatively impact on important harvests such as corn.

Climate change can shock and/or stagnate maize production, the most consumed and traditional crop in Mexico. The lack of moisture in the soil and the hot weather in Mexico due to a decrease in the number of precipitation episodes per year, result in the loss of harvests (Liverman and O'Brien, 1991). The threat to the food production systems can impact both the quantity and quality of food production (Myers et al., 2017). This can be reflected in the production of the last ten years when the average Mexican production of maize reached only 2.9 t/ha compared to the world's average production of 5.1 t/ha (Ureta et al., 2020).

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[1] El Niño/Southern Oscillation, defined as a seasonal, warm southward that moves along the Peruvian coastline, increasing sea surface temperature in central and eastern Pacific Ocean and seal level atmospheric pressure in western Pacific (Trenberth, 1997). The climate anomalies in Mexico are associated to 16 climate anomalies (Pavia et al., 2006).

Another important effect of water shortages is the lack of potable water for human consumption. Worldwide, three out of 10 individuals lack access to well-managed drinking water services and 3 billion do not have access to basic sanitation services (Smith et al., 2020). Despite the efforts of international organizations, such as the UN resolution 64/292, which recognises safe drinking water and sanitation as human rights. Mexico continues to endure a severe water shortage (Silva-Rodriguez, 2019).

The long-term shortages and poor management of reservoirs are at least in part a product of bureaucratic and political contradictions (Silva-Rodríguez, 2019), which carries unethical practices as it fails to guarantee water to all, failing to deliver a human right. Due to a lack of safe water in Mexico, consumers are forced to adopt unfavourable dietary habits such as substituting water consumption for SSB (Pliego, 2019). The state of Chiapas in the south of Mexico is one example of this nutritional transition caused by a lack of access to water (Ludi et al., 2017). The average per capita consumption of SSB in Chiapas is five times higher than in the rest of the country and 32 times greater than the world average intake (Gonzalez-Diaz, 2020). A study by Pliego (2019) found that each person in Chiapas consumes approximately 684 litres of fizzy drinks per capita each year, compared to the estimated 98 litres per capita annual consumption of SSB in the United States, where the beverage originated.

The high consumption of SSB has enhanced co-morbidity issues in Chiapas. From 2010 to 2014, DM2 (19.1%) and undernutrition (14.4%) were the prevailing comorbidities (Rashak et al., 2019). In addition, DM2 in adults of medium ages (41-65 years) was significantly higher (Rashak et al., 2019).

In rural areas the scarcity of water has another important outcome which is gender inequality. That is because women in rural areas particularly in the state of Chiapas in the southern part of Mexico have not received the same access to irrigation systems (Ruiz-Meza, 2013; Silva-Rodríguez, 2019). Ruiz-Meza (2013) identified that rural women under the National water legislation are not recognized as resource user under the customary rules of rural communities because it is assumed that women only use water for domestic purposes, thus ignoring the productivity uses and needs outside home (Ruiz-Meza, 2013). Women are not considered farmers under any National Water policies, enhancing gender disparities, especially in the agriculture sector. Women are, therefore, excluded from the water rights allocation (Ruiz-Meza, 2013). The absence of rights can lead to different eating and drinking habits. The policies do not recognize women in the field and create a barrier against women's opportunity to

cultivate and harvest fruit and vegetables that can then be brought home for consumption in meals and drinks (e.g., lemonade, watermelon water).

In contrast, the law allows transnational companies to extract from the aquifers in states like Chiapas. The Mexican government agreement allows them to extract 300,000 gallons of water per day (Lopez and Jacobs, 2018; CONAGUA, 2021). The extraction depletes the aquifers, leaving residents with water shortages and exacerbating inequality for accessing safe drinking water.

2.3.5 Political

Mexican national food policies have had an impact on the country's food security, bringing both positive and negative outcomes from a short to long term period, and impacting on the state of nutrition and health of the population (Swinburn, 2008).

One relevant policy in Mexico is the North America Free Trade Agreement (NAFTA), which has been linked to a newly structured food neoliberalist system that threatened food security (Otero et al., 2015). NAFTA was designed to liberalize trade and investments movements through North America (Velut, 2011) to develop the economy and increase businesses in the region. However, this agreement failed in aspects such as social protection and aid for labour, health, or environmental factors, while only protecting corporate investments (Faux, 2003). Therefore, the agreement increased social inequalities and continuously raised challenges for the small Mexican farmers. Because not all could cope with the changes some of them went out of businesses (Popkin, 2001; Hawkes, 2006; UNCTAD, 2013). The ease with which external policies were developing from the other trade partners, especially the US, directly disrupted the agricultural sector in Mexico (UNCTAD, 2013). One example was a developed policy in the U.S. after settling the NAFTA agreement, in which subsidies were given to U.S. local farmers to boost their productivity. The decision would increase the gap in competitiveness between the U.S. and Mexican farmers (Wise, 2010; UNCTAD, 2013; Friel and Ford, 2015). As a result, Mexican small farmers were losing market share against the U.S. food products, facing socioeconomic struggles within the agriculture business sector (Clark et al., 2012). Mexican policies failed to prioritize high quality and nutritional value to people's basic food baskets (UNCTAD, 2013) associated with free trade market policies, which affected their dietary habits (Baca, 2019).

Moreover, the reduction of the Mexican agriculture economy can be attributed in part on the NAFTA commercial trade characteristics of selling commodities at a lower price than the initial investment (Clark et al., 2012). One possible explanation was that the characteristic of open markets within the commercial trade agreement undervalued anti-dumping[2] and countervailing duties[3] (Zahniser and Link, 2002). Countervailing duties in Mexico would negatively impact the economy by directly affecting small Mexican agriculture businesses, lowering employment opportunities and raising food prices (UNCTAD, 2013; Diaz-Bonilla, 2014). Overall, commercial free trade, or NAFTA, caused a negative balance in the Mexican economy, estimated at $2.12 billion USD (Popkin, 2001; Market Intelligence Latin America, 2014), resulting in inflation and food price volatility in the agriculture sector (Oner, 2012).

The new set prices benefit processed food and long-shelf-life food products (e.g., processed food with added sugars, salt, and saturated fats) as opposed to 'short-life' food products (i.e., raw products such as fresh fruits and vegetables), whose prices have risen steadily (Hawkes, 2006). Food prices affected the population's ability to pay for food, which altered consumers' eating behaviour and increased their demand for cheaper products (Hawkes, 2006; Kant and Graubard, 2007; Maillot et al. 2007; Monsivais and Drewnowski, 2009; Bernstein et al. 2010; Stuckler and Nestle, 2012). The latter led consumers towards a nutritional transition and increased demand for cheap food products highly 'addictive' to palates (e.g. fizzy drinks, salty snacks, ready processed meals) which were highly affordable and accessible (Darmon and Drewnowski, 2015). Nowadays, 23% of energy sources are from ultra-processed food products, when WHO's recommendation is between 5-10% (Barquera and Rivera, 2020). This reflects the impact of the nutritional transition on Mexico's obesity prevalence, which increased by 42.2% between 2000-2018 (Barquera and Rivera, 2020).

The NAFTA commercial agreement was successful in addressing the economic issues in other sectors such as automobile manufacturing. Nevertheless, the Mexican government did not consider key aspects of food security in terms of high-quality and nutritious food products (Pingali et al., 2017).

The high reliance of Mexico on the US agricultural production system was a negative result of NAFTA. Instead, the NAFTA agreement increased the country's investment in the

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[2] Anti-Dumping occurs when a foreign manufacturer sells goods to a country for less of the market value, risking the level of competitiveness of local businesses (US Customs and Border Protection, 2019).
[3] Countervailing Duties is when the government offers subsidies, like tax breaks to producers that export goods to enable them to sell at a lower cost their products (US Customs and Border Protection, 2019).

manufacturing sector (Hornbeck, 2004). Hence, the NAFTA neglected the agriculture sector in Mexico, with consequences such as a decrease in agriculture labour opportunities and the primary rural economic workforce (Otero, 2011). Decreasing the offer of employment opportunities in the local agriculture production system, Mexico decreased domestic agriculture productivity as much as food sovereignty (Koc et al., 2007).

Previously it was mentioned (McNamara, 2015; Labonté et al., 2019) that the new USMCA trade agreement, did not address labour equalities and health aid issues from the previous version of the NAFTA.

The lack of individual labour rights combined with the pre-existing conditions of Mexico's agricultural production system does not provide sufficient employment opportunities. The situation makes it more difficult for the sector to grow economically and for workers in the sector to obtain sufficient food (Otero, 2011).

Conditions associated with hunger, malnutrition, being overweight and obesity are an outcome of a neglected universal right to food (UN n.d.; Bhardwaj et al., 2003; Fanzo, 2018). Not only is the right to food which has been neglected but the human right to health. The United Nations Human Rights considers the following determinants: food and housing, safe access to potable water, healthy and safe occupational conditions, and health education (OHCHR, n.d.). In addition, all state parties of the UN are obliged to respect the right to health, protect equal access and fulfil from a political and legal context all the previous determinants stated in article 12 of the International Covenant on Economic, Social and Cultural Rights (ICESCR) (OHCHR, n.d.). The UN food rights are missing within the Mexican system, which reflects the pre-existent gaps between health, nutrition, and food production that impact public health.

In the early 1990s, the Institute of Public Health in Mexico performed a study in which results showed a high prevalence of anaemia and stunting associated with inequities within the different socio-economic sectors in Mexico (Dommarco et al., 2019). The study reflected the lack of an integrated vision in public health policies to provide and ensure the state of nutrition. Mexican policies addressing diversification of food production, nutrition, and public health issues are managed through different state agencies, leading to a fragmented system and inefficiency when implemented (Shamah-Levy et al., 2017). From the perspective of food security, elements such as sustainability, food consumption, and production it was suggested by Ibarrola-Rivas and Galicia, (2017b) further integrated policies that encompass health, food, and the environment. The authors stated that Mexico lacks of cross-cutting policies that take

into account health, agriculture, the environment, and federal agencies. From a public health context the lack of integrated policies can exacerbate issues such as health inequities (Birbeck et al., 2019). Another example was given by Whittemore et al. (2019) regarding diabetes management and public medical clinics in low economic environments in Mexico, from which the health system required an increment in resources, access, and quality of care. In addition, the authors found a need to eliminate health literacy barriers to enhance culture and patient engagement.

In the context of Mexico, policymaking should aim for an integrated approach that considers behavioural aspects, social and health equity, globalisation, and the food system through research evidence—extrapolating effective policies and laws to enhance the cost-effectiveness of the Mexican systems and strategies aiming to improve health (Dommarco et al., 2019).

2.3.6 Legal

Several strategic legal objectives were set by the Mexican government to mitigate the prevalence of both obesity and overweight (Barquera et al., 2013).

Among the health legal actions taken by the government was nutritional labelling with the purpose of raising public awareness (Barquera et al., 2013). Since 2014 the Guideline Daily Allowance (GDA) was implemented in Mexico as the official nutritional label (White and Barquera, 2020). The Mexican Consumer Industry Council (ConMexico) and the Alliance for a Healthy Life presented the Mexican GDA labelling system that introduces four basic icons: energy, saturated fat, sugars, and sodium (Health-Food-Alliance, 2011) (See Fig. 2.2). However, Stern (2013) showed that the Guideline Daily Allowance (GDA) in Mexico failed to transmit the nutritional content of the food and beverage products and increased confusion amongst the population. Moreover, key findings from the Programme for International Student Assessment in Mexico (OECD, 2010) found that the GDA labelling was not clear, nor comprehensible for the assessed population of 15-year-old Mexican students. The study emphasized the importance of changing the GDA to improve the nutritional content of products' clarity and transparency (OECD, 2010). Recent research indicates that, despite Mexicans' awareness of nutritional labels, they are rarely used and have low levels of comprehension and acceptance (Vargas-Meza et al., 2019). Despite the studies and information presented to the Mexican authorities to change the nutritional labelling, the GDA label was retained until 2019, when the Mexican Congress approved the new front-of-pack warning labels (White and Barquera, 2020). These followed the nutritional label adopted by Chile; i.e.,

"the black stop sign" (Ramirez et al., 2016). The Chilean *"Black Stop Sign"* was implemented as part of the Chilean Food Labelling and Marketing Law in 2016, where consumers would be warned that food contained high content of energy and nutrients of concern such as added sugars, saturated fats and sodium on the front of the packages (Reyes et al., 2019).

According to the new legislation specified in the official Mexican Norm-051-SCFI/SSA1-2020 food and beverage producers are required to include black octagon warning labels on high-calorie products, added sugars, high sodium, high saturated fats and trans fats (White and Barquera, 2020). Table 2.1 represents and delivers the content regulation for industrialised processed food.

Table 2.1. Newly implemented nutritional labelling in Mexico (White and Barquera, 2020).

Black warning label	Implication
"Excess Calories"	For 275 calories or more per 100g
"Excess sugars" and "Excess saturated fats"	In content of 10% or more of the total calories
"Excess trans-fat"	In content of 1% or more of the total calories
"Excess sodium"	In content of 300 mg or more of sodium in beverages and packaged foods; for non-caloric beverages content of 45 mg or more of sodium.

The previous GDA label and the new front-of-package warning labels are shown in Figure 2.2. Moreover, the new label of the SSB in the right of the figure also shows a warning that the drink "Contains artificial sweeteners" not recommended for children, and "Contains caffeine"- children should avoid its consumption.

Figure 2.2. Previous Mexican GDA label vs. new front-of-package Black Warning labels (Sources: Health-Food-Alliance, 2018; Silverio, 2020).

Since warning labelling was implemented in Chile, it has demonstrated positive results in terms of changes in food purchasing and dietary intake, as well as the food industry's response in terms of food and beverage reformulation (Corvalán et al., 2019). Therefore, as in Chile an improvement is expected in consumers' product comprehension and clarity in Mexico, enabling them to make more informed healthy choices and reducing nutritional labelling misunderstanding.

Furthermore, the legal aspects in Mexico have excluded critical technological food applications such as encouraging producers to reformulate and innovate to improve product quality and nutritional value (Drewnowski and Specter, 2004). Now that the new labelling regulation considers the amount within a given total range, manufacturers may decide to reformulate their products to reduce the number of warning signs on the front of the package.

Another legal action prevalent in Mexico is the ease with which products with warning labels can be sold and distributed among the population. The issue is highly associated with the lack of labour laws and opportunities as those who are selling the products are in an informal labour situation. Roy (2009) describes "informalized State" as the consequences of a "deregulation" or the absence of a government strategic legal action plan forcing marginalised people to rely on unregulated informal employment opportunities. A dual system of formal and informal employment define labour markets in developing countries (Yahmed and Bombarda, 2020) and Mexico is no exception. In Mexico, the informal sector generates 10% of the GDA (INEGI, 2011; Alvi and Mendoza, 2017). Street food vending, for example, employs approximately 1.9

million Mexicans (Fuentes et al. 2007; Alvi and Mendoza, 2017). Between 1994 and 2006, Mexico street-food vending increased from 180,000 sellers to 560,000 (Long-Solís, 2007).

The ability to earn a higher salary, a desire to be autonomous, low pay in previous jobs, and termination of employment by dismissal, company closure, or contract expiration are all important reasons for men to join the informal sector (Maloney, 2004; Alvi and Mendoza, 2017). Given the need to supplement their family's income, marriage is the most important factor for women to enter the informal sector (Maloney, 2004; Alvi and Mendoza, 2017). These factors between male and female show another downside which is the low female labour force, which exacerbates gender discrimination (Yahmed and Bombarda, 2020).

Moreover, the lack of a strategic plan within a legal action leaves the street-food vendors without a standard food safety regulation, posing a considerable risk to consumers (e.g., food poisoning and air pollutants) as well as risks associated with digestive issues and parasites, which could affect the bioavailability of nutrients (Shea-Donohue et al., 2017). The lack of nutrients due to microbes can lead to malnutrition and obesity (Krajmalnik-Brown et al., 2012).

Mexican food street vending characteristics can include high saturated fats and/or sugars (e.g., fried pork tacos with fizzy drinks, tamales made with lard). Moreover, "street-food" prices can be "lower" which increases demand, and are set at strategic convenient points (e.g., close to schools and universities) in several neighbourhoods in both suburbs and large cities (Popkin and Reardon, 2018) (See also Section 2.2.3). The "palatability" factors associated with sugar/salt and saturated fats can also be associated with the rising offer, demand and consumption of "street food" and "take-away/combo packages" (De Alba, 2005; Long-Solís, 2007).

Therefore, low costs, strategic locations and high palatability have raised the demand, especially among the young population (e.g., students). Previous research (De Alba, 2005) showed that 79% of surveyed students in Mexico purchased "street-food" products such as "tortas" (i.e., hard roll Mexican sandwiches), "tacos", and soft drinks which are among the most consumed. A fact to highlight in De Alba (2005) study is that students gave a higher priority to "cheapness" than "cleanness" of the purchased food.

The fiscal instruments for health set in 2014 had the purpose of mitigating the obesogenic environment effects, improving the state of nutrition and reducing the prevalence of obesity in Mexico. The sugar tax implementation was exclusively on sugar-sweetened beverages (SSB),

(e.g., sweetened beverages, processed juices and fizzy drinks), the products that in the last ten years have seen a constant rise in demand and consumption among the Mexican population (Nestle, 2004; Lakdawalla and Philipson, 2009; Torero, 2014). The sugar tax implementation set an addition of 10% in the purchase price (1 peso per litre). The sugar tax implementation on sugar-sweetened beverages had strong opposition from producers increasing a gap between the private food industry and consumers in terms of health, quality, and nutrition (FSA, 2016; De la Cruz-Góngora et al., 2017).

The impact of the sugar tax was expected to prevent 189,000 cases of diabetes mellitus and 20,000 cases of cardiovascular disease in ten years, as well as a 2.6% reduction in obesity prevalence (Sanchez-Romero et al., 2016; Colchero et al., 2017; Torres-Álvarez et al., 2020). Two years after its implementation (2016), there was an 8% reduction in consumption of SSB (Colchero et al., 2017) with 17% reduction among the lowest socioeconomic groups (Colchero et al., 2016; Colchero et al., 2017).

Researchers suggested Mexican sugar tax on sweetened beverages should have been strengthened with additional interventions such as the availability, access and affordability of pure drinking water (Pedraza et al., 2019). Moreover, because implementation disregarded the WHO recommendation of 20% or more, it was stated that policies in countries such as Chile, Mexico and Colombia require more transparent and accountable measures to reduce the influence of transnational companies in government policy processes (Carriedo et al., 2021).

One of the most prevalent behaviours in Mexico following the implementation of the sugar tax on SSB was a 16.8% increase in the purchase of bottled water by low and middle income households (Colchero et al., 2017). Not only is bottled water consumption wasteful in terms of plastic waste, but it is also expensive, accounting for 20% of Mexico's minimum wage. In contrast, the price of bottled water in the United States represents only 5.5% of the federal minimum wage (Rodwan, 2019; Montero, 2020; US Labour, 2021).

Since 2000 the Secretariat for Rural Development and Equity for Communities (SEDEREC) developed a Small-scale Sustainable Agriculture programme in Mexico City (FAO, 2015). The programme promotes organic production in home and community gardens as a source of food for low-income households as well as cash from surplus sales at local markets (FAO, 2015). Between 2007 and 2012, the Secretariat invested approximately $6 million USD in 2,800 urban agriculture projects, including gardens in homes, housing units, and social rehabilitation centres, benefiting 15,700 city residents (FAO, 2015). Currently, SEDEREC official website

provides guidance and support for those who want to start an urban garden. In addition, family backyards have been implemented in different states in the country promoting UN's initiatives such as family farming. Since 2014, family backyards have delivered 20 different types of fruit species and 46 perennial species, contributing to family diets and economy as a source of income (Olvera-Hernandez et al. 2017). It has been determined that an agro-ecosystem adjoining the households serves a dual purpose: food consumption, as well as biodiversity and the preservation of germplasm, resulting from this human intervention (Duché-García *et al.*, 2017).

2.3.7 Ethical

Ethical standards promote values that are essential within policies and regulations. To achieve them, there should be a focus on collaborative work that takes into account equality, transparency, and accountability (De Cremer and Moore, 2020).

As reviewed in the different STEEPLE sections, nutrition equality should be instrumental in the mitigation of obesity and overweight prevalence, especially in developing countries such as Mexico. In addition, regulation should avoid favouritisms within the food industry (Mody, 2002; Hawkes, 2005) and procure healthy and sustainable products.

Nowadays, in Mexico, there is a disproportionate food industry marketing of ultra-processed food compared with what is promoted by the public health sector. Moreover, the marketing from the ultra-processed industry is supported by associated venues and retailers which constantly promote consumption (Moubarac et al., 2015).

As a basic human right, ensuring that everyone has access to clean drinking water should be a top ethical concern. Ensuring drinking water can gradually stop the continuous increment from the last twenty years of sugar-sweetened beverages can also be associated with behavioural aspects given by the continuous influence and familiarity of the product (Espinoza-Ortega et al., 2016). The continuous influence can be exacerbated by the combination of low prices, easy access and availability, lack of drinking water, retailer's promotions for consumption and food and beverages marketing practices (Witkowski, 2007). Unfortunately, previous study in Mexico (Barquera et al., 2018) showed that nutritional marketing targets 97% of young scholars as they have easy access within the school premises to food products such as sugar-sweetened beverages, sweet bread and candies. This reflects disproportionate unethical

behaviour from the food venues and retailers, exposing favouritism by selling these food products, rather than promoting healthy sustainable local consumption.

2.4 Limitations

The selection of the STEEPLE framework as a method to gather the literature review without the participation of stakeholders does have biases on the direction, levels of uncertainty and importance, and position of each theme in the context of eating choices and health behaviours. To address this limitation, the selected additional methods will evaluate a sample of the Mexican population to identify and corroborate the identified drivers in the literature. Additionally, the output drivers from this STEEPLE analysis will be supported by scenario development in chapter 5 to answer questions about the direction and levels of uncertainty and the importance of each theme towards eating choices and health behaviours.

Another limitation was that some discussed themes could have been covered under alternative headings. For instance, the ethics section could have mentioned that the government pays insufficient attention to agriculture and makes it easy for foreign fast-food chains to enter the market (i.e., FDI), enhancing the nutritional transition. In contrast, the issue was discussed in the economic element within the STEEPLE, the measure was done to avoid repetitions.

Finally, the assignation of the themes to each STEEPLE element was done through a qualitative approach. Therefore, there can be biases in how the themes are assigned to each STEEPLE element. In other words, when closely analysed, the suggested element for each theme can be assigned to a different STEEPLE element. In addition, the discussion of a particular theme could have been under-or over-valued, leading again to subjectivity issues. To address the limitation, the survey analysis and scenario development will help in the identification of the most relevant themes and their position in the context of eating choices and health behaviours.

2.5 Conclusion

Obesity in Mexico has evolved rapidly across the sociodemographic and political dimensions in the last thirty years. The STEEPLE analysis has revealed multiple related drivers of change to individual diets and health, leading to a higher incidence of obesity that has increased the public health burden in Mexico. Evidence suggests that there is a clear connection between the rise of urbanisation in Mexico and the numerous political reforms (i.e., implementation of the neoliberal system). The nutritional transition mirrored the political shifts (i.e., overconsumption of imported ultra-processed, poor nutritional value foods and beverages). In

addition, the political measures attracted more foreign direct investments, resulting in the increase and expansion of foreign food retailers, such as fast-food chains, throughout the nation. As such, the higher access and affordability of products such as SSB and salty highly processed snacks gradually supplant and replace traditional Mexican healthy diets.

Moreover, the economic and political system in the last three decades has increased the socioeconomic gaps in health among Mexican society. Rising social and health inequalities are exacerbated by the lack of investment in the agricultural production and established commercial agreements (e.g., NAFTA). The fractures in the agricultural sector, which altered agrarian lifestyles and forced people to migrate to urban areas, also caused social barriers and constraints, such as a severe lack of employment opportunities. The lack of employment and insufficient wages would exacerbate household food insecurity and nutritional deficiencies.

Thus far, health initiatives implemented in Mexico such as taxes on SSB have resulted in progress and reductions in the consumption of ultra-processed products. Nevertheless, more holistic approaches are required to integrate and support individuals' needs and limitations from a healthy diets/food security/equality approach. That is to ensure that behavioural choices can persist and be sustained long enough to reduce the public health burden of obesity.

Table 2.2 summarises the main outputs from the STEEPLE analysis, and highlights important drivers influencing individuals' diets and health in Mexican households.

Table 2.2. Outputs of the STEEPLE analysis.

STEEPLE	DRIVERS	IMPACT	OUTCOME
Social	Urbanisation; Growing population; Low level of education and health literacy; Obesogenic environment	Poor labour and education opportunities; Social and health inequality; nutritional transition.	Food insecurity Rising demand and excessive offer of low nutritional value food products and beverages. Nutritional transition. Gender inequalities.
Technological	Sedentary lifestyle.	Use of public transportation; Exposure to large hours of T.V., social media through tablets and mobile phones.	Lack of physical activity. Sedentary lifestyles. Digital obesity. Increase of chronic diseases and premature deaths.
Economic	Low purchasing power; FDI.	Low nutritional value food products, GDP losses, economic crises leading to higher food prices.	Poor eating habits/poor food and drink choices. Increase access for processed food and drinks (e.g., fizzy drinks). Increasing prevalence of food insecurity.
Environmental	Climate change	Yield losses; Water shortage/ Lack of precipitations, heatwaves, wider impact on growing crops.	Food insecurity Increasing consumption of SSB Increase of chronic diseases and premature deaths. Gender inequality.
Political	NAFTA	Neglected agriculture system, Poor employment opportunities and social inequality, commercial and economic power from the fast food industry.	Food insecurity Loss of employment Increase social and economic inequalities. Lack of investment to increase Mexico's growth and development.
Legal	Nutritional labelling; Taxation on SSB's; Home grown initiatives.	GDA failure to communicate nutritional properties to the public. SSB taxes implementation and the need to increase the offer and access to drinking water.	Reduce consumption of SSB's among the low socioeconomic sector. Increase population's food security health awareness and dietary choices.

STEEPLE	DRIVERS	IMPACT	OUTCOME
Ethics	Disproportionate marketing schemes. Lack of drinking water. Lack of transparency in regulations.	Obesogenic environment. Drinking water shortages	Poor nutritional choices and food insecurity Nutritional transition Increase of chronic diseases and premature deaths. Nutrition, health and gender inequities.

The ongoing division between political decisions such as allowing fast food franchises to flourish throughout the country and public health exacerbates the problems of unintegrated policies, which have a negative impact on people's health and well-being.

In Mexico, public health must be coordinated with social and economic development planning. Omitting nutrition and health factors from government initiatives can jeopardise the chances of ensuring the health of individuals, and if those individuals are economically active adults can pose critical problems for the country's development plans. Hence, initiatives such as the new nutrition label offer the opportunity for a change and a connection between food production and health by providing consumers with transparency and clarity when making food choices. In addition, for food producers, it offers an opportunity to improve their quality and nutritional standards.

Home food growth, for example, can ensure food security through healthy and sustainable practices and can be passed down as far-reaching initiatives from generation to generation. Moreover, home food growth handles the opportunity for women or those in need of financial aid to subsist, enhance food security and even, if adequately supported, grow and develop as small producers in the agricultural sector.

When viewed as a whole, the STEEPLE study led to the identification of the related results, allowing for a better understanding of the changes that Mexican households have gone through over the last thirty years. The sociodemographic, political and environment (climate change) changes have affected the population's lifestyles and led to nutritional transitions in the dietary patterns that ultimately have contributed to the growth of obesity. Although positive health initiatives have been promoted, there is still a long way to go particularly when integrating and closing gaps between sectors, policies, gender, health and nutrition equality.

The findings emphasise the importance of understanding how the population's food choices and dietary behaviours are influenced and what triggers them individually. As a result, it is necessary to investigate and characterise consumers' perceptions, motivators or influencers, and behavioural determinants of their food choices.

Chapter 3. Theories of health-behaviour change

3.1 Introduction

When developing health policies and public health campaigns to improve dietary patterns, a variety of factors impacting individuals' behaviour are frequently overlooked, reducing the effectiveness of the intervention's ability to engage, persuade and educate the population (Perry et al., 2015). The limitation of not taking individual behaviours into account can result in lower success rates for positive changes in dietary patterns, reducing positive and healthier long-term behaviours in the short and/or medium term (Glanz and Bishop, 2010). Additionally, the impact will be poor and/or limited to a small percentage of the population that accepts and begins to consistently apply positive dietary and healthier lifestyle changes (Kelly and Barker, 2016). Pine and Fletcher (2014) suggested health literacy does not significantly influence eating choices leading to obesity since the public health system primarily relies on medical, nutritional, and physical sciences with little emphasis on behavioural sciences.

The assessment of diet-related illnesses requires building a systemic understanding of health behaviour that combines three aspects (Engel, 1978; de Wit et al., 2020):
1) biology (e.g., the state of nutrition)
2) individual factors (e.g., perceptions, attitudes, self-efficacy, cognition) these are the different primary steps before an intention and the final behaviour, and
3) environmental factors (e.g., food security, healthcare systems, social norms) related to what surrounds an individual.

Improvements to healthcare (e.g. reducing levels of obesity) must consider people's adherence to healthier behaviours as they are just as important as the effects of diets and/or exercise regimes (Ma et al., 2017; Freedland, 2019). Therefore, a more integrated approach that considers a wider link between individual and environmental factors is needed to explain and influence a positive change of behaviour within the clinical and medical context (Glanz, 2016).

Behaviour change associated with health goes beyond what is considered logical, simple or straightforward. It requires a deeper analysis of the individual's motives and their surroundings to identify the factors that will drive them to adopt healthy lifestyle changes or new habits, including new dietary behaviours (Kelly and Barker, 2016).

Social psychology theories have been used in the past to change behavioural patterns when developing public health measures and interventions in fields including medicine, nursing, and dentistry as a discipline of healthy psychology (Coulson et al., 2016). Previous work (Leventhel and Cameron, 1987; Munro et al., 2007) determined that individuals must activate the following levels of understanding to encourage healthier, more positive behaviour: biological, behavioural, communicative, cognitive, and self-regulatory. These aspects are relevant as they can connect with what shapes behaviour and potentially impact health (e.g., the state of nutrition). The level of understanding enhances what can motivate individuals to act and/or further develop a behavioural attitude that can lead them to healthier decision-making (Nutbeam, 2000). Since the 1980s, social psychology theorists like Bandura (1986) and Ajzen and Fishbein (1977) have identified and developed theories connected to behavioural change. The approaches have been used as guidelines to explore, explain, develop and/or promote practical health programmes or health interventions, considering the complexity of behaviour and the level of influence on individuals' perceptions, cognition, subjective norms and attitudes (Nutbeam, 2000). The impact then affects the individuals' adherence to public health recommendations and/or general health initiatives (Nutbeam, 2000).

The aim of this chapter is to review and develop a framework with behavioural social theories to determine what can influence individuals' eating choices.

Following a review of the literature on social behavioural theories, this chapter presents a theoretical framework for the assessment of individual and environmental factors influencing diets, and lifestyles, to support developing a more systemic understanding of individual health-related behaviour.

3.2 Theory of Planned Behaviour

Developed by Ajzen (1985), the central focus of the Theory of Planned Behaviour (TPB) is to work as a predictor of behaviour by understanding how perceptions, attitudes and norms shape an individual's intention towards a final behaviour (decision-making). Figure 3.1 shows the TPB with three determinant internal factors shaping an intention that can lead to a final behaviour. The first element is the *attitudes towards behaviour,* which is the likelihood that individuals will perform a certain behaviour. The second element is *the subjective norm* which is the "social surrounding" influence of behaviour driven by the individual's family, friends

and/or colleagues. Finally, the *perceived behavioural control* is the sense of ease or difficulty to perform a certain behaviour (Asare, 2015). The perceived behavioural control is an element from Ajzen (1991) TBP theory which has been associated and compared with Bandura, (1977) self-efficacy concept, further explained in the chapter.
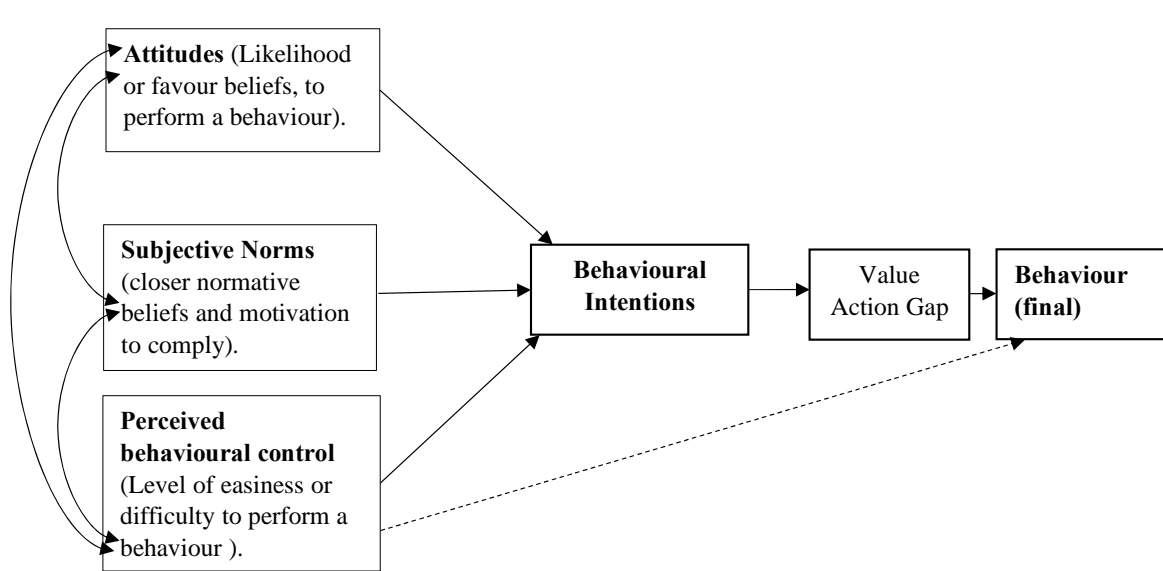
Figure 3.1. Theory of Planned Behaviour (Source: After Ajzen, 1991).

3.2.1 Intentions and the value action -gap.

Attitudes, subjective norms and perceptions all have different degrees and may have an asynchronous effect on intentions and behaviour. Each of the TPB elements will have a level of strength that will motivate and/or possibly trigger what can be the intention and the final behaviour. However, as a general rule, if the behaviour does not pose a significant control problem, the intention used to predict the final behaviour can be quite accurate (Ajzen, 1991). Additionally, it has been established previously that the discrepancy between intention and behaviour primarily concerns those who act but fail to accomplish their intentions (Sheeran, 2002). Between 2019 and 2020, a study by Gonçalves et al., (2021) conducted at Delft University among architecture students examined the intention-behaviour gap with TPB. The study revealed that the "attitudes" (i.e. likelihood to perform a behaviour) had a stronger significant correlation with final behaviour than the "intentions" (Gonçalves et al., 2021). The study demonstrated how "attitudes" can be placed above "perceptions," "subjective norms" and/or "intentions" to predict a final behaviour. Previous research has also suggested that intentions can be poor predictors of behaviour (Faries, 2016). The intention-behaviour gap is well known and widespread and has been demonstrated in exercise and healthy eating, which is discouraging for practitioners and significantly diminishes the effectiveness of lifestyle

prescriptions (Rhodes and De Bruijn, 2013; Faries, 2016). Nonetheless, the approach to public health in the past has been based on the premise that consumers will give up unhealthy behaviours to be healthier in order to prevent future diseases (Nestle et al., 1998). Unfortunately, when it comes to behaviour and food choices, consumers have failed to demonstrate the prevention factor that the public health system expected, resulting in a gap between the individuals' perceptions, attitudes, and intentions and the final behaviours. In other words, the final behaviour does not follow what an individual perceives or believes to be correct. This gap was described by Festinger, (1957) as cognitive dissonance or a value-action gap.

Festinger (1957) defined "cognitive dissonance" as an aversive or discrepant action/behaviour, increasing tension or discomfort, making individuals act against their own beliefs, knowledge, perception and past experiences (Ong et al., 2017; Dowsett et al., 2018). The behavioural gap will lead the individual to a sense of discomfort or mental anguish mediated by attitudes, beliefs, or principles. Individuals would have to resolve their sense of discomfort or mental anguish by taking one or more of the following steps outlined by Festinger (1957):

A) Change the belief – The simplest choice between an action and a belief is simply changing that belief; however, if the viewpoint is fundamental to the individual, this is the least likely option for resolving the dissonance.

B) Change the action – The promise of ensuring that the action will not be repeated, but behaviours such as guilt and anxiety are not a good learning technique, especially if the individual tries to mitigate those discomforting feelings.

C) Change the perception of the action – The most common resolution, the individual's rationalisation of the actions, leading individuals to think of their adopted behaviours in a different context, so it no longer becomes an inconsistency between their beliefs and their final behaviours.

The third step is key as it shows the factor of rationalisation, which is well known in relation to nutrition, in that it can cause individuals to underestimate actions that undermine health (Ryngach et al. 2018). The disassociation of individuals between their eating choices and health consequences can mitigate learned values, causing individuals to engage in behaviours that demonstrate they are in a constant value-action gap loop.

3.2.2 TPB used to study health behaviour in the context of nutrition

TPB has been used in previous nutrition and health research to describe and analyse the interaction between health and adherence to healthy eating choices. Carfora et al., (2015) studied the consumption of fruits and vegetables among Italian students between 13 and 19-years-old after receiving daily text messages for motivation and awareness. Subjects were divided into three groups (i.e., affective, instrumental and control groups). The "affective group" received messages to boost positivism by emphasising the benefits of consuming fruits and vegetables for mental health and well-being (e.g., stress prevention, serotonin production). The "instrumental group's" text messages would convey physical benefits of eating fruits and vegetables daily, as well as disease prevention information (e.g., cancer, cardiovascular diseases). The "control group" would not receive any text messages. Results showed there was a higher consumption of fruit and vegetables among the "affective group" compared to the "instrumental" and "control" groups. TPB as the technique used on the "affective" community considered aspects of "perceptions/awareness" that could influence "attitudes" and "intentions" towards a particular behaviour, such as the advantage of healthy eating with reducing negative feelings like stress.

McDermott et al. (2015) used TPB to understand the individual's behavioural intentions and the final action (decision) when purchasing food and beverages. Through a systematic review of the literature, they identified two consumer groups: Group 1 "health-compromising" - described as individuals with high preferences for the consumption of fizzy drinks, sugary snacks, and overall poor nutritional value products and Group 2 "promotion of health" - described as individuals with potentially 'healthy food preferences' (e.g., eating 5 portions of vegetables and fruits per day). They found a significant difference between the groups in aspects associated with their perception and their behaviour ($p < 0.01$). In addition, the intention and behaviour were directly associated with the "promotion of health " group ($p<0.01$), whilst the perception and behaviour were moderately linked with the health-compromising group ($p<0.05$) (McDermott et al., 2015). However, an important limitation found was that TPB as a sole guide would be insufficient to modify behaviours and implement interventions (McDermott et al., 2015). The study did not consider the environmental implications that could have an impact on the final behaviours.

3.2.3 Misperception or value-action gaps.

Brouwer and Mosack (2015) examined a group of women ranging in age from 18 to 53 years old and representing a variety of ethnic groups and origins. The authors used TPB to understand the relationship between women's beliefs and attitudes and their behaviours to examine if there was a cognitive dissonance or value-action gap. The authors discovered a pre-existing level of misconceptions about the nutritional value of different food products within a nutritional or health literacy context. The misconception was reflected particularly among young women participants, who did not consider vegetables and whole grains as 'healthy' (Brouwer and Mosack, 2015). These attributes can be related to perceptions and attitudes linked with culture, social norms and level of education (Jacoby et al., 2003; Caprio et al., 2008; Sassi et al., 2009). Nevertheless, the study by Brouwer and Mosack (2015) showed there is a problem with misperceptions that will enhance unhealthy eating choices.

Nevertheless, the issue within the public health system where there are deficiencies in the staff's ability to properly diagnose obesity should likely be considered as a critical possible reason, particularly when attempting to increase public engagement and attendance at public clinics and/or hospitals for proper diagnosis or treatment, as well as avoiding misperceptions.

3.2.4 Environment and its influence on internal behaviours

Obesity prevention and proactive action plans should be among the primary goals when developing or re-designing eating-behaviour policies (Affenito et al., 2012). To accomplish obesity prevention, it is necessary to comprehend the complexity of the numerous factors that influence behaviours and dietary patterns. Attitudes, perception, and cognition levels are some of the factors that influence an individual's intention and can lead to specific behaviour (Ajzen, 1985). However, environmental factors can also influence behaviour and dietary practices. For example, increases in food prices will affect personal and household income, influencing individuals' purchasing decisions (Xie et al., 2015). Socio-economic conditions can become an opportunity to develop dissonant behaviours that undermine important information about health implications of a poor dietary choice. For example, the purchase of a processed juice with high-sugar content over one portion/piece of fresh vegetable/fruit. The behaviour is relevant as it reflects the influence of environmental factors (i.e., food price) being determinant in the final behaviour.

Dietary transition is influenced by interactions between an individual's daily lifestyles and their environment (Hawkes et al., 2009). These interactions will affect 1) the individual's way of

thinking; 2) their perceptions, attitudes, cognition (knowledge); 3) the individual's behaviour; 4) food and drink choices and dietary patterns (Shaikh, 2008; Affenito et al., 2012; Rodrigues et al., 2016; Zacarías et al., 2019).

An individual's interaction with the environment, such as an obesogenic environment, can also influence behaviours and alter dietary patterns (Larsen et al., 2015). Undesired behavioural changes can emerge if individual perceptions and attitudes reflect vulnerability due to a null or low level of awareness and/or knowledge about what can negatively or positively impact individuals' health (Ratnapradipa et al., 2011). However, to increase the validity and effectiveness, there is a need to explore the individual's behaviour considering the environmental elements (e.g. community settings, food security) (Glasgow et al., 2004). If elaborating about food security, the factor of budget can also affect dietary performance (Hawley et al., 2021). Hence, the need to integrate factors of behaviours with food security (i.e., availability, accessibility, and affordability).

Dhurandhar (2016) suggested that a combination of environmental and individual factors would improve opportunities to balance internal and ambient factors which could lead to a healthy lifestyle choice among all socioeconomic groups.

3.3 Social Cognitive Theory

Social Cognitive Theory (SCT) was developed by Bandura (1986) to analyse aspects of cognition (knowledge and/or awareness) and the reciprocal causation of the individual's environment. As depicted in Figure 3.2, the theory is described as triadic of reciprocal causation between the individual's 'behaviour,' the 'person' or the *cognitive factors* and the *'environmental'* factors. The theory considers and distinguishes three type of environment:- a) imposed (physical or socio-structural environment thrust on individuals regardless of them liking it or not); b) selected (from a course action individuals can activate and select environment through their choices); c) constructed (the collective efforts in which people build social environment and institutional systems) (Bandura, 1999). Key aspects of this theory are to explore in-depth culture, life experience-learning, education and social interaction of individuals and how those impact their perception, cognition and behaviour (Bandura, 1989, 1999; Conner and Norman, 2005), suggesting that the circumstances that surround individuals will act as plausible triggers and/or behavioural influencers for individuals to perform, or not, a final behaviour.
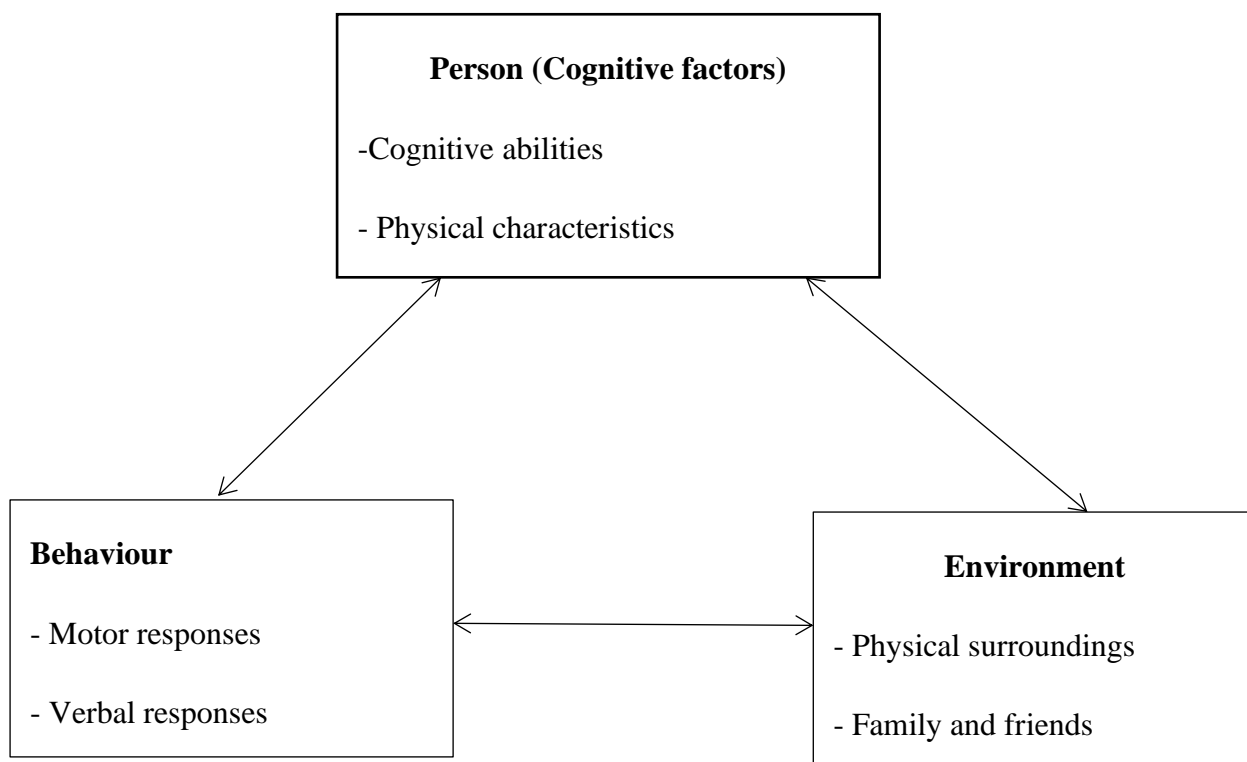
Figure 3.2. Social Cognitive Theory model (Source: Wood and Bandura, 1989).

3.3.1 Self-efficacy theory

The multifaceted causal framework proposed by the social cognitive theory concerns both the production of competencies and the regulation of behaviour (Bandura, 1986). Cognition is the guidance that establishes the foundation for behaviours (Bandura, 1999). Individuals develop their beliefs from a current skill and assess their own improvement in that particular skill (Maddux, 1995). In other words, individuals are more likely to perform a behaviour if they are convinced they can overcome and surpass any obstacle (Maddux, 1995). That level of conviction can be higher if individuals are convinced any obstacles can be tackled quickly (Maddux, 1995). The personal cognitive factors developed in the SCT within its triadic of reciprocal causation that impacts on behaviours and environments are the core of the self-efficacy theory (Bandura, 1986; Maddux, 1995). That is why environmental influences operate mostly through cognitive paths (Bandura, 1999).

The definition of self-efficacy refers to an individual's ability to have control over the events that impact his/her life (Bandura, 1989; Maddux, 1995). Self-efficacy is identified through three different dimensions: Magnitude (the number of steps an individual needs to take to

accomplish a behaviour); Strength (individuals' level of conviction and previous resolution of a particular behaviour); and Generality (individuals' successful and failed experiences which impact their level of self-efficacy) (Bandura, 1986; Maddux, 1995).

Self-efficacy is central to social cognitive theory because it influences action not only directly but also indirectly through its effect on other classes of determinants (Bandura, 1999). One's self-influence by personal challenge through setting and assessing one's performances is crucial to both personal motivation and self-directedness (Bandura, 1991; Locke & Latham, 1990). Hence, the level of efficacy will determine the failure or success resulting in a higher or lower level of motivation (Schunk and Gunn, 1986; Bandura, 1999). From a nutritional perspective, it reflects on how the level of self-efficacy has been negatively associated with the prevalence of obesity (i.e. a low level of self-efficacy would result in a higher obesity prevalence) (Soheila et al., 2018).

3.3.2 Self-efficacy and mental health

Self-efficacious individuals approach life with a "can-do" attitude, enabling them to view obstacles as problems to be solved rather than threats to be avoided (Shamsul, 2015). Self-efficacy is associated with positive well-being, stress management, increased self-esteem, improved physical condition, and improved adaptation to and recovery from disease (Bandura, 1997; Kuijer and De Ridder, 2003; Bisschop et al., 2004; Siu et al., 2007; Shamsul, 2015).

There are two forms of well-being: a) subjective well-being in association with a hedonic viewpoint, which includes factors such as physical health, positive and negative effects, and life satisfaction; and b) psychological well-being linked to factors like self-actualisation, personal development and environmental relations (Watson et al., 1988; Shamsul, 2015). A study conducted in China among employees showed that stressors and mental well-being was moderated by general self-efficacy (Siu et al., 2007). That is because emotion-focused coping is more common than problem-focused coping in people with high self-efficacy (Siu et al., 2007). In other words, self-efficacious individuals will prioritise what can be accomplished and attempted rather than what cannot be accomplished and should be abandoned.

In addition, because mental well-being will have an effect on individuals' mood, the latter has a high association between food choices and intake (AlAmmar et al., 2020). It is essential to identify what influences individuals' mental well-being and mood from an environmental

standpoint, which can be fixated within a cognition or perspective, leading to an increase or decrease in healthy eating choices.

3.3.3 Environmental factors that impact self-efficacy.

Other factors that influence self-efficacy may not be solely dependent on an individual's intellect but rather on the physical environment in which they live. One is that poor socioeconomic status highly correlated with social inequalities can impact individuals' self-efficacy (Bandura, 1994; Meinhold and Malkus, 2005). Another is the possibility for individuals to obtain knowledge through education and the public health sector.

As previously mentioned and in connection with the SCT, the externalities associated with internal aspects of an individual's learning process through acquired knowledge or education and daily life experiences play an important role in developing an individual's perceptions, attitudes, and beliefs, which reflect in their level of self-efficacy (Carr, 2003). That gives a second indirect factor with the level of education that can be associated with a higher or lower self-efficacy level. An example can be taken from the study conducted in Palestine by Khairy et al. (2021) which found that a prevalence for people having an overweight or obesity diagnosis to be linked to a loss of self-efficacy driven by lower educational standards. The lower self-efficacy directly impacted the public health sector as it reduced the level of communication between patients and doctors (Khairy et al., 2021). When doctors and patients fail to communicate effectively, both the individual's health and the health care system can be negatively impacted.

3.3.4 Education and self-efficacy

The examples mentioned in the previous section show how environmental factors can reduce or increase individuals' level of self-efficacy, leading them to behaviours that can impact their nutrition and well-being. If taking the last two elements of nutrition and well-being, it is imperative to consider how the set environment can impact self-efficacy leading to behaviours that can affect food security. A study conducted in East Java, Indonesia by Titaley et al. (2021), included a sample of new mothers with different levels of education. The study showed higher odds of breastfeeding among new mothers with a higher level of education compared to those with a lower level of education (Titaley et al., 2021). Hence, from the study it can be suggested that education can lead individuals to certain performed behaviours, proving a correlation with self-efficacy and breastfeeding practices.

Three key aspects can be highlighted from Titaley et al. (2021) study. The combined levels of self-efficacy, education and health literacy have an influence on the perception of an individual, which can positively and/or negatively impact health and nutrition. The fact that new mothers understand the importance of breastfeeding in preventing future diseases in their children, such as obesity, could lead to a higher prevalence in prevention and reduction of obesity. Hence, the study shows the importance of education, health literacy and self-efficacy to enhance nutrition and therefore, food security.

Studies by Titaley et al. (2021) and Khairy et al. (2021) showed that that self-efficacy levels from a cognitive aspect can have an impact on individuals' behaviours, including factors such as the communication from the public health sector and the awareness of users. Breastfeeding practices and information are usually transmitted by medical staff to patients as part of the public health system. However, when communication between the patient and medical staff is hampered, food security can also be compromised, especially during the critical first stages of life.

3.3.5 The limitations of self-efficacy

An important factor to highlight is that self-efficacy by itself can only minimise the value-action gap (Day et al., 2021) but not prevent it from occurring. Hence, self-efficacy will not prevent possible value-action gaps in all cases. This can be associated with the self-efficacy determinants mentioned in Section 3.3.1. of magnitude, strength, and generality (Bandura, 1986; Maddux, 1995).

As previously stated about social cognitive dissonance or value action-gaps in Section 3.2.1., an individual's beliefs or perceptions about his or her ability to perform a behaviour will not always be reflected in the final action. The self-efficacy expectations can depend on other factors such as the performance accomplishments, that is the exposure, skill or self-instructed performance; vicarious experience, referring to a learned observation or life-model; verbal persuasion which can be by a suggestion or exhortation from an external (usually trustworthy) influence; and emotional arousal which suggests the relationship between an action and a given sensation (e.g., anxiety, happiness, depression, optimism) (Bandura, 1977; Maddux, 1995). From all the previously mentioned dimensions of self-efficacy, the first three can be associated with a cognitive process. However, the fourth dimension (i.e., emotional arousal) will depend on the individual psychological and/or environmental circumstances not necessarily associated with a cognitive factor. That can be a reason for certain emotional links with some food

products. A study conducted in the U.S. by Graham et al. (2021) found that sugar consumption was highly associated with emotions, love, family and even life management. A significant observation from the study was that participants from middle-class families who could afford healthy diets opted to consume more sugar than recommended (Graham et al., 2021). Authors linked the problem of sugar consumption not with a lack of health literacy or food insecurity but with a lack of disassociation between emotions and food choices (Graham et al., 2021).

In addition, Graham et al. (2021) suggested changes within the food system in terms of regulation of marketing and a reduction in the availability of ultra-processed foods combined with cultural change. If applying Graham et al. (2021) findings from a social-behavioural perspective and including self-efficacy, the strongest influence on the participant's final behaviour can be attributed to an "emotional arousal". The "emotional arousal" can be also be driven by a marketing strategy that impacts culture, eating choices and dietary patterns (Pettigrew et al., 2012). A direct example is Valentines' Day, a celebration of love and friendship which can be highly associated with gifts such as flowers and sugary treats. Hence, Graham et al. (2021) recommendations can be supported, particularly the importance of regulating marketing to avoid negative cultural/behavioural changes.

Moreover, it is important to remark that a higher level of knowledge does not guarantee better or healthier dietary habits (Pine and Fletcher, 2014). In fact, only a small percentage of people will follow the health advice and change their behaviours because it is beneficial; others will have the intention but not the capacity to change their actions (Pine and Fletcher, 2014). The capacity can be associated with socioeconomic factors that regulate and determine the state of food security.

3.3.6 SCT in the context of nutrition and eating choices

Previous research in the field of nutrition, which has applied SCT, has analysed the effect of interventions and campaigns on individuals, either to increase their physical activity or to modify their diets as part of improving their health and daily lifestyle habits (Franko et al., 2013; Doerksen and McAuley, 2014; Zacarías et al., 2019). Franko et al. (2013) for example found that the factor of self-efficacy is critical as it can leverage support and enable social accountability as part of an integral dietary change programs, while Doerksen and McAuley, (2014) found self-efficacy was significantly associated with fat consumption.

Furthermore, the authors found that social engagements and emotional events, in addition to social cognitive perspectives and self-efficacy, are relevant factors for understanding individuals' temptation situations (Doerkesen and McAuley, 2014). Zacarias et al. (2019) findings promote SCT as a model that enables and promotes a holistic approach in health initiatives. Key findings from Zacarias et al. (2019) included an essential change in the perception of mothers when deciding what food and beverages to purchase. At the beginning of the intervention, 46% of the mothers identified taste as the main reason for purchasing a food product. However, at the end of the program, 63% of the mothers' perception and decision to buy a food or drink product had shifted to a nutritional/health reason. Other positive outcomes were: a reduction in the children's BMI z-scores; the identification of "affordability" as a factor that represented a challenge for the adoption of healthier dietary patterns among the participants; the importance of transmitting new cooking skills and nutrition orientation, to make it known to people how to make the best of the available food; and as a pivotal finding the lack of support from the husband/male partner towards their wife/female partner for the introduction and constancy of healthier dietary patterns (Zacarías et al. 2019).

In Zacarías et al. (2019), SCT was used as a framework to understand the level of knowledge and environment, translated as how individuals would adopt healthier behaviour and integrate elements from an individual and environmental perspective to achieve more effective health interventions (Bandura, 2004; Zacarías et al. 2019).

3.4 TPB-SCT framework.

TPB and SCT are two flexible theoretical models that integrate and deliver a systemic understanding to explore individual internal and external behavioural drivers. The integration of both methods to one single framework combines the social psychology theories of behaviour with environmental factors (Baumeister and Vohs, 2007). The framework of TPB and SCT together expands the exploration of internal behavioural factors of motivation, intention, and the final behaviour. Moreover, the perceived behavioural control element from the TPB has been considered (Ajzen, 1991) as one behavioural element closely comparable and compatible with Bandura, (1977) element of self-efficacy. That is because the TPB's perception of behaviour affects an individual's self, including their ability to perform a certain behaviour. Bandura's self-efficacy aspect is concerned with the capability to do a given behaviour.

Rodrigues et al. (2016) studied elements by considering three different study lines (biological, psychological, and social) to develop a framework that can be used in multiple clinical study

cases. For example, to understand and identify the extent to which physical activity may prevent osteoporosis (Krupa et al., 2016). As illustrated in Figure 3.3, the framework considered both individual and environmental factors. The environment can influence the intentions driven by perceptions and/or attitudes, and/or normative beliefs, thereby determining the final behaviour. Hence, environment would have the strength to modify the relationship between the intentions and the final behaviour.
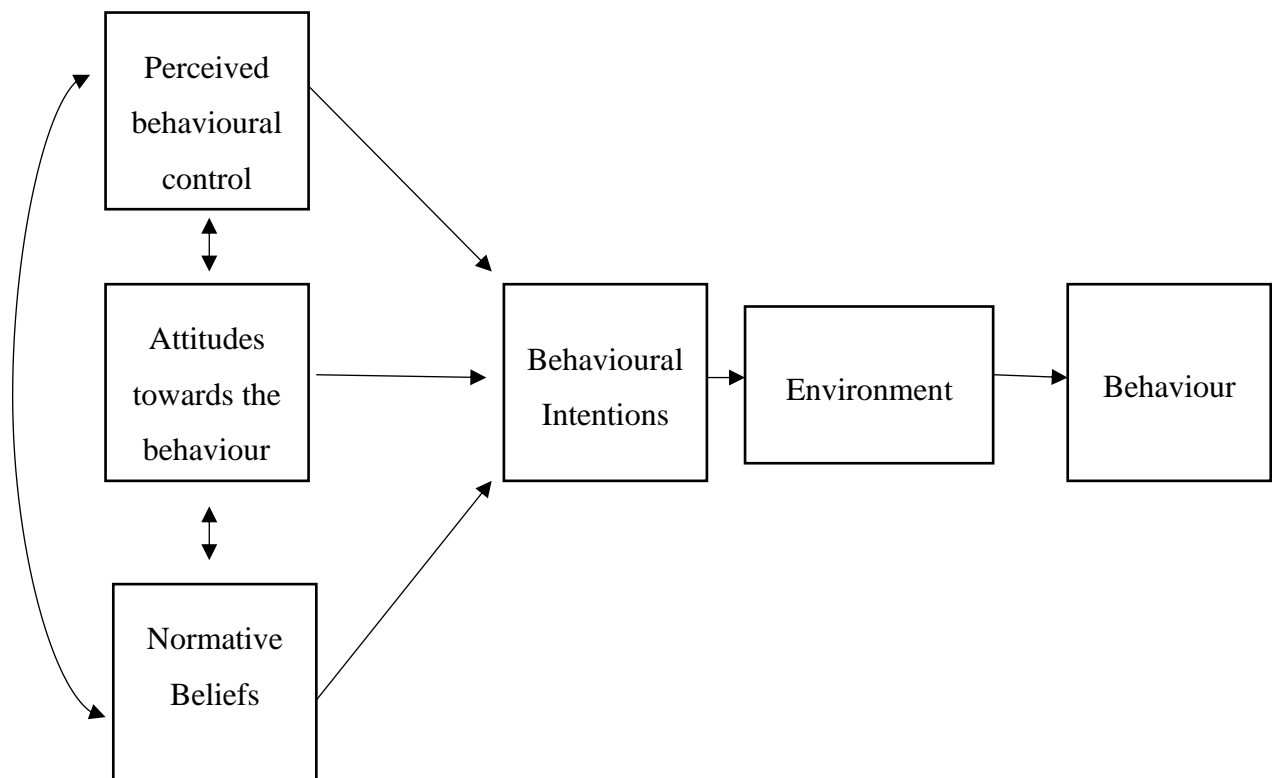
Figure 3.3. Alternative TPB-SCT model. (Source: Rodrigues et al., 2016).

Both TPB and SCT can serve as a guide to understand and explore in-depth aspects associated with individuals' behaviour such as attitudes, perceptions, and cognition. TPB delivers individual elements of behaviour (i.e., perception, attitude, and subjective norms) towards a final intention and behaviour. The model helps to identify a value-action gap (Mela, 2006) by interpreting disruptions between internal perspectives and final behaviours.

Previous studies have suggested that the SCT approach considers cognition and environment as factors that influence an individual's decision-making (Parmenter and Wardle, 1999; Zacarías et al., 2019). Therefore, the purpose of selecting SCT is to consider data mainly from

an environmental perspective (e.g., sociodemographic factors, social norms, food security) to understand its relationship with individuals' internal attributes (i.e., perception, motivation, cognition) and the behavioural responses and association with self-efficacy. Self-efficacy is a key determinant of individuals' behaviours and can explain the selected behaviours or the disruptions between perceptions and behaviours (i.e., value-action gaps).

According to SCT, a person's ability to select their daily diet is influenced by a variety of factors, including their inner behaviours and their environment or surroundings. These abilities include a learned behaviour that occurred over time or recent influence or experimentation to adopt new behaviours. Hence, the behavioural factors that would influence individuals' eating choices would be associated with their knowledge, attitudes, built skills and level of self-efficacy (Moitra et al., 2021).

Health programmes may serve as a good example of acquired knowledge to improve skills such as cooking. Community-based cooking measures are a popular strategy for promoting healthy eating (Garcia et al., 2016). A six-week USDA programme called Cooking Matters includes meal planning, nutrition training, and cooking sessions for communities (Hawley et al., 2021). The programme showed positive outcomes with people who completed the sessions reporting changes on their dietary patterns such as consuming more vegetables, low sodium and low-fat dairy products compared to individuals who did not participate (Pinard et al. 2015; Hawley et al., 2021).

In relation to cooking skills there is a high association with the subjective norms (i.e., behavioural patterns acquired from family members, friends, and close social groups) established in the TPB. The subjective norms particularly for eating habits are important and consistent factors transmitted for example from parents to children (Lahmann et al., 2017). Previous research mentioned a "mom's effect," in which the influence of the mother's dietary habits can be seen in her adult daughter's family food choices a generation later (Johnson et al. 2010; Bowen and Devine, 2011; Brown et al., 2012). However, not everything that parents can communicate to their children will resonate with them, and not everything will result in positive behaviour. As previously mentioned in Section 3.3.5, pre-existing habits motivated by emotional arousals can result in excessive sugar consumption in both parents and children, triggered by the negative marketing that can influence behaviour and culture, which the public health system should consider (Graham et al., 2021).

3.5 Synthesis of the theoretical framework and its impact on eating choices and obesity.

The application of social-behavioural theories as the basis for a behaviour assessment can help determine what needs to be changed in a policy or health programme. The need to integrate health policies that consider individual behavioural aspects (e.g., beliefs, attitudes, subjective norms), followed by socio-demographic and macro-environmental factors (e.g., economy, income, education levels, food systems), is critical for the development of effective health strategies. Since obesity is largely linked to medical-nutritional, psychological, and socio-cultural factors (Medina et al., 2021). There is a need to consider the interactions between individuals' behaviours and their environment to understand their eating choice, habits, health, and nutrition.

The use of TPB and SCT in previous work by McDermott et al. (2015) and Zacarias et al. (2019) respectively demonstrated how individuals would develop a perception based on their previous experiences, level of cognition, and sociodemographic factors heavily influenced by their environment. Moreover, the benefit of understanding both TPB and SCT is to assess individuals' level of confidence or self-efficacy to understand and put into practice healthy eating choices (Hiranrat et al., 2021). Therefore, relying solely on the TPB to develop health initiatives is a limitation found in McDermott et al. (2015), which formed the premise of combining TPB and SCT in this study to generate a more robust understanding of behavioural change determinants. In addition, studies such as Zacarias et al. (2019) provided a comprehensive account of the use of SCT in which after six months of nutritional and cooking trainings, mothers self-efficacy increased from 72.24 (SD 16.7) to 76.39 (SD 23.2) (Zacarías et al., 2019). The study demonstrated how SCT as a model assesses the impact on behaviours and self-efficacy from increased knowledge and awareness of health literacy and nutrition, which can relate to the attitudes, subjective norms, and perceptions of TPB.

Furthermore, there is no doubt that delivering health literacy and improving cooking skills can result in a positive outcome and an improvement in dietary patterns. However, healthy eating choices can be subject to many factors highly associated with individuals' behaviours (e.g., emotions), perceptions, subjective norms, and sociodemographic factors (e.g., level of income). Hence, it is important to understand the perspectives and limitations of individuals in association with their environment.

Additionally, behavioural changes such as the one proposed for necessary cultural changes, require a significant amount of time and effort and it is important to consider that the effect of implemented health initiatives now can only be seen over a longer period. When considering epidemiological emergencies and public health burdens in Mexico, such as DM2 and obesity, the need to incorporate behavioural research into the development of public health initiatives is critical. Moreover, if the health initiative "interacts" with an individual's daily life (e.g., through nutritional labelling, nutritional school lunches, implementation of cooking skills training in schools and universities), then positive changes can be accelerated.

A limitation of TPB is that it does not consider the environmental factors that may influence individuals' decisions or behaviours (Rodrigues et al., 2016). Additionally, the SCT, with its triadic of reciprocal causation, is not entirely clear in terms of the extent and weight of each element on the final behaviour of individuals (Wayne, 2019).

The theoretical behavioural framework (Figure 3.4) developed for this study considers the connection between the individual and the environment that can trigger both the behaviours and/or the value-action gaps. The need to understand in-depth the relationship between the individual's perceptions, beliefs, motivations and self-efficacy and the interaction and impact from their environment can deliver crucial data to generate a different narrative that can lead to opportunities for improvement within the health system. The value-action gap can determine what can diminish a perception or attitude which can result in a disruption, misperception, and negative behaviour. A combination of factors such as an individual's lifestyle, the challenges s/he faces, and how they respond from a behavioural perspective can generate and integrate data to provide a deeper level of understanding to improve health policy-making effectiveness. Moreover, the theoretical framework intends to link both individual and environmental factors that trigger behaviours to extend the level of knowledge and understanding for developing effective health interventions. It is critical to apply behavioural sciences, such as a theoretical social behaviour framework, within the public health context to understand how these systems may be improved, what actions are required, and what users need to learn and adopt over time (Glanz, 2016). Furthermore, there is a need to understand the various factors and levels of behavioural, sociocultural, economic, and demographic circumstances within the public health system in order to anticipate the needs associated with individuals' health (Shaikh, 2008; Glanz, 2016).

The theoretical framework serves to map-out and assess internal behavioural factors (e.g.,

perception, motivation, intention, self-efficacy) with the environment (e.g., sociodemographic, food security). This can offer an integrated response to the question, "what is currently driving obesity in Mexico?" Figure 3.4 shows the proposed framework and the combination of the two social-behavioural theories that can contribute to developing health initiatives that can target behaviour in a more holistic way in the future.
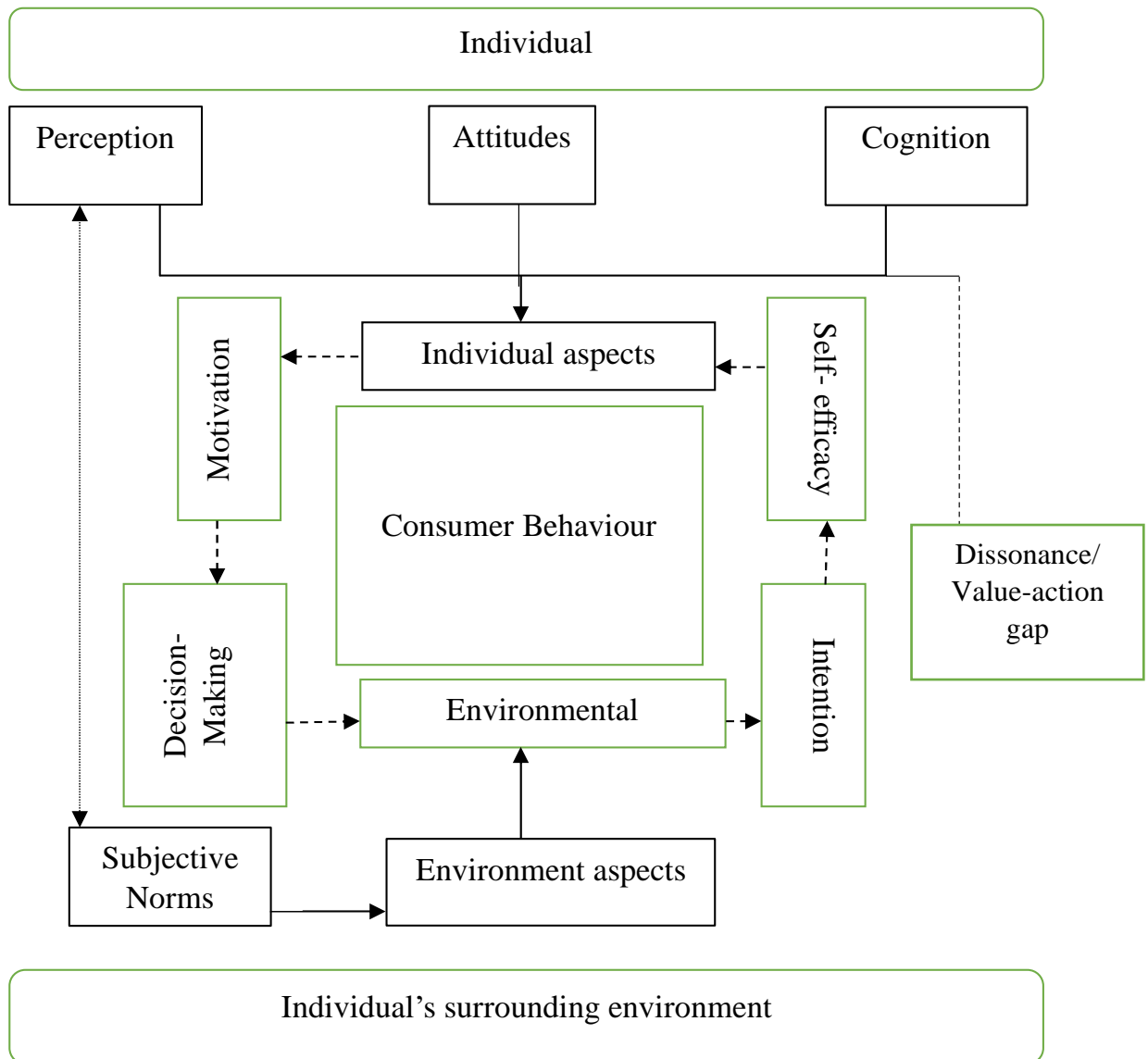
Figure 3.4. Synthesis of consumer behaviour influences.

3.6 Conclusion

Theories of behaviour can deliver essential data associated with the context of behaviours and the psychological responses (i.e. perception, motivation, intention, self-control, self-efficacy) alongside environmental influences that determine lifestyle patterns (e.g. dietary patterns) (Kwasnicka et al., 2016).

The chapter aimed to examine the influence of social-behavioural theories and a suggested holistic mapping model for determining how people make eating choices. Internal and environmental factors such as perceptions and marketing were considered. However, these factors can produce subjective results or be insufficient to target the study's aim or their output cannot be holistic enough to handle possible solutions to the problem. Thus, it is recommended that, prior to selecting theories, one clearly defines which factors or themes will be studied to establish a proper connection between observed behaviours and the object of study. The objective is to collect timely evidence that substantiates and establishes links between the issue and the behaviours. The evidence and connections can then be used to identify and contribute to the intended holistic approach necessary to solve a public health issue.

TPB and SCT together require further research, particularly to properly allocate where the elements of each would fit, their order, and the need for a validation test to understand in-depth their interaction (Rodrigues et al., 2016).

Chapter 4. Drivers of eating choices and health behaviours. A case study in Queretaro State, Mexico.

4.1 Introduction

This chapter aims to identify individual and environmental drivers to understand their influence on individuals' eating choices and health behaviours and the impact on nutrition in a selected participant group in Queretaro State, Mexico. It aims to bring insight into the environmental drivers identified in Chapter 2, such as food insecurity or any other significant components detected in the collected data, to establish an explanation for their role in the Mexican obesity prevalence.

Six institutions were chosen to identify persons to participate in a survey in two municipalities in one state in Mexico. Participants underwent anthropometric measurements and were questioned about their eating habits and health behaviours. The acquired data were analysed to ascertain the associations between eating habits and their effect on nutritional status. Figure 4.1 outlines the steps and the description for the development, application, and analysis of the developed survey within the research project.

4.2.1 Case study - Case selection - Geographic location, demographics, socio-economic profile of area	4.2.2 Profile of the participants - Participating institutions - Characteristics of sampled population.	4.2.3 Survey design - Approach; survey methods & justification
4.2.4 Survey implementation - Data collection & administration of questionaire	4.3 Statistical analysis Analytical approch & method of analysis	4.4 Findings - Disclose and interpretation of findings

Figure 4.1. Survey's development and analytical process

4.2 Methods

4.2.1 Case study and participant selection

Mexico has 32 federal states, which are divided into municipalities (UNDP, n.d.). From the 32 states, Queretaro was chosen using a convenience sampling approach, the principle of an organisation to the study query (also known as "availability sampling") (Saunder et al., 2012). In other words, the sampled population will be surveyed based on availability and willingness to participate. Additionally, due to financial constraints, surveying in the researcher's hometown facilitate the survey's distribution and collection of data from all selected organisations in the education and health sectors.

Queretaro state is in Mexico's central-north-western region referred to as the "Bajio" or lower region. It is divided into 18 municipalities, including the capital. Queretaro's economy is focused on tertiary activities such as service industries, finance and tourism and secondary economic activities, which include mainly the manufacturing industry. The primary sector, which focuses on agriculture and food production, is located at the end of the first two economic sectors (INEGI, 2020). An interesting fact associated with the primary sector and the agri-food production systems is that, between 1970 and 1993, production in Queretaro dropped from 18% to 4.6% of its GDP; the secondary sector remained constant at 36% of the GDP; and the tertiary sector increased from 45% to 60% of the GDP (Rello and Morales, 2002).

Queretaro State is divided into 18 municipalities, including the capital. Two municipalities were considered for the sample; the state's capital city, which bears the same name as the state and has an estimated population of 878,931 (INEGI, 2015) and the municipality of Jalpan allocated in the north of the state whose population is estimated at 26,902 (INEGI, 2015).

Combining the convenience sampling approach with inclusion criteria, as previously established by Fink (2014), may or may not produce data relevant to the set criteria. In other words, as it works within a readily available scheme sample, some participants may meet the inclusion criteria, while others will have to be excluded. Hence, the decision was made to simplify the inclusion criteria for this research as follows: both genders are participants; age range between 19 and 65 years old; living in Queretaro or Jalpan.

An invitation was sent to seven institutions from the state's public health and education sectors. That was due, to a) the availability of participants in terms of time could be extended in the selected institutions, compared to a street, supermarket, or venue premises; b) it is possible to

identify for individuals who met all the established conditions for inclusion; c) in the hospital and health clinic, surveyors were invited directly, but in universities, they were recruited via module leaders, who previously agreed to dedicate part of their class time to the survey.

From the seven institutions, six responded and agreed to participate in the study, these were:
- Two public hospitals
  - Mexican Social Security Institute (IMSS); Red Cross in the state of Queretaro;
- One public clinic
  - Nutritional Clinic from the Autonomous University of Queretaro (UAQ).
- Three universities
  - Normal School from the State of Queretaro Campus Jalpan (ENEQ); Technological Institute of Queretaro (ITQ); and University of Anahuac Campus Queretaro (ANAHUAC).

4.2.2 Survey design

The survey design considered a multidimensional approach to better understand and encompass different elements such as sociodemographic and other environmental drivers that impact individuals' eating choices and state of nutrition. The concept of a multidimensional approach to data is characterised by, for example, dichotomic facts as a representation of data in an n-dimensional space (Romero and Abelló, 2009). Factors such as the selected ones of internal and environmental drivers enable an extended perspective or analysis of what influences the prevalence of obesity (Romero and Abelló, 2009). Each internal and environmental driver is a descriptor of a specific situation, which integration delivers a multidimensional approach (Romero and Abelló, 2009). It is important to highlight that a multidimensional approach for the survey's development from a behavioural standpoint is critical, as it has been shown to improve understanding between human-information behaviour while taking both psychological and social factors into account (Fidel et al., 2004). Furthermore, previous research (VanderBroek-Stice et al., 2017) has used the multidimensional approach to investigate relationships between food addictions and various behavioural and psychological patterns, such as impulsivity, which can lead to obesity. For this research, the integration of the variables would follow from the two main factors mentioned in Chapter 1 (food insecurity and nutritional transition) to expand it towards the environmental drivers in Chapter 2 (Table 2.3). Hence, the built associations would consider environmental and behavioural variables. Additionally, the drivers that impact individuals' behaviours from the Theory of Planned

Behaviour (TPB) and Social Cognitive Theory (SCT) paths are shown in Chapter 3, Fig. 3.4. The built associations would consider behaviour and health outcome variables. The internal behaviours from the theoretical framework are taken as follows:

From the TBP

-Perception — an individual's perception of the ease or difficulty with which an activity can be performed or the "reality of circumstances."

- Attitudes- an individual's proclivity to engage in a particular behaviour or "the desire to do or not do something".

- Subjective norms - an individual's behaviour is influenced by their immediate social circle (i.e. family, friends, co-workers, and classmates).

From the SCT

-Cognition – individual's level of education, nutritional knowledge and/or health literacy.

- Environment – individual's direct and indirect elements that can impact or influence their eating behaviours.

The developed associations previously mentioned were to ascertain the impact to health and the nutrition state through the integration of three elements: environment, behaviours and health outcome. Moreover, three deductive hypotheses were developed to be accepted or rejected by the collected data and its analysis. The first hypothesis considered the connection between environment and behaviours. The second hypothesis considered the connection between behaviours and health outcomes. The third hypothesis considered mainly the internal behaviours.

The developed hypotheses were:

H_1) There is no association between power of purchase and obesity.

H_2) There is no association between level of health knowledge and obesity.

H_3) There is no association between low levels of perception, attitudes and cognition and obesity.

Considering the three elements of environment, behaviours and health outcome, the survey was divided into five different sections. The following Table 4.1. shows the justification for each section and the data to be collected.

Table 4.1. Overview of the survey structure.

Section	Justification	Data collection
S1. Personal Information	This information was collected to classify and build a profile of the individuals and assess their level of independence with other built variables. The analysis would seek to determine the sociodemographic factors that influence food choices and their effect on obesity.	- Age - Marital status - Gender - Level of education - Level of income (per month) - Current occupation
S2. Nutritional Status	The obtained information in the section would identify the differences among participants in terms of their state of nutrition. Moreover, it would identify participants with a positive obesity diagnosis to associate it with their food/beverage choices and environment.	Anthropometric[4] measurements (weight, height, hip, and waist circumference)
S3. Food security	The section would deliver the interaction between the individual and the environment. The interaction of what impact 1) eating choices, 2) understanding	- Importance of food prices - Purchasing patterns and limitations when purchasing groceries - Food price ranking perspective

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[4] Series of quantitative measures to assess body composition (Casadei and Kiel, 2019).

Section	Justification	Data collection
	of what is available, affordable, and accessible. Results can be integrated into a multidimensional analysis to understand the association of food security, eating choices and state of nutrition.	• Eating-out patterns • Choices when eating-out • Dietary influencers and technological patterns • Sugar taxes implementation perception
S4. Nutritional Knowledge	The information collected from this section considered the level of the participants' involvement and adoption of national public health recommendations. Moreover, the measure of the awareness levels would enable a connection in the analysis with individuals' attitudes and perceptions to capture the self-efficacy and a possible value-action gap.	• Nutritional orientation influencer in consumption behaviour • Knowledge of nutritional consumption and perception of following the nutritional dietary recommendations • Perception of food and drink choices.
S5. Lifestyles and internal behaviours (i.e., beliefs, motivations).	The data collected from this section would mainly inquiry about individuals' behaviours and attitudes, to understand the connection with eating choices and adoption of dietary patterns.	• Lifestyle sustainable consumption approaches • Motivations that could trigger healthier dietary patterns • Current self-perception and level of satisfaction of dietary patterns. • The willingness of changing towards more positive dietary patterns. • Physical activity

Section	Justification	Data collection
		• Personal and family medical history • Alcohol drinking habits

A pilot survey was conducted to evaluate and validate its content, format, and sequence of questions to ensure they were appropriate for the target group and the survey's overall goal (Abu-Hassan et al., 2006). The pilot survey sampled 14 participants in Mexico who were not linked with the selected institutions and who received the survey through email, along with instructions on how to complete it and submit comments and feedback about the survey's length and clarity. The comments addressed the survey's comprehension, clarity, and compliance to the set duration time required to complete the survey, as specified in the directions and information section at the start. Survey adjustments were made after carefully considering all input received from participants. Ethics approval was obtained from the Cranfield University Research Ethics System (CURES) in January 2018. All data were kept secure in accordance with the General Data Protection Regulation (GDPR).

Following the pilot survey, a clean-up of data and redefinition of the questionnaire were performed. In addition, the reliability test was done to measure any internal error (Md Ghazali, 2016) using Cronbach's alpha test were taken from Ahdika, (2021) study 0.0-0.20 (Less reliable); >0.20-0.40 (Rather reliable); >0.40-0.60 (Quite reliable); >0.60-0.80 (Reliable); >0.80-1.00 (Very reliable). The reliability was done considering the results from the pilot survey (n=14) Section 1 obtained an overall Cronbach's alpha of 0.510 (Quite Reliable); section 2 -0.722 (Reliable); section 3 – 0.742 (Reliable); section 4 – 0.867 (Very reliable); section 5 – 0.650 (Reliable).

The questions were synthesised and reduced from 66 to 51 to decrease the amount of application time required per participant. Appendix C shows the final survey version and Appendix D delivers the raw data.

4.2.3 Survey Implementation

The target number of participants was calculated Krejcie and Morgan (1970): The result showed a minimum sample size of n=384 considering a margin of error of 5% and a confidence level of 95%.

4.2.3.1 Dissemination of the survey

To address the issue of low response rate and bias in the sample a "hybrid" survey methodological technique was used to disseminate the survey (Monzon et al., 2020). For this study, a combination of a face-to-face interview and an online survey was selected as the hybrid approach to obtain a higher response rate and reduction of clarity bias (Szolnoki and Hoffmann, 2013). The benefits of the face-to-face interview included clarifying any question to the participant and the inclusion of illiterate participants. The advantages of the online survey method included participant's autonomy, ease of use, and an appealing format, particularly for young participants (Szolnoki and Hoffmann, 2013). Face-to-face interviews were conducted mostly at general hospitals (IMSS and Red Cross) and at ANAHUAC University.

The online survey was developed in Spanish using Qualtrics software. The purpose of using software such as Qualtrics was to obtain the benefits of a structured multiple-choice questionnaires, easy to develop, and convenient to implement. Moreover, it ensured data collection and organisation in a program with easy access, available elsewhere with a Wi-Fi connection and transferable to different technological gadgets. In addition, utilising Qualtrics software helps to reduce costs (Van and Jankowski, 2006). The universities and nutritional clinics (i.e., ENEQ, ITQ, and UAQ) provided access to a computer laboratory or room where participants could access the Qualtrics link and complete the survey electronically.

4.2.3.2 Anthropometric measurements

Following completion of the survey, participants were directed to a specified place (pre-agreed upon by the researcher and the institutions) for anthropometric measurements. The participants' height was determined using a portable wall-mounted stadiometer SECA 206, mounted and calibrated in the participant's allotted private space. Each participant's height was measured barefoot, standing with their backs to the wall, both feet together, heels touching the wall, and their bodies erect and centred. The participant's scalp was lightly pressed against the headpiece while the stadiometer was rolled down. The measurement was taken on a separate spreadsheet, together with the participant's name and the height displayed in the stadiometer's display window. The participant's weight was determined using a Tanita weight scale model (BC532) programmed with the participant's gender, age, and height. Each participant's weight was collected without shoes or other clothing to eliminate weight bias and movement was

avoided for at least five seconds. The participant's weight, displayed on the scale, was recorded in the same form used to record the participant's height.

The procedure to measure hip and waist was taken from the WHO's STEPS surveillance manual (2017) with a pocket flexible tape. The body position requested was a standing position on a sagittal plane, with both arms raised to the shoulder level and extended to each side, weight distributed evenly between both feet, and the participant instructed to breathe normally. The tape was wrapped horizontally in both front and back around the participant's midpoint between the last rib and the top of the hip for the waist measurement. The hip measurement was taken as the maximum circumference of the buttocks, making sure the tape was snug yet not compressing the skin, which would bias the measurement.

4.2.3.3 State of nutrition indicators

The BMI classification and the waist-hip ratio of participants were calculated using their weight, height, and waist/hip measurements respectively to determine their nutritional status. The waist/hip ratio was obtained by dividing the circumference size of both waist and hip in centimetres. The division of waist and hip would deliver the figure to be compared and classified with the cut-offs following the waist/hip ratio report (WHO, 2008). The report sets the risk range for the Mexican population as higher than or equal to 0.90 cm for males and greater than or equal to 0.85 cm for females. The classification of the W/H ratio was used to predict the risk of developing chronic diseases such as Type 2 diabetes and cardiovascular diseases linked with overweight and obesity (Berber et al., 2001).

The height and weight measurements were considered for the Body Mass Index classification, taking the official formula established by Quetelet in 1830, and formerly called Quetelet Index (Woodward, 2016), by dividing individual's weight in kilograms with the square of the height in metres (kg/m^2).

The difference within the nutritional status was classified as group A) individuals with a BMI below $25 kg/m^2$ and a W/H ratio classification below the cut-off for females (0.85 cm) and male (0.90 cm) and group B) participants with a BMI greater than $25 kg/m^2$ and a W/H ratio risk classification for females (>0.85 cm) and males (>0.90 cm).

4.3 Statistical Analysis

4.3.1 Analytical approach

All data were exported from Qualtrics to SPSS v. 26.0 for analysis.

The data were first examined using a normality test, which revealed that only 8% of the questions and variables were parametric, hence, the hypotheses were tested using a mixed method approach. The parametric part considered a linear regression test to predict the relationship between the BMI and the W/H variables of total female, and male. The non-parametric section was tested using a frequency test to obtain the profile of participants and a Chi-square test to understand and determine the group differences across the sociodemographic and nutritional. The Chi-Square test was performed to categorise and output the possible drivers of eating choices within a non-parametric or distribution-free test (Mchugh, 2013). The associations between sociodemographic variables from Table 4.1 across the BMI and W/H ratios examined the female and male groups.

The results of the analysis show how health outcomes interact with behavioural and environmental factors to influence people's eating habits. Furthermore, the associations found, identify probable causes that lead to obesity in the sampled consumers. Finally, to better understand the found associations and their distribution throughout the created groups, a mean and standard deviation were determined (i.e., the total population, female and male groups).

4.4 Results

4.4.1 Sociodemographic frequency profile of the sampled population

Of the participants 69% were female, and 31% were male. The age distribution of participants was as follows: 19-25 years old (66%); 26-35 years old (14%); 36-45 years old (8%); 46-55 years old (8%); and 56-65 years old (4%).

Sixty-eight percent were single, and 28% were married.

Distribution of occupations was: 64% of the participants were students; 19% were employees by wages; 11% housekeepers; 2% professionals; 1% self-employed; 0.2% occupational disability; 2% responded other; and there were 0.8% missing answers.

Income distribution was: 34% between 1,001-5,000MXN (0-20 GBP); 30% between $0-500MXN (20-41 GBP); 14% between 501-1,000MXN (40-204 GBP); 12% between 5,001-

10,000MXN (GBP 204-408); and finally, 4% above 10,000MXN (above 408 GBP); 6% missing answers.

The level of education distribution was: 59% high education (i.e., undergraduate, and postgraduate levels, either studying or completed); 15% medium-high education (high school and trade/technical school, either studying or completed); 15% basic education (elementary and middle school, either studying or completed) and 11% no education.

4.4.2 Sampled population and the relationship between BMI and W/H ratio.

Figure 4.1 show the relationship between the sampled population and their state of nutrition of BMI and W/H ratio.

The relationship between BMI and W/H ratio considering gender resulted in a positive Pearson correlation (r (292) = 0.545, p <0.001), R^2 0.297) within the female participants. The relationship between BMI and W/H ratio was positive Pearson correlation (r (133) = 0.666, p <0.001), R^2 0.444) among the male participants.
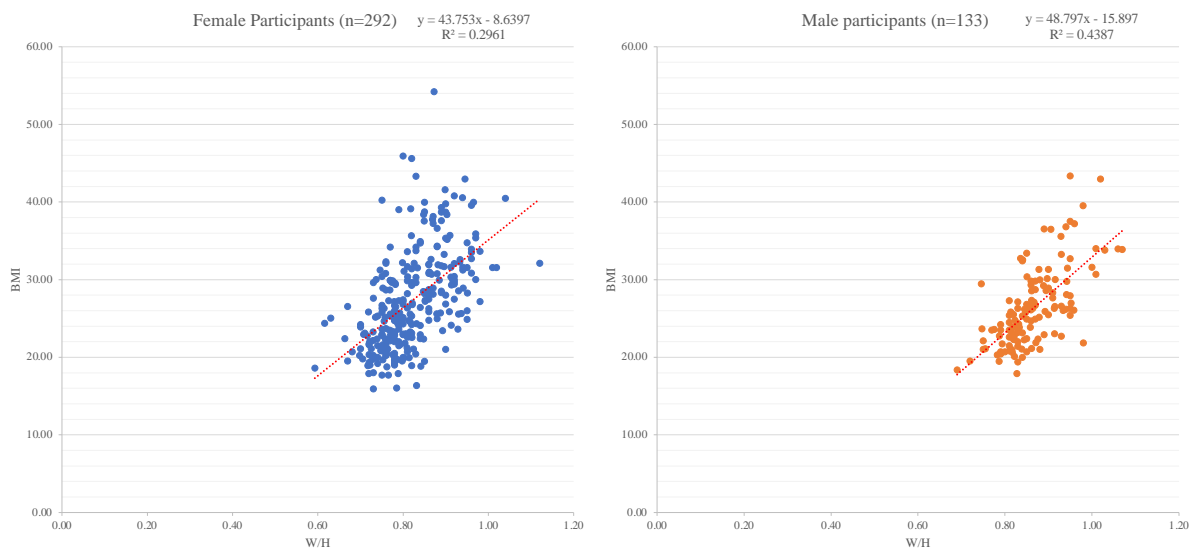
Figure 4.1. Relationship between the BMI and the W/H ratio in the sampled population.

From the Chi-square test there was an association between the BMI and W/H ratio in the female population; $X^2(1) = 66.57$ p <0.001. Table 4.2 showed among the female participants classified as group A of the nutritional status was 39%, while in group B it was 31%.

Additionally, table 4.2 showed there was an association between the BMI and W/H ratio in the male population; $X^2(1) = 24.83$, p <0.001. Among the male participants classified as group A of the nutritional status was 42%, while in group B it was 26%.

There was an association between the BMI and W/H ratio among the total population $X^2(1) = 92.48$, p <0.001. Distribution among the total population group A was 40%, while group B was 30%.

Table 4.2. Gender differences in the nutritional status.

Gender	Group A Normal weight and waist/hip ratio.	Group B High weight and waist/hip ratio.	Chi square (df)	P value
Female	39%	31%	66.57 (1)	<0.001
Male	42%	26%	24.8 (1)	<0.001

4.4.3 Sociodemographic elements and BMI classification

From the sample, 40% (n=168) classified as normal weight according to the BMI, 30% (n=126) classified as overweight, 27% (n=116) as obese and 3% (n=14) as underweight (26.83 Mean ± 6.2 SD CI95% 26.23 – 27.42).

Table 4.3 illustrates the associations between BMI classification and sociodemographic variables to understand their association and identify the distribution of the sampled population.

Table 4.3. Sociodemographic elements and BMI classification.

		BMI				X^2(df) P value
		Underweight	**Normal**	**Overweight**	**Obese**	
Gender	Female (n= 291)	4%	38%	28%	30%	1.549 (2)
	Male (n= 132)	3%	44%	33%	20%	0.461
Age	19-25 years old (n= 281)	5%	51%	28%	16%	79.11 (12) <0.001
	26-35 years old (n= 62)	0%	16%	40%	44%	
	36-45 years old (n= 32)	0%	22%	34%	44%	
	46-55 years old (n= 32)	0%	16%	28%	56%	
	56-65 years old (n= 17)	0%	12%	24%	64%	
Marital status	Single (n=285)	5%	51%	26%	18%	70.26 (12) <0.001
	Married (n=118)	0%	18%	36%	46%	
Household composition	Without children	5%	50%	26%	19%	60.80 (3) <0.001
	With Children	0%	18%	36%	46%	
Level of income	Between 0-500MXN (n= 126)	5%	51%	28%	16%	27.59 (12) <0.05
	Between 501-1,000MXN (n= 59)	5%	44%	22%	29%	
	Between 1,001-5,000MXN (n= 146)	1%	31%	34%	34%	
	Between 5,001 - 10,000 MXN (n= 49)	2%	33%	35%	30%	
	>10,001MXN (n=18)	0%	22%	28%	50%	
Level of education	Non-education (n=47)	0%	19%	26%	55%	43.08 (9) <0.001
	Basic education (n= 63)	0%	22%	38%	40%	
	Medium-High education (n= 64)	5%	50%	23%	22%	
	High education (n=250)	4%	46%	30%	20%	

There was a positive association between age and BMI classification among all participants, $X^2(12) = 79.11$, p <0.001. Younger participants were more likely to be at normal weight, whereas older participants were more likely to be overweight or obese.

There was an association between marital status and the BMI classification among participants, $X^2(12) = 70.26$, p <0.001. Single status participants were more likely to be at normal weight, whereas married participants were more likely to be overweight or obese.

There was an association between household composition and the BMI classification among participants, $X^2(3) = 60.80$, $p = <0.001$. Participants without children or non-dependants were more likely to be at normal weight, whereas participants with children or dependents were more likely to be overweight or obese.

There was a positive association between the level of income and the BMI classification among participants, $X^2(12) = 27.59$, p <0.005. Participants with a level of income between 0 and 1,000 MXN were more likely to be at normal weight, whereas participants with a level of income between 1,000 MXN and more than 10,000 MXN were more likely to be overweight or obese.

There was a negative association between the level of education and the BMI classification among participants, $X^2(9) = 43.08$, p <0.001. Participants with a lower level of education were more likely to be overweight and obese, whereas participants with a higher level of educations were more likely to have normal weight.

Tables 4.4 and 4.5 illustrates the associations between BMI classification and sociodemographic variables within the female and male participants to understand their association and identify the distribution of the sampled population.

Table 4.4 Sociodemographic elements and BMI classification within female participants.

		BMI				
		Underweight	**Normal**	**Overweight**	**Obese**	X^2**(df) P value**
Age	19-25 years old (n= 281)	6%	50%	26%	18%	60.64 (12) <0.001
	26-35 years old (n= 62)	0%	16%	40%	44%	
	36-45 years old (n= 32)	0%	21%	33%	46%	
	46-55 years old (n= 32)	0%	16%	24%	60%	
	56-65 years old (n= 17)	0%	8%	17%	75%	
Marital status	Single (n=285)	6%	49%	24%	20%	40.86 (3) <0.001
	Married (n=118)	0%	17%	39%	45%	
Household Composition	Without children	6%	49%	24%	21%	41.01 (3) <0.001
	With children	0%	19%	35%	46%	
Level of income	Between 0-500MXN (n= 126)	7%	50%	25%	18%	30.33 (12) <0.005
	Between 501-1,000MXN (n= 59)	4%	46%	15%	35%	
	Between 1,001-5,000MXN (n= 146)	1%	28%	33%	38%	
	Between 5,001 -10,000 MXN (n= 49)	0%	29%	38%	33%	
	>10,001MXN (n=18)	0%	0%	43%	57%	
Level of education	Non-education (n=47)	0%	17%	22%	61%	37.04 (9) <0.001
	Basic education (n= 63)	0%	25%	40%	35%	
	Medium-High education (n= 64)	3%	53%	20%	24%	
	High education (n=250)	6%	43%	28%	23%	

Table 4.5 Sociodemographic elements and BMI classification within male participants.

		BMI				
		Under weight	**Norm al**	**Overw eight**	**Obese**	X^2**(df) P value**
Age	19-25 years old (n= 281)	3%	53%	31%	13%	19.63
	26-35 years old (n= 62)	0%	18%	41%	41%	(12)
	36-45 years old (n= 32)	0%	24%	38%	38%	.074
	46-55 years old (n= 32)	0%	14%	43%	43%	
	56-65 years old (n= 17)	0%	20%	40%	40%	
Marita l status	Single (n=285)	3%	52%	31%	14%	16.61 (3) <0.005
	Married (n=118)	0%	22%	30%	48%	
Househ old compos ition	Without children	3%	53%	31%	13%	20.54 (3) <0.001
	With children	0%	15%	41%	44%	
Level of income	Between 0-500MXN (n= 126)	0%	56%	35%	9%	16.47 (12) .171
	Between 501-1,000MXN (n= 59)	9%	36%	55%	0%	
	Between 1,001- 5,000MXN (n= 146)	2%	39%	34%	25%	
	Between 5,001 -10,000 MXN (n= 49)	4%	36%	32%	28%	
	>10,001MXN (n=18)	0%	0%	43%	57%	
Level of educati on	Non-education (n=47)	0%	33%	50%	17%	18.37 (9) <0.05
	Basic education (n= 63)	0%	13%	33%	53%	
	Medium-High education (n= 64)	8%	46%	29%	17%	
	High education (n=250)	1%	49%	33%	16%	

4.4.4 Sociodemographic elements and W/H ratio classification

Twenty four percent of the female participants had a waist/hip ratio classification above the cut-off (>0.85cm) compared with 9% of the male population who had a waist/hip ratio above the cut-off (>0.90cm), $X^2(1) = .956$, p .328.

Table 4.6 showed the identification of the W/H ratio classification across the sociodemographic elements for the female participants.

Table 4.6. Sociodemographic elements and W/H ratio in female participants.

Gender	Female	Waist/Hip Ratio		X^2(df) P value
		Cut-off <0.85	Cut-off >0.85	
Age	19-25 years old (n= 185)	82%	18%	58.27 (4) <0.001
	26-35 years old (n= 45)	40%	60%	
	36-45 years old (n= 24)	42%	58%	
	46-55 years old (n= 25)	32%	68%	
	56-65 years old (n= 12)	33%	67%	
Marital status	Single (n=184)	80%	20%	48.73 (4) <0.001
	Married (n=91)	41%	59%	
Household composition	Without children	79%	21%	37.24 (1) <0.001
	With children	43%	57%	
Level of income	Between 0-500MXN (n=91)	77%	23%	14.68 (4) <0.05
	Between 501-1,000MXN (n= 48)	63%	38%	
	Between 1,001- 5,000MXN (n= 102)	51%	49%	
	Between 5,001 -10,000 MXN (n= 24)	71%	29%	
	>10,001MXN (n=7)	57%	43%	
Level of education	Non-education (n=41)	29%	71%	60.69 (3) <0.001
	Basic education (n= 48)	38%	63%	
	Medium-High education (n= 40)	70%	30%	
	High education (n=162)	82%	18%	

There was a positive association between age and the W/H ratio classification among the female population, $X^2(4) = 58.2$, p <0.001. Younger female participants were more likely to have a normal W/H ratio, whereas older female participants were more likely to have a high W/H ratio.

There was an association between marital status and the W/H ratio classification among the female population, $X^2(4) = 48.7$, p <0.001. Single female participants were more likely to have a normal W/H ratio, whereas married female participants were more likely to have a high W/H ratio.

There was an association between household composition and the W/H ratio classification among the female population, $X^2(1) = 37.24$, $p = $ <0.001. Female participants without children or non-dependents were more likely to have a normal W/H ratio, whereas female participants with children or dependents were more likely to have a high W/H ratio.

There was a negative association with a level of income higher than 10,001 MXN and the W/H ratio classification among the female population, $X^2(4) = 14.6$, p <0.05. Female participants with a level of income higher than 10,001 MXN were more likely to have a normal W/H ratio.

There was a negative association between level of education and the W/H ratio classification among the female population, $X^2(3) = 60.6$, p <0.001. Female participants with a lower level of education were more likely to have a high W/H ratio, whereas female participants with a higher level of education were more likely to have a normal W/H ratio.

Table 4.7 showed the identification of the W/H ratio classification across the sociodemographic elements for the male participants.

Table 4.7 Sociodemographic elements and W/H ratio in male participants.

Gender	Male	Waist/Hip Ratio (0.90)		X^2(df) P value
		Cut-off <0.90	Cut-off >0.90	
Age	19-25 years old (n= 95)	87%	13%	54.08 (4) <0.001
	26-35 years old (n= 17)	47%	53%	
	36-45 years old (n= 8)	25%	75%	
	46-55 years old (n= 7)	0%	100%	
	56-65 years old (n= 5)	0%	100%	
Marital status	Single (n=100)	85%	15%	42.23 (3) <0.001
	Married (n=27)	26%	74%	
Household composition	Without children	86%	14%	47.88 (1) <0.001
	With children	22%	78%	
Level of income	Between 0-500MXN (n= 34)	82%	18%	11.95 (4) <0.05
	Between 501-1,000MXN (n= 11)	64%	36%	
	Between 1,001- 5,000MXN (n= 44)	77%	23%	
	Between 5,001 -10,000 MXN (n= 25)	56%	44%	
	>10,001MXN (n=11)	36%	64%	
Level of education	Non-education (n=6)	33%	67%	26.46 (3) <0.001
	Basic education (n= 15)	20%	80%	
	Medium-High education (n= 24)	79%	21%	
	High education (n=87)	79%	21%	

There was an association between age and the W/H ratio classification among the male population, X^2(4) = 54.08, p = <0.001. Younger male participants were more likely to have a normal W/H ratio, whereas older male participants were more likely to have a high W/H ratio.

There was an association between marital status and the W/H ratio classification among the male population, X^2(3) = 43.23, p = <0.001. Single male participants were more likely to have

a normal W/H ratio, whereas married male participants were more likely to have a high W/H ratio.

There was an association between household composition and the W/H ratio classification among the male population, $X^2(1) = 47.88$, $p = <0.001$. Male participants without children or non-dependents were more likely to have a normal W/H ratio, whereas male participants with children or dependents were more likely to have a high W/H ratio.

There was a positive association between level of income and the W/H ratio classification among the male population, $X^2(4) = 11.9$, $p = <0.05$. Male participants with a level of income higher than 10,001 MXN were more likely to have a high W/H ratio.

There was a negative association between level of education and the W/H ratio classification among the male population, $X^2(3) = 26.46$, $p = <0.001$. Male participants with a lower level of education were more likely to have a high W/H ratio, whereas male participants with a higher level of education were more likely to have a normal W/H ratio.

4.4.5   Hypotheses and the relationship with environment, behaviours, and health outcomes.

4.4.5.1 H1)   There is no association between the power of purchase and obesity.

The relevant findings for H1) were as follows:

The findings were analysed from three different angles: income and self-perception of purchasing power. From this set of angles, it was possible to determine the association between individuals' behaviours and eating choices and see the impact on their nutritional state.

A contrast was found between the BMI and the W/H ratio with the power of purchase. Table 4.8 showed a positive association between the frequency of a limited grocery budget and the BMI. In other words, participants with a more limited budget also presented a higher BMI. However, there was a negative association between the frequency of a limited grocery budget and the W/H ratio. Participants with a more limited budget were more likely to have a normal W/H ratio, whereas participants with a lower limited budget were more likely to have a high W/H ratio.

Table 4.8 showed from the total sample a positive association between a higher attitude that eating out saves money and a higher BMI. Participants with a higher BMI were more likely to show an attitude that eating out saves money.

From the perspective that education level can enhance labour and income opportunities. Table 4.11 depicted the behavioural variables associated with individuals with risk classification and measured BMI and W/H ratio for both female and male participants. Both genders showed a negative association between the BMI and W/H ratio with no education and no-basic education completed. Both female and male participants with a high weight and a high W/H ratio were more likely to have no education or not have completed basic education. Females showed a higher frequency of not having formal education or completing of elementary school.

Table 4.11 showed a negative association between the female BMI with monthly income below 5,000 MXN (20 GBP). Female participants with a higher BMI, would have a monthly income of 5,000 MXN (20 GBP) or less, compared with female with a normal BMI.

Among the male participants, there was a negative association between their W/H and the monthly income below 5,000MMXN (20GBP). Male participants with a normal W/H would

have a monthly income of 5,000 MXN (20 GBP) or less, compared with male with a high W/H ratio.

4.4.5.2 H2) There is no association between level of health knowledge and obesity

The relevant findings for H2) were as follows:

Table 4.9 showed an associations found within the BMI were to be enrolled in a physical activity, T.V. viewing and going for a walk. The found associations with W/H ratio were with the attendance to nutritional orientation, T.V. viewing and influence of social media to dietary patterns.

Table 4.12 depicts the behavioural variables associated with individuals classified as group B in the nutrition status. The relevant findings were:

Female and male participants demonstrated a negative association between television viewing and anthropometric measures of W/H. However, female participants BMI was positively associated with activities of going for a walk. Male participants' W/H ratio was negatively associated with physical activity participation.

Younger female participants with a normal W/H ratio were more likely to be aware of the association between excessive SSB intake and the development of DM2. Older female participants with a high W/H ratio were less likely to be aware of the association between excessive SSB intake and the development of DM2.

4.4.5.3. H3) There is no association between low levels of perception, attitudes and cognition and obesity.

The relevant findings for H3) were as follows:

Table 4.10 reveals an association between BMI and satisfaction with present diets. The other found association was between W/H and the perception that SSB prices are moderately high.

Between genders Table 4.13 depicts the behavioural variables associated with those classified as group B according to their nutritional status. There was an association between the W/H and male participants' perceptions of the price of SSBs ranging from medium to high. The female attitudes revealed a negative association between their BMI and their satisfaction with their current diets. Additionally, there was a negative association between the W/H and the attitude that eating out saves time among female participants.

Table 4.8. First null hypothesis and the relationship of environmental and behavioural variables from the total sampled.

	Hypothesis	BMI				W/H ratio			
H1) There is no association between power of purchase and obesity.									
Theoretical framework	**Variables**	**<25 kg/m2**	**>25 kg/m2**	X^2 **(df)**	**P value**	**<0.85 <0.90**	**>0.85 >0.90**	X^2 **(df)**	**P value**
SCT-Environment	**Limited budget when buying groceries**	**16%**	**28%**	**7.21 (1)**	**<0.05**	**25%**	**19%**	**12.48 (1)**	**<0.001**
	Monthly income below 5,000MXN	37%	47%	3.72 (1)	0.053	56%	28%	1.80 (1)	0.179
	No education, nor basic education completed	**5%**	**21%**	**29.66 (1)**	**<0.001**	**8%**	**18%**	**84.06 (1)**	**<0.001**
TPB-Perception	Consumption of 5-a-day	41%	52%	3.41 (1)	.064	61%	32%	.007 (1)	0.935
	Likelihood of consumption of SSBs	29%	40%	.905 (1)	0.341	46%	24%	.424 (1)	0.515
	Likelihood of consumption of alcohol	19%	28%	.542 (1)	0.462	33%	15%	.940 (1)	0.381
	Likelihood of consumption of fast food	18%	20%	3.09 (1)	0.078	**30%**	**8%**	**14.16 (1)**	**<0.001**
	Likelihood of eating-out	17%	23%	0.009 (1)	0.923	27%	12%	.745 (1)	0.388
TPB-Attitudes	Motivation to eat fruits and vegetables if these were more affordable and varied.	40%	52%	.323 (1)	0.595	62%	30%	.081 (1)	0.776
	Eating out saves money	**6%**	**8%**	**.000 (1)**	0.550	9%	5%	.445 (1)	0.505

Hypothesis		BMI				W/H ratio			
H1) There is no association between power of purchase and obesity.									
Theoretical framework	**Variables**	**<25 kg/m2**	**>25 kg/m2**	X^2 **(df)**	**P value**	**<0.85 <0.90**	**>0.85 >0.90**	X^2 **(df)**	**P value**
	Food prices importance	39%	52%	.080 (1)	0.452	62%	29%	1.82 (1)	0.176
	Food waste	22%	27%	.887 (1)	0.199	**36%**	**13%**	**7.66 (1)**	**<0.05**

* Text in bold represent a significance difference of 0.05.

Table 4.9. Second null hypothesis and the relationship of environmental and behavioural variables from the total sampled.

	Hypothesis	BMI				W/H ratio			
	H1) There is no association between level of health knowledge and obesity.								
Theoretical framework	**Variables**	**<25 kg/m2**	**>25 kg/m2**	X^2 **(df)**	**P value**	**<0.85 <0.90**	**>0.85 >0.90**	X^2 **(df)**	**P value**
TPB-Perception	**Attendance to nutritional orientation**	17%	28%	3.15 (1)	0.076	**27%**	**17%**	**4.57 (1)**	**<0.05**
	Put into practice health initiatives	11%	15%	.106 (1)	0.416	19%	7%	1.76 (1)	0.184
	Enrolled in a physical activity	**24%**	**27%**	**4.53 (1)**	**<0.05**	35%	15%	3.42 (1)	0.064
	Activities with family include mostly watching T.V.	**32%**	**34%**	**13.96 (1)**	**<0.001**	**48%**	**18%**	**15.86 (1)**	**<0.001**
	Activities with family include mostly going for a walk	**29%**	**46%**	**7.31 (1)**	**<0.05**	49%	26%	1.25 (1)	0.263
TPB-Attitudes	Agrees selecting healthier diet to tackle climate change	42%	56%	.590 (1)	0.442	66%	33%	.061 (1)	0.804
	Preference for nutritional information from eat-out facilities	35%	46%	.262 (1)	0.608	55%	26%	1.05 (1)	0.304
	Concerned about eating choices and their impact on health	42%	56%	1.83 (1)	0.442	66%	33%	.002 (1)	0.804
Subjective norms	Usage of Apps for eating healthier	5%	10%	3.15 (1)	0.061	10%	5%	.003 (1)	0.955
	Influence of social media to dietary patterns	11%	14%	.308 (1)	0.579	**19%**	**6%**	**4.09 (1)**	**<0.05**
SCT-Cognition	Reading and understanding of Nutritional labels (GDA)	14%	20%	1.59 (1)	0.218	24%	10%	.010 (1)	0.921

	Hypothesis	BMI				W/H ratio			
H1) There is no association between level of health knowledge and obesity.									
Theoretical framework	**Variables**	**<25 kg/m2**	**>25 kg/m2**	X^2 **(df)**	**P value**	**<0.85 <0.90**	**>0.85 >0.90**	X^2 **(df)**	**P value**
	Associates DM2 with SSBs excessive intake	**39%**	**52%**	**.009 (1)**	**<0.05**	62%	29%	2.24 (1)	0.134
	Associates excessive fast-food eating with stroke events	39%	51%	.019 (1)	0.889	61%	29%	.897 (1)	0.344

* Text in bold represent a significance difference of 0.05.

Table 4.10. Third null hypothesis and the relationship between the BMI and W/H and the internal behavioural variables.

Hypothesis		BMI				W/H ratio			
H1) There is no association between low levels of perception, attitudes and cognition and obesity.									
Theoretical framework	**Variables**	**<25 kg/m2**	**>25 kg/m2**	X^2 **(df)**	**P value**	**<0.85 <0.90**	**>0.85 >0.90**	X^2 **(df)**	**P value**
TPB-Perception	**Medium-high price of SSBs**	16%	31%	2.84 (1)	0.092	**26%**	**21%**	**6.47 (1)**	**<0.05**
SCT-Attitudes	Willingness to change to healthier diets	43%	57%	.113 (1)	0.737	67%	33%	.000 (1)	0.988
	Satisfaction of the current diet	**32%**	**36%**	**6.53 (1)**	**<0.05**	46%	21%	1.49 (1)	0.221
	Eating out saves time	44%	56%	.517 (1)	0.472	33%	14%	2.64 (1)	0.104
	Support to Taxes on SSBs	25%	33%	.001 (1)	0.970	40%	18%	1.61 (1)	0.208

*Text in bold represent a significance difference of 0.05.

Table 4.11. First null hypothesis and relationship with BMI and W/H between genders.

		Hypothesis							
		H1) There is no association between power of purchase and obesity.							
Theoretical framework	**Variable**	**BMI**				**W/H ratio**			
		Female <25kg/m2/ >25kg/m2	X^2**(df) P value**	**Male <25kg/m2/ >25kg/m2**	X^2**(df) P value**	**Female <0.85/ >0.85**	X^2**(df) P value**	**Male <0.90/ >0.90**	X^2**(df) P value**
SCT-Environment	**Limited budget when buying groceries**	**16%/29%**	**4.67 (1) <0.05**	16%/26%	2.21 (1) 0.136	**24%/21%**	**17.5 (1) <0.001**	30%/12%	.021 (1) 0.885
	Monthly income below 5,000MXN	**38%/50%**	**4.81 (1) <0.05**	34%/38%	.714 (1) 0.398	56%/33%	.259 (1) 0.611	**55%/16%**	**9.18 (1) <0.005**
	No education, nor basic education completed	**7%/24%**	**21.60 (1) <0.001**	**3%/13%**	**7.6 (1) <0.05**	**10%/20%**	**57.9 (1) <0.001**	**4%/12%**	**27.03 (1) <0.001**
TPB-Perception	Consumption of 5-a-day	39%/53%	1.61 (1) 0.205	44%/49%	2.07 (1) 0.137	59%/33%	.051 (1) 0.821	65%/28%	.046 (1) 0.546
	Likelihood of consumption of SSBs	27%/40%	.427 (1) 0.514	33%/42%	.748 (1) 0.387	42%/24%	.770 (1) 0.380	53%/23%	.021 (1) 0.525
	Likelihood of consumption of alcohol	15%/23%	.278 (1) 0.598	29%/39%	.823 (1) 0.364	26%/12%	.638 (1) 0.424	49%/20%	.083 (1) 0.626
	Likelihood of consumption of fast food	15%/18%	1.50 (1) 0.136	25%/24%	1.103 (1) 0.294	**26%/8%**	**7.79 (1) <0.05**	**39%/10%**	**5.66 (1) <0.05**
	Likelihood of eating-out	17%/21%	.880 (1) 0.208	18%/27%	1.38 (1) 0.239	27%/10%	3.03 (1) 0.082	29%/15%	1.00 (1) 0.209
TPB-Attitudes	Motivation to eat fruits and vegetables if these were more affordable and varied.	39%/54%	.025 (1) 0.875	42%/47%	.643 (1) 0.423	62%/32%	.301 (1) 0.583	63%/27%	.011 (1) 0.594
	Eating out saves money	4%/8%	.905 (1) 0.341	11%/10%	.900 (1) 0.343	6%/6%	3.16 (1) 0.075	16%/5%	.832 (1) 0.254

		Hypothesis							
		H1) There is no association between power of purchase and obesity.							
Theoretical framework	Variable	BMI				W/H ratio			
		Female <25kg/m2/ >25kg/m2	X^2(df) P value	Male <25kg/m2/ >25kg/m2	X^2(df) P value	Female <0.85/ >0.85	X^2(df) P value	Male <0.90/ >0.90	X^2(df) P value
	Food prices importance	39%/53%	1.30 (1) 0.253	37%/50%	2.81 (1) 0.094	62%/30%	3.61 (1) 0.057	61%/26%	.001 (1) 0.609
	Food waste	**23%/25%**	**3.91 (1) <0.05**	20%/29%	1.35 (1) 0.162	**37%/11%**	**13.1 (1) <0.001**	34%/15%	.131 (1) 0.432

* Text in bold represent a significance difference of 0.05.

Table 4.12. Second hypothesis and its relationship with BMI and W/H between genders

		Hypothesis							
		H1) There is no association between level of health knowledge and obesity.							
Theoretical framework		**Female <25kg/m2 / >25kg/m2**	X^2**(df) P value**	**Male <25kg/m2 / >25kg/m2**	X^2**(df) P value**	**Female <0.85/> 0.85**	X^2**(df) P value**	**Male <0.90/> 0.90**	**P value**
TPB-Perception	**Attendance to nutritional orientation**	16%/27%	2.44 (1) 0.118	20%/28%	1.00 (1) 0.204	**25%/18%**	**5.68 (1) <0.05**	33%/15%	.226 (1) 0.634
	Put into practice health initiatives	10%/14%	.021 (1) 0.886	12%/18%	.781 (1) 0.245	17%/7%	.915 (1) 0.339	23%/8%	.627 (1) 0.282
	Enrolled in a physical activity	**20%/22%**	**4.62 (1) <0.05**	31%/37%	.230 (1) 0.632	28%/14%	.532 (1) .466	**52%/16%**	**4.00 (1) <0.05**
	Activities with family include mostly watching T.V.	**32%/32%**	**13.38 (1) <0.001**	34%/37%	1.49 (1) 0.222	**46%/18%**	**11.6 (1) <0.005**	53%/18%	**4.172 (1) <0.05**
	Activities with family include mostly going for a walk	**27%/46%**	**9.69 (1) <0.005**	35%/44%	.108 (1) 0.742	46%/27%	1.44 (1) 0.229	56%/24%	.338 (1) 0.377
TPB-Attitudes	Preference for nutritional information from eat-out facilities	34%/45%	1.18 (1) 0.276	37%/47%	.805 (1) 0.256	53%/26%	.695 (1) 0.404	60%/24%	.309 (1) 0.377
	Agrees selecting healthier diet to tackle climate change	40%/58%	1.56 (1) 0.202	46%/53%	.852 (1) 0.356	64%/34%	.832(1) 0.333	70%/29%	2.37 (1) 0.298
	Concerned about eating choices and their impact on health	39%/57%	2.19 (1) 0.138	43%/51%	.061 (1) 0.806	62%/33%	.741 (1) 0.389	67%/27%	1.66 (1) 0.183
TPB-Subjective norms	Usage of Apps for eating healthier	5%/10%	1.35 (1) 0.244	4%/10%	2.73 (1) 0.080	10%/4%	.705 (1) 0.401	8%/6%	2.14 (1) 0.119

		Female <25kg/m2 / >25kg/m2	X^2(df) P value	Male <25kg/m2 / >25kg/m2	X^2(df) P value	Female <0.85/> 0.85	X^2(df) P value	Male <0.90/> 0.90	P value
	Hypothesis								
	H1) There is no association between level of health knowledge and obesity.								
Theoretical framework									
	Influence of social media to dietary patterns	9%/13%	.047 (1) 0.828	15%/15%	.409 (1) 0.326	16%/6 %	1.95 (1) 0.162	24%/6 %	2.62 (1) 0.105
SCT-Cognition	Reading and understanding of Nutritional labels (GDA)	13%/19%	1.18 (1) 0.276	17%/22%	.648 (1) 0.270	23%/9 %	.727 (1) 0.394	26%/13 %	1.64 (1) 0.200
	Associates DM2 with SSBs excessive intake	38%/53%	.03 (1) 0.860	41%/49%	.111 (1) 0.739	**62%/3 0%**	**3.93 (1) <0.05**	63%/27 %	.011 (1) 0.917
	Associates excessive fast-food eating with stroke events	38%/53%	.018 (1) 0.893	41%/47%	.230 (1) 0.422	60%/30 %	.989 (1) 0.320	63%/26 %	.103 (1) 0.748

* Text in bold represent a significance difference of 0.05.

Table 4.13. Third hypothesis and its relationship with BMI and W/H between genders

		Hypothesis							
		H1) There is no association between low levels of perception, attitudes and cognition and obesity.							
Theoretical framework		**Female <25kg/m2/ >25kg/m2**	X^2**(df) P value**	**Male <25kg/m2/ >25kg/m2**	X^2**(df) P value**	**Female <0.85/ >0.85**	X^2**(df) P value**	**Male <0.90/ >0.90**	X^2**(df) P value**
TPB-Perceptions	**Medium-high price of SSBs**	18%/33%	1.10 (1) 0.182	13%/26%	2.11 (1) 0.107	30%/21%	.947 (1) 0.204	**18%/21%**	**10.33 (1) <0.005**
TPB-Attitudes	Willingness to change to healthier diets	42%/58%	.718 (1) 0.397	45%/53%	.014 (1) 0.708	66%/34%	.520 (1) 0.471	70%/30%	.398 (1) 0.508
	Satisfaction of the current diet	**29%/33%**	**4.98 (1) <0.05**	37%/42%	.929 (1) 0.226	43%/20%	1.72 (1) 0.189	54%/24%	.085 (1) 0.771
	Eating out saves time	19%/24%	1.34 (1) 0.246	24%/32%	.221 (1) 0.385	**31%/12%**	**3.91 (1) <0.05**	39%/17%	.006 (1) 0.939
	Support to Taxes on SSBs	27%/35%	.738 (1) 0.231	21%/30%	.930 (1) 0.215	43%/19%	2.84 (1) 0.09	36%/15%	.003 (1) 0.955

* Text in bold represent a significance difference of 0.05.

Tables 4.14, 4.15 and 4.16 summarised the means, standard deviations, and CI 95% for those variables who significant variables and both BMI and W/H for all participants, female, and male groups for each hypothesis.

Table 4.14. Means and standard deviations of variables from the total of participants.

Group	Variable	Mean ± SD 95%CI			
Total of participants		**BMI**		**W/H**	
		<25 kg/m2	**>25 kg/m2**	**<0.85 <0.90**	**>0.85 >0.90**
		H1) There is no association between power of purchase and obesity.			
	Limited groceries budget (BMI, W/H)	1.56 ± 1.05 1.38-1.73	1.96 ± 1.36 1.77-2.16	1.58 ± 1.12 1.43-1.72	2.21 ± 1.39 1.95-2.46
	No education nor basic education completed (BMI, W/H)	3.51 ± .828 3.38-3.65	2.98 ± 1.15 2.82-3.15	3.53 ± .829 3.42-3.64	2.59 ± 1.18 2.37-2.80
	Fast food consumption (W/H)	1.81 ± .392 1.75-1.88	1.89 ± .316 1.84-1.93	1.84 ± .367 1.79-1.89	1.89 ± .317 1.83-1.95
	Consumption of SSBs[5]	2.66 ± .101 2.46-2.86	2.51 ± .087 2.34-2.68	2.64 ± .109 2.42-2.85	2.54 ± .082 2.38-2.70
		H1) There is no association between level of health knowledge and obesity.			
	Attendance to nutrition orientation (BMI, W/H)	3.00 ±1.82 2.73-3.27	3.52 ± 1.69 3.30-3.73	3.12 ± 1.79 2.91-3.33	3.66 ± 1.66 3.38-3.94
	Enrolled in a physical activity (BMI)	3.16 ± .163 2.83-3.48	2.82 ± .136 2.55-3.09	3.10 ± .130 2.84-3.36	2.70 ± .173 2.36-3.05
	T.V. viewing with family (BMI, W/H)	3.32 ± .128 3.06-3.57	2.59 ± .106 2.38-2.80	3.17 ± .104 2.96-3.37	2.38 ± .131 2.12-2.64

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[5] No association with the anthropometric measurements.

Group Total of participants	Variable	Mean ± SD 95%CI			
		BMI		W/H	
		<25 kg/m2	>25 kg/m2	<0.85 <0.90	>0.85 >0.90
	Going for a walk with family (BMI)	3.17± .137 2.90-3.44	3.34± .101 3.14-3.54	3.25 ± .106 3.04-3.46	3.30 ± .129 3.30-3.56
	Associates SSBs with DM2 (W/H)	4.08±.072 3.94-4.22	4.15±.059 4.04-4.27	4.16±.055 4.05-4.27	4.05±.083 3.88-4.21
		H1) There is no association between low levels of perception, attitudes and cognition and obesity.			
	Influence on social media on diet (W/H)	2.25 ± 1.14 2.06-2.43	2.17 ± 1.12 2.01-2.33	2.34± 1.15 2.19-2.49	1.93 ± 1.03 1.74-2.12
	Satisfaction of current diet (BMI)	2.93± .890 2.78-3.07	2.84 ± 1.03 2.69-2.98	2.90 ± .946 2.78-3.03	2.82 ± 1.04 2.63-3.01

* Text in bold represent a significance difference of 0.05.

Table 4.15. Means and standard deviations of variables female participants (*** no association).

Group					
Female participants	**Variable**	**Mean ± SD 95%CI**			
		BMI		**W/H**	
		<25 kg/m2	**>25 kg/m2**	**<0.85 <0.90**	**>0.85 >0.90**
		H1) There is no association between power of purchase and obesity.			
	Limited groceries budget (BMI, W/H)	2.80 ± 1.25 2.66-2.93	2.88 ± 1.31 2.73-3.02	2.83 ± 1.25 2.69-2.96	2.85± 1.30 2.69-3.00
	Monthly income below $5,000MXN (BMI)	2.34 ± 1.11 2.21, 2.47	2.41 ± 1.14 2.28-2.54	2.36 ± 1.12 2.24-2.49	2.40 ± 1.14 2.26-2.53
	No education nor basic education completed (BMI, W/H)	3.09± 1.13 2.96-3.22	3.05 ± 1.13 2.93-3.18	3.15 ± 1.10 3.03-3.27	2.99 ± 1.16 2.85-3.12
	Fast food consumption (W/H)	1.85 ± .353 1.81-1.89	1.87 ± .338 1.83-1.91	1.85 ± .355 1.81-1.89	1.87 ± .334 1.83-1.91
	Consumption of SSBs[6]	2.65 ± .073 2.50-2.79	2.58 ± .071 2.44-2.72	2.65 ± .078 2.50-2.81	2.59 ± .067 2.45-2.72
		H1) There is no association between level of health knowledge and obesity.			
	Attendance to nutritional orientation (W/H)	3.24 ± 1.77 3.06-3.43	3.31 ± 1.76 3.13-3.49	3.27 ± 1.77 3.09-3.44	3.29 ± 1.76 3.10-3.48
	Enrolled in a physical activity (BMI)	2.82 ± .115 2.59-3.04	2.86± .111 2.64-3.08	2.94 ± .110 2.72-3.16	2.73 ± .116 2.50-2.95
	T.V. viewing with family (BMI, W/H)	2.90 ± .093 2.72-3.09	2.84± .090 2.67-3.02	2.93 ± .088 2.75-3.10	2.81 ± .095 2.62-3.00
	Going for a walk with family (BMI)	3.24 ± .090 3.06-3.42	3.22 ± .088 3.05-3.39	3.24 ± .087 3.07-3.41	3.22 ± .092 3.04-3.41

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[6] No association with the anthropometric measurements.

Group Female participants	Variable	Mean ± SD 95%CI			
		BMI		W/H	
		<25 kg/m2	>25 kg/m2	<0.85 <0.90	>0.85 >0.90
	Associates SSBs with DM2 (W/H)	4.13±.943 4.03-4.23	4.16±.923 4.06-4.25	4.13±.951 4.03-4.22	4.16±.912 4.06-4.26
		H1) There is no association between low levels of perception, attitudes and cognition and obesity.			
	Satisfaction of current diet (BMI)	2.88 ± .993 2.77-3.00	2.84 ± .994 2.73-2.95	2.88 ± .978 2.78-2.99	2.83± 1.01 2.71-2.95
	Eating out saves time (W/H)	2.07 ± 1.50 1.90-2.24	2.10 ± 1.53 1.93-2.27	2.09 ± 1.50 1.93-2.26	2.07± 1.53 1.90-2.25
	Influence on social media on diet[7]	2.16 ± .060 2.04-2.28	2.15 ± .057 2.04-2.26	2.20 ± .057 2.09-2.31	2.10 ± .060 1.98-2.22

* Text in bold represent a significance difference of 0.05.

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[7] No association with the anthropometric measurements.

Table 4.16 Means and standard deviations of variables male participants (*** no association).

Group		Mean ± SD 95%CI			
Male participants	**Variable**	**BMI**		**W/H**	
		<25 kg/m2	**>25 kg/m2**	**<0.85 <0.90**	**>0.85 >0.90**
		H1) There is no association between power of purchase and obesity.			
	Limited groceries budget[8]	2.67± .077 2.51-2.82	2.86± .077 2.71-3.01	2.62± .068 2.48-2.75	2.99± .089 2.81-3.16
	Monthly income below $5,000MXN (W/H)	2.32± 1.14 2.17-2.48	2.55 ± 1.08 2.41-2.68	2.36 ± 1.14 2.22-2.50	2.56 ± 1.07 2.40-2.71
	No education nor basic education completed (BMI, W/H)	3.45 ± .872 3.33-3.57	3.13 ± 1.10 3.00-3.27	3.46 ± .884 3.35-3.57	3.04 ± 1.12 2.88-3.20
	Fast food consumption (W/H)	1.83 ± .379 1.78-1.88	1.87 ± .342 1.82-1.91	1.85 ± .361 1.80-1.89	1.85 ± .357 1.80-1.90
	Consumption of SSBs	2.54± .084 2.38-2.71	2.51 ± .077 2.36-2.66	2.53 ± .081 2.37-2.69	2.48± .09 2.31-2.65
		H1) There is no association between level of health knowledge and obesity.			
	Enrolled in a physical activity (W/H)	3.29 ± .135 3.02-3.55	2.96 ± .124 2.71-3.20	3.09 ± .122 2.85-3.33	3.12 ± .139 2.85-3.39
	T.V. viewing with family (W/H)	3.15 ± .107 2.94-3.37	2.69 ± .097 2.50-2.88	3.07 ± .097 2.88-3.26	2.68 ± .108 2.46-2.89
	Going for a walk with family[9]	3.25 ± .112 3.03-3.47	3.39 ± .092 3.20-3.57	3.30 ± .098 3.11-3.50	3.35 ± .105 3.14-3.56
	Associates SSBs with DM2 (W/H)	4.09±.061 3.97-4.21	4.11±.055 4.00-4.22	4.15±.052 4.05-4.25	4.03±.066 3.90-4.16

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[8] No association with the anthropometric measurements.
[9] No association with the anthropometric measurements.

Group					
Male participants	**Variable**	**Mean ± SD 95%CI**			
		BMI		**W/H**	
		<25 kg/m2	**>25 kg/m2**	**<0.85 <0.90**	**>0.85 >0.90**
		H1) There is no association between low levels of perception, attitudes and cognition and obesity.			
	Satisfaction of current diet[10]	2.93 ± .056 2.81-3.04	2.84 ± .057 2.73-2.96	2.86 ± .053 2.76-2.97	2.91 ± .063 2.78-3.03
	Eating out saves time[11]	2.70 ± 0.99 2.51-2.90	2.56 ± .092 2.38-2.74	2.68 ± .087 2.51-2.86	2.54 ± .107 2.33-2.75
	Influence on social media on diet [12]	2.25 ± .071 2.10-2.38	2.20 ± .067 2.06-2.33	2.27 ± .063 2.14-2.39	2.15 ± .076 2.00-2.30
	Medium-high price of SSBs (W/H)	1.72 ± 1.50 1.51-1.92	2.05 ± 1.50 1.86-2.26	1.78 ± 1.50 1.60-1.96	2.05 ± 1.52 1.84-2.27

* Text in bold represent a significance difference of 0.05.

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[10] No association with the anthropometric measurements.

[11] No association with the anthropometric measurements.

[12] No association with the anthropometric measurements.

4.5 Synthesis and discussion of the findings

The first hypothesis (no association between the power of purchase and obesity) was rejected because there was evidence that a low power of purchase, particularly among the female participants, would lead to obesity.

Findings showed a higher prevalence of obesity among the female (30%) compared to the male participants (20%) (Table 4.2). Female obesity prevalence increased with age, reaching 60% between ages 46 and 55 and 75% between ages 56 and 65 (Table 4.3). The obesity prevalence and age among male did not show the same increase as the male participants between 46 and 55 years old had a 43% prevalence of obesity, and those between 56 and 65 years old had a 40% prevalence of obesity (Table 4.4). For women, being overweight and obese increased with age ($p<0.001$), but among the male participants, there was no significant difference (p-value 0.074). Similarly, being overweight and obese increased with a lower level of income among female participants ($p <0.005$) but not among male participants (p value 0.171) (Tables 4.3. and 4.4). The finding corroborates previous results from the national survey conducted between 2018-2019 in Mexico, which showed the BMI obesity classification was more prevalent in women (40%) compared to men (31%) (Shamah-Levy et al., 2020).

The rise in weight and W/H ratio was more likely in married participants (Tables 4.3, 4.4, 4.5, 4.6, and 4.7). The marital status or transition from single to married is consistent with a previous study by Qian et al. (2019), which found an association between being married and an increasing prevalence of being overweight and obese among Chinese adults. The authors' reasoning for the finding was that young single people in China were more concerned with maintaining their fitness and appearance than married people (Qian et al., 2019). In addition, household composition showed that having children would increase the prevalence of obesity and overweight (Tables 4.3 to 4.7). The findings are consistent with those of Umberson et al. (2011), who discovered that parents (both female and male) gain more weight than childless adults in the United States.

Furthermore, there was a negative association between the level of education and the level of overweight and obesity from all participants and between genders (Tables 4.3 to 4.7). In

addition, there was a negative association between the BMI and the W/H ratio and no education, nor basic education completed (p <0.001) among all participants (Table 4.8). The finding can suggest that a basic education or non-existent level of education can indicate a higher level of obesity for male and female respectively. There was a higher risk of overweight or obesity (61%) and high W/H ratio (71%) in female with no education, compared to male with no education (17% overweight or obesity) and (67% hight W/H ratio) (Tables 4.3, 4.4, 4.5, 4.6, 4.7). These results are like other countries such as Russia and Turkey. Huffman and Rizov (2007) in Russia and Işeri and Arslan (2009) in Turkey found a negative association between education and obesity prevalence (World Population Review, 2021). As previously stated in Section 2.2.1, the level of education and obesity in Mexico have been associated with pre-existent social and economic inequalities particularly among Mexican women (Pérez-Ferrer et al., 2018).

In considering the socioeconomic factors, findings showed an association between the BMI, the W/H ratio, and a limited grocery budget (Table 4.8). However, the percentages showed a higher impact for participants with a BMI higher than 25kg/m^2 (28%) and for participants with a W/H ratio below the cut-off (25%). The findings suggest that, regardless of any anthropometric classification, participants would experience a limited grocery budget. Female participants were found to have positive and negative associations between BMI, W/H, and a limited grocery budget (Table 4.11). Furthermore, an interesting finding was the association between the BMI and W/H and a monthly income less than 5,000MXN (20 GBP) for both genders. The associations between genders and a monthly income less than 5,000MXN was negative among female participants with the BMI and positive within the male participants with their W/H ratio (Table 4.11). Despite the previous findings, there is a contrast among male participants, whose W/H ratio increased (64%) as income increased >10,001 MXN (408 GBP) compared to female participants (43%) (Tables 4.6 and 4.7). The finding is consistent with that of Qian et al. (2019), who found a higher positive correlation between health risk and income level among Chinese male adults compared with Chinese female adults. The findings above can suggest that variables of non-level of education, limited groceries budget and the level of income would correlate negatively with women and positively in men. The finding can put in evidence a level of inequality particularly between genders and these variables. Obesity is higher among the female participants compared to

male and the negative associations with the factors of labour and income opportunities can corroborate reverse causality. Kim and Von (2018) proposed a reverse causality within-population from Canada, the US, and the UK, in which obesity was the cause of a lower income. Given Mexico's labour and economic challenges, the reverse causality of obesity to education, income, and job opportunities may represent another reason for the prevalence of obesity in Mexican women, whereas for the male population the impact can be attributed to excess and/or misbalance of caloric intake and energy expenditure.

The second hypothesis (no association between the levels of health knowledge and obesity) was rejected because even with high levels of health knowledge, individuals were found to be obese.

Findings showed that the level of health literacy would only be significant among the female participants (Table 4.12).

The association between the enrolment of physical activity and the BMI and W/H ratio was identified positive in the female and negative in the male participants respectively, (Table 4.12). In addition, only among the female participants was there a positive association between going for a walk and the BMI (Table 4.12). There was a positive association between watching T.V. and the levels of BMI among the female participants and negative association with W/H ratio for both genders (Table 4.12). In other words, the variable T.V. viewing was higher among participants with a normal W/H ratio (46%) and the lower W/H ratio (53%). The association between T.V. viewing and obesity is not new. Previous research in the Australian population suggests that, even among physically active people, television viewing can serve as an alternate marker for behaviours that can lead to obesity and sedentary lifestyles (Salmon *et al.*, 2000). The association between the awareness that excessive SSB consumption can lead to the development of DM2, and the W/H ratio was identified among the female participants only. Female participants with normal W/H ratio showed a higher (62%) awareness to the association of excessive intake of SSBs and DM2 compared to the female participants with a higher W/H ratio than the cut-off (30%) (Table 4.12).

Individuals with health information and health behaviour recommendations such as physical activity and diet improvement can still engage in activities that promote sedentary behaviours or impact their health (e.g., likelihood of fast food eating). Moreover, the internal behaviours

can lead individuals to take a different choice and trigger a cognitive dissonance or value action gaps.

The third hypothesis (no association between the levels of perception, attitudes, cognition and obesity) was rejected because evidence showed internal behaviours can be skewed, leading to overweight and obesity.

In relation to the theoretical framework's internal behaviours and the prevalence of obesity, two of the findings suggested that participants from the group with normal weight and W/H ratio (i.e., group A) were more likely to consume and prefer fast food when eating out (Table 4.11). The high preference and likelihood was shown despite the higher attendance to nutritional orientation among females from the group A (Table 4.12). The results can represent an evident disruption between the perceptions, intentions, and cognition with the final behaviours among female participants as described in Section 3.2.1. Reducing one's level of discomfort can be achieved through altering one's perception of one's activities. One example of altered perception is the notion that eating out can save time (Section 3.2.1). The statement is supported by the finding that female participants who had a stronger belief in saving time when eating out (32%) (Table 4.13) would also show a higher prevalence of fast-food consumption (26%) (Table 4.11).

Another possible reason can be attributed to age as Tables 4.4 and 4.6. showed that female participants from group A would be younger (i.e., 19 to 25 years old). In contrast, previous studies have suggested that young adults from the US between 18 to 23 years old who had cooking skills would decrease their frequency of fast food intake (Larson et al., 2009; Monsivais et al., 2014). In addition, other study showed that experienced, confident and older Australian householders would purchase greater amounts of fruits and vegetables to cook at home (Winkler and Turrell, 2010; Monsivais et al., 2014). The finding and contrast with previous studies is connected to an additional critical finding where there is a lower level of satisfaction with current diets among the female participants from group A (Table 4.13). Results showed that 56% of participants between 19-25 years old would be classified in group A (Tables 4.3 and 4.4). Thus, the young female participants' dissatisfaction with their food choices can be attributed to a lack of time to prepare food at home and/or limited cooking skills, both of which may contribute to fast-food consumption. In addition, female

participants' dissatisfaction can be associated with the perception of a constant health risk, weight increment and health issues. Dissatisfaction can pose a risk, as Berdah (2010) stated that weight issues can increase dissatisfaction, resulting in anxiety, increasing the likelihood of presenting eating problems, and lowering internal behavioural factors such as self-efficacy. Satisfaction is an essential behavioural attribute that can be linked and used by individuals for the construction of their attitudes, perceptions, self-efficacy, cognition and motivation (Canrinus et al., 2012). As a result, the finding can suggest that the level of self-efficacy can predict an individuals' intention and final behaviour. Thus, it is critical to evaluate and consider internal behavioural factors such as attitudes, perceptions, cognition, intentions and self-efficacy as internal promoters or detractors impacting their eating behaviours. These internal behaviours and the other environmental and sociodemographic factors must also be studied further. Low levels of self-efficacy due to lower education, income levels and/or limited budget may also play a critical role among men and women who have health risks when willing to switch to healthier diets.

4.6 Limitations

A limitation of the chapter was that the survey was carried out early in the research process, before the literature review was completed. Hence, it is recommended to complete the literature review to be able to develop a concrete and smaller survey from which information can be punctually and assertively obtained. In addition, due to financial limitations the study was limited to one region in Mexico. The limitation does limit in terms of obtaining a wider and broad that would represent other regions different from Queretaro. The possibility of carrying out the survey in other regions can increase the level of a representative sample and the reliability of the study.

The recruitment and participation of younger students with a high level of education, whose representation was higher than that of other participants with a low level of education, constituted a further limitation. Participants with a low level of education were not fully represented.

In addition, quantitative data could have been considered with analyses such as multiple regression analysis, and path analysis in r (supporting mainly the behavioural theories analysis) without any violation of the test assumptions.

The developed survey was extensive, which could have been a trigger for individuals to reply without reflecting on the truth of their answers. The lengthy survey could have introduced bias in the findings and the analysis, from which the final drivers were considered to build the scenarios. It is advised that a survey with more objective questions be developed to analyse and focus the research's purpose and objectives.

4.7 Conclusion

The findings showed an association between power of purchase) particularly among female participants and obesity. There is an evident gap and social inequality between genders from which a positive (male) and a negative (female) association between education level and obesity was found. The finding also leads to other factors such as higher food insecurity (i.e., limited grocery budget) among women compared to men.

A high level of health literacy does not prevent the development of obesity. In addition, internal behaviours such as perceptions, attitudes and cognition can be skewed by the individuals' environment leading to obesity. The findings corroborate the proposed drivers in Chapter 2 – Table 2.2 of food insecurity, low level of income, low level of education, disproportionate and mischievous marketing affecting internal behaviours. Hence, a perception of convenience of eating out fast food with a high awareness that SSB is associated with DM2 does reflect the capability of the obesogenic environment in promoting cognitive dissonance or value-action gaps.

The connection and influence between the environmental and behavioural drivers are closer than predicted and can change depending on sociodemographic factors such as gender and age. In other words, a driver may influence a young girl may not have the same influence on an older female. Additionally, cognitive dissonance or value action gaps were identified, emphasising the need to improve the communication and delivery of public health recommendations. For younger women, current diets were unsatisfying, which may reflect

low self-efficacy, possibly due to low cooking skills, resulting in negative eating choices and health behaviours.

Chapter 5. Future scenarios of eating choices and health behaviours

5.1 Introduction

Scenarios have been used to deduce cause-and-effect links within a system; for instance, through health initiatives and policymaking and their impact on, for example, obesity prevalence (Vandenbroeck et al., 2007; Butland et al., 2007). Hence, scenarios provide the opportunity to develop strategies and plans that help to mitigate issues and gaps within the system.

Numerous scenario typologies exist (e.g., predictive, exploratory, and normative) to communicate an expected future (Lena et al., 2006). Exploratory scenarios typically assess external influences on the operation of a system (e.g. organisations, institutions, industries), and support the development of strategies that can provide answers to questions such as "*what can happen?*", exploring several different outcomes (Börjeson et al., 2005).

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), n.d.), suggested three crucial advantages of *explorative* scenarios that are relevant for this research:

1) A higher level of flexibility in considering internal and external influences. In this research, exploratory scenarios allow development of a better understanding of diets and habits and related environmental uncertainties that can alter or promote behaviours (see theoretical framework in Chapter 3).

2) Applicability to a wide range of themes, which in the context of this research were the environmental outcomes (Chapter 2), and the collected data of individuals cases through the survey analysis (Chapter 4) to increase the level of understanding within a Mexican household.

3) To enable macro-level assessments of the effectiveness of a variety of solutions or interventions, obtained by the triangulation of the research data (i.e., outputs of Chapters 2, 3 and 4).

The exploratory typology was adopted for this study to evaluate how eating choices and health behaviours may alter nutritional status and transition diets from a present to a future

state. Four alternative scenarios were developed to explore future changes in diets and health behaviours and the implications (i.e., challenges and opportunities) for health policy (objective 3). The development of the scenarios considered the level of importance and uncertainty associated with issues or themes such as the one presented in the research question: "What drives obesity in Mexico?" In other words, scenarios have been developed to inform policy makers how sectors within the system influence the behaviour and environment of individuals, hence affecting their dietary choices and nutritional status.

The chapter proceeds with Section 5.2 in which the scenarios development process is explained considering the selected methods a) ranking space, b) selection of key drivers and c) the construction of 2x2 matrix with two selected axes. In addition Section 5.3 delivers the narratives and analysis of each of the proposed scenarios from which the discussion of the possible future events of eating choices and health behaviours in Mexico. Finally, Sections 5.4 and 5.5 set the discussion of the delivered scenarios and the conclusion considering the chapter's aim to evaluate how eating choices and health behaviours may alter the nutritional status and transition diets from a present to a future state.

Some comparisons are made to contrast the approach used to develop these scenarios with previous foresight studies. Keaver et al. (2013) identified the differences between acting and not acting upon health issues in Ireland and how prompt actions can prevent and reduce the economic burdens of public health, especially in obesity issues. Keaver et al. (2013) approach considered a review of the epidemiological studies and databases of BMI. Additionally, a multivariate, categorical regression model with cross-sectional data of age and BMI from the past and current was tested as a predictor model. Another foresight study (de Haen and Réquillart, 2014) considered the analysis of a raised question of how foresight mechanisms can ensure sustainable consumption. Their analysis considered literature from reports and journals from the food systems to consumption global pattern reports. The authors were able to identify critical issues (e.g., disruptions in the food system) and significant connections between consumption and production to set recommendations for policies and future foresight studies. Recently, foresight research (Lentz, 2021) highlighted three crucial concerns (gender, poverty, and nutrition) and their importance in global food system transformation, advocating policy trade-offs between the three pivotal issues and others. The

analysis was done through a systematic review in which the author segregated as a different set of megatrends from which they qualitatively tagged and clustered according to the crucial concern. The author incorporated a political economy axis and developed the scenarios considering the set of megatrends. Lentz (2021) then considered a visioning and back casting approach to provide a future or themes within two different groups 1) possible and 2) plausible. The difference between both terms is their level of certainty for the scenario to occur. Finally, the output themes associated with gender, poverty and nutrition were used to deliver the opportunities for practitioners, policymakers, donors, and stakeholders.

5.2 Scenario development

The scenarios were developed using the axes of uncertainty technique (van 't Klooster and van Asselt, 2006), which aims to bring together different perspectives on the future development of a system, taking a systematic approach to build an integrated image of the future state of the system.

The technique required the identification of two 'critical' drivers of change, selected from a larger number of relevant drivers. Rhydderch (2017) approach was used to support the literature review and survey to rank the level of uncertainty. A driver is defined as the themes and trend which influences or changes the outcome within a focal issue (Garvin and Levesque, 2005). The drivers are clustered in a 2x2 matrix (Figure 6.2) using a simple ranking method to assess 'criticality' (or priority) based on two criteria (Rhydderch, 2017):

- "Uncertainty" – is a measure of how predictable or unpredictable the driver is for triggering behaviours that can suggest as issues for the prevalence of obesity
- "Importance" – is a measure of how the driver ranges and is considered in the context of eating choices or behaviours which can lead to obesity.

The figure represents the quadrant, and the relevant drivers are the A, B, and others, whose level is subject to the qualitative assessment of the organisation and/or stakeholders. The drivers are then measured and allocated, considering both the uncertainty and the importance.
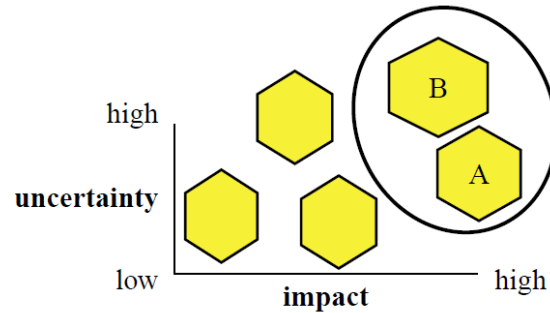
Figure 5.1. Two axes key drivers' quadrant (Source: van 't Klooster and van Asselt, 2006)

5.2.1 Identification of drivers

The two drivers of change were identified in a stepwise manner.

First a broad range of global drivers were identified (Step 1) from

1. A review of literature, using the STEEPLE framework to identify a broad range of influences on consumers' eating choices and health behaviours globally (Chapter 2).
2. A review of behavioural theories to understand both internal (e.g., TPB - perception, self-efficacy, health efficacy, subjective norms) and external (e.g., SCT - food and agricultural policies, socio-demographic inequalities) influences on consumer eating choices and health behaviours (Chapter 3), and
3. A survey of the significance (or prevalence) of these drivers on consumers' eating choices and health behaviours, focusing on consumers from the North-central region Queretaro, Mexico (Chapter 5).

A detailed account of alignment from the previous chapters (i.e., 2, 3 and 4) for the identification of drivers is presented and summarised below (Figure 5.2):

Chapter 2	Chapter 3	Chapter 4
Literature Review- Part 1	Literature Review- Part 2	Survey

Chapter 2 — Literature Review- Part 1
- Food Insecurity
- Low education
- Social inequality
- Low purchasing power
- Nutritional labelling
- Taxes on SSBs
- Disproportionate marketing
- Sedentary lifestyle

Chapter 3 — Literature Review- Part 2

Perception
Attitudes
Cognition

Subjective norms
Social norms

Self-efficacy

Intention

Value-action gap

Behaviour

* Disruption

Chapter 4 — Survey
- Limited groceries budget
- Low level of income (<5000MXN)
- No education, nor basic education completed
- Likelihood of fast food consumption
- Perception that eating out saves time
- Attendance to nutritional orientation
- Low enrolment of physical activity
- Daily activities include T.V. viewing
- Daily activities include going for a walk
- Influence of social media to dietary patterns
- Associates DM2 with SSBs excessive intake
- Low satisfaction of the current diets

Figure 5.2. Identified drivers of change (Step 1).

5.2.2 Prioritising and selection of drivers

The scenario development process incorporated the technique of "Ranking Space" or driver ranking, which enables the distribution and assignment of the drivers of change (Braun and Clarke, 2006; Chermak, 2011; Maguire and Delahunt, 2017). The purpose of the ranking space is to conduct a relevance/importance assessment of the output drivers (Figure 5.3) with the focal issue (i.e. obesity prevalence in Mexico) (Essa-Chanie and Gizaw-Desta, 2013). In addition, the uncertainty would consider the possibilities of occurrences of a particular driver within the context of eating choices and health behaviours. The category for the uncertainty levels was guided by Courtney (2003) study, which showed four levels defined as follows: Level 1 –guaranteed to occur; Level 2 – plausible few occurrences; Level 3 – may occur; Level 4 – the minimal probability of occurrences.

The drivers were classified in terms of their internal and external influence on consumers' eating choices and health behaviours (Step 2). A review of literature and surveys was used to rank the level of uncertainty of drivers identified as causing obesity. The approach follows that suggested by Rhydderch, (2017). This funnelling approach supported narrowing down the drivers to highlight and direct their trajectory (Egges et al., 2008) within the scenario development and ranking space exercise.

Finally, an assessment was made of the significance (or prevalence) of drivers on Mexican consumers eating choices and health behaviours (Step 3).

The ranking space exercise and the distribution of the output drivers are depicted in Figure 5.3. and the rationale from the most important and uncertain to the lowest rank are shown in Tables 5.1 through 5.5.

A — External/Environmental drivers

B — Internal drivers

Ranking space

1. Limited groceries budget
2. Level of income
7. Likelihood of fast food consumption
12. Satisfaction of current diets
9. Enrolment of physical activity
11. Level of education
3. Attendance to nutritional orientation
5. Social media influence to dietary patterns
8. Perception that eating out saves time
4. Association of DM2 with excessive consumption of SSBs
6. Daily activities include going for a walk
10. Daily activities include TV viewing

Importance

Uncertainty

Figure 5.3. Ranking space of drivers of eating choices and health behaviours in Mexico.

Table 5.1. Rationale for ranking drivers.

Driver	Criteria/rank		Evidence used to substantiate judgment (i.e., ranks assigned)
	Importance	Uncertainty	
Drivers with a high level of importance and no pre-determine (high uncertainty)			
1. Limited groceries budget.	10	7	- **Importance:** evidence has shown an association between the state of nutrition (i.e., higher obesity prevalence, particularly in women) and food price inflation (Conklin et al., 2019) within an unequal social and economic population (Finkelstein et al., 2014). - **Uncertainty:** consumers' disposable income is often influenced by the prevailing economic conditions, which affect food price inflation and the market's volatility (Conklin et al., 2019).
2. Level of education.	7	8	- **Importance:** evidence shown that the level of education was associated with the level of education and genders. The general influence of education on obesity enables a higher socioeconomic position and

Driver	Criteria/rank		Evidence used to substantiate judgment (i.e., ranks assigned)
	Importance	Uncertainty	
Drivers with a high level of importance and no pre-determine (high uncertainty)			
			access and comprehension of health information, increase accurate views, and greater capacity for self-control (Sassi et al., 2009). - **Uncertainty:** the causal relationship between education and obesity is not well understood, particularly in OECD nations such as Mexico (Devaux et al., 2011), enhancing the uncertainty level. In addition, it can bring insight to the found association of education-gender-obesity.
3. Likelihood of fast-food consumption.	8	5	- **Importance:** evidence showed a likelihood of fast-food consumption in the younger population in Mexico (19-25 years old). The threat it poses to public health and food-related decisions from consumers from an early age makes the driver important (Van Der Horst et al., 2011).

Driver	Criteria/rank		Evidence used to substantiate judgment (i.e., ranks assigned)
	Importance	Uncertainty	
Drivers with a high level of importance and no pre-determine (high uncertainty)			
			Uncertainty: The level of uncertainty was determined from a behaviour/ fast-changing attitudes among consumers (Hruba, 2014). Attitudes towards the activity, such as convenience, taste, or perception of cost (Majabadi et al., 2016).
4. Enrolment of physical activity.	8	5	- **Importance:** evidence suggested an association between physical activity enrolment and BMI within female participants and W/H ratio among male participants. Considering its effect on BMI and W/H ratio and its role in maintaining energy balance and preventing obesity and comorbidities, the driver is important (Jehan et al., 2020). - **Uncertainty:** the level/amount of physical activity or desire to enrol in physical activity cannot be predetermined. Therefore, there is high uncertainty as the

Driver	Criteria/rank		Evidence used to substantiate judgment (i.e., ranks assigned)
	Importance	Uncertainty	
Drivers with a high level of importance and no pre-determine (high uncertainty)			
			behaviour depends partly on an individual desire/attitude such as perceptual enjoyment, self-control, time and convenience 2015) to perform a specific behaviour (Rhydderch, 2017).
5. Daily activities include watching T.V.	6	7	- **Importance:** evidence revealed that T.V. viewing was associated with both BMI and W/H within both genders. Since the 1980s and most recently there has been an increment in the incidence of T.V. binge watch highly associated with obesity (Dietz and Gortmaker, 1985; Robinson et al., 2017). In addition, to technology facilitating T.V. watching within other screens such as computers, mobile phones, etc. (Fang et al., 2019). Increasing the easiness of the activity in an everyday basis (Wheeler, 2015). - **Uncertainty:** the behaviour cannot be predetermined as it

Driver	Criteria/rank		Evidence used to substantiate judgment (i.e., ranks assigned)
	Importance	Uncertainty	
Drivers with a high level of importance and no pre-determine (high uncertainty)			
			depends in both internal but also external factors. The individuals' environment and the subjective norms of the family can become significant indicators of sedentary lifestyles, which can determine an individuals' screening time (Harvard, n.d.).
6. Satisfaction of current diets	4	6	- **Importance:** evidence suggested a lack of satisfaction from the current diets among young female participants. The significance was assigned since the internal behaviour driver is inextricably linked to one primary element: lifestyle satisfaction (Schnettler et al., 2017). The fact that women are more obese than men in Mexico does reflect a lack of satisfaction with deeper interior concerns that demand investigation. - **Uncertainty:** the driver was ranked with a high level of uncertainty as it depends on a

Driver	Criteria/rank		Evidence used to substantiate judgment (i.e., ranks assigned)
	Importance	Uncertainty	
Drivers with a high level of importance and no pre-determine (high uncertainty)			
			human perception/attitude (Rhydderch, 2017), but also environmental (Schnettler et al., 2017). Hence, the individuals behaviours and social norms itself requires attention from the public health sector (Sayer et al., 2018) to take its parameter for the improvement of eating choices, perceptions/attitudes (Schnettler et al., 2017).

Table 5.2. Rationale for the high level of importance, low uncertainty.

Driver	Criteria/rank		Rationale for ranks
	Importance	Uncertainty	
Drivers with a high level of importance and pre-determine (lower uncertainty)			
7. Level of income	8	3	- **Importance:** evidence suggested income level is either negatively or positively associated with obesity levels. Income is important because it acts as a mediator between individuals' eating decisions and impacts the possibility of improving food quality and nutrition (French et al., 2019). Household food purchases are critical to analysing because they can influence the quality of dietary intake and represent substantial potential intervention targets (French et al., 2019). - **Uncertainty:** the driver has a low degree of uncertainty as income is pre-determined based on the job's established compensation basis (Feigenbaum and Li, 2015).

Table 5.3. Rationale for the low level of importance, high uncertainty.

Driver	Criteria/rank		Rationale for ranks
	Importance	Uncertainty	
Drivers with a low level of importance and no pre-determine (high uncertainty)			
8. Social media influence on dietary patterns	4	6	- **Importance:** social media was associated with the waist/hip ratio exclusively in young people, suggested by findings from the survey. Internet use in Mexico from 18 to 37 years old decreases from around 86% to 48% (Pew Research Center, 2018) due to restrictions on connectivity and technical devices in Mexico (Mecinas-Montiel, 2016; Cave et al., 2018). The low reliance sets the driver within a low important rank. **Uncertainty:** The driver is ranked as highly unlikely. Hence, it is not predetermined. There is a risk that connectivity and technology gadgets will become more available in the future, hence growing social media and its content, and potentially influencing individuals' eating habits. In other words, it has the potential to engage in a societally approved information-dissemination cycle,

Driver	Criteria/rank		Rationale for ranks
	Importance	Uncertainty	
Drivers with a low level of importance and no pre-determine (high uncertainty)			
			which will require future research (Klassen et al., 2018).
9. Perception that eating out saves time	4	8	- **Importance:** evidence suggested that saving time when eating out was associated with young females and BMI. It has been proposed that young working individuals link convenience with fast food, resulting in a decreased intake of healthy foods (Inglis et al., 2005; Escoto et al., 2012). However, the importance was ranked low as the perceptions seem to change over time and with age. - **Uncertainty:** the driver is considered highly uncertain as perceptions interlinked with the behaviours can be volatile traits highly dependent on individuals' environments (Chartrand et al., 2012).
10. Daily activities include going for a walk	4	7	- **Importance:** evidence suggested an association between the female participants BMI and going for a walk. However, for the impact on preventing obesity, walking activity remains a driver with low importance.

Driver	Criteria/rank		Rationale for ranks
	Importance	Uncertainty	
Drivers with a low level of importance and no pre-determine (high uncertainty)			
			A reason can be the lack of access to safe spaces (Son et al., 2016). - **Uncertainty:** the driver was ranked uncertain as it depends on an individual's internal attitudes and social influence to make the decision/choice to perform the behaviour (Future-Thinking, 2011).

Table.5.4. Rationale for the low level of importance, low uncertainty.

Driver	Criteria/rank		Rationale for ranks
	Importance	Uncertainty	
Drivers with a low level of importance and pre-determine (lower uncertainty)			
11. Attendance to nutritional orientation	4	4	- **Importance:** there is evidence that female attendance at a nutritional orientation is associated with a higher W/H ratio. According to the data, the driver has low importance because it has a minimal impact on preventing obesity. It was previously proposed (Warin et al., 2015) that for increased efficiency, nutritional orientations should be

Driver	Criteria/rank		Rationale for ranks
	Importance	Uncertainty	
Drivers with a low level of importance and pre-determine (lower uncertainty)			
			personalised, localised and meet individuals' everyday situations should be used. - **Uncertainty:** Its priority can decline because of not being able to follow the dietary treatment or due to other lifestyle activities. As a result, the driver may be defined with a low degree of uncertainty, as environmental and social norms might contribute to a loss in the will/ability to adhere to dietary orientation (Williams et al., 2010).
12. Association of DM2 with excessive consumption of SSBs	3	3	- **Importance:** evidence suggested consumers associate SSBs consumption with DM2. However, the awareness does not prevent them for reducing or quitting SSBs. Hence, it was ranked as low important driver as the - **Uncertainty:** the driver was ranked as predetermined. Improvements to interventions involving public health information or health literacy are required to increase individuals' comprehension (Friis et al., 2016). Additionally, other action lines

Driver	Criteria/rank		Rationale for ranks
	Importance	Uncertainty	
Drivers with a low level of importance and pre-determine (lower uncertainty)			
			such as boosting food security are necessary to encourage folks to make healthy dietary choices.

The definition of the two critical drivers was assessed according to their causal-impact relation with the focal issue (i.e., obesity). It was selected 1) Limited groceries budget and was re-defined as **level of affordability** connected with the economic component of the STEEPLE (Wilson, 1998; Maack, 2001). The second key driver would be identified as the **level of education** associated with the social element of the STEEPLE (Wilson, 1998; Maack, 2001).

The selected key drivers were mapped out on the scenario frame to develop the four scenario narratives. The rest of the drivers were included in the narratives as drivers of change which are closely linked to identify cause and effects of individuals' eating choices. These drivers were divided and clustered in an internal and external group considering the STEEPLE, theoretical framework and survey findings as shown in Figure 5.4.

The critical drivers form the skeleton of four alternative scenarios, which identify and explain possible outcomes of eating choices and their effects on health and nutrition due to driver interactions with the other agents of change such as sedentary lifestyle or likelihood of fast food consumption (van Wijck and Niemeijer, 2016) (Step 4). Additionally, the constructed narrative's primary distinction and characteristics are the reactions from humans based on internal behaviours such as perceptions and knowledge (Azman and Mahadhir, 2017).
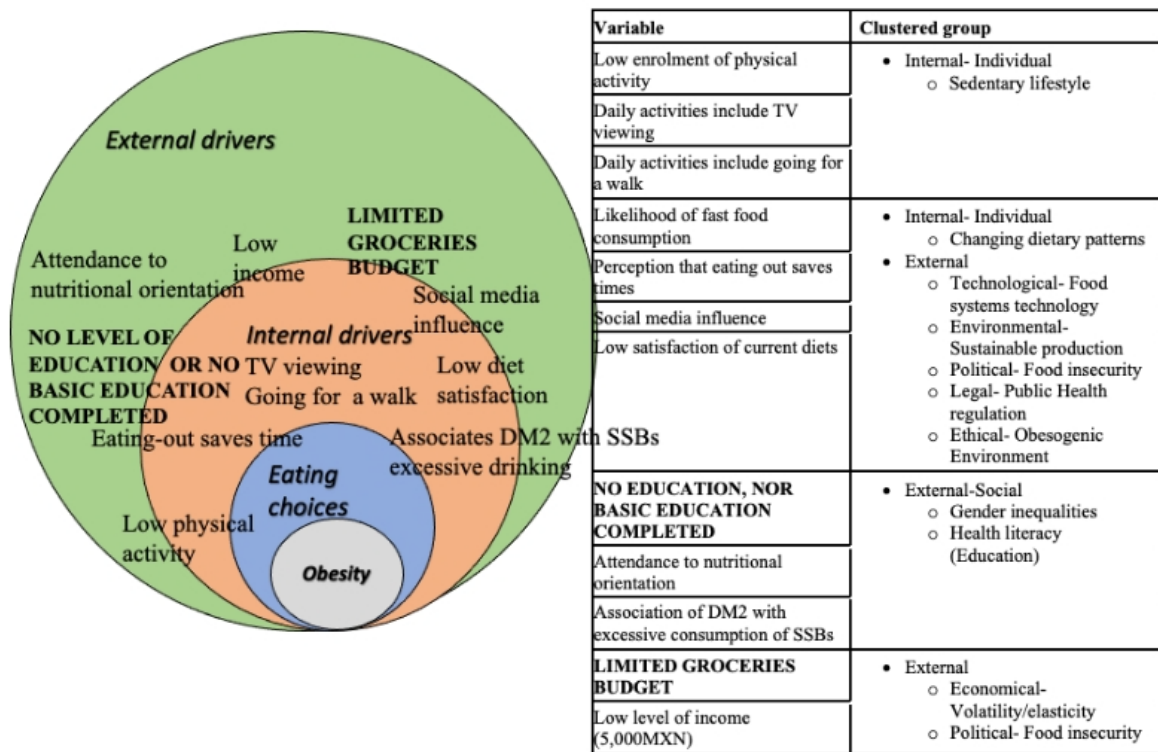
Variable	Clustered group
Low enrolment of physical activity	• Internal- Individual ○ Sedentary lifestyle
Daily activities include TV viewing	
Daily activities include going for a walk	

Likelihood of fast food consumption	• Internal- Individual
	  ○ Changing dietary patterns
	• External
	  ○ Technological- Food systems technology
	  ○ Environmental- Sustainable production
	  ○ Political- Food insecurity
	  ○ Legal- Public Health regulation
	  ○ Ethical- Obesogenic Environment

Perception that eating out saves times	
Social media influence	
Low satisfaction of current diets	

NO EDUCATION, NOR BASIC EDUCATION COMPLETED	• External-Social
	  ○ Gender inequalities
	  ○ Health literacy (Education)

Attendance to nutritional orientation	
Association of DM2 with excessive consumption of SSBs	

LIMITED GROCERIES BUDGET	• External
	  ○ Economical- Volatility/elasticity
	  ○ Political- Food insecurity

Low level of income (5,000MXN)	

Figure 5.4. Critical drivers selected to form the scenario axes.

5.2.3 Limitations

The qualitative approach of scenario design has limitations in that it may be seen as subjective (Swanson and Sato, 2012). The author may alter parts of each narrative output following the subject under investigation. Additionally, the recommended analysis for each narrative is subject to change when government plans or changes in the political landscape occur. For this study, the considered drivers were chosen based on the survey's significant results (Chapter 4), supported by literature and (Chapters 2 and 3). However, reviewing the output analysis and survey findings with experts and stakeholders can add value to the activity and mitigate concerns of subjective bias. Thus, the traditional way of interviewing stakeholders or gathering input through workshops (Lena et al., 2006), especially for the ranking and selection of drivers, could expose and address subjective bias and provide evaluation or sense-check of data collected from consumers via the survey. Instead, evidence from the literature was used to corroborate and integrate information that supported the drivers and

their influence on individuals' eating choices and health behaviours. In comparison to a purely subjective judgement expressed by the author, the supporting evidence from the literature gives value to the selection and ranking of the drivers.

5.3 Scenario Narratives

The scenario narratives illustrate an individual's interpretation of how the world is and how s/he interacts with their surroundings (van Wijck and Niemeijer, 2016). The narratives capture the interdependencies between the internal and external drivers, their influence on an individual's eating choices and the potential consequence (i.e., impacts on health behaviours and subsequently obesity).

The scenario narratives enable to address questions of interest, and examination of the individuals socioeconomic situation (e.g., country, language, professional background, income) (Evans et al., 2015). Narratives have been used to describe the circumstances around individuals' eating choices to better comprehend and describe how the event would unfold (Quigley, 2020).

Figure 5.5 depicts the scenarios' names according to the quadrants, considering the two selected key drivers.

Each of the given scenario narratives is divided into four sections. a) State of the drivers, describes the factors that cause a significant change in the system, reshaping it in novel and unexpected ways (Policy Horizons Canada, n.d.); b) A Day in the Life, which delivers the narrative using an individual as an example, highlighting their challenges and/or benefits in the context of the scenario; c) State of nutrition, which delivers the expected circumstances or impact on the state of health and nutrition of the individual; d) Opportunities and challenges, present an analysis of each scenario, emphasizing the critical factors to consider in light of the established narrative.

In addition, each scenario includes an overview of the individual or internal aspects that would impact eating choices, diets, and nutrition. Hence, the narrative technique considered previous findings from the STEEPLE (chapter 2), theoretical behavioural framework (chapter 3) and survey findings (chapter 5).

The narratives emphasise the individual's behaviours or internal aspects such as their perception, knowledge, beliefs and attitudes and the external aspects such as food insecurity and food production system that would have an impact in the state of nutrition, and diets.

The selected time horizons for developing the narratives consider the sector's assessment and its policies influencing key drivers. The education sector usually assesses its initiatives over a maximum of one to three years (Chang, 2008). Food production and economic sectors are evaluated every twenty to thirty years and must consider the impact of factors such as overpopulation and climate change (Reilly and Willenbockel, 2010; Ye et al., 2013). Considering the timeframes utilised to review strategic plans or policies in relevant sectors, a fifteen-year horizon was considered appropriate with a view toward 2035.

1 "My hedonistic plate"

2 "The Golden Era of Nutrition and Diets"

High affordability

Low level of education
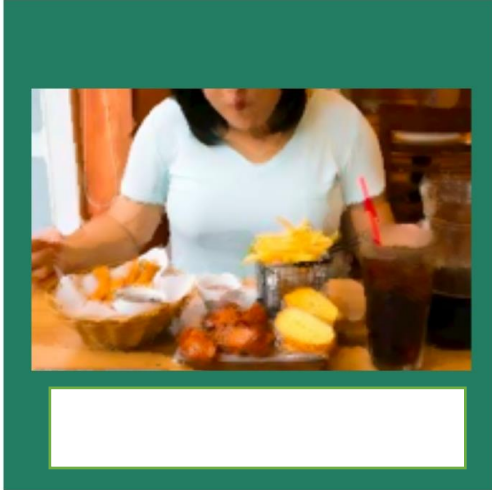
High level of education

4 "No progress, constant food insecurity "
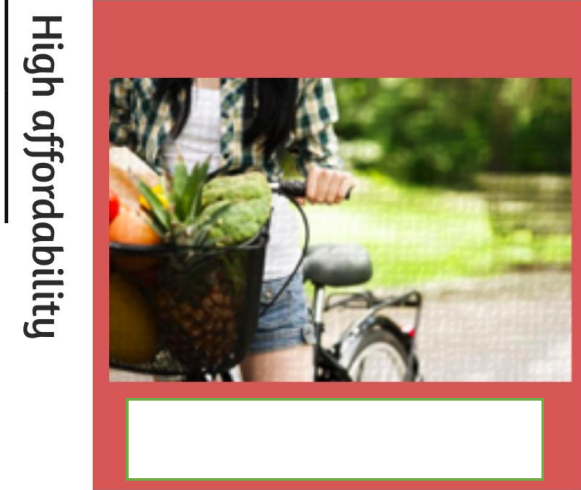
3 "Good health awareness yet unaffordable food"

Low affordability

Figure 5.5. Scenario frame - the state of diets and nutrition in Mexico in 2035.

5.3.1 "My hedonistic plate".

The population is experiencing a "garden of Eden." In other words, individuals are experiencing abundance of choice, without any economic restriction. However, the choices are still those associated to have an impact in developing and prevailing public health issues such as obesity, overweight and comorbidities.

5.3.1.1 State of drivers

The following table 5.5 clusters the internal and external drivers of change, from which a description is delivered to introduce the generalities and characteristics of the scenario supported by literature.

Table 5.5 Mapping of the cause-effect of internal and external drivers under "my hedonistic plate" scenario.

| Internal | Individual | Sedentary lifestyle | The population has not entirely ceased their physical activity. The balance between food intake and energy spent weighs more on food intake, growing obesity, overweight and comorbidities. Without behavioural modifications such as increasing physical activity to generate, maintain, and prevent weight gain (Hill et al., 2012), a sedentary lifestyle will continue expanding generation after generation. |
| | | Changing dietary patterns | A large sector of the population bases its diets in animal food source products, increasing to a maximum the consumption of red meat and reducing dramatically, proteins by plants, whole cereals, vegetables, and fruits. |

External	Social		As the economy improves and grows throughout the country, food that was previously considered "luxurious" owing to its high cost becomes available. In Mexico, between 2009 and, 2013 beef meat increased by 52.74% (Kyekyeku, 2015). The population nowadays can easily access and afford them without any sort of limitation.
		Gender inequalities	Inequalities are present, especially between genders, which hampers social prosperity and development. The slow rate of enhancement and ensuring women's rights in the country has left an evident gap between the opportunities and lifestyle quality between women and men. The lack of actions/policies has caused a prevalence and increase of obesity and poverty of women in Mexico (Wells et al., 2012).
		Health literacy (Education)	The government has neglected the educational system. There is an absence of awareness and knowledge, primarily associated with health and prevention. The lack of organisation and linkage between the education and health sector will mitigate the efforts done in the latter. Education has a strong link to health as a predictor of healthy behaviours, risk reduction related to poor dietary choices

			driven by food insecurity, and prevention of obesity (Feinstein et al., 2006)
Technological		Food Systems Technology	There is little or no support for developing innovation and technology in the country. Most tech and innovation come from abroad and foreign companies, making it scarce. The little innovation development has a) enhanced the lack of connection in terms of research and development; b) little application of technology business models; and c) lack of public policies supporting technology-based companies (Amorós et al., 2019; Portuguez et al., 2019). These issues resonate in the food systems industry, particularly affecting the small and medium industries.
Environmental		Sustainable production	There is pressure from other countries which have already achieved sustainable dietary behaviour. Mexico could reach that point. However, there is no clear leadership or a sense of collaboration between institutions that could develop a robust strategy to enhance sustainable production. The lack of strong links and initiatives between sectors such as agriculture, education and health blocks the possible implementation of sustainable nutrition production in the country (Traoré et al., 2012).

		Volatility of prices	Government investment and industry have confidence; they can keep pushing the economy from the base of their production. However, both the government and food industry need to acknowledge and invest on the agriculture food production to increase production variety and offer, especially for products such as pulses and fruits and vegetables. Policies that can boost the investment while at the same time acting upon transparent trade deals can decrease any risk of food price volatility (Ghanem, n.d.).
	Economic	Price inelasticity	Food price inelasticity is common as food products would be affordable for the population to acquire. As a result, food taxes are no longer the norm, resulting in an equal offering of food goods regardless of their nutritious quality. Subsidies on items ranging from fruits and vegetables to sugar and saturated fats create an atmosphere of freedom of choice and possibilities. However, the decision has diminished any previous health efforts. In other words, it does not follow the rule that making it affordable can increase the demand for food products that can slowly improve positive eating changes (Andreyeva et al., 2010).

		Food insecurity	Food production has ensured food security, but not necessarily following the high need for "healthy," "nutritious" or "sustainable" diets. The behaviours persist because health and nutrition are not prioritised in the food sector or reflected in the products available to consumers. Evidence of more than thirty years has recognised the need to shift negative environmental influences that promote unhealthy eating patterns (Popkin et al., 2012). In this time, this has not been the rule.
	Political		
	Legal	Public health regulations	The lack of information and knowledge has been one of the main factors responsible for the adopted dietary behaviours. Health aspects and prevention of diseases which were highly known in the past are not causing a real effect on people's behavioural choices towards healthier diets. The lack of initiatives to expand individuals' health literacy blocks the possible adoption of healthier eating patterns (Andrulis and Brach, 2007).
	Ethical	Obesogenic environment	Government has intervened, primarily investing in food production, yet not promoting a regulation which could ensure nutrition and quality in the food offered. Production and distribution of

			food products without a guarantee of the quality and nutrition, will keep expanding the issue of obesity (Mozaffarian, 2018).

5.3.1.2 A day in the life of Natalia

Natalia is a 30-year-old woman who has four children. She and her husband live in a semi-urban community in the centre of Mexico. She has struggled with her weight since she was a teenager. Her medic has warned her about developing premature Diabetes Mellitus type 2, as she has previously been diagnosed with gestational diabetes (Noctor and Dunne, 2015).

The tendency among adults when getting married and having a family is to significantly reduce physical activity (Hull et al., 2010). In addition, a stigma of obesity prevails in society making some individuals feel uncomfortable when performing physical activity in public (Bombak, 2015). In other words, stigma discourages individuals due to a low sense of self-efficacy, causing them to feel embarrassed or hesitant when engaging in physical exercise (Thiel et al., 2020).

Factors such as overpopulation, an increase of technological gadgets, and lack of security have also increased the prevalence of sedentary lifestyles (Medina et al., 2013; Park et al., 2020). Additionally, due to a lack of knowledge, lack of health awareness prevails in some parts of the population, resulting in a persistent notion that fat equals sustenance and a healthier state for birthing (Martinez et al., 2017).

The social norms and hectic lifestyles cause Natalia and many women to succumb in the consumption of food not necessarily with a high nutritional value. Factors such as palatability and convenience due to saving time have become the main reasons given by women like Natalia. Dishes sold in these vending areas are usually Mexican fried fast-food dishes and processed food. Since 2012 the demand for processed, ready-made meals was already showing an increase of 30% especially among the young population groups living in urban areas (Marrón-Ponce et al., 2018).

In addition, when younger Natalia never developed culinary skills as the ready-made food products were an easier, convenient and affordable choice. Hence, if she did not enjoy eating out in a fast food establishment, she would purchase some ultra-processed products at a convenient local market.

Due to the fact that food products became affordable, the demand for products such as beef meat has exploded, particularly among the male population (Gómez-Dantés et al., 2016; Navarro and Vélez, 2019). In contrast, the consumption of pulses such as beans and whole cereals have decreased. Corn remains the primary source of cereal, followed by refined flour. Fruits augmented their demand. However, vegetables stagnated in terms of consumers' choices and demand and, despite the ease of access and affordability, the consumption of vegetables remains low compared to fruit (Ramírez-Silva et al., 2009; Gaona-Pineda et al., 2018). Individuals claim lack of time and lack of ideas to develop new dishes that could include a higher variety of vegetables to consume. Red meat and ultra-processed food products such as ham and sausages have replaced the consumption of other products such as fish and other proteins by plants.

Food vendors still get money from private food companies (like soda companies) in exchange for promoting and selling their products. This has impacted in a large demand despite the progress made by the public health initiatives such as the black warning labels. The black sign warning food labels implemented by the public health sector at end of 2020 (i.e., 15 years ago) did show a positive effect particularly among young individuals. However, the acknowledgement of the impact on health does not seem to cause any behavioural effect to decrease the consumption of ultra-processed food products. In addition, the taxes implemented on SSB since 2014 were not continued with the claim of higher equal access and affordability to all food products claimed by the producers.

At the moment, the high affordability of any food product enables Natalia to purchase certain food products which in the past were not possible to purchase. Hence, affordability has become a double-edged factor. On the one hand, the initiative has helped people like Natalia and in general women who in the past would suffer more in terms of a limited groceries budget. On the other, it has given the chance for ultra-processed and saturated fat food to dominate the consumers' demand.

5.3.1.3 State of Nutrition and Diets

In this scenario, people's impression of health is lowered in favour of convenience, leading them to prefer ultra-processed foods high in saturated fats, cholesterol, and refined sugars (SEDECO, 2014). Eating-out has become a more frequent activity among all socioeconomic levels, compared to 15 years ago in which middle income zones were denser and showed a higher demand (Rosales-Chavez et al., 2021)

Individuals recognise the composition of food products, particularly with the "black warning labels" implemented fifteen years ago. However, the constant bombarding of marketing and selling points stagnated the expected reduction for sweetened sugar beverages and snacks. Public health programmes require evaluation owing to the low impact on obesity and a high degree of ambiguity. There is a high need to increase transparency and patient empowerment and prevent paternalistic or misdirecting approaches (Ferraz, 2015). Public health campaigns require an assessment to deliver health policies that can change society, food business, and increase health literacy. The challenge of a poor level of eduation is the direct blockage to the effectivness of health initiatives, particularly those associated with domestic practices. Examples are the lack of cooking skills among young individuals, which place convenience over nutritional value.

The prevalence of obesity and overweight have persisted in the general population. The incidence of obesity and overweight has slightly shifted between genders. Nowadays, the level of obesity is slightly higher among the male population and overweight is more prevalent among the female population. The prevalence seems to move slowly towards the estimations made by 2050 in terms of obesity between genders 57% male and 34% female (Rtveladze et al., 2014; DiBonaventura et al., 2017). The estimations hold as the primary cause of death cardiovascular diseases (CVD) followed by diabetes mellitus type 2 DM2 and complications such as fatty liver, lipogenesis and hypertension (Teh et al., 2010; Yang et al., 2014; Vos et al., 2017; Jensen et al., 2018). among the population. The prevalence of both CVD and DM2 remain as first and second causes of death comparable with 2018 (INEGI, 2018).

5.3.1.4 Opportunities and challenges.

Opportunities

- Develop a training scheme at school-basic education level that can help individuals to increase their knowledge in terms of knowing food variety, its specifications of growth and harvest and culinary skills. Additionally, information should be handled according to the most recent research and should be influenced by social norms, the environment, the system, and climate change.

- Periodic free distribution of healthy recipes using a variety of communication means including television, newspapers, magazines, and social media, to improve and spread awareness within society, incentivize cooking dishes with diverse ingredients, and increase the demand for diverse culinary items.

- The high variety and affordability of food products can increase demand, this delivers the opportunity to support numerous small local producers.

- Campaigns to increase physical activities should include relevant information about how the government is handling critical external issues that could be causing a barrier for individuals to execute and enrol in periodic physical activity. These barriers include security in parks and grounds for exercise in the cities, improvement of paths for cyclist, increase of physical activity time for workers as part of their job.

- Raising consumer awareness, health literacy, and education through additional information that supports the black warning labels (US Department of Health and Human Services, 2010). One measure can include a developed strategy between food producers, educators, and the public health sector, to communicate and deliver a more robust orientation to consumers regarding food and beverage compositions and their choices. The information can be provided in pair with the free distribution of healthy recipes periodically.

Challenges

- Economic and financial support should be given to small and medium producers. In addition, small retailers who aim to open their business should be given economic subsidies and incentives. The move can prevent and release sellers from relying on sponsorships from ultra-processed corporations, absolving them of any duty for product marketing that could boost offer and demand. There is a need to regulate and address market-power misbalances that can promote the consumption of unhealthy food products (Wood et al., 2021).

- There is a need to re-establish regulations based on a food product's content, quality, and nutrition. Food manufacturers should be acknowledged for their commitment to innovation, nutrition, and quality. Independent bodies of health and quality specialists should be tasked with the role of ensuring compliance and transparency with the regulation (Carriedo et al., 2021).

- Education is critical for a country's development and innovation, but mostly to guarantee a better quality of life (Hakimovich et al., 2020). Education can aid starting critical transitions within sectors, system, and society to bring them closer together and make them more effective to achieve objectives. Therefore, education within all levels (i.e., basic, medium-high, high) should be a pivotal element in the government's agenda and safeguard the access for all the social groups in Mexico, without exceptions. The government should identify national areas with a high proportion of high school dropouts and implement a strategy geared at reintegrating and/or offering education at an individual's pace and convenience.

- Obesity, overweight and comorbidities prevalence increase the vulnerability, virus transmission and health risk of individuals against any future microbiologic outbreak or epidemic (Chua and Zheng, 2020). It is imperative to synchronise health initiatives and bring them closer in a scope that could bring higher effective measures to improve individuals' state of health and mitigate future risks.

5.3.2. "The Golden Era of Nutrition and diets"

Consumer behaviour within the state of nutrition and diets is at its best moment. The impact of the high level of education has enabled and increased population proactivity towards prevention and self-care. Strengthening the country's food security and sovereignty requires linking critical areas such as trade, economics, research, human rights and climate change (Clapp, 2015). The system has functioned under the premise that the benefits of tight collaboration as a team will positively reflect in the most remote and isolated corner.

5.3.2.1 State of drivers

Table 5.6 clusters the internal and external drivers of change, from which a description is delivered to introduce the generalities and characteristics of the scenario.

Table 5.6. Mapping of the internal and external drivers under "The golden era of nutrition and diets".

		Sedentary lifestyle	It has increased the population's proactivity and adoption of behaviours toward health prevention. Therefore, the level of consciousness increases in parallel with the active, healthier lifestyles among the community. Hence, the notion of self-consciousness increases consistency between attitude and behaviour, leading to healthier practices (Pu et al., 2020). The higher level of education at the same time has promoted health consciousness (Feinstein et al., 2006) and enhanced self-efficacy.
Internal	Individual	Changing dietary patterns	Diets within this scenario have increased their level of nutritional value, quality, safety, and sustainability. Food security and knowledge have led to individuals making decisions based

			on health awareness rather than food insecurity-related choices (Li and Powdthavee, 2015).
External	Social	Gender inequalities	Career opportunities have grown, allowing more people to get a better degree of knowledge, which has had a favourable effect on people's perceptions, attitudes, and behaviours. One main factor was the recognition of women and the importance of their role within a sociodemographic perspective. The measures have slowly influenced and promoted significant reductions in the gender disparity. There is an environment of ensuring gender equality which at the same time has aided with a higher optimization of health in the population (Veas et al., 2021).
		Health literacy (Education)	Social attitudes about healthy eating have improved throughout time because of an increase in health literacy. Individuals have adopted more rational thinking, conscious and preventive attitudes towards self-care, health, and nutritional well-being. Self-care principles can lead and increase motivation to achieve and make healthier choices (Martínez et al., 2021). Education can set a higher level of awareness which can open individuals' consciousness.
	Technological	Food systems Technology	The potential of tech-innovation within the food production systems has brought different sets of opportunities to reinforce health literacy

			from school and enhance the motivation of individuals to adopt a healthy, preventive, and sustainable culture. Healthy, sustainable food options, such as those provided by food reformulation, can mitigate and avoid nutritional problems like obesity (Rabadán et al., 2021).
	Environmental	Sustainable production	Perception and awareness have changed as society's level of education have risen. Higher education has led to an increase in self-efficacy and higher conscious behaviours towards health and the environment. The understanding of sustainability can bring clarity for individuals, in which education role can enhance the opportunities and skills to reflect and collaborate towards sustainable choices (Clugston and Calder, 2007).
	Economic	Volatility of prices	Food and drink prices stability has resulted positively in all socioeconomic sectors. Investing in local food production has made the Mexican economy less subject to variations in global food costs. The measure has helped the country maintain more control over its food supply. An increase in agricultural investment is necessary to meet the objective of growing a safe, high-nutrient supply, decreasing its cost, and boosting food security (Food and Agriculture Organization of the United Nations, 2021).

		Price inelasticity	There is higher stability in the economy reflected on stable food prices. One reason is the government's investments in the food production system, higher education, higher income that ensures the stability of food prices, demand, diminishing food insecurity (Dawe and Timmer, 2012).
	Political	Food insecurity	Mexico has invested in sectors such as the agri-food industry, enhancing production competitiveness and increasing food security and sovereignty. In addition, the strengthened relationship between politics and the economy ensures food security through a commercial goods approach rather than political (Dawe and Timmer, 2012).
	Legal	Public health regulation	Along with schools and technology and increasing food security, public health regulations are completing the whole scheme of preventive/proactive campaigns. The proactive prevention scheme has maximise the health impact from the sector (Njuguna et al., 2020). Restructuring and upgrading the economy's burdened sector has been made possible by new financial resources.
		Obesogenic environment	Cities and food establishments were re-designed to enhance the consumption of healthy and sustainable diets. Consumption and demand usually make health and prevention towards health and environment rule in most

			people's lifestyles over the less visible obesogenic environment. The promotion of health while at the same time protecting biodiversity has enhance food sustainability (Loken and Campari, 2020).

5.3.2.2 A Day in the life of Monica

Monica is a mid-30s indigenous woman from a little town in the Sierra of Queretaro. Monica speaks several ethnic languages, Spanish and foreign languages. She is finishing her Masters online in technology and innovation. Her parents also live in the Sierra of Queretaro, where both produce broccoli, supported by the agriculture production programme. The programme started as central support for the Mexican agriculture/livestock food production, enhancing business opportunities, especially for small and medium producers. There has been an increase in support to local production businesses which has reflected the stabilisation of the economy within all socioeconomic sectors (SES), through income-earning opportunities, mitigating shocks and price crises (FAO, 2017).

The Food security and agriculture sector has ensured the population a vast variety of food products which has increased the adequate nutritional intake (Hatløy et al., 1998). Monica's nutrition is based mainly on whole cereals, protein from plants (i.e., legumes, nuts) and fruits and vegetables. Animal food product has reached a balance between the production and the demand of main sources such as poultry, pig, and beef. Currently, there has been a significant increase in the consumption of fish due to its association with positive health outcomes, increasing consumption by +6.3% compared to 15 years ago (FAO, 2019a). Since demand has increased it has open new possibilities to support the fishing sector. Additionally, the government has invested in the protection of species, lakes, and rivers.

Fishermen as small farmers or food producers have joined within a single organised civil group whose meetings have served to expose their progress, needs and overall development. Monica usually goes to these meetings in representation of her parents to expose the conditions of their broccoli field. All the reports are sent to the assigned government actor in

charge of the region's agriculture, fishery and livestock production from which cases are exposed to the central government. The interaction is periodic and constant and has served well to develop initiatives and reform policies in protection of the lands, species, and producers.

Health initiatives from the past not only remained constant but were improved such as the black warning labels implemented in 2020. A positive output was the gradual decrease in demand for ultra-processed food products with high saturated fats, sugars, and salts (Taillie et al., 2021). Additionally, schools established a robust health programme that included daily physical exercise and culinary techniques in their curricula. The prepared food would be part of their daily self-made lunches. The outcome of the measure was that students such as Monica shifted their eating choices to prepare food such as corn, vegetables, honey, fruit, chia, and amaranth that would replace her desire for fizzy drinks, sugars, or salty snacks.

Growing fields were established in communities to promote locally grown food; these grounds would also be used for educational purposes by the community and schools. The primary objective was to demonstrate to future generations the origins and procedures of food cultivation and collection for the abovementioned lunches. The commercialisation of the food is organised and sold for the local community and the extra for government to sell to other close regions and cities. Food assets are managed and administered for community welfare and development. Natalia's community has earned many awards in the past due to their management of growing food and sustainable dietary choices (Willett et al., 2019). As the population's sovereignty and stability rises, along with educational opportunities and food security, there is no need for them to depend on migrating nor working within illegal ways.

5.3.2.3 State of Nutrition and Diets

Individuals' food choices in this scenario are demanding and consuming more self-produced food products. The system's integration with other sectors, including schools and food producers, and individuals from civil and health organizations and stakeholders put them closer than ever to addressing community welfare, health and food sovereignty (Patel, 2009) among others. The community's work and organisation established a win-win cooperation with the government. That way the latter can assist them, but most importantly setting a

discussion to know their needs and develop initiatives and policies. In other words, the government supports the community's ongoing efforts through policies to ensure food security and sovereignty. Communication between the community and the government has aided in the reforms of key critical policies relating to food supply chain improvements and commercialization (International Food Policy Research Institute, 2020).

The population's plans for their communities are aligned with accumulated knowledge of health and climate change. The scheme included the growth of fruit trees, vegetables, herbs, and small farms for sheep, laying hens, chickens, pigs, and edible insects. The latter has a millenary legacy in Mexico of consumption from their pre-colonial ancestors (Ramos-Elorduy and Pino, 1989). Hence, cultural-traditional food practices are resurging within society. Meat consumption was also reduced by adopting a half-half production innovation technique with an alternative food source such as edible insects (e.g. grasshoppers, crickets and ants) (Kouřimská and Adámková, 2016). In addition, they learn how to dry edible cactus to elaborate flour and combine with amaranth and maize flour to make tortillas. Thus, maize demand was more balanced as a result, the adoption of more sustainable techniques benefited yield, water distribution, and management.

The prevalence of obesity and overweight in adults and the elderly population in Mexico from both genders have shown an annual continuous decline. One reason was due to the development of strategies through multidisciplinary teams from the different sectors. Effective leadership brought positive decisions and collaboration (Smith et al., 2018) within the different systems, following two main objectives nutrition and climate change (Kumanyika et al., 2010). Interventions ensured a scheme of local equal distribution, and commercial production trade demand, without risking food security. The number of cases of obesity and overweight has decreased dramatically, especially in the female population and an attributed factor was gender equality (Garawi et al., 2014). Gender equality expanded in sectors such as education, labour, and decision-making roles. The social-health improvements resulted in a shift in the environment, as internal behaviours such as self-efficacy improved, particularly among women (Di Tullio, 2019).

Furthermore, there is a continuous public health regulation associated with food labelling and the application of taxes and subsidies to self-produced food. Simultaneously, as indicated

previously, constant social and environmental changes and advancements within the education sector have benefited the population's food choices and decreased cognitive dissonances or value-action gaps (Robb et al., 2019).

5.3.2.4 Opportunities and challenges.

Opportunities

- Integrate education, public health, and food production sectors to create initiatives that incorporate inclusiveness and interdisciplinary responsibilities to establish and advance comprehensive, integrated plans that address additional challenges such as climate change and social development (Traverso-Yepez and Hunter, 2016).

- The investment in and growth of local food producers gives the opportunity, particularly for women to participate and be part of organise civil groups, making them part in critical management discussions and final decisions. Women's involvement has decreased gender disparities and boosted their economic power, productivity, and decision-making ability, all of which are aided by stronger self-efficacy (Karpinski et al., 2020). Critical socioeconomic difficulties that formerly drove women to abandon their communities and schooling to relocate to urban areas and work in the informal sector have been gradually mitigated. The involvement of women's participation in sectors such as agriculture and food production regulations is becoming more relevant, closing gender inequalities in labour, education, health and salaries (Seguino, 2000; Patil and Babus, 2018).

- The reduction of social issues which take individuals away from their communities can be reduced through investments and initiatives in the food production sector from small producers to improve their welfare (Satterthwaite et al., 2010). The measure may benefit local food demand, resulting in the formation of new enterprises and job prospects. The future outcome of the measure can mean the reduction of illegal immigration to the United States.

- The environment can support civil organisations of small producers who are conscious of taking care of their community and their environment. Consumer behaviour is increasingly shifting toward a more proactive attitude toward environmental management and biodiversity protection, resulting in beneficial

improvements in food pattern selection. Some actions have been focussing on the reduction, for example, of GHG emissions. Changes and diversification within the industry improve management and efficiency (Biodiversity, 2010; de Groot et al., 2010), which supports sustainable production.

- The smaller fields, organisation, and improved administration enable the development of traditional systems via technological innovation, reducing food waste (Parfitt et al., 2010). Moreover, the measure can bring transparency on governments actions to support and improve food paths distribution and commercialisation.

- Increase the investment of protein by plants, whole cereals, raw vegetables, fruits, and edible insects' production which consumption can have positive impact on health by diminishing the prevalence of cardiovascular diseases (CVD) in the country and opening new commercial opportunities (O'Hare Ryan, 2020).

Challenges

- It is critical to assist producers with the commercialization and distribution of their products. Economic pressures can suffocate positive community practices and decrease their access and availability of needed resources. As a result, they are compelled to abandon their practices in quest of new opportunities via relocation.

- The need for relocating can oblige individual to dissert school, leaving education as an option rather than as an opportunity of growth and development.

- The threat of climate change effects can become the new reason for individuals' need for relocation. Sustainable measures shown in this scenario should be considered for diminishing the effects attributed to the environment. Water issues (e.g. scarcity, floods) should be addressed with the set management/distribution schemes to sustain communities and production efforts (Ivanova et al., 2016).

- The growth and expansion of the community markets require support and invigilation to protect the community's interests. Hence, the government must establish policies that protect small producers in their transactions and negotiations, particularly with intermediaries. To boost fair/ethical business trades that can be sustainable for both the producer and the consumer (Blizkovsky and Berendes, 2016).

5.3.3. "Good health awareness, yet unaffordable food".

Consumer's behaviour related to diets has gradually transitioned as the level of education and knowledge has increased among the population. The transition has reflected and amplified the individual's higher demand for food and drinks with a higher nutritional content and quality. However, it has been challenging to maintain food prices at an affordable level, especially as the industry announces changes in their production systems to comply with the consumers' demand. The low level of affordability evokes a different kind of gap between consumers and the food industry, making it impossible for the entire population to adopt healthier dietary patterns (Darmon and Drewnowski, 2015).

5.3.3.1 State of drivers

Table 5.7 clusters the internal and external drivers of change, from which a description is delivered to introduce the generalities and characteristics of the scenario.

Table 5.7. Mapping of the internal and external drivers under "Good health awareness, yet unaffordable food".

Internal	Individual	Sedentary lifestyle	One of the first changes that individuals reflected on their behaviours was an increase of physical activity. The positive behavioural pattern was supported by schools and the community, as a social/physically active trend. The advantage of encouraging physical activity through other sectors such as schools and among communities is their potential to reach a larger audience (CDC, 2021). Hence, the environment of individuals is surrounded for

			encouraging positive, healthier behaviours.
		Changing dietary patterns	The public has demonstrated a favourable attitude toward the adoption of nutritionally sound, sustainable diets. However, economic restrictions continue to restrain food affordability to a level that a sizable portion of the population cannot sustain. The connection between a healthy diet and food security is impossible without a sustainable food and economic system (Berry et al., 2015).
External	Social	Gender inequalities	The high level of education has partly contributed to closing gaps of inequality including, genders, especially with the higher level of education offered, which gradually increases labour opportunities. The partial improvement is because the economic situation stresses social issues from the past, which show persistent restrictions towards women affecting more the economic growth (Vásconez-Rodríguez, 2018; Altuzarra et al., 2021; Du et al., 2021). The inability to expand economic growth diminishes positive attitudes

			among society, essential to tackle gender inequalities (Du et al., 2021).
		Health literacy (Education)	Schools and the improvement in education levels have supported a teaching-learning process focusing and trying on leading a better life quality, including health. Education then can really become the foundation of health and well-being (UNESCO, 2021).
	Technological	Food systems Technology	The decisive interventions in the education sector by the government have proven to increase the development of new innovative technologies, supported by nutritional data-driven innovation. The action has given support to an increased capital which can be re-integrated to the food production system to enhance agriculture and high nutritional quality production (Corp-Mercy, 2021).
	Environmental	Sustainable production	Diets are partly shifting towards a healthier and sustainable path. However, affordability has represented a significant threat in people's transition towards more sustainable diets. The high education and awareness have allowed individuals to know more about the

			association between their food choices and environment. The reality of low food affordability does limit the possibilities for achieving a radical shift towards sustainable diets regardless of the awareness (Haghighian et al., 2021).
	Economic	Volatility of prices	Constant fluctuation, globalization issues, climate change, and conflictive external negotiations increase the chances of unclear commercial agreements impacting the food production management and economy. It will take longer before Mexico can reach a market and production balance. The reason is a constant economic struggle that impacts food, energy and the markets, which enhances its volatility (Tadesse et al., 2014).
		Price inelasticity	The demand for food products and their high prices in the markets increases the episodes of inelasticity, especially as the population is trying to endure the high cost of healthier food products. Economic developments influenced food costs, particularly products with a better nutritional value and quality (Vu, 2020).

	Political	Food insecurity	The government has not yet been able to accomplish a simultaneous system that can ensure food security due to the high level of prices in food. However, the constant pressure from society and the increased collaboration with other sectors have moved the system towards a restructure in management and analyses to bring higher levels of effectiveness. The collective, reflective engagement from civilians have generated positive collective insights to improve the system (Doherty et al., 2020). It is now the link between the food industry and the government to respond.
	Legal	Public health regulation	Despite the increased feeling of proactivity and disease prevention fostered by health literacy and education, obesity and overweight continue to disproportionately afflict people who cannot afford foods and drinks of higher quality and nutritional content. The paradox of obesity and food insecurity association remains as long as the government won't fully tackle the affordability issue (Scheier, 2005; Brown et al., 2019).
	Ethical	Obesogenic environment	The challenges associated with restructuring in the food business

			continue to be the "primary reason" why some corporations avoid making significant changes or take longer to implement. Nevertheless, the collaboration and availability of data/knowledge with the reformulation of food products are plausible due to the higher level of education (Harastani et al., 2020). Thus, collaboration among companies operating in the similar food industry is critical for exchanging data and developing strategies to improve the nutrition and quality of products.

5.3.3.2 A Day in the life of Javier

Javier is a young man aged 15 years old. He has one sister, aged 9 years old. He lives in Mexico City with both of his parents, who work as teachers in an elementary school. His state of nutrition is compared to what it was 30 years ago in 2020 when 40% of adolescents in his age range (i.e., 12-19 years old) were developing overweight and obesity (ENSANUT, 2018).

Obesity, overweight and malnutrition prevalence was reduced among children. In contrast, adolescents remain a group that slowly increases in its prevalence of overweight and obesity. A main reason for this is the fact that schools could not sustain the distribution of fresh, high nutritional value school lunches. Hence, lunch offers product donated from private businesses particularly long-shelf life such as ultra-processed food products (Noll et al., 2019). By food group, a school lunch was 70% starch, 15% cereal, 5% pulses, 5% fruits and

vegetables, 5 % ultra-processed product (e.g., yogurts with added sugars or a piece of sugar bread).

Physical enrolment is not easy since environmental concerns (e.g., pollution), security concerns, and a lack of spare time continue to be common hurdles that some persons attempt to overcome for health reasons (Rawlings et al., 2019). For adults these activities are usually organised between neighbours and within their communities. In the case of children, schools continue to be the ideal place for them to participate in sports and develop lifelong active habits. However, when becoming adults and entering the labour activities, marriage and family, the physical activity significantly diminishes. The promotion of physical activity supported by education should consider increasing the level of motivation to enrol in a daily physical activity (Gao and Eun-Lee, 2019) with the use of pedagogical strategies. Pedagogical strategy is working out methods that, instead of providing direct solutions for defined problems, encourage fostering creative tension and opportunities to develop critical learning (Lewis and Dehler, 2000). In addition, a previous study (Sierra-Díaz et al., 2019) stated a higher level of motivation to enrol in a physical activity when promoting through pedagogical strategies. Moreover, the government needs to provide and improve neighbourhood security and cycling paths to promote an amenable, motivating environment (Loukaitou-Sideris, 2006).

Food production has become a struggle in part due to the climate change effects (i.e., droughts and floods). Another reason has been attributed to ineffective management, development, and expansion of the food production sector, which has resulted in Mexico relying significantly on imports, which contributes to high food prices (Gürkan et al., 2003). Hence, people constantly struggle to purchase basic high value nutritional food products. They rely on more "affordable" options such as tubers and starch vegetables as cheap fried snacks.

5.3.3.3 State of nutrition and diets

The country has struggled with the neglect of the food production sector to depend entirely on international commercial trade (UNCTAD, 2013). Budget constraints greatly hinder individuals' ability to adopt better, healthier, and more diverse diets. Previously it was stated that high food prices can lead individuals' choices to be monotonous and constrained

(French, 2003; Meerman and Aphane, 2012) regardless of the efforts made by education and public health sectors to prevent obesity and overweight in the country through "smarter," "healthier" attitudes and awareness (Begley et al., 2019). The high price of food puts fresh food like fruits and vegetables at a disadvantage against long-time shelf-life products high in salts, saturated fats, and sugars.

Consumer behaviour within the context of food and drinking demand underwent significant positive change from a higher level of education, health literacy, and increased knowledge among the population (Willman-Iivarinen, 2017). The main reason is that the system's environmental situation which sets high food prices can drive individuals towards the opposite end of a healthy intention and behaviour. There is a need to meet individuals' demands through other aspects of food security, most notably affordability and accessibility, for individuals to adopt what they are aware, and conscious is beneficial and nutritious.

5.3.3.4 Opportunities and challenges

Opportunities

- The high level of education should be taken in advantage to bring closer technicalities associated with food security through the promotion and support of initiatives for example of home food growth and growing small spaces. Bridge the gap between research and civil society organisations in order to advance in policy and development of political reforms (Osei-Amponsah et al., 2006).

- Investment in education has increased the reliability of the system's collaboration with different research institutes to work closely. The academic linkages can bring opportunities to develop strategies that can ensure food security and sovereignty, and decrease the level of dependence of food imports (O'Gorman, 2018).

- The agriculture sector is one of the primary industries that the government can add to a developed, fundamental human rights act. Financial support schemes and subsidies to the sector can reduce food price volatility, gradually decreasing food prices and ensuring food security and nutritional equality (FAO, 2011).

- Collaboration between sectors in the system can ensure elements associated with nutrition equality and food security (Baer et al., 2015; Development-Initiatives, 2020).

161

Challenges

- The educational attainment of children and adolescents is gradually growing. However, there is a need to ensure strategies that include culture, social norms and internal behaviours such as self-efficacy and motivation to extend and increase positive behaviour such as prevention (Sadana et al., 2007).

- High food prices are a constant constraint for almost all socioeconomic groups that cannot pay for quality and nutritional food choices, increasing the risk through food insecurity to develop premature nutritional issues (Meerman and Aphane, 2012). There is a need to subsidize a variety of fresh, high-nutrient foods. The motion can help bridge the gap between individuals' awareness and desire to adopt healthier eating patterns and the security to do so. Efforts must be increased to address the environmental indirect defaults that undermine individuals' desire to live an active lifestyle (Friel et al., 2013; Gorski and Roberto, 2015).

- Sugar tax money should be used to financially assist and safeguard the expansion of fresh food and agriculture, which may help create employment and provide food security. Additionally, income can be used to assist with water distribution and management, such as constructing drinking fountains in educational facilities (Pan American Health Organization and WHO, 2015).

5.3.4 "No progress, constant food insecurity"

The situation illustrates the system's incapacity to be managed successfully in terms of nutrition and food choices. In addition to their poor nutritional status, the systemic issues have also affected directly and indirectly individuals' food choices, as demonstrated by their relatively poor state of overall health and lack of overall welfare (Jacka et al., 2014; Chen and Antonelli, 2020). The scenario has had a significant impact on the country's public health, increasing it and sparking disputes and socioeconomic concerns, eroding development and social welfare.

5.3.4.1 State of drivers

Table 5.8 clusters the internal and external drivers of change, from which a description is delivered to introduce the generalities and characteristics of the scenario.

Table 5.8. Mapping of the internal and external drivers under "No progress, constant food insecurity"

Internal	Individual	Sedentary lifestyle	There was an overall decrease as people are becoming ill and have reduced amounts of energy, time, and motivation. Moreover, as education has been affected, the sector that could have supported from early ages (Sierra-Díaz et al., 2019) proactive attitudes leading to behaviours among the communities to enhance physical activity is missing. Lack of support for projects that can facilitate collaboration with other sectors, as well as a lack of financial support, can result in a critical decline in physical activity (Schmid et al., 2021).

External	Social	Changing dietary patterns	The constant food insecurity has an impact on individuals' dietary patterns. Most of them suffer nutritional issues due to scarcity and rely on the most affordable and accessible food products, such as high-energy dense, low nutritional value. Food insecurity impeding and limiting individuals to make healthy food choices poses a direct danger to health, as seen by the increase of obesity, comorbidities and health risk linkages (Hashemzadeh et al., 2021).
		Gender inequalities	Gender inequalities have been a constant and continuous problem in the country that has generated a crisis of security and safety for the female population. Additionally, the female population is a weaker economic force, with an average income much lower than that of men. Low labour and education opportunities only enhance gender disparities (Heath and Jayachandran, 2017).
		Health literacy (Education)	The populace with a low education level is only informed about health and nutrition by what the public health sector communicates. Therefore, multidisciplinary transmission and orientation to lead and adopt healthier lifestyles is limited. The campaigns seem out of frame or not parallel with the "reality" of daily struggles in people's lifestyles. There is a need for multisectoral and intersectoral schemes that can improve coherence of health

			policies for increasing their effectiveness and successful implementation (WHO, 2018). Among those required interlinked sectors are health and education.
	Technological	Food Systems Technology	The country has gradually lost the innovation and technology efforts of development. The decreased effort of tech development clashes with the prevalent issues of nutrition and poor diets due to scarcities within the country's technological infrastructure and research. Moreover, the lack of technology in the food system decreases sovereignty and local/national production. The lack of technology applications, along with issues such as climate change, exacerbates food insecurity (Campbell et al., 2016).
	Environmental	Sustainable production	Nutrition is dependent upon what is accessible and affordable. Diets are unsustainable because they rely on industrialised processed foods with little nutritional value and starchy foods. Consumption of fruits and vegetables decreases and almost all protein sources remain beyond individuals' ability to afford them. Instead of promoting local consumption, the country now relies on trade bringing food from outside the country. The constant food insecurity blocks any possible autonomy or shift towards sustainable diets (Menezes, 2011).

	Economic	Volatility of prices	Crisis and monetary devaluation and uncertainty about investment are an everyday situation. Money is being hoarded in the vaults of a few, while the poorest and marginalised experience perpetual hardship and shortages because of rising food prices. The economic challenges, income losses and challenges in daily livelihoods exacerbate inflation and increase the country's financial debts, inflating food prices (Clapp and Moseley, 2020).
		Price inelasticity	There are massive issues in people's ability to purchase and access food products. The low wages only increase the demand for cheap and usually low nutritional value food and beverage products. The situation has resulted in an increase in nutritional issues and a higher economic public health burden. In addition, there is a cross-price elasticity situation in which high nutritional value food products are being substituted by high energy-dense low nutritional value food products (USDA, n.d).
	Political	Food insecurity	Food security, quality, and nutrition are jeopardised due to ineffective management and limited investment in the local agri-food business. Mexican domestic food security is highly dependent on external food production and commercial trade. Therefore, the number of FDIs in the country has increased massively, which has brought critical issues such as the exploitation of natural resources

			used for business purposes. Without government oversight and control, access to natural resources such as water is limited. Foreign direct investment exacerbates social and environmental problems (Borregaard and Dufey, 2002).
	Legal	Public health regulation	There is a resurgence of malnutrition and micronutrients deficiency, along with the pre-existent issue of obesity and overweight, which has increased the economic public health burden. Food insecurity, poor income, and a lack of available employment and education exacerbate social and economic problems, resulting in the prevalence of obesity and comorbidities (Bhurosy and Jeewon, 2014).
	Ethical	Obesogenic environment	Misuse and abusive marketing are an everyday situation without a regulation that could moderate commercial advertisements. Instead, food marketing exacerbates the population's nutritional difficulties by promoting highly addictive and inexpensive foods that individuals have everyday access to while travelling to work and school. Moreover, as there are low labour opportunities, people rely on informal food street vending. Newly open informal commerce is rapidly increasing selling food and beverages in the streets as people do not have jobs, as an extreme measure for financial aid. Additionally, there

			are no regulations or safety and hygiene procedures in place to control out breakouts of food-borne diseases. The manipulation of food marketing and the obesogenic environment only increases the demand among a population with critical socioeconomic and health challenges (Martinho, 2020).

5.3.4.2 A Day in the life of Jose

Jose is a young man in his mid-20s who works in a manufacturing company and spends more than 48 hours per week at work. As a result of financial pressure and the need for long working hours, he abandoned school at the young age of twelve (Levison et al., 2008). Despite the sacrifices his salary is insufficient to meet his daily necessities. As a result, he occasionally finds part-time work on the side of his manufacturing employment. Therefore, he mostly eats out choosing what is available and affordable. One option is to purchase food from local street vendors, as his job does not provide food to its employees throughout their work shift. He can spend up to ten hours working without having any solid food and this is when fizzy drinks become his meal and energy source. Moreover, when he finally decides to eat something, it needs to be fast and cheap. Jose's eating choices are constrained by his limited financial means, low cooking skills, and lack of time, which forces him to choose products that are inexpensive, high in calories, low in nutritional value, high in sodium and saturated fats, and low in fibre. He eventually makes his way to a convenience store, where he purchases an instant soup packet, a bag of crisps, and another fizzy drink (Long-Solís, 2007). Jose might have some basic notions of what he should be eating, but his circumstances force him to go against basic health principles, resulting in the adoption of unhealthy eating/drinking habits that have a harmful effect on his health and nutrition (Kaiser et al., 2004).

Food systems follow the "business as usual" approach. The effects that nutritional labels and the sugar tax had on individuals' demand were minimal, not because they were the wrong

initiatives but because the options delivered to society were minimal in terms of welfare opportunities including food security. The government established a food production system within a framework within which FDIs or private foreign multinational firms might proclaim and establish a base. Agriculture was neglected due to the low support in the sector and the issues associated with poor management have led to a high dependence on imported goods. The challenge increases as the country cannot handle and manage factors such as climate change with the constant floods and drought areas.

Jose struggles with stunting and lacks muscle and strength. He has high levels of triglycerides and cholesterol and a high fat percentage (Zhang et al., 2017). Additionally, he suffers from micronutrient deficiencies because of a diet deficient in high-quality food items, such as ultra-processed inexpensive goods. He has been given a warning of developing CVD due to the malnutrition modifying his cholesterol levels (Contreras et al., 2010). Currently, public health randomly selects a small group of the population that will be covered for free medical treatment as the system collapses. Jose was lucky to be chosen and was treated for six consecutive months. However, he does not trust the medical treatment that he is receiving, due to his own poor health condition (Armstrong et al., 2006). Additionally, medical treatments are not covered; it is costly, and the state, owing to the country's epidemiological crises, only increases the health burden.

On Sundays, his single free day during the week, he frequently goes out with his peers to play football. However, as the game concludes, it is customary for them to purchase beers and fast food. Evenings are often spent watching television and sleeping for fewer than five hours before his busy work week begins.

5.3.4.3 State of nutrition and diets

The triple public health burden associated with micronutrient deficiencies and undernourishment have escalated rapidly, compared to the cases of obesity and overweight. Nonetheless, obesity and overweight are still prevalent conditions due to the long-term risks associated with malnutrition and the development of metabolic syndrome (Lottenberg et al., 2007).

Diets are limited to what individuals can secure to eat, with a low level of nutrition and food insecurity. There is a higher consumption of ultra-processed food and drinking products, and low consumption of legumes, whole grains, vegetables and fruits, fibre and high in added sugars (Development-Initiatives, 2018). Food insecurity and poverty have compromised cognitive development which at the same time has compromised the country's economic and social growth (Wight et al., 2014).

5.3.4.4 Opportunities and challenges

Opportunities

- There is a need for government to support local small producers to extend the regional and local food production to ensure food security and sovereignty.

Challenges

- Poor food production systems, particularly in agriculture, increase the risk of malnutrition and obesity, hence decreasing Mexicans' life expectancy (Lee et al., 2012). Food insecurity is causing greater harm and increases the prevalence of malnutrition, stunting, obesity and overweight. Hence, it is necessary to develop robust, holistic strategic plans to gradually grow the sector and open markets that can guarantee food security locally, nationally, and internationally.

- A significant economic burden on public health can result in challenging measures that increase health inequities (Price, 1988). In other words, given the fact that the population of Mexico in this scenario is already in a vulnerable health state, privatising medical treatment can increase the number of cases and worsen the economic burden on the health system (Davari et al., 2012; Alkhamis, 2017).

- There is a need to support local food street vending to comply with safety and hygiene regulations, compromising and aggravating health with constant episodes of diarrhoea and malnutrition (Motarjemi et al., 1993), increasing diseases and compromising productivity. Simultaneously, it is critical to connect street-food vendors with small producers to improve the food options that can include fresh vegetables and fruits, low saturated fat, low salt, and no added sugars options. In addition, linkages can evolve into food hubs from which farmers can sell their products directly (Matson et al., 2013).

- The lack of technology and innovation decreases the cost/effectiveness of the developed initiatives affecting the public health services (Lipper et al., 2014), decreasing the potential of the funding/supply model (Ramponi et al., 2021) and effective epidemiological management (Budd et al., 2020).

- The low level of education reduces the possibilities of development and increases social and health inequalities triggering aspects of social conflicts, gender inequalities, insecurity and illegal migration (Darling-Hammond, 2007; Raffo et al., 2007; Zajacova and Lawrence, 2018).

- Climate change and water scarcity must be addressed through environmental, technological innovation and socioeconomic research. The efforts to reduce climate change have been demonstrated to reduce social difficulties such as poverty and inequality (Silva-Rodríguez, 2018) . The government should support collaborative efforts, as well as more money put into research and development. Lack of investment can have a detrimental effect on management and distribution, reducing the likelihood of establishing a scheme that can ultimately enhance, reinvest, and ensure an efficient water distribution system within the primary food sector (i.e. agriculture) (Pusch et al., 2005).

5.4 Discussion

The scenarios have illustrated the need for an integrated approach between different relevant sectors such as the food industry, education and public health to address the problem of eating choices and their influence on obesity prevalence in Mexico. The output drivers and their specific ranking did show that eating choices are mostly made by an individual and economic influence. Considering the selected key drivers, these are mainly associated with sociodemographic factors such as social equality, economic and labour opportunities. The reduction or absence of the mentioned opportunities can lead to challenges such as sociodemographic inequalities.

The sociodemographic discrepancies can impair an individual's quality of life and welfare. This is similar to Nisbett et al. (2022), who propose that sociodemographic inequalities like

education and affordability determine access to resources like nutritious food or safe drinking water. The lack of sociodemographic equality can increase and lead to negative internal emotions such as a constant levels of anxiety, loss of willingness or low self-efficacy. The statement is in agreement with previous studies (Knol et al. 2019; Khorramrouz et al. 2020), stating that food insecurity would decrease individuals' self-efficacy. Negative internal built attitudes can modify individuals' perceptions or knowledge of the public health or education sectors, resulting in a lower intention to engage or follow health guidelines.

The lack of actions from the government to ensure and promote clear, ethical, and transparent procedures in the food business and a lack of commitment to consumers' health and nutrition can misalign with established public health objectives. Scenarios three and four depicted the previous statement, demonstrating how positive intentions for healthier eating choices can be disrupted by a lack of resources or a misalignment between sector objectives (e.g., health, education and food sectors). In contrast, scenario two exemplified how social progress, equality, education, and welfare may result in positive attitudes such as productivity and proactiveness. Attitudes such as proactiveness and productivity can help to strengthen positive intentions and desired behaviours. In other words, food security along with a constant promotion and clarity of health initiatives can set the base for actions, that can individuals' engagement to health and nutrition. Therefore, eradicating inequality, reducing food insecurity, and expanding socioeconomic and educational possibilities are crucial if favourable health behaviours are to be achieved. The argument is supported by a previous study (Pepetone et al., 2021), which found that people in vulnerable conditions are less likely to engage in and apply health literacy in their final eating choices. In this scenario, the food sector does compromise and works along with local producers, increasing job opportunities and food security.

Finally, scenario one presents only the chance of ensuring food regardless of their nutritional quality. The scenario suggests a gap between health initiatives and food producers, and a null support from the education sector in terms of health literacy and cooking skills. Food producers' deceptive marketing methods, lack of health sector investment, and low education all together clash. As a result, despite of having a high access to nutritional food sources, their intake is low. Food industry misinformation shapes perceptions and convenience

attitudes. In parallel, the lack of cooking skills and time drives individuals' choice towards the consumption of ultra-processed and ready-made goods.

The scenarios and narratives imply that coordination between public health, education, and food production is key to prevent unhealthier eating choices. The collaboration between the proposed sectors can lead to healthy and sustainable food systems as previously suggested by Story et al., (2009). The support between these three sectors, their initiatives, and the collaborations between them can provide opportunities for positive change. At the same time, communal food insecurity issues can be reduced to prevent health and nutritional issues. The identified internal and external drivers of change can help identify pivotal links between the sectors and work through a cause-effect approach. Future individual eating choices in Mexico can be further explored through the causal-effect linkages, encompassing both the internal and external forces, and analysing their opportunities and challenges for each of the developed scenarios.

Table 5.9 summarises the final drivers from the external and internal from the narrative and its analysis to encompassed them in a systemic understanding of eating choices.

Table 5.9. Summary of the developed scenarios.

Scenario 1	Identification of external and internal drivers for all scenarios.
There are passive behaviours toward healthy lifestyle choices. Significant disconnection between the system and the sector's management makes the system opaque.	**External** - Commercial food trades - Volatility of prices - Food technologies
Scenario 2	
Proactive behaviours promoting healthy lifestyle choices. Constantly undergoing quick, drastic, and beneficial transformations.	

Between sectors, there is communication and connectivity.	- Policies and regulations from the food, health, and education sectors. - Collaboration between institutions/sectors for the obesity management. - Nutritional orientation and treatment of obesity (Community/individual). - Education system which includes innovation and research. - Social norms
Scenario 3	**Internal**
The intention is to be proactive in making healthy choices. However, it is difficult to do due largely to economic constraints. Food security is a concern.	- Subjective norms (closest social circle for the individual) Cognition
Scenario 4	- Perception - Attitudes – intention - Self-efficacy
There are evident flaws throughout the system. Individuals are disjointed. There is a high level of distrust in the administration and regulation of sectors. Political openness is absent, evoking perpetual insecurity.	- Preferences - Cognitive dissonance/Value-action gaps

5.5 Conclusion

Scenarios are an effective tool for imagining how society will evolve in the future. These exercises are intended to identify solutions that a) strengthen the system's cohesiveness and cross-disciplinary collaboration; b) avoid existing programmes from being undermined due to their ineffectiveness. The exercise provides insight into the evolution and connectivity of internal and external drivers that influence food choices and have an impact on people's health and nutrition. With the assistance of chapters 2, 3, and 4, exploratory scenarios as axes of uncertainty prove to be an excellent strategic tool for putting the drivers of change into the narratives. Scenario's study highlighted the potential and problems associated with selecting which sectors of the system require restructuring and under what circumstances. After gaining an awareness of how and what influences food choices and health behaviours, potential recommendations can be provided from an internal to an external perspective. In

order to do so it is crucial to emphasise how the internal drivers flow into the external and vice versa to understand the linkages between individuals, political actors and the different sectors in the system. Chapters 6 and 7 will provide the systemic understanding necessary to deliver potential policy implications for improving public health, education, research, agriculture, and food production to maximise their effectiveness in reducing and avoiding obesity issues.

6. Discussion

6.1 Introduction

A holistic understanding of consumer behaviour is developed in this chapter to address the study's ultimate objective of providing advice on how to minimise and/or prevent obesity in Mexico. A systemic framework of consumers' behaviours is presented as a basis for the re-evaluation and re-development of political measures. Through the framework, essential elements from established policies can be recognised to develop final recommendations that address the thesis's final objective of mitigating and preventing obesity prevalence. The built systemic path was output from the overall findings of the thesis, as shown in Chapter 1-Figure 1.3.

6.2. A systemic framework for understanding eating choices

Figure 6.1 depicts the mapping of eating choices from the overall findings, identifying interlinkages between the external and internal drivers that influence individuals' eating choices. The figure intends to visualise all the drivers mapped out, crossing between the system's environment and the individuals to understand the systemic understanding of eating choices. Each connection denotes a possible initiative represented by icons whose meanings are presented at the bottom of the figure.

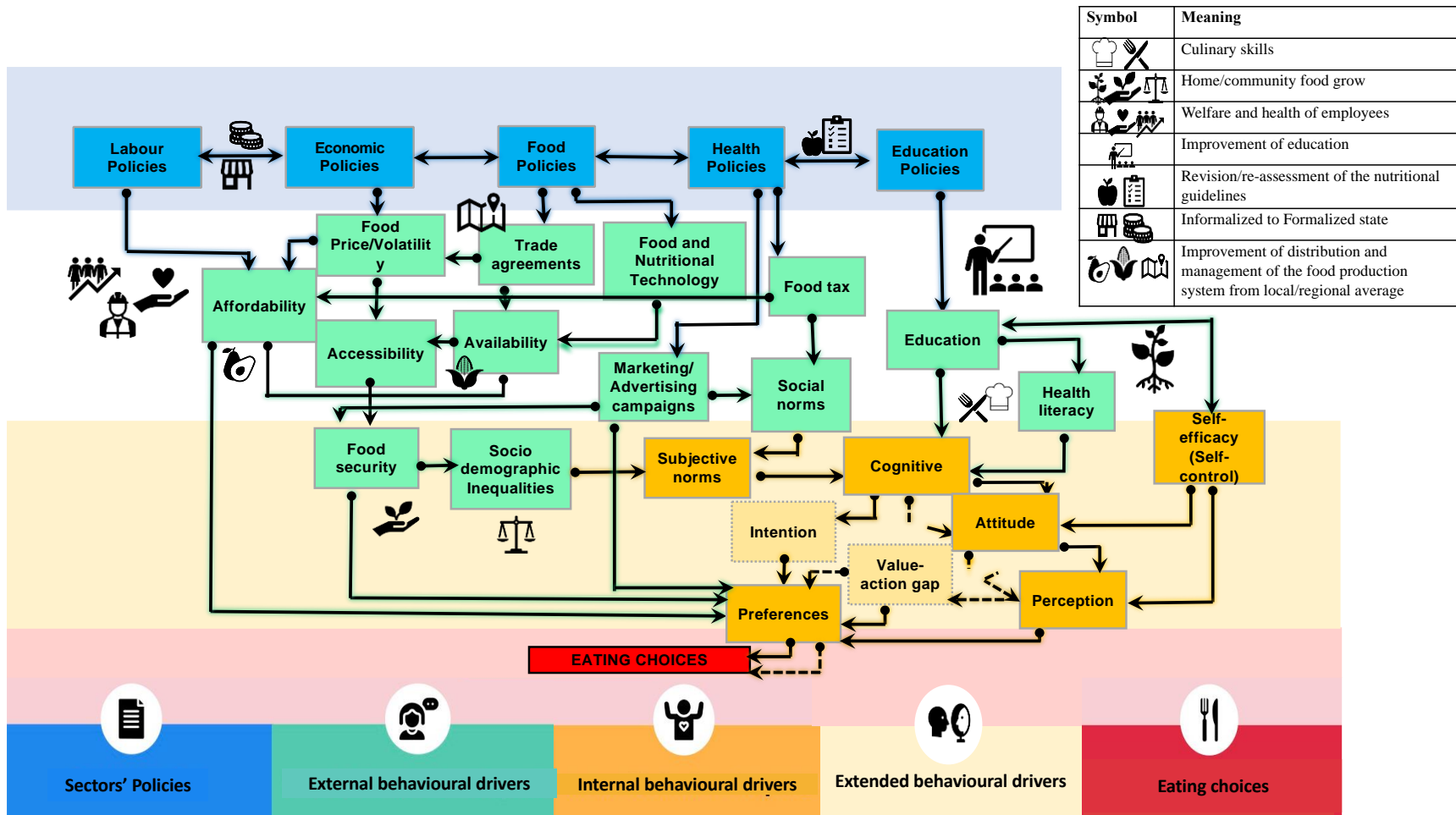| Symbol	Meaning
	Culinary skills
	Home/community food grow
	Welfare and health of employees
	Improvement of education
	Revision/re-assessment of the nutritional guidelines
	Informalized to Formalized state
	Improvement of distribution and management of the food production system from local/regional average

Figure 6.1. Systemic understanding of consumer eating behaviours.

177

The systemic understanding provides insight into which drivers should be considered when adopting measures, programmes or initiatives associated with nutrition and health, as those would influence consumer eating choices and health behaviours. The figure portrays how a systemic perspective might improve the effectiveness of sectoral policies by elucidating and evaluating the factors that individuals consider and reflect upon when making a final eating choice. From the health and nutritional context, the figure offers insight from a systemic, environmental, societal, and individual context that should be considered while addressing obesity issues.

6.2.1. Understanding internal behavioural drivers of eating choices.

Consumption behaviours are determined by a complex web of interlinked drivers that affect individuals both directly and indirectly. Numerous drivers influence eating choices, ranging from the most direct, such as societal norms or food product marketing, to the most indirect, such as food price volatility or commercial agreements such as NAFTA (Gálvez, 2018). Most of drivers have an influence on people's perceptions, preferences and final food choices. Individuals' internal behaviours, such as perceptions, attitudes, and cognition have a direct link with their dietary preferences and ultimate eating choices. The built linkages from both the internal and external drivers will manifest differently for each individual and vary according to their current circumstances. The interlinkages between the external drivers and internal behaviours of attitudes and self-efficacy can develop a strong internal conviction/intention that can lead towards the final behaviour (Chapter 3-Section 3.2). However, as previously discussed, individuals' final behaviours are not always guaranteed nor aligned with their set perceptions, attitudes, and cognition (Section 3.2.1).

Internal behavioural drivers profoundly impacted by the environment can lead individuals towards an opposite final behaviour or eating choice. For instance, an intention generated by a cognitive driver (e.g., health literacy) may not be mirrored in the final behaviour. Table 4.14 in Chapter 4 shows that most people are aware that excessive SSBs can lead to DM2 in people. Though, the likelihood of consumption of SSBs is present within a medium-high intake among individuals (Table 4.14). In addition, there were no significant differences in the likelihood of SSBs intake between gender (Tables 4.11). The results were extrapolated for the ranking space exercise in the scenario development, from which the cognition or awareness of associating SSBs excessive consumption with DM2 was ranked as low of importance and pre-determined

driver (Fig. 5.3). The reason for this is that the driver of being aware does not reflect on the final behaviours in the sampled men and women. In other words, the likelihood of SSBs consumption is inconsistent with the cognition or the gained awareness from the public health orientations/campaigns. The inconsistency does flag a cognitive dissonance regarding SSB consumption among sampled individuals, regardless of their gender.

A possible reason for this prevalent cognitive dissonance or value action gap is the fact that food industry regulations do not follow a public health agenda showing a clear disconnection between sectors that needs especial attention from the Mexican government. The projection from scenario one (Section 5.3.1) portrayed poor eating choices driven by the lack of policies to prevent misleading marketing and a step back from developed health initiatives with the revocation of SSBs taxes for a "fair" market. The scenario depict a detriment on the system to safeguard individuals' health and wellbeing, as there is no clear collaboration amongst sectors that ensures health and welfare. Individuals in the first scenario demonstrated a lack of concern for their health by making poor, undesirable meal choices that contradicted what health campaigns advocate.

In scenario four (Section 5.3.4) the problem of not implementing SSBs taxes is exacerbated as the individuals experience food insecurity, which results in negative attitudes toward sectors and their actions, such as a high level of distrust for the public health system. Negative attitudes are primarily a result of growing social discontent and a lack of opportunities and welfare. The analysis from the scenarios suggests the connection between the food industry, consumers, and health initiatives through government regulations is critical. The reason is that sectoral policies must be aligned around a shared objective: putting society's welfare and health ahead of economic/business interests. The statement is consistent with the findings of Mozaffarian et al. (2018a), who evaluated the government's involvement in encouraging nutrition and healthy eating. The authors stated that it is vital to coordinate the effect of food production and health sectors to overcome most internal and external barriers to healthy eating choices. In addition, reduction of the cognitive dissonance and value-action gap does require the suggested alignment of initiatives and the close collaboration between the sectors. This is consistent with Gallardo-López et al. (2021) study, which proposes a collaboration between sectors to redirect work toward a shared objective while minimising internal behavioural concerns such as cognitive dissonance that might sabotage a sector's efforts and progress. In other words, the health/nutrition aim can only be achieved if all sectors work together to avoid or minimise

disturbances on both the external and internal paths that could risk the effectiveness of health initiatives.

6.2.2. Understanding external behavioural drivers of eating choices.

The subjective norm was allocated as the culmination of the internal drivers, extending outward to the external drivers. It is important to highlight that the subjective norms are still a close driver to the individual position, as these are influences from family members, partners, friends (Section 3.2). Its first link with the external drivers is through the established social norms from the individuals' environment, which can or not influence their internal behavioural drivers. The social connection considers the sociodemographic factors (e.g., age, gender, economic status, education level) that determine an individual's societal description role and position in society. It is in this element of individuals role in society that sociodemographic inequalities were considered as a critical driver of influence of eating choices. That is because social inequality driver has the potential to undermined initiatives and reduce positive impact to ensure health and nutrition. Moreover, it considered the gender inequality, which throughout the thesis has been shown as a main driver of obesity prevalence among women in Mexico (Sections 1.1, 2.3.1, 4.4, 5.4). From the sociodemographic inequality that can influence eating choices, there are two separate yet associated paths: one is education, and the other one is food security. The education sector considers the cognitive drivers such as health literacy, which are connected with the internal drivers of self-efficacy and can, in some cases, influence perceptions and attitudes (Section 3.3.1). Furthermore, education provides a socioeconomic opportunity and can broaden knowledge, which can boost self-efficacy (Section 3.3.4).

However, as also mentioned, self-efficacy can be limited and can be diminished by other external drivers such as misleading marketing and internal drivers such as cognitive dissonance and value action gaps (Section 3.3.5). Nevertheless, it is important to consider education as an environmental driver that plays an important role in building individuals' knowledge and perceptions and gives a higher opportunity from a socio-economic perspective to proxy healthier eating choices. The statement is in agreement with Azizi et al. (2021), which confirmed the association between education and healthier diets with nutritional diversity and low caloric intake in the UK population. This is how the education driver is considered as an asset for knowledge, positive attitudes (self-efficacy), increase of labour, capital opportunities and reduction of social inequality that can be connected with food security and its considered pillars of affordability, accessibility and availability (Sections 4.4.5.1 and 5.4). Food access

and power of purchase can be reachable considering other connections such as commercial food trades and stable economy (Sections 2.3.3, 2.3.5). In addition, the food security connections with industry initiatives included the SSBs tax and marketing. These last two drivers showed a key influential path that needs to be transparent and clear within the internal processes of the food companies and must be monitored and regulated by the government. Some processes include the food nutritional technology (i.e., product's formulations) and their presentation to the consumers (i.e., nutritional labels, advertisement/marketing) (Sections 2.3.6, 3.3.3, 4.5, 5.4).

Overall, the systemic understanding included the sectors of education, health, food interlinked when trying to identify what drives eating choices. Finally, two additional areas were included in the system's structure: labour and economic policies. That is because policies emanating from those sectors continue to exert control over the system's administration and dictate what other sectors may and cannot do. In addition, both labour and economic situations condition the country's growth and development (GDP, GNP, GNI) critical for measuring and assessing the country's health and welfare from a global perspective. The suggestion is consistent with previous study suggesting to view economic measures such as GDP as a welfare evaluation, from which data can deliver critical input to improve the system (Dynan and Sheiner, 2018).

6.2.3 Understanding of the connection between the internal and external behavioural drivers of eating choices.

One pivotal factor that shapes perceptions, cognition and attitudes is social norms (Higgs, 2015). It is easy to see that individuals are being influenced, particularly if there is a high level of uncertainty (including low self-efficacy) or low awareness of what constitutes a positive behaviour (Higgs, 2015; Higgs and Thomas, 2016). Low health awareness or uncertainties can be the consequence of a disconnection between two environmental drivers a) level of education and health literacy (Wijayaratne et al., 2018); and b) food marketing and advertisement campaigns. Throughout this thesis the benefits of education to society have been explored. In fact, its association with the internal behaviour of self-efficacy does show a positive attitude, enhancing the preference for healthier choices (Sections 3.3.1 and 3.3.2). This statement is consistent with Wijayaratne et al. (2018), among Australian population, which dietary gatekeepers program (i.e., those who buy and prepare food at home) showed positive associations between the level of education with healthier food choices and cooking skills. Hence, behaviours can improve with an increment of education, health and food literacy. The

suggestion should not be diminished as findings did show a significant difference in the education level between genders and their state of nutrition (Tables 4.3, 4.6 and 4.7).

Furthermore, education boosts self-efficacy (i.e., the confidence in oneself to achieve something), which in parallel can increase an individual's proactiveness to decrease sedentary lifestyles or make healthier eating choices. By not enforcing, guaranteeing, and improving education, society can develop a persistent attitude of low self-efficacy or unawareness, which increases uncertainty towards a specific eating choice, leaving easy access to ultra-processed food and beverage marketing to influence, manipulate, or mislead consumers' decisions. The improvement of education needs to be supported by the public health sector. That is because these two sectors can work together towards a common goal of health awareness and skills development (e.g., cooking skills), which can mitigate food marketing's negative influences on perceptions, preferences, and final eating choices. The Mexican government needs to set the proper regulations to prevent and avoid food industry's unethical practices towards consumers. Unethical practices include resistance to health initiatives (such as the tax on SSBs) or implementing "health", "informative" measures without any assessment by the public health sector. An example was the creation and implementation of the GDA by the food industry, without intermediaries that could monitor or assess the measure. The prevention of actions such as the ones mentioned above, is critical as it can reduce any deceptiveness and/or ambiguity of food policies on consumers (Sections 2.3.6, 4.4.5).

Furthermore, the ranking of drivers (Section 5.2.2) showed the low importance, yet high uncertainty of the driver "social media influence on dietary patterns." As previously stated (Table 5.3), the government must keep the uncertainty around this driver in account when implementing health measures, as it has a substantial impact on the younger Mexican population. That is mainly because the food industry can use the driver as marketing, from which unethical and misleading information can target the younger population enhancing poor and unhealthy eating choices. The statement is consistent with the study by Chung et al. (2021) of UK adolescents aged 10 to 19, which showed that social media had a detrimental influence on behaviour, particularly encouraging unhealthy eating practices (e.g., high consumption of low nutritional food value products or following extreme or harmful measures on diets). In contrast, Holmberg et al. (2016) study of Swedish adolescents found that social media could become a positive asset to improve self-efficacy and eating choice behaviours. As a result, social media platforms must be monitored and regulated to maintain a healthy balance of their influence on behaviours and food choices.

Concentrating on the relationship between food, the economy, and labour productivity that promote health, efforts should be made across sectors to ensure food security. One main target should be the re-evaluation of what and where it is invested, how it is managed and distributed. Investment for example in the agriculture and fishery sectors can ensure the availability, accessibility and affordability of high quality and nutritional products at a national and international level.

The second scenario (Section 5.3.2) illustrates how society can work together to achieve important and shared goals to improve social issues such as gender inequality and promote health prevention. However, to establish and promote health prevention, it is necessary to reduce the current gaps between society, the public health sector, and the food production sectors of processed food. In addition, it is essential to strengthen and develop more active ties between the education and public health sectors. The environment or external drivers then can lead to positive changes among society such as increasing healthier eating choices. To make scenario two a possibility there is a high need to improve and support food sectors, which have been neglected or poorly sustained such as agriculture (Section 2.3.5). The results can lead to an improvement of pivotal issues such as health/nutrition, sociodemographic inequalities, and food insecurity. The statement goes in agreement with Burden and Fujita (2019) study from the fishery sector, which suggested that improving the sector's management can contribute to a reduction of conflict over resources use and inequalities while opening new opportunities to sectors that can contribute to achieving healthy diets and food security.

Working in the food sector can also ensure a production for a self-consumption while improving eating behaviours. However, the persistent food insecurity described in the narrative developed in the third scenario (Section 5.3.3) demonstrated that people experiencing constant food insecurity can find it challenging to make healthy eating choices. Hence, it is vital for the Mexican government to rationalise on what can bring not only economic or commercial gains, but what can bring welfare, health and opportunities to society.

The Mexican government needs to regulate and guarantee the protection of the environment and natural resources and the effects of climate change. Climate change's effects on Mexico's and the world's food systems provide high health and food security challenges that must be addressed. The statement is consistent with Braun et al. (2008), who examined global climate change and growing food costs and forecasted significant consequences, particularly in

developing nations, including a rise in poverty and health problems, as well as a declining effect of efforts to assure food security.

Because of the current challenges that can enhance poverty and malnutrition, essential systemic connections must be developed and reinforced between the food sector, the economy (including commerce and trades), and education (including research and technology/innovation). That is congruent with a previous study (Cole et al., 2018), which examined global food production systems and advocated for the use of technology and research to evolve the system in a social, health, and market context. Additionally, the suggestion is consistent with Anderson and Cook (1998) study of global food systems, which advocated sectoral alignment to develop a framework that benefits individuals, communities, the environment, and social and health fairness.

6.3 Potential policy recommendations.

As presented in the systemic understanding, the path depicts different icons at the bottom, suggesting what political recommendations can be structured and incorporated to improve and boost positive eating choices and behaviours. The explanation of the political recommendations was segregated into three categories considering the pivotal sectors in Figure 6.1 a) the food system, b) education, and c) public health.

6.3.1 Potential policies in the food system.

For food insecurity, which endangers people's health, well-being, and social equality, potential policies that might influence better eating choices and health outcomes for consumers are detailed below.

6.3.1.1 Food security through re-assessment of established collaborations.

There is a need to ensure local, regional, and national food security through the improvement of food investment, management, and distribution. The aim is to improve nutrition and quality while also enhancing the impact of social aspects such as equality and human rights. This is consistent with a recent global review (Smyth et al., 2021) of food security, which intends to build sectoral initiatives that can incentivize economic and non-economic actors. The latter consider, for example, research conducted by institutions of environment, social science, technology, and engineering, among others. The benefits can include ensuring food security and social development. They can also include nutritional and quality characteristics that contribute to and improve the current CONEVAL-established Basic Food Basket (Section

1.2.5) through better management and integration of non-food sectors into the food production system. The purpose is to identify and eliminate constraints and improve the food basket's quality, variety, and nutritional value at an affordable price, while also making it accessible and affordable in rural and urban areas. The pivotal elements of this strategy start from support/investment in the local production, management and balanced distribution, to guarantee food security, quality of diets and nutrition (Bilali et al., 2019).

Some advantages are:
- o Ensuring national food security and aid for vulnerable populations facing economic challenges and a constant nutritional deficiency.
- o Identifying and monitoring food production requirements in various regions.
- o Implementing strategy that can adopt a more sustainable approach that brings social and economic balance and, most importantly, respect the human right to health and food security (Anamuri, 2005).
- o Mitigating financial constraints through the participation, collaboration, and technical assistance of large producing enterprises, while simultaneously developing and generating social/economic and growth opportunities.

The disadvantages or rebound effects of these measures could be:
- o Not being able to fulfil food production requirements in certain localities or regions due to a lack of support and investment for its proper management and implementation.
- o Poor participation or support of measures from local authorities.
- o Ineffective strategy from which only a few would benefit, thereby increasing inequality.

Hence, it is recommended that organisations such as CONEVAL through the Food Basic Basket and DICONSA establish a closer link with both the Agriculture, Livestock, and Fishing Secretariat (SAGARPA) and the Secretariat of Economy. The inclusion of the Employers' Confederation of the Mexican Republic (COPARMEX) and the Communication Council Voice of Businesses can be considered to work in collaboration to identify average local productions and design a strategy. The collaboration should also include participation from universities and different research areas (e.g., agriculture, technology and innovation, ocean life studies, administration, economy, production systems, law, and regulation experts). The

measure can be linked to other strategies such as the one aiming to develop community and regional food production projects.

6.3.1.2 Community/regional food production projects.

The expected benefits can be made through programmes such as SEDEREC (Section 2.3.6), which allows individuals in rural and urban areas to get financial and technical assistance to start food production. In urban areas, the programme must establish a foundation for the practice's expansion. Additionally, the programme would require technical support (i.e., manuals, consultants, general training) and resources (i.e., seeds, water distribution, pest management, and plant diseases). The provision of technical assistance and resources can be set through an agreement with a large private producer. A periodic monitoring strategy can provide corrective actions that enable the measure's continuity, improvement, and expansion.

The advantages or potential benefits from the measure include:
- Addressing financial pressures and concerns about obesity and malnutrition by reducing food insecurity (Galhena et al., 2013).
- Ensure the supply of wholesome and nutritious food that is sourced locally and sustainably (Appendini and Quijada, 2016).
- Provide school meals and community kitchen programmes to ensure that primary school meal suppliers are local and of high quality.
- Involve students and young generations, particularly in urban areas, raising awareness and developing perceptions around food production.
- Prevent social issues such as gender inequalities through the inclusion of women and girls in the practice of food growth production (Galhena et al., 2013).
- Extend sustainable measures that raise people's knowledge and influence their eating choices on a holistic level (Sofo and Sofo, 2020) without food limitations. In other words, improve individuals' daily lifestyle, which can lead them to potential positive behavioural changes (Sadighi et al., 2014).

The disadvantages or rebound effects of these measures could be:
- Inefficient resource allocation, such as water, or financial issues that limit the practice and exacerbate food scarcity and health inequality.
- Rejection or reluctance from the big industrial food producers to collaborate in the measure.

- o Low involvement and lack of interest from society.

- o No progress in other aspects of individuals' lifestyles such as improvement and increase of labour opportunities.

Considering both the advantages and disadvantages, institutions involved in social development must engage closely with food sector secretariats such as the Rural Development and Equity for Communities (SEDEREC) and the Agriculture, Livestock, and Fishery Secretariat (SAGARPA). Private large producers can support the government in implementing technical guidance and supply in-kind resources. In addition, the work would require a close strategic plan with the Water Commission (CEA), Secretariat of Education (SEP) and research institutes to support innovative, robust, and sustainable distribution systems. The National Council for the Evaluation of Social Development Policy (CONEVAL) and public health can monitor and assess the practices and management to inform and set guidelines and standards for improvement.

6.3.1.3 Formalisation of food-street vending businesses

Inclusion and formalisation of food street vendors is critical in Mexico. One reason is that vendors present an ongoing danger of injury and unsafe working conditions (Martínez-Luis et al., 2019). Moreover, the sociodemographic elements of education, health services and housing remain difficult to achieve without a fixed salary or outside the system's social and healthcare benefits reflecting social inequality (Martínez-Luis et al., 2019).

By reducing the ease of access to fast food and SSBs, the strategy can contribute to mitigate obesity. The measure may have the potential to encourage individuals and sectors, such as health and education, to collaborate on sustainable business models for vendors, such as food growing or the provision of cooking and selling spaces within formal communal dining areas. Moreover, it offers the opportunity to establish a formal business that can gradually expand and enables gradual financial insurance. With health and financial difficulties cited as reasons for leaving education, the legislation provides a means of reducing school drop-out. Individuals can expand their social and economic prospects, which can aid in the expansion and growth of their businesses. The potential effects of the strategy can enhance sustainable development, increase equality and protection of human rights (OECD, 2002).

Some advantages from the potential policies are:

- o Handling subsidies to support street vendors to expand and grow without limitations, while conserving "business autonomy" and enhancing business growth and entrepreneurship (Zylfijaj et al., 2020).
- o Increase the country's GDP and contribute to national economic growth through the expansion of fiscal contribution (Delechat and Medina, 2020).
- o Give those in precarious situations the opportunity to receive health attention and benefits by legally registering with the national social care health institute (IMSS) and receiving aid and guidance to start or re-enter education (Martínez-Luis et al., 2019; Delechat and Medina, 2020).
- o Decrease the obesogenic selling points and misleading marketing. Reduces the possibility of food-borne diseases and possibly points of infection or outbreaks (Njaya, 2014).

The possible disadvantages are:

- o Reluctancy or a low interest/participation to economically formalize or adopt new measures (i.e., responsibilities), despite the legal benefits that can be obtained (Anjaria, 2006; Batreau and Bonnet, 2016).
- o Disagreement, conflict, and reluctance by some actors in the food industry or sectorial leaders to close their possibility to expand their selling points.

The success of such initiatives would require collaboration among the economic secretariat and social development secretariat. The set initiatives required the inclusion in parallel of the labour, education, and health sectors, to ensure sociodemographic equality from a gender and health perspectives, boost of health literacy and economic opportunities. Moreover, the initiatives can expand food systems in Mexico to breach gaps between the sector, employees, collaborators, and consumers. That way, it can guarantee an alignment with other sectors' initiatives, such as the health sector, preventing any possible segregation or clash between their initiatives.

6.3.2 Potential policies in the education sector.

The outcome of poor eating choices and behaviours with a poor understanding and comprehension of health effects reflects the need to enhance understanding through the curriculum taught in early years and vocational training institutions. Moreover, improving the

education system can lead to technological research support essential for the development of effective initiatives.

6.3.2.1 Improvement of the Education system in Mexico.

Education should be prioritised in Mexico to give individuals the means to improve their wellbeing, increase economic and professional development, and promote social/gender equality.

The set of established measures require objectives that can support individuals regardless of their gender, which must become a top priority for the government. After completing basic education, the offer should be expanded to include free education at vocational training institutions or technical schools in urban and rural areas. The offer should be unconditional and appropriate to the needs and lifestyle of individuals using information and communication technologies (ICT). Additionally, the strategy seeks to prevent abandonment due to financial pressures.

The benefits from the measure are to develop strategies to address the country's low level of education (Pont and Montt, 2013), while at the same time mitigating health issues such as obesity. Education's primary goal is to balance and improve equity (e.g., in labour and wealth) within society, particularly across the female Mexican population. In addition, the significant difference found in term of education and obesity between genders (Sections 4.4.3 and 4.5) does suggest the importance of protecting and enhancing women's right to complete their education. This suggestion is similar to one made in a Korean study (Chung and Lim, 2020), which found that women with a greater degree of education had a lower prevalence of obesity than women with a lower level of education. Education provides an opportunity for individuals to expand their knowledge and understanding of health. Additionally, education can be beneficial as a means of personal development and self-efficacy. Education delivers the potential to enhance and broaden individuals' views and attitudes, allowing them to make more sustainable choices and adopt them as dietary behaviours. This is consistent with Kapelari et al. (2020) study of the European population which suggested that both formal and informal education can be crucial in enhancing informed eating choices. Through health literacy and self-efficacy, education can help prevent and lessen the occurrences of cognitive dissonance or value-action gaps in individuals' eating choices.

Some advantages for improving the education system are:

- o Increase sociodemographic equality and opportunities for prosperity and health.
- o Enhance individuals' self-efficacy and food security, decreasing social/economic limitations or barriers that block or reduce the adoption of healthier behaviours.
- o Increase, or and develop new competencies, training, and skills, to promote continuous improvement within a professional and personal context.
- o Stimulate critical advances in technology and innovation for solutions to pre-existing challenges and preventing, mitigating those expected in the future.

The disadvantages or rebound effects of these measures could be:

- o Increased abandonment, lower percentage of graduates.
- o Inadequate technology and innovation, which can result in failures and a limited range in reaching populations in urban and rural areas.
- o The absence of measures that allow participation by individuals with special needs (e.g., pregnant women, mothers, individuals with financial pressures) that increase abandonment and exacerbate social, gender, and economic disparities.
- o Impacts social inequalities, which can lead to low self-efficacy and increase susceptibility factors that make it more likely that someone will have poor health and nutrition.

The government needs to reassess how education is delivered if aiming its contribution to improving social equality and increment development. Civil society participation is critical and required in planning the curriculum and managing education processes. The strategy requires a focus on ensuring standards and delivering a more equitable distribution of education to address future nation-state challenges (Serdyukov, 2017).

6.3.2.2. Set the importance of teaching children cooking skills from a young age.

Cooking skills is critical from a young age to start developing skills and proactiveness to ensure healthier eating choices that can follow scholars through adulthood (Sections 3.3.6, 3.4, 3.5, 4.5, 5.3.1.2, 5.3.1.4). The initiative seeks to make young scholars aware of how critical it is to aim for food quality, nutrition and sustainable practices when preparing food. The strategy can be integrated into the school programme or curricula, which can teach students not only nutrition concepts but also cooking skills.

The policy's benefits can be used to expand Mexico's approach to school meals, not just to combat food insecurity but also to educate children about the process of food production. Additionally, the programme's approach should emphasize developing an awareness and understanding of nutritional, high-quality meals. The concept stems from the need to enhance critical daily domestic skills to improve individuals' quality of life. Technically and psychologically, instruction must be levelled.

Identified advantages from the strategy are:

- o Reduce misperceptions such as "convenience" of spending less time cooking, which is gradually increasing in the youngest generations (Pendergast and Dewhurst, 2012).
- o Increase the importance of domestic roles and prevent gender disparities (Pendergast and Dewhurst, 2012).
- o Enhance capacity to broaden one's dietary options and cultivate better habits over time (Hartmann et al., 2013).

The disadvantages can be:

- o Risks associated with cooking such as working with cutting instruments or fire for the little scholars, non-equal distribution of resources or small/insufficient premises to implement the strategy in schools.
- o If procedures and resources are not dispersed and properly managed, staff and students can become overburdened.
- o The lack of a proper level of organisation, leadership, and teamwork from directors can lead to a failed strategy, which can result in passive attitudes and high dependence on the government's actions. Blocking the possibility of proactive behaviours.

The strategy should be implemented at the primary and secondary levels of basic education. Thus, it plays a critical role in moulding young people's abilities throughout adolescence and adulthood. Additionally, food security is important for a population that has not yet defined its eating patterns and health behaviours, as well as its abilities, such as cooking. Establishing and enhancing proactive and autonomous actions that promote and ensure high-quality food production and distribution within communities can help to integrate the strategy with sustainable measures and local production.

6.3.3 Potential policies in the health sector.

The consequences of poor eating habits and a reduced reliance on public health guidelines require a rigorous review of strategies that re-engage patients to adopt healthier habits. A strategy to start is with the nutritional orientation standard (i.e., Norm-043-SSA2-2012) (Section 1.2.2), from which other extensions can be developed that connect with other sectors such as education and the food industry.

6.3.3.1 Modification and improvement of Mexican Health Secretariat Norm-043.

Modifications of the norm or standard aims to increase public awareness and understanding about health. Additionally, strengthen its influence and reduce individuals' uncertainty regarding nutritional orientations provided by the public health system and nutritional counselling (Sections 4.4.5.2, 4.4.5.3, 4.5, 5.2.2, 5.4).

Improve the effectiveness of the health and nutritional guidelines' language to increase health awareness and comprehension. The material offered by the standard should comprise the most recent scientific information presented in a pragmatic scheme. There needs to be a clear, concrete, and understandable form. Furthermore, the information presented must explain health strategies linked to other policies such as food system and education. The linkage can expand individual awareness that can lead to greater acceptance of initiatives and adoption of healthier eating choices (Magni et al., 2017).

The collection of scientific information should include individuals' behaviours to amplify and identify critical elements that can improve the link between behaviours, diets and health (Shahid and Bishop, 2019). The guideline must consider and recognize consumer heterogeneity. The recognition of people to the guidance can impact individuals' behaviours both positively and negatively. For example, it can increase reliance on the guideline or expand misperceptions or a lack of understanding (Lenoir-Wijnkoop et al., 2011; Mozaffarian et al., 2018b; Shahid and Bishop, 2019). The Norm-043 should include a section outlining the strategies and partnerships implemented in conjunction with the food industry to provide nutritious and high-quality food. Additionally, an extension and link with the new reform in Norm- 051-SCFI/SSA1-2020 (Section 2.3.6) could help highlight the importance of the newly developed nutritional label information (i.e., warning black labels) in bridging health with the food industry. The measure can be accomplish through efforts that ensure consumers' comprehension of a product's nutritional value, improving their eating choices through information. The extension of the norm can also incorporate a combination of text and visual

designs. This finding is consistent with a prior study (Clarke et al., 2020), which found that combining text and visual graphs (e.g., pictures, drawings, figures) increases the potential of strategies by improving knowledge, attention, and clarification of the initiative's objective.

Additionally, the standard should include a part that promotes health equity by emphasising critical sociodemographic factors such as education, employment, gender, and income opportunities. Establishing these links creates a framework to promote the connection between health and social elements, which will support consumers, particularly those living in precarious situations, to improve their conditions (Sections 4.4, 4.5, 5.3.2, 5.3.4, 5.4). Some of the output benefits from the framework can include support for individuals who want to operate in the food production sector, particularly women. The framework can facilitate the process of extending to an alignment between sectors (Muller et al., 2009). An extension of the norm should be delivered using information and communication technology (ICT). Its objective would be to expand information distribution through virtual and interactive platforms that can further explain nutritional visualisation like the eat well plate and include recipes for all age groups. In addition, the menus and recipes can be distributed by SMS text, social media, newspapers, television, and radio. Guidance should include a new section of the effects of food consumption on climate. It can be portrayed with images of which type of food impacts the environment. It can also include awareness about the risks of food loss and food waste to raise knowledge and consciousness.

Advantages from the strategy are:
- o A starting point for reforms, using relevant and assertive data, that provide consumers with a health-related information and creates opportunities for knowledge sharing between the health industry and the public.
- o Positive, healthier behaviours might emerge as a willingness to adopt public health recommendations, which can, in turn, minimise unhealthy cognitive dissonance or value action gaps.
- o The awareness and adoption of healthier practices can enhance individuals' self-efficacy leading to an increment of self-care (Reisi et al., 2016).

Building consumer knowledge and awareness of the health impacts of their eating choices/behaviours could lead over time to systemic improvements that increase health equity and build trust in the public health sector.

The possible disadvantages are:

- o Possible increase of discomfort and backlash due to loss of profits from the private companies whose products are mentioned as containing substances which have and cause unhealthy behaviours.
- o Company-led marketing that could undermine public health campaigns and discredit the public health sector, which can reduce the possibilities of an alignment between the two sectors (i.e., public health and food producers).
- o There can in the first instance be reluctance and confusion particularly among "loyal" consumers.

The modification of the norms in the first instance should aim at expanding individuals' knowledge of health literacy through closer approaches that can bring back people's reliance on the sector (Sections 4.5, 5.3.4, 5.4). Moreover, the initiative should also instil a sense of care, trust, and equality through assertive communication, through which individuals can perceive and create positive perceptions and attitudes that can lead them to adopt health recommendations in their daily lifestyles. Additionally, the initiative may provide a chance for sectors such as public health to re-organise and manage and set new multidisciplinary collaborations. The new collaborations can initiate a necessary dialogue between sectors such the food industry to develop transparent policies to work towards a common objective of providing healthier, higher-quality food.

6.3.3.2 Welfare and health for employees

The strategy of welfare and health for employees seeks to include within the labour law a responsibility for private companies to ensure a safe and healthy workplace. The health strategies would be presented annually, monitored and assessed by the public health authorities. Among the developed solutions should be an activity-permissive period of 3-5 minutes to stand and move every 30 minutes, and/or 5-10 minutes to stand and move every 45-60 minutes, particularly in long-hour job sitting situations.

This will encourage employers and employees to embrace healthier lives while reducing sedentary behaviour (CDC, 2016). For example, the effect of a short break of 1-3 minutes every 30 minutes reduced sedentary behaviour by approximately 36 minutes during the workday per week over an 8 weeks period (Mailey et al., 2016).

The employees' physical and emotional health conditions are predicted to improve. In other words, the method seeks to have a beneficial effect on an individual direct/internal behaviour backed by an environmental influence (i.e., a labour health strategy). The benefits can be reflected gradually with a reduction of daily sedentary behaviours (Sections 1.2, 2.3.1, 2.3.3, 4.5, 4.7, 5.2, 5.3.1, 5.3.4). The health improvements can include weight, waist and comorbidities reduction, prevention and mitigation of cardiometabolic diseases, hypertension, dyslipidaemias, cholesterol, insulin sensitivity (Thorp et al., 2012; De Jong et al., 2018). Additionally, significant benefits include the reduction of pain in various physical body regions (e.g., neck, shoulders, upper and lower back, elbows, knees, foot, and ankles) (Mailey et al., 2016; Daneshmandi et al., 2017). The benefits from a mental level include reduction of depressive mood, prevention of concentration losses, improvements in cognitive performance (Wollseiffen et al., 2016).

Some advantages include:
- Improved health can result in increased production and reduced absenteeism, benefiting both individuals and businesses (Taylor et al., 2013; Wollseiffen et al., 2016).
- Healthier productive times can lead to higher salary and/or periodic staff bonuses, translated into socioeconomic gains.
- Less stress and improvements in the mood of individuals (Wollseiffen et al., 2016).
- Higher health awareness and change to healthier behaviours (e.g., reduction of sedentary behaviours) (Taylor et al., 2013).

The possible disadvantages are:
- Reluctance from some companies to adopt an additional social responsibility due to prioritising previous environmental and economic responsibilities.
- Emerging difficulties in implementing the measure due to limited space, lengthy breaks necessitating a higher level of supervision, a lack of organisation, and lack of business procedures.

The reforms to the labour law should work in parallel with the public health sector to assess and monitor the implemented strategies.

Chapter 7. Synthesis and conclusion

7.1 Introduction

The chapter aims to synthesise and summarise key themes and recommendations emerging from the research. Limitations encountered during the research process are also discussed. Finally, the contributions to knowledge from the theoretical and methodological perspective are summarised, pointing the way forward for future research into eating choices and health behaviours in the context of obesity.

The research proposed the following objectives and the new insight were as follows:

1. To determine a range of external drivers that affect health-related behaviour and can lead to obesity.

To determine gaps from a broader spectrum of external drivers leading to obesity, these were examined and associated with two primary environmental issues: food insecurity and nutritional transition. The first external factor identified was food insecurity, exacerbated by low wages, expensive fresh food, high access to ultra-processed food, ineffective food and nutritional aid programs, and the absence of transparent policies within the industrial food system. The second external factor strongly associated with food insecurity was the nutritional transition, characterised by the gradual decrease in the consumption of fresh and nutrient-dense foods, modification of traditional diets, and the absence of clear dietary recommendations by food producers. As a health issue, obesity increased the economic burden on public health due to premature diseases and deaths, missed working days, and an increase of health issues associated with overweight and obesity every year among children and adults.

2. To identify the behavioural factors leading to obesity, considering both internal and external drivers of change that influence eating choices and health behaviours and impact on nutrition in Mexico.

The STEEPLE framework guided and identified the analysis of macroenvironmental factors, and survey data analysis from a Mexican sample was used to corroborate and expand the identification of influences on eating choices and health behaviours. From the framework it was understood and output several environmental drivers that have progressively influence eating choices and health behaviours. Some of them were associated with social and gender

inequalities that have led, for example, to a higher prevalence of obesity in women comparable with other similar developing countries. Other macroenvironmental drivers were associated with food insecurity exacerbated by political agreements which reduce the access of nutritional and high quality of food products. The political decisions led to changes in internal behaviours such as perceptions, attitudes, and cognition, resulting in unhealthy eating choices. For example, the young Mexican population was exposed to harmful marketing and had convenient access to unhealthy street food vending, which they favoured to save time. In addition, the absence of regulations to standardise and improve the clarity of nutritional information on food packages decreased the likelihood of informing the population to promote a culture of informed, healthy food decision-making.

3. To develop alternative scenarios that explore future changes in diets, eating choices and health behaviours and the implications for policy interventions to address obesity in Mexico.

The future of eating choices and health behaviours led to four different scenarios from which policy implications would require an integrated and collaborative working scheme from the public health, food production, and education sectors. The policy implications considered equality among different sociodemographic elements such as gender, education and labour to increase individuals' well-being and health. Opportunities in education, labour, and fair salaries for both genders play an essential role in obesity prevention. The developed actions, initiatives, and policies centred on continuously enhancing the system from the perspective of the well-being and health of individuals can result in greater food security and social and economic prosperity. In the absence of an integrated and collaborative system, the interventions and policies of each sector may clash constantly and be ineffective. The resulting problems (such as political conflict and ineffectiveness) may include a constant social and economic struggle and a decrease in health and life expectancy, especially for those with a social economic disadvantage. In addition, the national public health sector will increase in cost over time.

4. To inform policy makers of suggestions that support and provide advice on how to minimise and/or prevent obesity in Mexico.

The initiatives and recommendations proposed to enhance collaboration between the education, food production, and health sectors are intended to establish a single, unified disease prevention objective. Based on this objective, the education system recommends promoting

activities that can improve individuals' cooking skills, beginning at a younger age and extending the initiative to the younger adult population. The programme can be integrated with the agriculture sector by promoting, supporting, and developing urban food-producing areas that are accessible to the public. The measure has the potential to increase domestic production and consumption.

In addition, it was suggested that the food industry and public health sectors work more closely together to protect consumer health and ensure the quality and nutrition of food products. The food sector should focus on a strategy that considers both health and climate change to progress as an industry and establish new positive relationships with consumers. Doing so can increase the benefits for both the industry and consumers. Governments should support and reinforce public health programmes at all times. Health campaigns that are part of schools' practical modules can help people feel more confident in their abilities and reduce cognitive dissonance and value-action gaps. The improvements from a behavioural perspective can protect vulnerable individuals (e.g., young population, low socioeconomic groups, low education sector) against misleading marketing and strengthen consumers' power of choice.

7.2 Systemic understanding of eating choices and health behaviours

Eating choices are influenced by both internal and external drivers which surround the individual. These drivers can become more easily controlled, accessible, or simply closer to the individuals and are typically associated with social, subjective norms, health literacy and cognition, which highly influence the relationship between eating choice and health behaviours. However, health literacy-influence to perceptions do not always convert into healthier eating choices or behaviours. One reason can be a stronger influence of the closer social group (i.e., subjective norms), environment, an industry, or a sectors' policy that impact the individual's lifestyle. Another reason can be associated with food insecurity, which makes individuals' eating choices recommended by health professional unattainable.

The lack of **food security** can drastically limit an individual's ability to make healthier eating choices. Socioeconomic limitations can lead to cognitive dissonance or value action gaps reflected on the individual health behaviour. Moreover, **socioeconomic inequalities** do have a critical role in shaping eating choices, especially among the female population in Mexico, because women's income and education levels are often lower than men's, compounding the problem of food insecurity and positioning women as a vulnerable group confronted with, for example, limited grocery budgets.

Economic constraints and **gender inequality** have a significant impact on individuals' eating habits and attitudes. The impact on attitudes can lead to dietary dissatisfaction and a constant decrease in self-efficacy. Furthermore, the inequality and vulnerability experienced by Mexican women reflect a system that does not always work in their favour in terms of improving their health and well-being. Thus, what drives obesity in Mexico must be understood not exclusively on individuals' behaviours or eating choices but also in the influence and impact of environmental factors such as social, economic and gender inequalities.

Outputs from this thesis suggest addressing policy gaps and counteracting sector-specific strategies to identify and tackle what increases food insecurity and/or misleads eating choices, particularly among vulnerable individuals (e.g., the younger population and women with limited budgets). Among those gaps is the need for food sectors to enhance and aim for clarity and transparency in their formulation, marketing and label's products. If, for example, the food companies maintain a thorough, clear, and understandable ingredient label, consumers may learn more about the product and a bridge between both can be established. The food companies then can deliver an ethical and socially responsible image, committed to their consumers' health and well-being. These actions may also result in the establishment of new processes, such as the selection of local suppliers for basic requirements and the creation of job possibilities, while also addressing other societal issues, such as gender inequality. Hence, these companies can start a radical positive change to achieve social, health and environmental responsibilities. Those changes can set a brandmark for successful and sustainable food companies. Furthermore, there is a need to build cooperation and collaboration with other sectors such as education and health in order to successfully and effectively impact consumers.

7.3 Conclusion

The systemic understanding of eating choices and the proposed policy recommendations in Mexico demonstrate how critical cross-sectoral policies and programmes are to contributing to a gradual improvement in eating choices. The influence and impact of eating choices should be addressed holistically, encompassing coordinated policies across the education, food, and health sectors, including strategies aimed at positively promoting internal behaviours to achieve a critical human right: health.

Establishing coordinated policies, such as supporting locally grown food (Section 6.3.1.2), as well as educating and delivering cooking skills (Section 6.3.2.1) and establishing information and communication technologies (ICT) systems, can constantly inform and interact with

consumers about the benefits of healthier eating choices (Section 6.3.3.1). The measure can be used to bridge the sectors' initiatives towards a common goal of improving health and nutrition.

In addition, the systemic understanding and the recommended initiatives from the STEEPLE, survey and scenarios' findings handle critical drivers that should be considered when structuring initiatives and proposing sectoral collaborations. The main aim is to mitigate and prevent nutritional issues such as obesity, reduce sociodemographic inequalities and improve individuals' welfare.

The gradual closure of pre-existing gaps within the education, health, and food systems, their processes, and strategies to align objectives can enhance collaborations that can lead to improvements in health and the mitigation or prevention of obesity. Individuals' welfare should be the central marker and the main influencer for changing agents in the Mexican government framework. That is because government initiatives have the potential to steadily strengthen their capacity to connect and expand benefits across society, thereby reducing sociodemographic inequality and increasing development opportunities. As a result, the vast majority of the population could receive benefits. In addition, the public will perceive the government's actions as well-intentioned, increasing their willingness to cooperate and interact. To accomplish this, governments must establish and structure investment and financing mechanisms that gradually improve daily practises, such as more accessible and well-equipped health centres in rural areas or agreements requiring the food industry to expand its collaboration with local communities and producers.

Finally, while attempting to mitigate an epidemic problem such as obesity, all actions contribute. However, collaboration amongst sectors is critical to reducing obesity and promoting healthy food choices.

7.4 Contribution to knowledge

The contribution to knowledge in this research project was a more holistic and improved perspective of consumers' eating choices and health behaviours. Figure 6.1 proposes a better systemic understanding of eating choices and health behaviours derived from the literature, theoretical framework, consumer survey and scenarios. The figure offers insight into what shapes individuals' eating choices from an internal and external behavioural perspective. It also highlights critical connections and handles drivers that can increase the prevalence of obesity.

The systemic understanding serves as a framework for government and health practitioners to use as a guideline when developing interventions and actions that mitigate health issues and enhance positive health behaviours.

7.4.1 Theoretical / empirical contributions

The thesis contributes to the behavioural theory literature by combining two theories, Theory of Planned Behaviour and Social Cognitive Theory, demonstrating their utility in providing insight and guidance for building a holistic understanding of individuals' eating choices and health behaviours. The theoretical framework is combined with a survey and scenarios to broaden and bring an expected future of consumer choices. The selected methods can be used to develop cross-sectoral policies and tactics for addressing present difficulties such as a lack of coordination between sectors or gaps in efforts that exacerbate the country's health and nutrition challenges.

The inclusion of individual behaviours in the study elucidates the interdependence of critical internal and external variables and their influence on eating decisions. Considering both the internal and external drivers of consumer health behaviour includes benefits such as identifying and mapping drivers and their pathways of influence. The mapping can assist in conducting a more comprehensive behavioural analysis and monitoring to determine the influence and impact of various sectors and their impact on nutrition and health-related initiatives.

7.4.2 Methodological contributions

The thesis proposes an alternative scenario development approach, which includes the combination of STEEPLE analysis (i.e., via desk-based research) and a behavioural survey instead of typical stakeholder workshops. The combination of methods can save time, economic funds and prevent or reduce the challenges when dealing and organising workshops with stakeholders and clients. Additionally, the survey technique to gather data has the potential to reduce biases and provides the researcher flexibility to incorporate any relevant questions that can better align with the study's aim and scope. Incorporating a literature review through the STEEPLE with a survey through the guidance of theoretical framework can help mitigate the biases associated with subjectivities by supporting with evidence the proposed internal and external drivers.

7.5 Limitations

7.5.1 Empirical limitation

Financial restrictions reduce the geographic scope of study; including areas from the north and south of Mexico. Incorporating other regions may broaden the scope of perspectives considered by gathering data from wider cross-section of the population (e.g., larger socio-demographic) to better understand individual eating habits and environmental circumstances. Sociodemographic variances can lead to differences in the social and cultural norms and can serve as proxy of differences among population as previous study suggested (Fuller-Iglesias and Antonucci, 2016).

Another limitation was the fluidity of policies, which affected the ability to reflect on their long-term impact on consumer choices and health behaviour. The 2018 government transition, political developments, and recent implementation of programmes (e.g., black warning nutritional labels at the end of 2020), were not fully reported due to insufficient data or limited research.

Additionally, COVID-19 has resulted in significant behavioural changes, particularly consumer eating choices and health behaviours, which have altered individuals' awareness and responsiveness to the public health initiatives and sector policies. The survey did not quantify or incorporate the perception of obesity as a pandemic or the COVID-19. As a result, it may constrain the policies addressed, leaving out others that affect consumer choices and behaviours.

7.6 Further work

There is a need to expand the study to different regions of Mexico to detect and indicate potential distinctions in how eating habits are influenced. The objective would be to identify structural and necessary changes for the development and implementation of new schemes, diversifying the sample from a sociodemographic, environmental, and biological context. The diversification can bring critical data for effectively redesign and tailor initiatives considering the differences within the education, public health, and food sectors. By expanding the sociodemographic sample, perspectives can be widened from a local and regional to a national and worldwide level. The gathered data can be utilised to strengthen and expand multidisciplinary collaboration across sectors and research institutions, opening new partnerships to conduct research and development on forthcoming challenges. These new

and strengthened collaborations have the potential to bring critical knowledge to improve and bridge undetectable systemic gaps in this research. Most importantly, extending sociodemographic data can be used to advance tailored research to increase the effectiveness of regional and national strategies for prevention and mitigation of eating choices and health issues.

The constant changes in the initiatives and policies required an in-depth and constant understanding of their influence to eating choices and health behaviours. Because people's opinions and behaviours change, it is critical to have a backup plan, such as risk assessments and monitoring and evaluation, to adjust policies and initiatives. For example, the black warning nutritional label just recently implemented in Mexico at the end of 2020, or the development of strategies through the use of information and communication technologies (ICT) do require of constant and longitudinal research to better understand their influence of eating choices and health behaviours.

Given that this study examined health-related behaviours and activities aimed at engaging the population, it is necessary to study further their influence considering sociodemographic factors such as age, gender, education level, or economic level. The objective would be to gather critical data on the relevance of people's eating choices and health behaviours. The research is necessary because as seen in the findings, the interaction between the environmental with internal drivers can lead to unpredictable behaviours. Additionally, difficult periods like COVID-19, which disrupted people's lifestyles, can easily alter or change individuals' perspectives through the experience, which can eventually result in alternative beliefs or changing attitudes. The objective would be to comprehend any change in perceptions, beliefs, attitudes, and knowledge from an internal perspective in order to comprehend the impact of sudden environmental changes such as a pandemic on eating choices.

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Zylfijaj, K., Nikoloski, D. and Tournois, N. (2020) 'The Impact of the Business Environment on the Formalization of Informal Firms. The Case of Kosovo', Südosteuropa, 68(4), pp. 505–529. doi: 10.1515/soeu-2020-0035.

Appendix A- Table 1.1. Food groups and examples identified in Mexican Tradition Diets (Source: Valerino-Perea et al. 2019).

Grains and tubers	Maize	Legumes	Vegetables	Fruits	Oils and fats	Beverages	Meat
Maize, amaranth, sweet potato, rice, wheat, potato sweet, potato, yucca.	Corn tortilla, soup "pozole", "menudo" (maize kernels, meat, chile and seasoning), "tamales" (corn cake) and	Beans	squash, chili, tomato, onion, "chayote", "nopales" (edible cactus), "tomatillo" and "quelites", "maguey", "huazontle", "mezquite", "quelites" (edible flowers), mushroom, Spirulina algae	"anona", apple, banana, "capulín", citrus fruits, guava, "guanabana" "jícama", "mamey", mango, melon, papaya, peach, pear, pineapple, "pitahaya" plums, prickly pear and "zapote".	Avocado, vegetable oil, cream	"Atole" (hot corn dough beverage), chocolate drink, "pulque" (fermented maguey drink), coffee, "agua fresca" (Fruit mixed water with sugar); fruits juice.	Turkey, chicken, pork, rabbit, beef, lamp, chevon, dogs.

Sweet and sweeteners	Herbs and condiments	Nuts and seeds	Fish and seed Food	Dairy	Eggs	Insects	
Honey, sweet traditional bread, sugarcane, desserts, sweets.	"Annato", "acuyo", chili, coriander, "epazote", garlic, onion, parsley, pepper, vanilla.	Peanuts, pumpkin seeds, chia and sesame seeds.	Shrimp	Cheese, milk	Chicken eggs	Grasshoppers and locusts, ants and their larvae. Maguey worms, ants and their larvae, water-fly and water-fly eggs.	

Appendix B- Table 1.2. Extracted data and included studies.

Reference Number	STEEPLE	Author	Keywords
1	Social	Mokhtar, S. and Deng, Y. S. (2015) 'Identification of key forces influencing sustainable development in Taiwan'	Macro-environment, Sustainable development, PEST analysis
2	Social	LAURELL, 2015- Three decades of neoliberalism in Mexico: The destruction of society'	Neoliberal reform, Mexico, Latin America, poverty, state violence, narcotic cartels

3	Social	Brenner, N. and Theodore, N. (2012) 'Cities and the geographies of "actually existing neoliberalism"', Spaces of Neoliberalism: Urban Restructuring in North America and Western Europe, pp. 1–32. doi: 10.1002/9781444397499.ch1.	Challenging; hegemonic dynamics of capitalistic ac; Contemporary neoliberalization conceptualized as c; Contextual embeddedness of neoliberal restructurin; Crises of Keynesian welfare policies; national and; Critical geography perspective on neoliberalism; Dysfunctional effects; neoliberal to capitalistic; Neoliberal doctrine "one size fits all"; Neoliberalism and "utopia" of free markets; Spaces of neoliberalization; path-dependent intera; Uneven geographical development and regulation.
4	Social	CLARK ET AL 2012 - Exporting obesity : US farm and trade policy and the transformation of the Mexican consumer food environment'	Trade, Obesity, Policy, Food environment, US, Mexico
5	Social	Barquera et al. 2003- Geography of Diabetes Mellitus Mortality in Mexico: An Epidemiologic Transition Analysis'	Mexico, Epidemiological transition, Diabetes Mellitus, Public Health

6	Social	Bermudez and Tucker, 2003- 'Trends in dietary patterns of Latin American populations	Food Consumption, Dietary Habits, Diet, Nutrition Transition
7	Social	McGranahan and Satterthwaite, 2014- 'Urbanisations concepts and trends'	Report
8	Social	Popkin, 2015 - 'Nutrition Transition and the Global Diabetes Epidemic'	Nutrition transition; low- and middle-income countries; obesity; dietary change; food system nutrition transition; low-and middle-incom countries; obesity; dietary change; food system
9	Social	Mercado, S. et al. (2007) 'Urban poverty: An urgent public health issue', Journal of Urban Health, 84(SUPPL. 1), pp. 7–15. doi: 10.1007/s11524-007-9191-5.	Equity; Governance; Health; Poverty; Social; Urban
10	Social	Urbanisation, climate change and health equity: how can health promotion contribute? **Rebecca Patrick,Sue Noy &Claire Henderson-Wilson**	Urban,climate change,socio-ecological,equity,resilience

11	Social	Aceves-Martins, M. *et al.* (2016) 'Obesity-promoting factors in Mexican children and adolescents: Challenges and opportunities', *Global Health Action*, 9(1). doi: 10.3402/gha.v9.29625.	Health determinants; developing countries; childhood obesity; health and environmental change
12	Social	Food portion patterns and trends among U.S. children and the relationship to total eating occasion size, 1977-2006 **Carmen Piernas 1, Barry M Popkin**	n/d
13	Social	Swinburn, B. A. *et al.* (2011) 'The global obesity pandemic: Shaped by global drivers and local environments', *The Lancet*. Elsevier Ltd, 378(9793), pp. 804–814. doi: 10.1016/S0140-6736(11)60813-1.	n/d

14	Social	Sizing up the Effect of Portion Size on Consumption: A Meta-Analytic Review **Natalina Zlatevska, Chris Dubelaar, Stephen S. Holden**	Portion size, food marketing, consumption norm, unit bias, obesity, supersizing
15	Social	Llewellyn, C. and Wardle, J. (2015) 'Behavioral susceptibility to obesity: Gene-environment interplay in the development of weight'	Appetite, Behaviour, Children, Eating Behaviour, Obesity, Weight
16	Social	Naylor, P. J. et al. (2010) 'Publically funded recreation facilities: Obesogenic environments for children and families?'	Food Environment, Healthy eating, Nutrition policy, Public Recreation facilities
17	Social	Obesogenic environments: current evidence of the built and food environments **Tim Townshend 1, Amelia Lake 2**	built environment; food environments; obesogenic environment; physical activity.
18	Social	Corsica, J. A. and Hood, M. M. (2011) 'Eating disorders in an obesogenic environment'	Environment, eating disorders

19	Social	Yayan, E. H. and Çelebioğlu, A. (2018) 'Effect of an obesogenic environment and health behaviour-related social support on body mass index and body image of adolescents', Global Health Promotion, 25(3), pp. 33–42. doi: 10.1177/1757975916675125.	body mass index; body perception; obesogenic environment; social support.
20	Social	Long-Solís, J. (2007) 'A survey of street foods in Mexico city', Food and Foodways,	Report
21	Social	Bañuelos-Barrera, Y. et al., 2016- 'Family, obesogenic environment, and cardiometabolic risk in Mexican school-age children',	Obesogenic environment, family, cardiometabolic risk, Mexican children
22	Social	Public Citizen's Global Trade Watch, 2018. NAFTA's legacy fro Mexico: economic displacement, lower wages for most increased migration.	Report

23	Social	Labonté, R. et al. (2019) 'USMCA (NAFTA 2.0): Tightening the constraints on the right to regulate for public health', Globalization and Health. Globalization and Health, 15(1), pp. 1–15. doi: 10.1186/s12992-019-0476-8.	Trade and investment policy; public health; NAFTA; USMCA; Regulatory coherence; TRIPS-plus, Labour and Environemntal protection.
24	Social	Ibarrola-Rivas, M. J. and Galicia, L. (2017) 'Rethinking Food Security in Mexico: Discussing the Need for Sustainable Transversal Policies Linking Food Production and Food Consumption', Investigaciones Geográficas. Elsevier, 2017(94), pp. 106–121. doi: 10.14350/rig.57538.	Food security; Mexico, Sustainability; Agriculture; Dietary patterns; Nutrition.

25	Social	Via, M. (2012) 'The Malnutrition of Obesity: Micronutrient Deficiencies That Promote Diabetes', ISRN Endocrinology, 2012, pp. 1–8. doi: 10.5402/2012/103472.	Obesity, Diabetes, vitamins, minerals.
26	Social	Poverty and urban inequality: the case of Mexico City metropolitan region* **Alicia Ziccardi**	n/d
27	Social	Gameren, E. Van and Hinojosa, S. U. (2004) 'Education and Employment Perspectives for Mexican Rural Youth'	Economic development, Poverty households, Education, Employment, Poverty
28	Social	Dover, R. V. H. and Lambert, E. V. (2016) '"Choice Set" for health behavior in choice-constrained settings to frame research and inform policy: Examples of food consumption, obesity and food security'	Policy, food consumption, food security, Health beahviour, Health policy, Obesity

29	Social	Mirowsky, J. and Ross, C. E. (2005) 'Education, learned effectiveness and health', London Review of Education, (February). doi: 10.1080/14748460500372366.	n/d
30	Social	Cohen, A. K. et al. (2013) 'Educational attainment and obesity: A systematic review',	Educational status, obesity, review, social class
31	Social	Pérez-Ferrer, C. et al. (2018) 'The nutrition transition in Mexico 1988–2016: the role of wealth in the social patterning of obesity by education', Public Health Nutrition, 21(13), pp. 2394–2401. doi: 10.1017/S1368980018001167.	Education; Health inequalities; Mexico; Nutrition transition; Obesity; Wealth

32	Social	Obesity prevalence in Mexico: impact on health and economic burden **Ketevan Rtveladze 1, Tim Marsh 1, Simon Barquera 2, Luz Maria Sanchez Romero 2, David Levy 3, Guillermo Melendez 4, Laura Webber 1, Fanny Kilpi 1, Klim McPherson 5, Martin Brown 1**	Obesity Mexico Health care Cost Economic Mexican adults.
33	Social	Esposito, L. et al. (2020) 'The economic gradient of obesity in Mexico: Independent predictive roles of absolute and relative wealth by gender'	Gender, Mexico, Obesity, Wealth, Economic, Role
34	Social	Jones, A. et al. (2003) 'Tackling Obesities : Future Choices – Obesogenic Environments – Evidence Review'	Report

35			Physical activity, urbanisation, sedentary, adolescents
	Social	Ojiambo, R. M. et al. (2012) 'Effect of urbanization on objectively measured physical activity levels, sedentary time, and indices of adiposity in Kenyan adolescents'	
36			Children, Mexico, obesity, physical activity, television viewing
	Technol ogical	Colditz, G. et al. (2002) 'Association of obesity with physical activity, television programs and other forms of video viewing among children in Mexico City',	
37		Parsons, T. J. et al. (1999) 'Childhood predictors of adult obesity: A systematic review', International Journal of Obesity, 23(SUPPL. 8).	Adult; Child; obesity; predictors; systematicc review
	Technol ogical		
38			Child, Mexico, Obesity, Overweight, Review, Activity
	Technol ogical	Eisenberg, C. et al. (2013) 'Interventions to increase physical activity and healthy eating among overweight and obese children in Mexico'	

39	Technol ogical	Rivera, J. et al. (2018) 'Technology use, sedentary lifestyles and physical activity in university students.', Revista Iberoamericana de Ciencias, 5(1), pp. 17–23. Available at: http://www.reibci.org/publicados/2018/feb/2600103.pdf.	Use of technologies, physical activity, sedentary, university students, Mexico
40	Technol ogical	Sieberg, Daniel (2011): Digital Diet: The 4-Step Plan to Break Your Addiction and Regain Balance in Your Life.	Book
41	Technol ogical	Yamamoto Kimura, L., Alvear Galindo, G. and Moran Alvarez, P. et al. (2013) 'Out-of-school activity and obesity in children Influence of family and neighbourhood environment.', Rev Med Inst Mex Seguro Soc, 51(4), pp. 378–83.	Child; obesity; overweight; leisure activities; sedentary lifestyle.

42	Technol ogical	Sepúlveda, D. M. et al. (2017) 'Development of an Interactive Social Tool for Mexican Young Adults to Lower and Prevent Overweight and Obesity', in Communications in Computer and Information Science, pp. 285–292. doi: 10.1007/978-3-319-58753-0_43.	Head-mounted display; Multisensory integration; Perception; Test; Vestibular; Virtual reality; Vision
43	Econom ic	Bashir, M., Schilizzi, S. and Pandit, R. (2012) The Determinants of Rural Household Food Security in the Punjab , Pakistan : An Econometric Analysis	Food security, rural households, logistic regression, Punjab, Pakistan
44	Econom ic	Mutisya, M. et al. (2016) 'The effect of education on household food security in two informal urban settlements in Kenya: a longitudinal analysis'	Education, Food Security, Urban

45	Econom ic	Corvalan, 2006 - Latin America: Avoiding the nutrition transition "trap" in Tackling the Double Burden of Malnutrition	Report
46	Econom ic	Hawkes, 2006 - Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases	Nutritional transition, Obesity, Policies, Chronic Diseases, Lowest ncome group, Socioeconomic
47	Econom ic	Kimoto et al. 2014 - Food, eating and body image in the lives of low socioeconomic status rural Mexican women living in Queretaro State, Mexico	Obesogenic environment, Mexican women, Low-socioeconomic status, Obesity and Overweight
48	Econom ic	FAO (2019) Mexican food system- Opportunities for the Mexican field for Sustainable Development 2013 agenda. Mexico City. Available at: http://www.wipo.int/amc/en/.	Report

49	Econom ic	Mexican Households' Purchases of Foods and Beverages Vary by Store-Type, Taxation Status, and SES **Lilia S. Pedraza,1 Barry M. Popkin,1 Juan C. Salgado,2 and Lindsey S. Taillie1,***	food purchases, retailers, socioeconomic factors, taxes, Mexico
50	Econom ic	PROFECTO, 2013 - Consumption habits of food prepared away from home.	Report
51	Econom ic	ENIGH, 2018	Survey
52	Econom ic	Alvi and Mendoza, 2017 - 'Mexico City street vendors and the stickiness of institutional contexts: Implications for strategy in emerging markets'	Emerging markets strategy, informal economy, Mexico, institutional contexts
53	Econom ic	Perez-Lizaur, A., Palacios, B., Castro-Becerra L., Flores-Galicia, Isabel., 2008. Mexican System of Equivalents. 3erd ed. Ogali.	Book

54	Econom ic	Mexican-Health-Secretariat (2010) Food guide for the Mexican population. Mexico City.	Report
55	Econom ic	Gaona-Pineda, E. B. et al. (2018) 'Dietary intake and adequacy of energy and nutrients in Mexican adolescents: Results from Ensanut 2012'	Adolescents, Diet, Mexico, Nutrients, Intake
56	Econom ic	Drewnowski, A. and Eichelsdoerfer, P. (2009) 'Can Low-Income Americans Afford a Healthy Diet?',	Food prices, affrodability, diets
57	Econom ic	PROFECO, 2019. Who is who in the food prices. Available at: https://www.profeco.gob.mx/precios/canasta/default.aspx. Last seen: 17 03 2021.	Report
58	Econom ic	Ortiz-González, F. (2016) 'The supermarket: a trading arena for inventing work and consumption.', Society and Culture, 19(2), pp. 105–116.	Supermarket; offer and demand; wealth path; personal path

59	Econom ic	Supermarkets in Mexico: Impacts on Horticulture Systems **Rita Schwentesius Manuel Ángel Gómez https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-7679.00185**	n/d
60	Econom ic	SEDECO, 2014. Basic Food Basket Price comparison. Available at: https://studylib.es/doc/5298036/comparativo-de-precios-de-la-canasta-b%C3%A1sica-con. Last seen: 22 03 21.	Report
61	Econom ic	Barquera, S., Rivera-Dommarco, J. and Gasca-García, A. (2001) 'Food and nutrition policies and programs in Mexico', Salud Publica de Mexico, 43(5), pp. 464–477. doi: 10.1590/s0036-36342001000500011.	Food policy; nutrition programms; Mexico

62	Economic	Ortiz-Hernández, L. (2006) 'Evolución de los precios de los alimentos y nutrimentos en México entre 1973 y 2004', Archivos Latinoamericanos de Nutricion, 56(3).	Accessibility; Costs; Energy density; Fruits; Industrialized foods; Meats; Price; Vegetables
63	Economic	Ansari, S. and Babu, R. R. (2018) '5. North American Free Trade Agreement (NAFTA)', Yearbook of International Environmental Law, 29, pp. 390–397. doi: 10.1093/yiel/yvz032.	Report
64	Economic	OECD, 2020. Agricultural Policy Monitoring and Evaluation-Mexico. Available at: https://www.oecd-ilibrary.org/sites/87afa5a1-en/index.html?itemId=/content/component/87afa5a1-en. Last seen 15 03 21.	Report

65	Econom ic	Neoliberal Globalization, NAFTA, and Migration: Mexico's Loss of Food and Labor Sovereignty **Gerardo Otero**	peasant economy, development, agriculture, food sovereignty, migration
66	Econom ic	USTR, 2021. US-Mexico trade fact. Available at: https://ustr.gov/countries-regions/americas/mexico. Last seen: 20 03 21.	Report
67	Econom ic	SAGARPA and SIAP (2016) 2016 Food and Agricutural Atlas. Mexico City.	Report
68	Econom ic	NAFTA's Developmental Impact on Mexico: Assessment and prospects Jean- **Baptiste Velut**	NAFTA, regional integration, free trade, Mexico; development, employment
69	Econom ic	Farquhar, W. B. et al. (2015) 'Dietary Sodium and Health'	Diet, Sodium-restricted, hypertension, kidney, sodium chloride, dietary

70	Economic	Association of Processed Meat Intake with Hypertension Risk in Hemodialysis Patients: A Cross-Sectional Study **Pei-Yu Wu 1, Shwu-Huey Yang 1, Te-Chih Wong 1, Tzen-Wen Chen 2, His-Hsien Chen 2, Tso-Hsiao Chen 3, Yu-Tong Chen 1**	n/d
71	Economic	Colin-Ramirez, E. et al. (2017) 'Food sources of sodium intake in an adult mexican population: A sub-analysis of the SALMEX study'	Hypertension, Processed foods, salt, Mexico, sodium intake, food sources
72	Economic	Hawkes, C. (2005) 'The role of foreign direct investment in the nutrition transition.'	Foreign Direct Investment, Nutrition.
73	Economic	Clark, S. E. et al. (2012) 'Exporting obesity : US farm and trade policy and the transformation of the Mexican consumer food environment'	Agricultural trade, food environment, food systems, NAFTA, obesity, trade policy

74		Cuevas Garciá-Dorado, S. et al. (2019) 'Economic globalization, nutrition and health: A review of quantitative evidence', Globalization and Health. Globalization and Health, 15(1). doi: 10.1186/s12992-019-0456-z.	Globalization; trade liberalisation; FDI; nutrition transition; non-communicable disease
	Econom ic		
75		Mobile food vending and the after-school food environment **June M Tester 1, Irene H Yen, Barbara Laraia**	n/d
	Econom ic		
76		Organisation for Economic Co-operation and Development (2014) OECD: Obestiy Update 2014, OECD Health statistics. doi: 10.1007/s11428-009-0404-2.	Report
	Econom ic		

77	Econom ic	Dommarco, J. A. R. et al. (2019) 'The role of public nutrition research organizations in the construction, implementation and evaluation of evidence-based nutrition policy: Two national experiences in Mexico'	Malnutrition, Nutrition policy, Program evaluation, Public Health Nutrition
78	Econom ic	Ministry of Public Education, 2015. Diagnosis of the Physical Culture and Sports Program. Mexico City: Secretariat for Planning and Evaluation of Educational Policies. General Directorate of Policy Evaluation S269	Report
79	Econom ic	Health Foundation Movement, 2017. Mexico: Fundación Movimiento es Salud. Available at: http://fundacionmovimientoessalud.org.mx/ponte-al-100/. Accessed: 23/10/19	Report

80	Econom ic	Gordon-Larsen, P. (2014) 'Food Availability / Convenience and Obesity'	Food, availability, obesity
81	Environ mental	Swinburn, B. A. et al. (2019) 'The Lancet Commissions The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report', 6736(January). doi: 10.1016/S0140-6736(18)32822-8.	n/d
82	Environ mental	An, Ji, and Zhang, 2018 - 'Global warming and obesity: a systematic review'	Climate change, global warming, obesity, systematic review
83	Environ mental	Colchero, M. A. et al. (2016) 'Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study'	Beverage, tax, sugar intake, economics, purchasing,

84	Environmental	Climate change as a driver of food insecurity in the 2007 Lesotho-South Africa drought **Jasper Verschuur, Sihan Li, Piotr Wolski & Friederike E. L. Otto**	Climate change Environmental impact (Subjects)
85	Environmental	Cubasch, U. and G.A. Meehl. 2001. Projections of future climate change. In Climate change 2001: The scientific basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), eds. J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, and D. Xiaosu. Cambridge: Cambridge University Press.	Report

86	Environmental	Liverman, D.M. 2001. Vulnerability to drought and climate change in rural Mexico. In Global Environmental Risk, ed. J.X. Kasperson, and R.E. Kasperson, 201–216. New York: Earthscan.	Book
87	Environmental	Conde, C., R. Ferrer, and D. Liverman. 2000. Study of the vulnerability of temporary corn agriculture through the CERES-MAIZE model. In Mexico: a vision towards the 21st century. The climatic change in Mexico, ed. C. Gay, 93–110. Science Atmoshperic centre UNAM.	Book
88	Environmental	Bee, B. A. (2014) '"Si no comemos tortilla, no vivimos:" women, climate change, and food security in central Mexico'	Adaptive capacity, climate change, food security, gender, knowledge, Mexico

89	Environ mental	Liverman, D. M. (1990) 'Drought Impacts in Mexico: Climate, Agriculture, Technology, and Land Tenure in Sonora and Puebla	Agriculture, drought impacts, land tenure, Mexico, technology, agriculture, climate
90	Environ mental	Magana, V., C. Conde, O. Sanchez, and C. Gay. 1997. Assessment of current and future regional climate scenarios. Climate Research 9: 107–114.	Climate scenarios; General circulation models; Global climate change; Mexico Country Study; Regionalization; Statistical models
91	Environ mental	Liverman, D. M. and O'Brien, K. L. (1991) 'Global warming and climate change in Mexico'	Global environmental change, water, ecology, Mexico
92	Environ mental	Myers, S. S. et al. (2017) 'Climate Change and Global Food Systems: Potential Impacts on Food Security and Undernutrition', Annual Review of Public Health, 38(1), pp. 259–277. doi: 10.1146/annurev-publhealth-031816-044356.	planetary health, global health, climate change, food security, malnutrition, global environmental change

93	Environ mental	Ureta, C. et al. (2020) 'Maize yield in Mexico under climate change', Agricultural Systems. Elsevier, 177(October 2019), p. 102697. doi: 10.1016/j.agsy.2019.102697.	Climate change; Crop yields; Irrigation; Maize; Rainfed
94	Environ mental	Smith, C. D. et al. (2020) 'Lack of safe drinking water for lake chapala basin communities in mexico inhibits progress toward sustainable development goals 3 and 6', International Journal of Environmental Research and Public Health, 17(22), pp. 1–12. doi: 10.3390/ijerph17228328.	sustainable development goals; Lake Chapala; Mexico; CKD; diarrheal disease; water sanitation and hygiene; environmental health; environmental justice; Latin America; GIS
95	Environ mental	Gender and water governance in Mexico **Jorge Alejandro Silva Rodríguez de San Miguel**	Gender mainstreaming, Water governance, Water access, Water resources management

96	Environmental	Sweet Extermination: How Soda and Beer triggered an epidemic of diabetic disorders among the Highland Mayans of Chiapas, Mexico **Jaime Tomás Page Pliego**	n/d
97	Environmental	Ludi, E., Bosi, L. and Jones, L. (2017) Water for food security Lessons learned from a review of water-related interventions.	Report
98	Environmental	Gonzalez-Diaz, 2020. Chiapas, the state of Mexico where soft drink consumption is 30 times higher than the world average.	newpaper
99	Environmental	Rashak, H. A. et al. (2019) 'Diabetes, undernutrition, migration and indigenous communities: Tuberculosis in Chiapas, Mexico', Epidemiology and Infection, 147. doi: 10.1017/S0950268818003461.	Diabetes mellitus (DM); indigenous; Mexico; tuberculosis (TB); undernutrition

100		Colchero, M. A., Molina, M. and Guerrero-López, C. M. (2017) 'After Mexico Implemented a Tax, Purchases of Sugar-Sweetened Beverages Decreased and Water Increased: Difference by Place of Residence, Household Composition, and Income Level', The Journal of Nutrition, 147(8), pp. 1552–1557. doi: 10.3945/jn.117.251892.	bottled water; household purchases; mexico; sugar-sweetened beverages; taxes
	Environmental		
101		Rodwan, 2019. Bottled water U.S. and International Developments and Statistics. Available at: https://bottledwater.org/public/BMC2017_BWR_StatsArticle.pdf. Last seen 19 03 21.	Website
	Environmental		

295

102	Environ mental	Montero, 2020. Bottled water and Covid-19. News UNAM. Available at: http://www.agua.unam.mx/noticias/2020/unam/not_unam_mayo27.html. Last seen: 19 03 21.	Report
103	Environ mental	US Labor, 2021. Wages. Available at: https://www.dol.gov/general/topic/youthlabor/wages. Last seen 19 03 21.	Fact sheet
104	Environ mental	Ruiz-Meza, L. E. (2013) 'Gender segregation in the allocation of water rights in the rural irrigation systems in Chiapas, Mexico', Cuadernos de Desarrollo Rural, 10(72), pp. 201–222.	Agency; Gender; Irrigation districts; Water rights; Women farmers
105	Environ mental	Lopez and Jacobs, 2018. In town with little water, Coca-Cola is everywhere. So is Diabetes. NYT.	newspaper

106	Environ mental	CONAGUA, 2021. Public Registry of Water Rights. Available at: https://app.conagua.gob.mx/TituloRepda.aspx?Id=11CHS10095 9/30FMDA16|0|5|A. Last seen: 19 03 21.	Report
107	Political	Obesity prevention: the role of policies, laws and regulations **Boyd A Swinburn**	n/d
108	Political	Neoliberal Globalization, NAFTA, and Migration: Mexico's Loss of Food and Labor Sovereignty **Gerardo Otero**	peasant economy, development, agriculture, food sovereignty, migration
109	Political	Velut, J.-B. (2011) 'NAFTA ' s Developmental Impact on Mexico: Assessment and prospects', Open Edition, 1, pp. 0–23.	NAFTA;ALENA; regional;integration; development;Méxic o;development; employment.
110	Political	Faux, J. (2003) 'How NAFTA Failed Mexico'	NAFTA, Trade, Globalisation

297

111	Political	Popkin, B. M. (2001) 'Symposium : Obesity in Developing Countries : Biological and Ecological Factors The Nutrition Transition and Obesity in the Developing World 1', (March), pp. 871–873.	nutrition transition; obesity epidemic
112	Political	Hawkes, 2006 - Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases	Nutritional transition, Obesity, Policies, Chronic Diseases, Lowest ncome group, Socioeconomic
113	Political	UNCTAD, 2013.	Report
114	Political	Wise, T. A. (2010) The impacts of U . S . agricultural policies on Mexican producers. Massachusetts.	Book
115	Political	Friel, S. and Ford, L. (2015) 'Systems, food security and human health',	Diet, Environment, Food Insecurity, Food system, Inequalities in Health, Public policy, Social determinants

116	Political	Clark, S. E. et al. (2012) 'Exporting obesity : US farm and trade policy and the transformation of the Mexican consumer food environment'	Agricultural trade, food environment, food systems, NAFTA, obesity, trade policy
117	Political	Baca, A. S. (2019) 'The Food Consumption Pattern of the Free Market: The Mexican Experience Under NAFTA'	Free market, malnutrition, NAFTA, Mexico, maize
118	Political	Effects of North American Free Trade Agreement on Agriculture and the Rural Economy **BY STEVEN ZAHNISER**	North American Free Trade Agreement, (NAFTA), Mexico, Canada, United States, trade, investment, environment, transportation, employment, rural economy
119	Political	Diaz-Bonilla, E. (2014) 'Agricultural trade and food security: some thoughts about a continuous debate'	Report
120	Political	Market Intelligence Latin America, S. C. (2014) Mexico: Food Trends and agriculture opportunities.	Report

121	Political	**Oner, C. (2012)** Inflation: Prices on the rise, International Monetary Fund.	Magazine
122	Political	Kant, A. K. and Graubard, B. I. (2007) 'Secular trends in the association of socio-economic position with self-reported dietary attributes and biomarkers in the US population: National Health and Nutrition Examination Survey (NHANES) 1971-1975 to NHANES 1999-2002', Public Health Nutrition, 10(2), pp. 158–167. doi: 10.1017/S1368980007246749.	Survey
123	Political	Maillot, M. et al. (2007) 'Nutrient-dense food groups have high energy costs: an econometric approach to nutrient profiling.', The Journal of nutrition, 137(7), pp. 1815–20. doi: 137/7/1815 [pii].	Energy Intake; Food; Food Industry; Food Industry: economics; Food: classification; Food: economics; France; Humans; Models; Econometric; Nutritive Value

124		Monsivais, P. and Drewnowski, A. (2007) 'The Rising Cost of Low-Energy-Density Foods', Journal of the American Dietetic Association, 107(12), pp. 2071–2076. doi: 10.1016/j.jada.2007.09.009.	n/d
	Political		
125		Bernstein, A. M. et al. (2010) 'Relation of food cost to healthfulness of diet among US women', American Journal of Clinical Nutrition, 92(5), pp. 1197–1203. doi: 10.3945/ajcn.2010.29854.	n/d
	Political		
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128	Political	The bumpy road from food to nutrition security – Slow evolution of India's food policy **Prabhu Pingali, Bhaskar Mittra, Andaleeb Rahman**	Nutrition,Food security,Political economy,Policy,Staple grains,Diet diversity,Asia,India
129	Political	Hornbeck, J. F. (2004) 'NAFTA at Ten : Lessons from Recent Studies'	Report
130	Political	Koc, M., Jernigan, C. and Das, R. (2007) 'Food Security and Food Sovereignty in Iraq'	Food security, Global Economy, Nutritional, Health

131			Labour markets, Social policy, Trade
	Political	McNamara, C. (2015) 'Trade liberalization, social policies and health: An empirical case study'	
132	Political	United Nations Human Rights Office of the High Commissioner.N.D. Special Rapporteur on the right to food. https://www.ohchr.org/EN/Issues/Food/Pages/FoodIndex.aspx. Accessed 21/10/19.	Report
133	Political	Bhardwaj, M. et al. (2003) 'Ethics in food and agriculture: Views from FAO'	Agricultural policy, bioethics, environmental governance, food policy, sustainability, United Nations
134	Political	Fanzo, J. (2018) 'The ethics of food in the health system architecture',	Human right, food, food system,

135		Dommarco, J. A. R. et al. (2019) 'The role of public nutrition research organizations in the construction, implementation and evaluation of evidence-based nutrition policy: Two national experiences in Mexico'	Malnutrition, Nutrition policy, Program evaluation, Public Health Nutrition
	Political		
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	Legal		
137		Mexico Adopts Food Warning Labels, Why Now? **Mariel White 1, Simon Barquera 1**	Front-of-pack labeling; non-communicable chronic diseases; nutrition policy; obesity; warning labels
	Legal		
138		Food-alliance (2011) 'Chronology of front-of-package food and beverage labelling in Mexico.' Mexico, pp. 1–2.	Report
	Legal		

139	Legal	Stern, D., Tolentino, L. and Barquera, S. (2013) 'Revision of front labelling: analysis of the Guideline Daily Allowances (GDA) and its understanding by students of nutrition in Mexico.', National Health Public Institute, 53, p. 37. doi: 10.1017/CBO9781107415324.004.	Report
140	Legal	OECD (2010) OECD Perspectives : Mexico Key Policies for Sustainable Development, October.	Report
141	Legal	Front-of-pack nutritional labels: Understanding by low- and middle-income Mexican consumers **Jorge Vargas-Meza,Alejandra Jáuregui ,Selene Pacheco-Miranda,Alejandra Contreras-Manzano,Simón Barquera**	n/d

142	Legal	Ramirez, Rodrigo, Sternsdorff, Nicole, Pastor, C. (2016) Chile's Law on Food Labelling and Advertising: A Replicable Model for Latin America? Available at: http://www.emol.com/noticias/nacional/2011/04/13/475822/manalichcalificad.	<mark>Report</mark>
143	Legal	Development of the Chilean front-of-package food warning label **Marcela Reyes, María Luisa Garmendia, Sonia Olivares, Claudio Aqueveque, Isabel Zacarías & Camila Corvalán**	Front-of-package FoP Warning label Stop signs Chilean labelling law
144	Legal	Corvalan, 2006 - Latin America: Avoiding the nutrition transition "trap" in Tackling the Double Burden of Malnutrition	<mark>Report</mark>
145	Legal	Drewnowski, A. and Specter, S. (2004) 'Special Article Poverty and obesity : the role of energy density and energy costs.'	Poverty, Food security, Obesity, Education, Income, Energy density, Food costs, Added sugars, Added fat, Palatability, Socioeconomic status

146		Why India Cannot Plan Its Cities: Informality, Insurgence and the Idiom of Urbanization **Ananya Roy**	Indian cities, informality, insurgence, neoliberalism, urban development
	Legal		
147		Gender, Informal Employment and Trade Liberalization in Mexico **Sarra Ben Yahmed, Pamela Bombarda**	formal and informal labor, gender, trade liberalization, Mexico
	Legal		
148		INEGI, 2011. "Bank of Economic Information", available at: http://dgcnesyp.inegi.org.mx/cgi-win/ bdieintsi.exe/. Last seen: 20 03 21.	Report
	Legal		

149		Fuentes, H., Zamudio, A., Ortega, C., Mendoza, J. and Soto, J., 2007. Tax evasion generated by street hawking, Tax Administration System, available at: www.sat.gob.mx/administracion_sat/estudiosevasion_fiscal/Documents/I1_2007_eva_fis_gen_com_amb.pdf. Last seen 29 03 21.	Report
	Legal		
150		Maloney, W.F., 2004. Informality revisited, World Development,	Report
	Legal		
151		Parasites, nutrition, immune responses and biology of metabolic tissues **T Shea-Donohue 1, B Qin 2, A Smith 2**	Th-2; cell; disease; immune modulation; malnutrition; mucosa.
	Legal		
152		Krajmalnik-Brown, R. et al. (2012) 'Effects of gut microbes on nutrient absorption and energy regulation'	Absortion, Energy, Nutrient
	Legal		

153	Legal	Obesity and the food system transformation in Latin America **B M Popkin , T Reardon**	Food service; food system; obesity; retailers.
154	Legal	De Alba, M. 2005. "The meanings," Memory of the seminar "The ambulance in Mexico City: recent research," (CD, with no page numbers), National Autonomous University of Mexico and French Center for Mexican and Central American Studies .	n/d
155	Legal	Nestle, M., 2004. Food Politics. University ofCalifornia Press, Berkeley, CA.	Book
156	Legal	Lakdawalla, D. and Philipson, T. (2009) 'The growth of obesity and technological change', Economics and Human Biology, 7(3), pp. 283–293. doi: 10.1016/j.ehb.2009.08.001.	Food prices; Obesity; Technological change

157	Legal	Torero, M. 2014. Food security brings economic growth not the other way around. IFPRI. Available at: http://www.ifpri.org/blog/food-security-brings-economic-growth-not-other-way-aroundLast seen 05/09/2019.	Report
158	Legal	Food Standards Agency, 2006. Our Food Future.	Report
159	Legal	De la Cruz-Góngora, V. et al. (2017) 'Understanding and acceptability by Hispanic consumers of four front-of-pack food labels', International Journal of Behavioral Nutrition and Physical Activity. International Journal of Behavioral Nutrition and Physical Activity, 14(1), p. 28. doi: 10.1186/s12966-017-0482-2.	FOPL understanding;FOPL acceptability;Food labelin; correspondence; daily allowance; food labeling; fopl acceptability; fopl understanding; front-of-pack labels; guideline; hispanics; insp; logos; multiple traffic lights; mx; packaged foods; pilar; stars rating; torres

160	Legal	Sanchez-Romero, L. M. et al. (2016) 'Projected Impact of Mexico ' s Sugar- Sweetened Beverage Tax Policy on Diabetes and Cardiovascular Disease : A Modeling Study', PLoS Medicine, 13(11), pp. 1–17. doi: 10.1371/journal. pmed.1002158.	n/d
161	Legal	Arantxa-Colchero, M. et al. (2017) 'In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax'	Consumer, Mexico, Sugar-sweetened beverage, Consumer attitude , health care policy, purchasing, tax.
162	Legal	Torres-Álvarez, Barrán-Zubarán, Canto-Osorio, (2020). 'Body weight impact of the sugar sweetened beverages tax in Mexican children: a modeling study', Pediatric Obesity, (January), pp. 4–11. doi: 10.1111/ijpo.12636.	children; modeling study; obesity; sugar-sweetened beverage, tax.

163		The caloric and sugar content of beverages purchased at different store-types changed after the sugary drinks taxation in Mexico **Lilia S. Pedraza, Barry M. Popkin, Carolina Batis, Linda Adair, Whitney R. Robinson, David K. Guilkey & Lindsey Smith Taillie**	SSBs tax, Mexico, Calories, Sugar, Food-stores
	Legal		
164			Political economy, Sugar-sweetened beverage, Taxation, Transantional corporations
	Legal	Carriedo, A. et al. (2021) 'The political economy of sugar-sweetened beverage taxation in Latin America: lessons from Mexico, Chile and Colombia', Globalization and Health.	

165	Legal	FAO, 2015. Mexico City. Urban and Peri-urban Agriculture in Latin America and the Caribbean. Available at: http://www.fao.org/ag/agp/greenercities/en/ggclac/mexico_city.html. Last seen: 17 03 21.	Report
166	Legal	Olvera-Hernandez et al. 2017. Importance of plant species in peasant family backyards of northeastern Puebla, Mexico.	Diversity, importance of species,backyard food growth management
167	Legal	Duché-García, T. T. A. et al. (2017) 'BACKYARD AGRICULTURE AND AGROECOLOGY IN THE STRATEGIC FOOD SECURITY PROJECT (PESA-FAO) OF THE STATE OF PUEBLA', Agricultura Sociedad y Desarrollo, 14(2), p. 263. doi: 10.22231/asyd.v14i2.592.	development of capacities, agroecological practices, Strategic Food Security Project (PESA-FAO), food sovereignty

168	Ethical	Moubarac, J.-C. et al. (2015) Ultra-processed food and drink products in Latin America : Trends , impact on obesity , policy implications. Washington DC.	Report
169	Ethical	Espinoza-Ortega, A. et al. (2016) 'Motives for food choice of consumers in Central México'	Consumers; Food CConsumers; Food Choice Questionnaire; Mexico
170	Ethical	Food Marketing and Obesity in Developing Countries: Analysis, Ethics, and Public Policy **Terrence H. Witkowski**	food marketing; obesity; developing countries; ethics; public policy
171	Ethical	Barquera, S. et al. (2018) 'The obesogenic environment around elementary schools: food and beverage marketing to children in two Mexican cities'	Child obesity, Food-marketing, Nutrition, Sugar-sweetened beverages, environment.
172		Mexico's agriculture development: Perspectives and outlook	report

173		OECD, 2020. Agricultural Policy Monitoring and Evaluation- Mexico.	report
174		INEGI, 2017. Price Indexes.	report
175		Statista, 2020. Inflation Rate in Mexico 2025.	report
176		Statista 2020. Average annual OPEC crude oil price from 1960 to 2021. Chemical and Resources, Petroleum and Refinery.	report
177		Grain SA. 101 Years of rainfall records- a valuable resource for crop production.	report
178		PROFECO, 2019. Who is who in the food prices.	report
179		Jacoby E., Keller I., 2006. THE PROMOTION OF FRUITS AND VEGETABLES CONSUMPTION IN LATIN AMERICA: GOOD OPORTUNITY FOR AN INTERSECTORIAL ACTION FOR A HEALTHY EATING.	Fruits and vegetables consumption, Latin America.

180		National Institute of Social Economy, 2017. The best fruits are grown in Mexico.	report
181		Agri-food and Fisheries Information Service, 2016. We are the ninth largest vegetable producer in the world.	report
182		SAGARPA 2016. Agricultural Atlas. Mexico.	report
183		FAO, 2015. Mexico City. Urban and Peri-urban Agriculture in Latin America and the Caribbean.	report
184		SNIIM, 2021. Wholesale Prices of Fruits and Vegetables.	report
185		Delgado, 2019. Mexico, the first consumer of soda in the world.	Food Culture, Health, Lifestyle, Tradition
186		Montero, 2020. Bottled water and Covid-19.	Report
187		US Labor, 2021. Wages.	Report
188		Rodwan, 2019. Bottled water U.S. and International Developments and Statistics.	Report

189		CONAGUA, 2019. National Water Tariffs.	Report
190		INEGI, 2017. National Household Survey.	Report
191		CONAGUA, 2021. Public Registry of Water Rights.	Report
192		Food Guidance Centre, 2011. Food outside home, price estimation.	Report
193		ENIGH 2018. Households Expenditure National Survey.	Report
194		PROFECO, 2013. Consumption habits of food prepared away from home.	Report
195		USTR, 2021. US-Mexico trade fact.	Report
196		SEDECO, 2014. Basic Food Basket Price comparison.	Report
197		FAO, 2021. Food Loss and Food waste.	Report
198		Health Food Alliance, 2018. There is no reason to keep as they are the ultra-processed labels.	Report
199		Silverio, 2020. Excess calories and sugars, warns new soft drink labelling.	Website

200		INEGI, 2011. "Bank of Economic Information"	Report
201		UN, 2010. Resolution A/RES/64/292.	Website
202		Cohen, M. J. and Garrett, J. L. (2010) 'The food price crisis and urban food (in)security',	copin strategies, food crisis, food prices, food security, markets, social protection, urban, urban agriculture
203		Colchero, M. A. et al. (2019) 'Affordability of food and beverages in Mexico between 1994 and 2016', Nutrients,	Affordability, beverages, energy density, Food, Income, Mexico, Nutrient-rich, Food index
204		Drewnowski, A. (2010) 'The cost of US foods as related to their nutritive value'	Cost, Food, Value, Nutritive value, US
205		McArthur, L. H., Holbert, D. and Peña, M. (2003) 'Prevalence of overweight among adolescents from six Latin American cities: A multivariable analysis',	Adolescents, prevalence, overweight, Cities

206		Cammock, R. et al. (2021) 'From individual behaviour strategies to sustainable food systems: Countering the obesity and non communicable diseases epidemic in New Zealand'	Food systems, non-communicable disease, obesity, sustainability
207		Chapman, J. et al. (2020) 'Challenges and opportunities of the fourth revolution: a brief insight into the future of food',	Big data, digital food, food security, food value chain, fourth revolution.
208		Darmon, N. and Drewnowski, A. (2015) 'Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: A systematic review and analysis'	Diet, cost, energy density, food prices, nutrient density, nutrition economics, socioeconomic status
209		Otero et al. 2015. Food security, obesity, and inequality: Measuring the risk of exposure to the neoliberal diet https://doi.org/10.1111/joac.12252	class diets, emerging markets, inequality, neoliberal diet, obesity

210		Using PEST Analysis as a Tool for Refining and Focusing Contexts for Information Systems Research, **Guo Chao (Alex) Peng, Miguel Baptista Nunes**	PEST or STEP analysis, Information System, Enterprise Resource Planning (ERP) System, China, Chinese Companies
211		Chile's Law on Food Labelling and Advertising: A Replicable Model for Latin America?	report
212		Climate Change and Extreme Weather Events; Implications for Food Production, Plant Diseases, and Pests **Cynthia Rosenzweig, Ana Iglesias, X.B. Yang, Paul R. Epstein & Eric Chivian** https://doi.org/10.1023/A:1015086831467	Public Health Climate Change Infectious Disease Food Production Plant Disease
213		Parasites, nutrition, immune responses and biology of metabolic tissues **T Shea-Donohue 1, B Qin 2, A Smith 2**	Th-2; cell; disease; immune modulation; malnutrition; mucosa.

214		The impacts of U.S. agricultural policies on Mexican producers **Timothy A. Wise**	n/d
215		A Study of British Organic Food Market **Jing Zhao1, * and Xiaoning Dou 2**	Organic food; market analysis; UK market; PESTLE model
Book			
Report			
Newspaper			
Website			
Fact sheeet			
magazine			
Survey			

Appendix C Survey

Introduction:

Hi! Thank you for being part of this nutrition and eating habits project.

The survey's objective is to find solutions through consumers for developing and implementing nutritional programs that fits within the society's needs and demand.

This survey is divided in 5 blocks:

1. Personal information
2. Nutritional profile
3. Internal/external drivers of consumers' behavior.
4. Nutritional knowledge
5. Individual sensorial preferences

The duration of the survey is approximately 15 mins.

Instructions:

1. Please do not leave any response in blank.
2. All your answers will remain anonymous and confidential.
3. Remember this is not a test. Answer according to your own personal criteria.

Section 1. Personal Information

Objective: To gather participant's information such as name, age, gender, occupation, level of education, income range (if applicable), and family/individual nutrition clinical history.

In addition, the information gathered in this section will help to select respondents who would be will to participate in the validation stage.

Question 1

What is your name?

Question 2

What is your age?

A1. Under 18 years old
A2. 19-25 years old
A3. 26-35 years old
A4. 36-45 years old
A5. 46-55 years old
A6. 56-65 years old
A7. 66 years old or older.

Question 3

Marital status

A1.Single, never married
A2. Married or domestic partnership
A3. Widowed
A4. Divorced
A5. Separated
A6. Other

Question 4

Do you have any children?

A1. Yes

A2. No

If answered yes,
How many do you have? Number of children:_____
How old are they? Age ranges
A1.1   0-5 years old
A1.2   6-10 years old
A1.3   11-15 years old
A1.4   16-20 years old
A1.5   >20 years old

Question 5

What is your occupation?

A1. Student
A2. Professional
A3. Employed for wages.
A4. Self-employed
A5. Not employed and looking for a job
A6. Not employed but not currently looking for a job
A7. Housekeepers
A8. Military
A9. Retired
A10. Occupational disability
A11. Other (please specify) _____

Question 6

What is the highest degree and/or level of education you have completed?

A1. No schooling completed
A2. Basic education (middle school, high school).
A3. Basic education completed (high school).
A4. Undergraduate student
A5. Undergraduate completed
A6. Post graduate student.
A7. Post graduate completed
A8. Studying Trade/technical school
A9. Trade/technical school completed
A10. Other (please specify) _____

Question 7

What is your monthly income?

A1. Between 0-500MXN
A2. Between 501- 1,000 MXN
A3. Between 1,001-5,000 MXN
A4. Between 5,001 and 10,000 MXN.
A5. Above 10,000 MXN.

Question 8

Are you enrolled or do you practice any physical activity?

A1. Yes
A2. No

If answered yes,
How frequent and how many hour/minutes per day you practice per occasion:
A1.1 >6 times per week ____
A1.2 3-5 times per week_____
A1.3 1-2 times per week____
A1.4 Every 15 days___
A1.5 Monthly____
A1.6 Occasional___

Question 9

In terms of your current individual medical history. Please select any illnesses/conditions which you have had diagnosed.

A1. Diabetes Mellitus Type 1
A2. Diabetes Mellitus Type 2
A3. Cancer
A4. Hypertension
A5. Cardiovascular or coronary diseases
A6. Obesity
A7. Overweight
A8. Other, please specify:
A9. I do not suffer with any disease.

Question 10

Does any of your immediate family and or relatives (son, daughter, grandparents, uncles, aunts, and/or cousins) have been diagnosed with any of these illnesses/conditions?

A1. Diabetes Mellitus Type 1
A2. Diabetes Mellitus Type 2
A3. Cancer
A4. Hypertension
A5. Cardiovascular or coronary diseases
A6. Obesity
A7. Overweight
A8. Any other, please specify:
A9. I am not sure

Question 11

Do you smoke?

A1. Yes
A2. No

If answered yes,
With what frequency do you smoke?
A1.1. Several times a day
A1.2 Once a day
A1.3 Several times per week
A1.4 Occasionally

Question 12

Do you drink alcoholic beverages?

A1. Yes
A2. No

If answered yes,
How frequent and how much quantity do you drink alcohol per occasion? Ingestion of beer, rum, tequila, brandy, etc. ONE is equivalent to one cup of wine (40ml),

bottle or can (330ml), glass of alcohol (40ml)

A1.1   Every day ___

A1.2   4-6 times per week____

A1.3   2-3 times per week____

A1.4   1 time per week _____

A1.5 Monthly____

A1.6 Less than a month____

Section 2. Nutritional status

Objective: To classify participant according to their BMI index, waist/hip ratio. Also this section will help to assess the eating frequency index for identifying the type of food eaten and the 24 hours recall for the total of macronutrients (kcal, protein, fat, and carbohydrates).

Question 1

What is your weight? (Open answer)

A1. (Measure taken when taking face-to-face survey).

Question 2

What is your height?

A2. (Measure taken when taking face-to-face survey).

Question 3

What is your waist-hip ratio?

A3. (Measure taken when taking face-to-face survey).

Question 4

What is your BMI?

A4. Taken from A1 and A2.

BMI=Weight (kg)/Height (m) ^{2}.

The result will help to classify the participant according to the WHO, BMI classification (Source: WHO 2006).

Classification	BMI
Underweight	<18.50
Normal range	18.50-24.99
Overweight	$\geq$ 25.00
Obese 1	30.00-34.99
Obese 2	35.00-39.99

Obese 3	$\geq$40.00

Section 3. Internal and external drivers for consumers' behaviour

Objective: To further understand the main internal and external drivers of consumers and how does it relate with their nutritional status and final eating/drinking behaviours.

Question 1

How important is for you the FOOD PRICE when purchasing any food product?

A1. Not at all important
A2. Slightly important
A3. Mildly important
A4. Important
A5. Very important

Question 2

How frequent do you get your food/beverages?

A1. Daily
A2. Weekly
A3. 2-3 times per month
A4. Monthly

Question 3

Which rate do you think you dispose to buy food from your income in a weekly base scheme?

A1.1 Beef meat
A1.2 Poultry
A1.3 Broccoli
A1.4 Beans
A1.5 Milk

A1. 0-1,000 MXN per week
A2. 1,001-3,000 MXN per week
A3. 3,001- 5,000 MXN per week
A4. >5,001 MXN per week
A5. Not sure

Question 4

When buying your groceries, do you consider having a limited budget?

A1. Never
A2. Sometimes
A3. Half of the time
A4. Many times
A5. Always

Question 5

List from 0 to 5 (being 0 the most affordable and 5 the least affordable) from the following food items that you find in your preferred market/store/supermarket, according to a personal **economic criteria.**

Question 6

At home mainly who decides what food/drinks to purchase?
A1. Wife/female partner
A2. Husband/male partner
A3. Both female/male equally
A4.Sons and/or daughters
A5. All members equally
A6. Other (please specify)
A1.6 Fish fillet
A1.7 Corn Tortilla
A1.8 Pork Meat
A1.9 Sugar drink beverage
A1.10 Bottled pure water

Question 7

What percentage of time per week you would eat-out? (Being 0 the lowest and 5 most of the time)

Rarely				Most of the time	
0	1	2	3	4	5

Question 8

From 0 to 5 being 0 the lowest and 5 the main reason of why do you decide to eat-out according to your current lifestyle.

	Least reason				Main reason	
	0	1	2	3	4	5
Time saving						
Family/Friends gathering						
Saving money						
Offer inside work						

Question 9

From 0 to 5 being 0 the least and 5 the main degree of preference for the following eating-out options.

	Least degree of preference				Main degree of preference	
	0	1	2	3	4	5
Hamburgers, pizzas.						
Meat, chicken restaurant						

Vegetarian/vegan						
Mexican dishes						
Fish and seafood restaurant						

Question 10

Do you consider social media, internet, could influence in what you choose to eat/drink?

A1. Never
A2. Sometimes
A3. Half the time
A4. Most of the time
A5. Always

Question 11

Are you a consumer that likes to read labels, to have an idea of the origin of the food products?

A1. Never
A2. Sometimes
A3. Half the time
A4. Most of the time
A5. Always

Question 12

When reading nutritional food products labels, do you usually understand what they mean?

A1. Never
A2. Sometimes
A3. Half the time
A4. Most of the time

A5. Always

Question 13

Have you previously used health and food
mobile apps, which could motivate you
eating better?

A1. Never
A2. Sometimes
A3. Half the time
A4. Most of the time
A5. Always

Question 14

One practical aspect when eating out that
could help you choose healthier is that
establishments would offer nutritional
information on food and beverages.

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Question 15

How much you agree/disagree to taxes
applied in sugar products?
(Refreshments, sugar bread)

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Section 4. Nutritional knowledge

Objective: To understand what is the current perception and awareness from participants of the nutrition norms and guidelines in Mexico.
The information will help to do a cross-section analysis with responses from sections 2, 3 and 5 of survey to determine the importance of nutritional knowledge in participants' eating habits and therefore the impact their knowledge has on their nutrition.

Question 1

Have you attend to any nutritional orientation courses previously offered by the public national health institution in your community or in your clinical health services?

A1. Yes
A2. No
A3. I did not know about these health services.
A4. I did know but I never have time to go.
A5. I don't follow any public health service activity for community.

Question 2

Do you find it interesting and usually put into practice the recommendations of nutrition orientation given by the public health sector through radio, T.V. and internet?

A1. Never
A2. Sometimes
A3. About half the time
A4. Most of the time
A5. Always

Question 3

Nutrition is a term that its best define as an improvement in the physical appearance or an improvement to health.

A1. Physical appearance
A2. Improvement of health

Question 4

The recommended portion of fruit and vegetables is of 5 portions per day. Do you always follow this recommendation?

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Question 5

The recommended size portion of meat it's of a hand palm (75-90grams). Do you always follow this recommendation?

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Question 6

How probable is that you add salt to your food plate even without tasting it first?

A1. Extremely unlikely
A2. Unlikely
A3. Neutral
A4. Likely
A5. Extremely likely

Question 7

Do you associate the overconsumption of sugar and soda with gaining weight and development of diabetes mellitus type 2?

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Question 8

Do you associate the overconsumption of fast food with gaining weight and possibly developing a heart stroke?

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Question 9

If you would decide to improve your health which of the following mobile apps you would prefer the most?

A1. Mobile app that would regulate physical activity and weight
A2. Mobile app that would regulate diet and weight
A3. Both mobile apps
A4. None of them.

Question 10
Does it happen to you that you need to throw away food that you buy, because of spoilage?

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Section 5. Lifestyles and internal behaviours (i.e. beliefs, motivations).

Objective: To understand what is the current individual beliefs within the context of eating habits and nutrition. To understand if participants are aware of their eating habits related to their current health status according to normative and individual motivations. Cross analysis with section 2, 3, 4 will help to analyse the possible cognitive dissonance regarding current knowledge and beliefs.

Question 1

From the following options. With which you would identify the most?

A1. Use of car/public transportation or
A2. Cycling/walking
A1. Health prevention or A2. Health treatment
A1. Produce and buy food or A2. Buy food
A1. 5-10 minutes cooking or A2. 30mins-1 hour cooking
A1. Product's brand and taste or A2. Product's price and taste
A1. Product with package or A2. Bulk product.

Question 2

From the following activities, list them (from 1 to 3) from the most frequent to the least frequent according to you current lifestyle.

A1.Going out with friends/family to eat out.
A2. Seeing T.V. with family.
A3. Going out with friends/family for a walk.

Question 3

Which motivation source you would first look for starting a healthier lifestyle?

A1. Self/Individual motivation
A2. Family motivation
A3. Friends' motivation
A4. All of the above
A5. None of the above.

Question 4

An important motivation for starting a healthier lifestyle would be more variety and less cost in fruits and vegetables.

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Question 5

Enjoying eating means also eating healthier.

A1. Strongly disagree
A2. Disagree
A3. Neither agree nor disagree
A4. Agree
A5. Strongly agree

Question 6

If someone would let you know that eating well not only benefits your health but also the environment and combats climate change. Would you then consider to improve your eating behaviours?

A1. Strongly oppose
A2. Somewhat oppose
A3. Neutral
A4. Some in favour

A5. Strongly in favour

Question 7

Are you aware and do believe that what you decide to eat and drink today could affect your health tomorrow. Does this concern you?

A1. Not at all concerned
A2. Slightly concerned
A3. Half concerned
A4. Very concerned
A5. Extremely concerned

Question 8

How satisfied are you with your current eating and drinking habits?

A1. Not at all satisfied
A2. Slightly satisfied
A3. Half satisfied
A4. Very satisfied
A5. Extremely satisfied

Question 9

How willing are you to change your current eating/drinking behaviour towards a healthier and nutritional daily lifestyle?

A1. Not willing
A2. Somewhat not willing
A3. Neutral
A4. Somewhat willing
A5. Willing

Appendix D Raw Data shared link

Cranfield Online Research Data (CORD) : 'Data supporting the Thesis "A study of obesity drivers in Mexico using alternative future scenarios to define policy interventions".

https://doi.org/10.17862/cranfield.rd.19145906.v3