Dietary quality of out of home eating and food processing levels in urban and rural Ecuadorian adolescents

Nima Yaghmaei

Promoters: Prof. dr. ir. Carl Lachat

Tutor: Prof. dr. Angelica Ochoa-Avilés

Master dissertation submitted in partial fulfilment of the requirements for the degree of Science in Nutrition and Rural Development

Main subject: Human Nutrition – Major: Public Health Nutrition
Abstract

**Background:** In the past decades there has been a global disease transition leading to increasing deaths from non-communicable diseases. Recently, developing countries going through industrialization and urbanization have become increasingly affected by nutrition related health issues. This is a result of dietary transitions from nonprocessed traditional foods to processed industrialized diets. Ecuadorian adolescents are becoming increasingly overweight, and are faced with a burden of various cardiovascular risks. Subsequently, there is a need for dietary assessment; in particular the assessment of influence from out of home foods and processed foods is needed in order to better understand the nutrition transition.

**Objective:** The main objective of this thesis was to determine the relationship from, and between, out of home foods, and levels of food processing, on the diet and diet patterns of Ecuadorian adolescents. As well, there was an aim to investigate the influences of out of home foods, and levels of processing across sociodemographic groups, and how dietary patterns may be influenced across individuals.

**Design:** The study performed is a cross sectional study among 779 adolescents 10-16 years old from the Azuay province in Ecuador. The adolescents represent both urban and rural populations. Food intake was measured using 2-day 24-hour dietary recalls, as well as other factors such as location of consumption, and location of production. Food intake was categorized by locations of preparation, location of consumption, and level of food processing. These factors were assessed across the entire group, as well as consumer groups, and different sociodemographic groups.

**Results:** Home foods were lower in energy density (0.92kcal/g) than out of home foods (1.34kcal/g), and school foods (1.74kcal/g). As well, out of home foods were higher in fat, sodium, and sugar compared to home foods. Ultra-processed foods were the largest energy contributor to out of home foods (71.3%). Ultra-processed foods were higher in fat, 12 times higher in sodium, and over 100 times higher in added sugar than nonprocessed foods. Out of home foods consumption in consumer groups was positively associated with higher energy density (P<0.01), higher fat intake (P<0.01), higher sodium intake (P<0.01), higher added sugar intake (P<0.01), and higher intake of ultra-processed foods (P<0.01). However, no significant difference in anthropometric measurements between consumer groups was found.

**Conclusion:** Out of home foods, and ultra-processed foods were found to associated with one another, and with dietary factors associated with cardiovascular risk, and NCDs. The influence of out of home foods, and ultra-processed foods were not exclusive to urban, or ‘better off’ adolescents, therefore indicating a transition in diets that has already occurred, and will continue. More research is needed for classifying and understanding the influences that out of home foods, and ultra-processed foods have on developing countries, as well, interventions and measures are required at the moment to mitigate further health issues from the nutrition transition, and global disease shift.
Acknowledgment

Here it is, the final document, in my final step of formal education. Education is a personal journey for everyone, but it is not one taken alone. I would like to extend my gratitude to every single person that has impacted me in my nineteen years of schooling, from my incredibly patient teachers throughout my childhood, to the professors who allowed me the freedoms to handle my studies in the way suited for me. I never found school easy. Focusing, and sitting still have never been my strengths, and these difficulties have dragged me down through the years, so all the teachers, tutors, mentors, professors, and others who recognized this and still appreciated me, I relay my first thank you.

I would like to thank Angelica, my tutor, and the entire staff the University of Cuenca, who helped me in September 2015 during my time there. Outside of the thesis work, your warmth made my stay in Ecuador an incredible experience that I will never forget.

I would like to thank professor Patrick Kolsteren for giving me the opportunity to work on this topic, and professor Carl Lachat who was my promoter, and acted as a crutch for my erratic work habits.

I would like to thank the university’s academic and administrative staff, in particular Anne-Marie Remaut De Winter, and Marian Mareen. You made me, and everyone else in our program, feel cared for, and like family. I have used every opportunity in the past few weeks to say hello because I will miss both of you so much.

I would like to thank the city of Gent, and the nation of Belgium for accepting me, and opening their doors to this loud mouthed Canadian to call their place home for two years. I hope I made it a better place, not worse.

I would like to thank my dearest friends. All of them. My fondest memories will be the times with all of you. I have grown so much in these two years, and you are an integral part of this growth.

Finally, I would like to thank my parents. I am sorry I have not lived at home for so many years. It is the courage, and hard work of my parents that has brought me to this height in my life. They have been there for me in every occasion of my life. I am dedicating my life to giving back to those in need, and I can only dream of one day providing to someone anywhere close to what you have provided me.

With love,

Nima
Dedication

This thesis, and all my future work is dedicated to the people.

To the children who have been brought up in an environment where temptations, economics, food access, and societal norms have created the potential to suffer from health conditions far too prematurely.

To all those who suffer injustice in this world, whether it be because of their gender, religion, ethnicity, race, socioeconomic status, sexual orientation, etc. Privilege to live a healthy, happy, prosperous life comes with responsibility. The responsibility to dedicate every ounce of energy to making sure others have the same opportunities as you.

In my, short but so far eventful, life, I have seen far too much to stay quiet, to remain comfortable, and to ignore. I have shaken your hands, seen your eyes, heard your voices, and felt your pain. I am at your disposal, and I can make no promises other than to, for better or worse, try my best to make things right.
# Table of contents

Abstract............................................................................................................................... I
Acknowledgment.................................................................................................................. II
Dedication............................................................................................................................ III
Table of Contents.................................................................................................................. IV
List of figures....................................................................................................................... V
List of abbreviations............................................................................................................. VI
1. Introduction...................................................................................................................... 1
   1.1 Justification.................................................................................................................. 2
   1.2 Objectives.................................................................................................................... 3
      1.2.1 Main objectives...................................................................................................... 3
      1.2.2 Specific objective.................................................................................................. 3
1.3 Hypothesis.................................................................................................................... 3
1.4 Limitations................................................................................................................... 4
2. Literature Review............................................................................................................ 5
   2.1 Context....................................................................................................................... 5
      2.1.1 Global nutrition transition .................................................................................. 5
      2.1.2 Latin America and Ecuador’s transition............................................................... 6
      2.1.3 Cardiovascular risk.............................................................................................. 7
      2.1.4 The location......................................................................................................... 7
   2.2 The Diet..................................................................................................................... 8
      2.2.1 Dietary patterns and behaviours........................................................................... 8
   2.3 The Factors................................................................................................................ 9
      2.3.1 Out of home foods............................................................................................... 9
      2.3.2 Processed foods.................................................................................................. 11
      2.3.3 Sociodemographics.......................................................................................... 11
3. Methodology.................................................................................................................. 13
   3.1 Original study............................................................................................................ 13
   3.2 Data collection.......................................................................................................... 13
   3.3 Dietary intake.......................................................................................................... 13
   3.4 Meal times................................................................................................................ 14
   3.5 Cardiovascular risk factors..................................................................................... 14
   3.6 Sociodemographic groups...................................................................................... 14
   3.7 Location of preparation and consumption............................................................. 14
   3.8 Processing level..................................................................................................... 15
3.9. Data analysis

4. Results

5. Discussion

5.1. Location

5.1.1. Location of preparation vs. consumption

5.1.2. Animal fat in school foods

5.2. Meal times

5.2.1. Breakfast impact

5.3. Food groups

5.3.1. Cardioprotective foods

5.3.2. Cardiovascular risk foods

5.4. Processing levels

5.4.1. Nonprocessed foods

5.4.2. Culinary Ingredients

5.4.3. Processed foods

5.4.4. Ultra-processed foods

5.5. Consumer groups

5.5.1. Anthropometric results

5.5.2. Other considerations

5.6. Sociodemographics

5.6.1. Settings

5.6.2. Urban-rural divide

5.6.3. Socioeconomic status

5.6.4. Cost discrepancies

5.7. Future outlook

5.7.1. School food program

5.7.2. Environment

5.7.2.1. Behavioural influences

5.7.2.2. Availability

5.7.2.3. Industry

5.7.3. Personal

5.7.3.1. Intervention

5.7.3.2. Temptations

6. Conclusions

7. References

8. Appendix
List of Tables

Table 1- Energy Density and Diet Quality by Location of Preparation of Foods..........................17
Table 2- Energy Density & Diet Quality by Level of Processing of Foods Consumed..................18
Table 3- Food Group Sources Distribution by Location of Preparation........................................19
Table 4- Energy Input from Processing Levels by Location of Production..................................19
Table 5- Location of Production, Location of Consumption, and Consumption Based on Processing Levels by Place of Residence & Socioeconomic Status........................................20
Table 6- Location of Preparation by Designated Meal Times.....................................................21
Table 7- Level of Processing by Designated Meal Times.............................................................21
Table 8- Diet Quality, processing consumption, and anthropometric results across consumer groups based on levels of out of home prepared food consumption.............................................22
List of Figures

Figure 1- Causes of death by the year 2000................................................................................................5
Figure 2- The Rise in NCD related deaths globally......................................................................................6
Figure 3- The Location of Azuay Province in the Ecuadorian Highlands.......................................................7
Figure 4- Rural Women Roasting Traditional Guinea Pig...........................................................................9
Figure 5- Traditional and industrialized foods were regularly combined....................................................10
Figure 6- Contrast between the urban (above), and rural (lower) setting of the study.................................12
Figure 7- Ecuadorian tortillas were a common snack to buy on the street......................................................25
Figure 8- A wide variety of fruits on offer at local urban market.................................................................27
Figure 9- Chicken Soup, an example of a traditional food impacted by culinary ingredients (sodium), and ultra-processed ingredients (broth cube).................................................................................................29
Figure 10- Traditional roasted pork in a rural market..................................................................................32
Figure 11- Potatoes being deep fried in animal fat in the rural market......................................................33
Figure 12- An urban market with produce at the lower level, and cafeteria style food in the upper........36

List of Abbreviations

BMI – Body mass index
CI- Confidence Interval
CVD – Cardiovascular disease
DBP – Diastolic blood pressure
LMIC – Lower middle income countries
NCD – Non communicable disease
NR-NCD – Nutrition related non communicable disease
SBP – Systolic blood pressure
1. Introduction

The end of the 20\textsuperscript{th} century set the path for the alarming phenomena of global disease transition, which was both strengthened and continued into the 21\textsuperscript{st} century (1). The sharp decline of communicable diseases in developing countries has been counteracted by a rapid increase of non-communicable diseases (NCDs) that had been previously unique to industrialized nations (2). This shift of diseases that has occurred has been partly attributed to an increase in prevalence of overweight and obese populations in the developing world (3). The growing burden of NCDs, such as, heart disease, stroke, diabetes, and high blood pressure, nowadays account for the majority of deaths in both developing and industrialized countries (1). Taking into account the significantly younger populations of lower income and lower-middle income countries, children and adolescents represent a considerable target group for NCD risks (4). This, as well as the limited health resources and preparation in such countries, is a cause for great concern in terms of the global health picture for many years to come.

Mounting evidence suggests that there are a number of dietary patterns which are seen as protective against NCDs, especially cardiovascular diseases (5). A diet consisting of fruits, vegetables, whole grains, and fish has been recognized as protective, while a diet with high quantities of added sugar, sodium, and refined carbohydrates, have shown the opposite effect, and are considered cardiovascular risk foods (5). The combination of a poor diet without protective foods, as well as, limited physical exercise and activity at an early age are believed to be key contributing factors to the development of NCDs in future years (6).

With that being said, globalization, food system modernization, as well as, the general increase in development throughout the world in the past decades, has led to a shift in global diets and lifestyles. Developing countries are now catching up to industrialized nations, and find their dietary intakes to include more energy, and less nutrient dense foods (7; 8). These changes have led the way to an altered dietary lifestyle where out of home eating, in the form of ready to eat meals, restaurants, schools, street foods, and work sites, have become a significant part of daily energy intake (8).

Out of home foods are considered a concern by researchers because they have been characterized with higher energy densities, larger portion sizes, and reduced consumer information and health options (8). Different demographics have been found to consume a varied level of out of home foods. However, adolescents and school children tend to be the largest consumers of out of home foods (8). Similarly to out of home foods, foods that are considered processed, which tend to be more energy dense, less nutrient dense, and higher in sugar and sodium, are increasing in consumption levels (9). This can be heavily attributed to the fact that processed foods are more convenient, often cheaper, and more palatable (9). As well with expansion of food production and a globalized food industry, processed foods are appearing more commonly in developing countries, and are becoming more accessible to all income brackets (5). All these factors contribute to a multidimensional domain that has led to global disease transitions, a domain that includes not only diet and activity patterns, but social and economic stresses as well (3).

An area of the world that has been at the forefront of this disease transition is Latin America, which has seen good levels of development in previous decades, as well as, an increased prevalence of NCDs (3). The South American nation of Ecuador is an example of such circumstances. Ecuador’s urbanization and
development has contributed to a significant change in lifestyles, and dietary patterns, which have led to cardiovascular disease (CVD), and diabetes, presently accounting for the majority of deaths (10).

Overall, global disease and nutrition transition has been established as a fast growing health concern that may shape the populations of many nations in the coming years. Understanding all factors associated with this transition is key to our future policies and measures used in order prevent a future escalation of problems. Out of home eating has been recognized as an important contributor to dietary patterns internationally, and the out of home foods have been consistently associated with dietary patterns that can be linked to the development of NCDs and CVDs (4; 5). However, much remains to be known about the true significance of out of home eating in developing countries, and the variety of foods consumed in such settings. The relationship between socioeconomic status, out of home eating, consumption of processed foods, and overall dietary quality in lower and middle income countries, is yet to be properly documented (8). It is essential that we better our understanding to help develop stronger policies to fight the burden of NCDs on the rise in the developing world. In this study, the dietary quality of school attending adolescents in the area of Cuenca and Nabón in Ecuador will be assessed in regards to the practises of out of home eating, and level of processed food consumption, in order to compare the out of home foods and home foods on diet quality, dietary patterns, and cardiovascular risks.

1.1. Justification

Foods categorized by either consumption or preparation location, as well as, level of processing, were used to compare dietary quality, dietary patterns, and cardiovascular risks of Ecuadorian adolescents in both rural and urban settings.

Currently there is a limited amount of knowledge regarding out of home consumption, particularly by location of preparation, for at risk groups in developing countries (11). This lack of knowledge is also the case for the association between levels of food processing and out of home foods for at risk groups in developing countries.

By presenting relationships of dietary quality, and dietary patterns in regards to out of home foods and processing levels, there will be a better understanding of the issue at hand. At date there is a need for longitudinal studies associating dietary patterns and out of home eating with cardiovascular risks in developing countries, and this study will build evidence to provide a platform for further studies (12). As well, this study will help fill knowledge gaps which can later prove valuable to officials and researchers when implementing policies addressing the health concerns that Ecuador currently faces.
1.2. Objectives

1.2.1. Main objective
To determine the relationship from, and between, out of home foods, and levels of food processing, on the diet quality and diet patterns of Ecuadorian adolescents.

1.2.2. Specific objectives
1. To compare the dietary quality of foods based on locations of preparation.
2. To compare the dietary quality of foods based on levels of food processing.
3. To compare the access of food groups based on location of preparation.
4. To determine the relationship between location of preparation with different levels of food processing.
5. To compare the patterns of food consumption based on location of preparation, and levels of food processing, across different sociodemographic groups.
6. To compare the patterns of food consumption based on location of preparation, and levels of food processing, for different meals.
7. To categorize consumers based on out of home prepared foods into quartiles in order to compare diet quality, diet patterns, and cardiovascular risks.

1.3. Hypothesis

Null hypothesis:
There is no difference in the risk factors (dietary quality and cardiovascular risks) based on out of home foods consumed by rural and urban Ecuadorian adolescents.

Alternative hypothesis:
There is a difference in the risk factors (dietary quality and cardiovascular risks) between out of home and home foods consumed by rural and urban Ecuadorian adolescents.
1.4. Limitations

As with all studies, this investigation has limitations. The data is from 2008-2009, meaning that it is a few years old. This may not fully represent the current situation in Ecuador, seeing as food systems are quite dynamic. As well, as this study is cross sectional, causalities cannot be claimed, only associations. In the future further studies on the matter will hopefully provide such information.

The limitations which are commonly faced by food intake studies based on individuals exist for this study as well. There is the problem of recall bias in this case. The categorization of food locations by place of consumption is much more straightforward than that of place of preparation; therefore classification of place of preparation did present challenges, and have higher potential for false information. Out of home foods in general are difficult to correctly measure in both portion size, as well as, nutritional quality, therefore there is a potential for bias by those means as well. Finally, all out of home prepared foods fell under the same category without differentiating between quick stops, restaurants, fast foods, food trucks, etc., which have all been known to have very different food qualities (11).

Classification and categorization of processing levels of food, which is further discussed in methodology, was a challenge. Arguments can be made on whether certain food items should, or should not be in certain categories of processing. Overall, the problem of classification of processing level exists in the sense that each setting is different, and the same means of classification cannot be necessarily transferred to another setting.

Associating diet quality and diet patterns to cardiovascular risk through anthropometric measures is a target as it would provide significant evidence for the connection of diet to adolescent health. However, at this point in time, that is difficult for the following reasons. The large variety of genetic backgrounds of adolescents found in the study signal a difference in nutritional phenotypes which were not investigated (5). As well saturated fats and levels of cholesterol consumption were not examined, therefore making linkages to blood cholesterol has reduced reliability (5). The linkages of diet behavior and anthropometric results in adolescents have been difficult to demonstrate previously, and with the variety of foods present in each category of food locations, and processing levels, it was not possible to make those linkages in this study.
2. Literature review

The present study will examine the relationships, and the influence of out of home foods and processing levels, on diet quality, diet patterns, and cardiovascular risk. To do so, and to interpret the results in a meaningful way, it is important to understand the context of the study. In the following section, the influence of dietary patterns previously documented will be discussed, as well as the previously documented influences of out of home foods, processed foods, and sociodemographic situations on the topic.

2.1. Context

2.1.1. Global nutrition transition

The transition that has occurred globally, especially in developing countries, in regards to NCDs is nothing short of alarming. Countries undergoing these transitions are unequipped to handle such long term and malignant burdens to their health care systems, and in turn, the populations of such nations are not able to access the health care that they desperately require. It is widely known that a healthy lifestyle consisting of exercise, and a diet of cardio protective foods, throughout many years can go a long way to reducing the potential for adverse health and NCDs (5). However, this knowledge has not been enough to curve the growth of NCD prevalence, or to stem the transition of dietary patterns that resemble the “westernized diet” which is rich in animal products, fats, sugars, and sodium.

![Figure 1: Causes of death by the year 2000 (1) (Red lines Symbolize NR-NCDs)](image)

It has been discussed that the rapid change in the global system of food, which includes increased production and availability of processed food, has been a major driving influence for the global obesity crisis (9). The term Nutrition Related NCDs, (NR-NCDs), has been termed due to the significant impact this nutrition transition has had on the prevalence of NCDs (3). CVDs and diabetes currently account for 80% of deaths in LMIC, with these deaths and health problems occurring at younger ages in such
countries (13; 14). As efforts to curb NCDs and unhealthy lifestyles is growing in wealthier nations, developing countries are falling behind, and at present the level of both research and interventions in such issues is limited.

2.1.2. Latin America and Ecuador’s transition

In the past decades Latin America has shined as one of the beacons for successful development, but with this has also comes the global disease and nutrition transition. Latin America has had some of the world’s highest urbanization rates, a factor which tends to lead quickly to the NCD shift (16). These numbers are predicted to continue increasing, since by 2030 there is expected to be a 50% increase in diabetic deaths, while 50% of men, and 60% of women are predicted to be overweight or obese (16). Within LMIC, Latin American countries represent some of the highest levels of overweight, and obese individuals in the world, particularly in the regions of the Andes Mountains (17; 18).

![Figure 2: The Rise in NCD related deaths globally (WHO Global Report 2014)](image)

Ecuador is particularly a place of interest because of the level of obesity and overweight individuals, especially in adolescents. Similar to the rest of Latin America, it has seen a significant increase in latest years (20). In the meantime the level of nutrition research being conducted in Ecuador, especially towards nutrition transition and out of home dietary intake is scarce (20). National surveys indicate that 90% of individuals consume less than 5 servings of fruits and vegetables daily, and further research has found that to be true in the younger populations, particularly adolescents (20; 5). In 2008, 40% of men were overweight, while 50% of women were overweight; this number was even higher within individuals of a lower socioeconomic status (20). Since then, the prevalence of overweight women has reached 58% and is set to increase, while diabetes deaths have doubled in the past decade (21; 20). With such problematic figures emerging from Ecuador, it is clear that there is need for action in order to mitigate a further health crises and long term troubles for the nation.
2.1.3. Cardiovascular risk

Cardiovascular diseases are the main contributor to deaths associated with NCDs, and therefore should be highly considered when looking at the risks of a population to NCDs (5). NR-NCDs have been attributed to lack of exercise, and poor dietary quality, which usually includes the consumptions of food attributed to cardiovascular risk (3). Out of home foods and processed foods have been associated with properties considered cardiovascular risk, and therefore it is necessary to compare cardiovascular risks and dietary practices of individuals consuming different levels of out of home foods, and processed foods (9; 12). Cardiovascular risks often predate the development of NCDs and establishing their presence in adolescents is beneficial to have a better understanding of long term implications of poor dietary quality. However, at present, these associations are not fully clear, since in adolescents established connections between consumption of out of home foods, and processed foods, on anthropometric outcomes has not yet been found (6).

2.1.4. The location

The study was conducted in the Azuay region of the central highlands of Ecuador. The region is quite elevated, with Cuenca, the biggest city at 2350m above sea level, and is part of the Andean mountain range (22). The two study locations were the city of Cuenca, which has approximately half a million inhabitants and the rural area of Nabón with a much smaller population of approximately 15,000 inhabitants (23). Despite being in the same region of Ecuador, the two areas vary quite a lot. Nabón is higher in elevation, and is home to more indigenous people, which make up roughly one third of the population, while in Cuenca they only represent 1%. Nabón also has higher rates of poverty, with 88% of the population being considered “poor”, while in Cuenca that number is reduced to 38% (24;25).
The study included adolescents who attended school in either Cuenca, or Nabón. In Cuenca, school attending adolescents makes up 73% of the adolescent population, but in Nabón, it is only 58% (1). In previous studies conducted, despite a portion adolescents not included because of school absence, it is apparent that metabolic disorders exist within the study group. Overall, 18% of adolescents were overweight, and 2% were considered obese (1). Generally, urban adolescents tended to have a higher risk of being overweight, or obese (1). 6% were within blood pressure risk designation, and 34% had dyslipidaemia (1). A matter of great concern is that 51% of rural adolescents, and 38% of “poor” adolescents were found with dyslipidaemia (1). Along with a reduced level of physical exercise, and poor dietary habits, the adolescents of both Cuenca and Nabón are far from optimal in health standards. As a double burden, in many areas of Ecuador, particularly rural highlands, undernutrition is still an issue, and although reduced, the level of stunting highlights the need to maintain diligence in terms of food insecurity (26).

2.2. The Diet

Part of the steps in mitigating NCDs and reducing the risk of excessive weight gain is through consuming a good quality diet, one that is particularly high in protective foods, and low in cardiovascular risk foods. Whole food items, such as fruits, vegetables, whole grains, fish, etc, are considered part of a protective diet (5). Despite having a vast variety of plant diversity, in fact the world’s most vegetable dense region, and high levels protective foods available throughout the markets, only approximately 11% of Ecuadorian adolescents in the study were eating enough fruits and vegetables per day (5). The overall availability of fruits and vegetables were deemed a non issue, however, the convenience and distribution of this availability were not necessarily considered.

Added sugar, refined carbohydrates, and sodium are considered to be damaging foods in terms of NCDs (5). These items were readily available for consumption by the adolescents, and were highly popular (5). A diet high in damaging foods has spread to the rural regions of Ecuador as well, which has been a highly influential cause for the overall increase of calorie consumption in Ecuador (5; 20). The trend of out of home eating, and unhealthy food is seen as part of modern lifestyles, and cool factor by adolescents, and these behaviour trends go a long way in establishing dietary norms (27).

2.2.1. Dietary patterns and behaviours

The dietary consumption patterns and behaviours of individuals, based on personal choice, external influencers, and environment, dictate the dietary intake of that individual. Overall, the adolescent setting in this study is fairly homogenous, particularly in the rural regions, and general trends of consumptions are seen throughout much of the population (5). This also signals the importance of interventions to cater to the entire group, not just certain portions of the population.

Many students have a basic knowledge of good food practices, although there are some large gaps of knowledge. Home foods and traditional foods are generally seen as healthy choices, whilst out of home foods are considered less healthy (28). Many students blame temptations, positive taste, and peer influence for consuming too many out of home, and unhealthy foods (28). Self efficacy tends to be low within the students for healthy food, whilst parents blame the environmental surroundings of the students
for their unhealthy practises (28). Reversely, the schools see the parents and the consumption patterns of the family as part of the blame (28).

The costs of less healthy, but more energy dense foods tend to be less (29). The presence of this cheaper, more filling food, particularly in areas close to schools leads to an environment where cost, convenience, and peer pressure, replace potential learned behaviours of healthy food, and cause unhealthy food patterns (29;28). This study did not consider food costs, however it has been previously documented that particularly within “poorer” family, especially in rural regions, large portions of income is dedicated to foods costs, a situation where food insecurity becomes regular and diets are often compromised (26).

2.3. The Factors

2.3.1. Out of home foods

Out of home foods are considered a concern by health experts because they have been characterized with higher energy densities, lower nutrient densities, larger portion sizes, and reduced consumer information (8). A simple increase of out of home foods twice a week has been associated, in study considering both location consumption and preparation, with an increased risk of overweight or obesity by 33% (11). While in other studies, out of home eating was found to have no association with BMI (27). Leading to a conclusion that there is a much bigger need for conclusive results regarding out of home food consumption especially considering that often out of home foods can make up over 50% of daily energy intake, especially in adolescents, and that the influence of out of home foods is very unique to every
setting (8). The difficulty of tracking and considering out of home foods is also extending in the fact that consumers often have no control over the contents, and portion size of their food, leading to oversized and over stimulating foods (30).

For the purpose of this study, the place of consumption was not the main consideration, but instead, the place of preparation. This is because foods prepared out of homes in locations such as fast food establishments or industrial factories, tend to exhibit the same qualities as processed foods, which is a reduction in dietary quality, therefore where the food ends up being consumed is irrelevant (12). Place of consumption is not the focus because of the nature of consumption behaviours previously documented, where foods prepared out of the home were taken home for consumption, thereby being considered home foods by consumption (12). Previous studies have also opted for using location of preparation instead of location of consumption based on the same concepts, describing the location of preparation as “the real one” (4).

Not all trends in out of home foods are in the same direction. In rural regions of LMIC, more out of home consumption has been connection to higher protein, and meat consumption (4). In some LMIC consumption of out of home foods is associated with increased vitamin A, and iron consumption, and is seen as an important contributor to nutrition (4;27). In China no association of out of home foods and increased energy intake for adolescents has been found (8). This trend is observed in China, and many other countries where out of home foods are in many cases, still traditional foods (8). Other than potential health benefits, out of home foods are expanding as a form of social prestige, an opportunity for social gatherings, and perhaps most influential, a more convenient way to fill up while busy going about life.

Consumption levels of out of home foods are quite varied, and considering that, frequency of consumption, can be highly influential. It is crucial that consumer groups are categorized appropriately (11). Studies often conduct consumer grouping, but usually using frequency of consumption. This is problematic considering that in this method; a small chocolate snack would have the same registered value as a full fast food meal, despite having an entirely different level of dietary influence. It has been stated that there is a need for addressing total sources of out of home prepared foods, due to most studies being focused on specific single sources, such as fast foods, school foods, or junk foods (11). Therefore

Figure 5: Traditional and industrialized foods were regularly combined (Yaghmaei, 2015)
this study applied categorization to individuals by their overall energy influence from out of home prepared foods, and therefore obtaining a much more complete understanding. This will be done by grouping based on percentage of daily energy derived from out of home prepared foods.

### 2.3.2. Processed foods

For the purposes of convenience, in terms of transport, storage, and distribution, as well as, personal convenience in regards to being able to consume in anyplace, at any time, without needing preparations, processed foods have become a major part of our diets (9). This trend is not restricted singularly to developed nations, but the processed food system has now stretched its reaches throughout the globe.

Cardio-protective foods that have been identified as items like fruits, vegetables, whole grains etc, have a common feature of being whole ingredient items which are often quite perishable and without significant processing (5). Food items that are present in diets with cardiovascular risk are often classified as processed foods. Processed foods, especially ultra-processed foods are detrimental to health since they are often higher in added sugars, sodium, and excessive oils, and contain lower levels of proteins, fibers, and natural food ingredients (9). These factors result in processed foods being more energy dense, with more fats, sugars, and sodium, than nonprocessed foods (9). They are also often considered more palatable, particularly with the combination of added sugar and fat which has been documented as addictive (9;31). In a previous published systematic review, consumers were broken down in quintiles based on level of processed food consumption. Only the lowest quintile was close to reaching the required nutrient intake, all other groups were deficient (32).

One of the fundamental causalities for the obesity trend globally is the change in diets, with processed foods being an integral part of this change. Processed foods are associated with foods prepared outside of the home setting, and therefore the associations between the two were closely examined. In this study, ultra-processed as previously defined by Carlos Monteiro was used for identification (9).

### 2.3.3. Sociodemographics

Different demographics have been found to consume a varied level of out of home foods, however, adolescents and school children tend to be the largest consumers of out of home foods, which reiterate the concerns of shifting diet patterns as populations age (8). As previously discussed, the association between out of home foods is still disputed for adolescents, but in some cases show a strong association. The effects in regards to bodyweight between consistent consumers of out of home foods, and those who consume out of home foods less frequently, has shown to increase with age, therefore making it crucial to address the issue at an earlier age such as adolescents (12). As well, previous findings have found contradicting levels of overweight and obesity prevalence between genders, in which men have tended to consume out of home foods more frequently, but also had lower levels of overweight and obesity (12).

Socioeconomic status is an important characteristic for dietary patterns, out of home food consumption, and obesity. Out of home food consumption has regularly shown an increase with income, however, in most settings individuals belonging to a lower socioeconomic status tend to be at higher risk of overweight and obesity (8; 20). This is in direct contrast with the Azuay region of Ecuador, where ‘better off’ students had higher levels of obesity (5). The higher intake of out of home foods in individuals of the higher socioeconomic status usually is characterised by place of consumption, and often not place of preparation. This creates a potential for some home-style meals consumed to be considered out of home, while take away fast food eaten at home would fall under the category of home foods. As previously
discussed, this can be problematic, and therefore in this study, we wish to better understand our context by categorizing out of home foods based on place of preparation. As well, since out of home prepared foods have variety between them, it is understandable that lower income adolescents could be purchasing lower quality out of home prepared foods (11). Reliance on school prepared meals can be attributed to the level of economic power an adolescent has, and it is expected that ‘poorer’ students will have a larger input from school prepared foods. Areas of ‘poorer’ students may also have less funded school, making the impact of the school food more problematic if not properly addressed.

![Figure 6: Contrast between the urban (above), and rural (lower) setting of the study (Yaghmaei, 2015)](image)

The locations of the individuals are a considerable characteristic, since, much like gender and socioeconomic status, differences between the two groups have been observed. Urbanization and industrialization have created more obesogenic environments and increased the levels of out of home, and processed foods consumed (10; 8). Therefore, naturally, processed foods have been found to be consumed at higher levels in urban populations; however, at the same time rural populations have been associated with some poorer diet qualities and higher rates of dyslipidaemia (5). Rural adolescents tend to consume fewer calories, and less out of home foods, but consume more sugar, more carbohydrates (5). In the Azuay region of Ecuador, the variety of food choices between Cuenca, and Nabón, the urban and rural region respectively, are quite difference, and the difference in access, irrespective of financial costs should also be considered, in order to complement socioeconomic categories. For this reason, we will be investigating and differentiating, out of home food consumption, and processed food consumption for both urban and rural populations.

The differentiation of individuals by sex, socioeconomic status, and setting while assessing dietary quality, and dietary patterns, will help determine the most vulnerable groups, and the potential environmental causes for behaviours and diets that are considered detrimental to health.
3. Methodology

3.1. Original Study

The Azuay region of Ecuador, located in the southern highlands of the Andes, has a high level of childhood obesity, and dyslipidaemia. An intervention known as ACTIVITAL based on school health promotion was designed, and part of the baseline requirements for the intervention was the collection of dietary information from school going adolescents in the area. The collected data was used for the reference article of this thesis as well (5).

3.2. Data Collection

In the region of Azuay, the cross sectional study was conducted using a total of 779 participants which were either in 8th, 9th, or 10th grade. Of these school going adolescents, 606 were from the urban region of Cuenca, while 172 were from the rural region of Nabón. For the blood samples, 334 students volunteered to do the further testing.

The study was conducted between January 2008, and April 2009, with both the ethical approval of Ecuador and Belgium. Written consent was provided by parents or guardians, and pregnant or sick students were excluded from the study.

3.3. Dietary intake

2-day 24-hour recalls were used for the food intake, one day being randomly allocated for a weekday, and the other randomly allocated for a weekend. The use of utensils and portion sizes local to the region were used as a form of quantifying the logged food intakes. As well, cooks were used to prepare recipes to calibrate and quantify the ingredients used, especially traditional dishes, which were without much detailed information in the recalls.

Added sugars were estimated by including all sugars added in processing, or preparation phases of a food recipe or food products, while natural sugars were excluded. For the food groups, 20 food groups were identified and designated in accordance to the Health Department of Mexico standards. The methodology for the formulation of the database, classification information of food items, and classification of particular food groups, has been previously published (5).

Foods groups that were considered for observation were cardio protective and cardiovascular risk food groups. As they were compared by weight, the overall weight distribution of the food intake was observed.

The cardioprotective foods that were considered were seafood, fruits, vegetables, and whole grains. As previously explored seafood and whole grains make up a small percentage of intakes, nonetheless it is important to include them. This is because if they are to be recommended then the sources should be well established and understood.
3.4. Meal Times

- Meals – Breakfast, Lunch, Dinner
- Snacks- Morning, Afternoon, Night

Meal times were designated depending on the school schedule of the adolescents. Those in morning school, and afternoon schools used different schedule. For the morning schools, breakfast was from 5:00-7:00, morning snack from 7:00-13:00, lunch from 13:00-16:00, and afternoon snack from 16:00-18:00. For the afternoon schools, breakfast was from 5:00-8:00, morning snack from 8:00-11:00, lunch from 11:00-12:00, and afternoon snack from 12:00-18:00. For both sets of students the dinner from 18:00-21:00, and the night snack schedule, from 21:00 onwards, were the same.

Weekends were the same for all adolescents. Breakfast was from 5:00-9:00, morning snack from 9:00-12:00, lunch from 12:00-15:00, and finally afternoon snack from 15:00-18:00. The weekend’s dinner schedule was the same as the weekdays.

3.5. Cardiovascular Risk Factors

Cardiovascular risk factors that were measured were body weight, height, and waist circumference using calibrated equipment. Through this body mass index (BMI) as weight/ height \(^2\) was also determined. Both systolic blood pressure and diastolic blood pressure was measured in triplicates.

Other anthropometric tests were conducted on the students; however, these were not examined for the purposes of this study.

3.6. Sociodemographic Groups

- Gender – Male or Female
- Settings- Rural or Urban
- Socioeconomic status- “Poor” or “Better off”

Consumers were distinguishable based on three characteristics; gender, setting, and socioeconomic status. Gender was as reported in the data collection methods. Settings were either rural or urban, based on the location of residence. The city of Cuenca was considered urban, while Nabón was rural. Finally, the Integrated Social Indicator System for Ecuador’s tool was used to calculate socioeconomic levels of the adolescent’s household. The individuals were grouped into two categories, “poor” group and “better off” group.

3.7. Location of Preparation & Consumption

The cross sectional study contained information both on the location of preparation of the foods, as well as the location of foods consumed. The two were separated, although some previous studies have used the
The locations of consumption and preparation are seen as two different concepts, and therefore were separated. The location of consumption was simply kept as home or out of home, whilst the location of preparation, was split into three locations, home, out of home, and school. The reason for distinguishing school prepared items is that the school environment represents an out of home area, but unlike other out of home sources, the school environment does not have the same variety of choice, nor the need for financial expenditure, therefore the input of school produced foods can be considered one that the students have very little control over. The advantage however is that school environment is completely under control of local authorities, and can be seen as a pivotal place for providing healthy foods. Therefore the distinguishing of the school location for preparation was considered an important area.

3.8. Processing Levels

- Nonprocessed
- Culinary Ingredients
- Ready to eat processed foods
  - Processed
  - Ultra-processed

The categorization was done based on the nature and extent of the processing in relation to the original food products. The processing level was distinguished into three categories, nonprocessed or minimal processed foods, culinary ingredients, and ready to eat processed foods, which were further distinguished into processed foods, and ultra-processed foods.

Minimal or nonprocessed foods were considered foods that were either in their original form, whole food items, or items that had been processed in methods that does not alter the nutritional characteristics of the food. Items such as fruits, nuts, vegetables, milk, natural fruit juices, whole grains, nonprocessed meats, fish, etc, were used in this category, as well as items that underwent minimal processing including grinding, fat reduction, cutting, slicing, packaging, fermenting, etc, such as polished grains, or unflavoured yogurts.

Culinary Ingredients were considered items that were based on whole foods that had gone under the processes of extraction or refining. These food items are typically not consumed individually, and are mostly unpalatable, but are instead used as ingredients combined with nonprocessed foods to create palatable food items. Therefore, the category of culinary ingredients included items such as flour, cooking oils, sugar, salt, etc. Since culinary ingredients are such a specific category of food, it is anticipated for the energy density, and dietary quality of culinary ingredients to be different than other levels of processing.

Processed foods were split into two categories, simply processed foods, and ultra-processed foods. Processed foods were food items considered whole food stuff with the combination of culinary ingredients, such as sugar, salt, or oil, and certain processing methods, in order to create the processed food item. In this section included foods such as canned and salted vegetables, fruits in sugar syrup, salted and smoked sausages, and cheese. The section of ultra-processed foods was for food items that had gone through industrial processing, changes in the nutritional qualities that were unrecognizable from
the original food product, or were based on a combination of non-whole food ingredients (34). The processes conducted on ultra-processed foods are the addition of substances, or the use of methods that significantly change the nature of original food items (34). These sections pertain to a wide variety of foods including, sweetened beverages, pastries, cakes, refined breads, candy, sweets, French fries, pizzas, etc.

3.9. Data Analysis

The two-day dietary consumption of the 779 adolescents was analyzed using the software STATA version 11.0 (College Station, TX, USA). For each adolescent, every food item consumed was categorized based on the location of preparation, the location of consumption, the food group, the level of processing, the meal time, the diet quality, and the adolescent themselves were identified by their sex, place of residence, and socio-economic status.

By the use of comparing means with a 95% confidence interval, the location of preparation was compared by diet quality, level of processing, sex, socio-economic status, place of residence, meal times, and food groups. The same was done for location of consumption. As well, the same system of comparing means with a 95% confidence interval, the level of processing of food items consumed by each adolescent was compared by diet quality, location of preparation, location of consumption, sex, socio-economic status, place of residence, and meal times.

The consumers were divided into quartiles by the level of out-of-home prepared food that was consumed. The lowest quartile consumed the least percentage of daily energy intake from out-of-home prepared food, whilst the highest quartile consumed the most. Once divided, the diet quality of the consumers, patterns of consumption based on processing, and cardiovascular risk through BMI and blood pressure were compared through the use of both means with a 95% confidence interval.

Further testing using the “nptrend” command in STATA was used. This conducts a non-parametric test across the categorical variables, which in this case were the consumer groups. The subsequent result indicated variation throughout the quartiles of the overall population. An association was significant with a p-value below 0.05. Further steps were taken by isolating different sociodemographic groups, and then dividing into quartiles. Rural adolescents were separated from urban adolescents, and both groups were then identified by levels of out-of-home prepared food intake, followed by the same measures based on socioeconomic status. Once sociodemographic were isolated, and categorized, non-parametric tests were conducted in order to compare results to the overall population samples.
4. Results

Out of home foods were examined both by location of preparation and location of consumption. The potential for taking out of home prepared foods to eat at home, and vice versa, meant that location of consumption was a less distinguishing means of categorizing foods by location. This is evident since mean daily energy intake was 64.8% from home prepared foods, while it was 84.5% from home consumed foods, indicating a large contribution from out of home prepared foods, brought home. Therefore, tables pertaining to locations of consumption can be found in the annex of this report.

All comparisons of means were done using a 95% confidence interval (CI).

Table 1: Energy Density and Diet Quality by Location of Preparation of Foods

<table>
<thead>
<tr>
<th></th>
<th>Home Produced</th>
<th>Out of Home Produced</th>
<th>School Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% CI</td>
<td>Mean</td>
</tr>
<tr>
<td>Energy (kcal/g)</td>
<td>0.92</td>
<td>[0.91;0.94]</td>
<td>1.34</td>
</tr>
<tr>
<td>Carbohydrates (% of kcal)</td>
<td>63.1</td>
<td>[62.5;63.8]</td>
<td>63.6</td>
</tr>
<tr>
<td>Protein (% of kcal)</td>
<td>14.1</td>
<td>[13.8;14.3]</td>
<td>11.0</td>
</tr>
<tr>
<td>Fat (% of kcal)</td>
<td>22.3</td>
<td>[21.9;22.9]</td>
<td>24.5</td>
</tr>
<tr>
<td>Fiber (% of kcal)</td>
<td>1.3</td>
<td>[1.1;1.3]</td>
<td>1.8</td>
</tr>
<tr>
<td>Sodium (mg/g)</td>
<td>1.2</td>
<td>[1.1;1.3]</td>
<td>1.7</td>
</tr>
<tr>
<td>Sugar (% of kcal)</td>
<td>13.2</td>
<td>[12.7;13.6]</td>
<td>23.5</td>
</tr>
</tbody>
</table>

Table 1 presents the energy density and dietary quality of foods based on the location of preparation. Overall, out of home prepared foods, and school prepared foods, were higher in energy density than home prepared foods (1.34kcal/g, 1.74kcal/g vs. 0.92kcal/g). Of macronutrients, carbohydrates and proteins were more readily available in home prepared foods (63.1%, and 14.1%), while out of home prepared foods were slightly higher in fats (24.5%), and school prepared foods were considerably higher in fats (33.0%). Out of home foods were surprisingly the highest in fiber (1.8%), while sodium levels were
higher in out of home foods (1.7mg/g), but not as high as school prepared foods, which were nearly twice as high in sodium as home foods (2.1mg/g vs. 1.2 mg/g). Sugar levels were highest in out of home foods (23.5%), followed by school prepared (14.6%), and finally home foods (13.2%).

Table 2: Energy Density & Diet Quality by Level of Processing of Foods Consumed

<table>
<thead>
<tr>
<th></th>
<th>Nonprocessed</th>
<th>Culinary Ingredients</th>
<th>Processed</th>
<th>Ultra-Processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal/g)</td>
<td>1.1 (1.1-1.1)</td>
<td>3.7 (3.6-3.8)</td>
<td>2.3 (2.2-2.4)</td>
<td>1.9 (1.9-2.0)</td>
</tr>
<tr>
<td>Carbohydrates (% of kcal)</td>
<td>64.1 (63.3-65.0)</td>
<td>66.1 (64.9-67.3)</td>
<td>21.4 (19.0-23.7)</td>
<td>60.6 (59.8-61.4)</td>
</tr>
<tr>
<td>Protein (% of kcal)</td>
<td>17.8 (17.4-18.1)</td>
<td>2.1 (2.0-2.3)</td>
<td>26.8 (25.7-27.9)</td>
<td>9.1 (8.9-9.3)</td>
</tr>
<tr>
<td>Fat (% of kcal)</td>
<td>17.2 (16.6-17.7)</td>
<td>34.0 (32.8-35.1)</td>
<td>51.1 (49.1-53.1)</td>
<td>30.6 (29.8-31.4)</td>
</tr>
<tr>
<td>Fiber (% of kcal)</td>
<td>1.7 (1.6-1.8)</td>
<td>0.3 (0.3-0.4)</td>
<td>0.5 (0.4-0.6)</td>
<td>1.3 (1.2-1.3)</td>
</tr>
<tr>
<td>Sodium (mg/g)</td>
<td>0.2 (0.2-0.2)</td>
<td>23.8 (22.5-25.1)</td>
<td>4.9 (4.7-5.2)</td>
<td>2.4 (2.3-2.5)</td>
</tr>
<tr>
<td>Sugar (% of kcal)</td>
<td>0.1 (0.0-0.1)</td>
<td>50.5 (48.9-52.2)</td>
<td>3.8 (3.3-4.4)</td>
<td>10.5 (10.2-10.9)</td>
</tr>
</tbody>
</table>

Table 2 compared the same measures as Table 1, however this time using different levels of processing. Culinary ingredients, as previously discussed, were unique in some dietary characteristics since they are predominantly made of sodium, sugar, and cooking oils. That is visible since more than half, 50.5%, of the energy comes from sugar, and 34.0% comes from fat.

The energy density of nonprocessed foods (1.1 kcal/g) is significantly lower than that of processed foods (2.3 kcal/g), and ultra-processed foods (1.9 kcal/g). All processing levels were relatively similar in carbohydrate levels, except for processed foods which were significantly lower at 21.4% of energy availability. Protein levels in nonprocessed foods (17.8%) were higher than ultra-processed foods (9.1%), but lower than processed foods (26.8%). Nonprocessed foods were the least fatty foods (17.2%), while processed foods (51.1%) and ultra-processed foods (30.6%) were much fatter. Nonprocessed foods were significantly higher in fiber than processed and ultra-processed foods (1.7% vs. 0.5% & 1.3%). Ultra-processed foods were 12 times higher in sodium than nonprocessed foods (2.4 mg/g vs. 0.2 mg/g), while processed foods (4.9 mg/g) were nearly 25 times higher in sodium than nonprocessed foods. The same trend continued for added sugar, ultra-processed foods were higher than processed foods and nonprocessed foods (10.5% vs. 3.8% & 0.1%).
Table 3: Food Group Sources Distribution by Location of Preparation

<table>
<thead>
<tr>
<th></th>
<th>Home Prepared</th>
<th>Out of Home Prepared</th>
<th>School Prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% CI</td>
<td>Mean</td>
</tr>
<tr>
<td>Weight (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>70.3</td>
<td>69.2-71.3</td>
<td>25.8</td>
</tr>
<tr>
<td>Seafood (% of weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>66.3</td>
<td>61.3-71.2</td>
<td>27.3</td>
</tr>
<tr>
<td>Whole Grain (% of weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>71.7</td>
<td>66.0-77.4</td>
<td>21.0</td>
</tr>
<tr>
<td>Fruit (% of weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>63.8</td>
<td>61.5-66.0</td>
<td>31.9</td>
</tr>
<tr>
<td>Vegetables (% of weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>82.9</td>
<td>81.3-84.6</td>
<td>12.5</td>
</tr>
<tr>
<td>Animal Fats (% of weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>52.6</td>
<td>49.4-55.8</td>
<td>28.0</td>
</tr>
<tr>
<td>Refined Grains (% of weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45.9</td>
<td>40.5-51.2</td>
<td>43.8</td>
</tr>
<tr>
<td>Snacks (% of weight)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>42.0</td>
<td>40.1-43.9</td>
<td>52.2</td>
</tr>
</tbody>
</table>

Table 3 represents the share of food (by weight) that each location of preparation inputs into diets. In comparison to this input by weight, are the food groups considered cardio protective or cardiovascular risk foods. There are a few trends apparent. By weight out of home foods are responsible for a quarter of intake, while school prepared foods are only responsible for 3.9% of the total weight on a daily basis. Therefore, the majority of foods eaten by the adolescents were prepared at home. Compared to the overall input, school foods tended to be much higher in animal fats, refined grains, whole grains, and snacks. Out of home prepared foods were lower in whole grains and vegetables, while higher in fruits, refined grains, and snacks. Home prepared foods were more likely to include vegetables, but less likely to include snacks, refined grains, animal fats, and fruits.

Table 4: Energy Input from Processing Levels by Location of Production

<table>
<thead>
<tr>
<th></th>
<th>Home Produced</th>
<th>Out of Home Produced</th>
<th>School Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% CI</td>
<td>Mean</td>
</tr>
<tr>
<td>Nonprocessed (% of kcal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>66.7</td>
<td>65.7-67.7</td>
<td>20.1</td>
</tr>
<tr>
<td>Culinary Ingredients (% of kcal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17.8</td>
<td>17.3-18.3</td>
<td>26.2</td>
</tr>
<tr>
<td>Processed (% of kcal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.8</td>
<td>2.4-3.2</td>
<td>5.9</td>
</tr>
<tr>
<td>Ultra--processed (% of kcal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.7</td>
<td>11.9-13.5</td>
<td>71.3</td>
</tr>
</tbody>
</table>

Table 4 compares the levels of processing based on location of preparation. There is a clear trend that home prepared foods are composed of more nonprocessed foods (66.7%), while that input is reducing in out of home prepared foods(20.1%), and school prepared foods (31.9%). Culinary ingredients were the highest energy input in out of home prepared foods (26.2%), followed by home prepared (17.8%), and finally school prepared foods (6.8%). Ultra-processed foods represented the majority of the energy input for out of home prepared foods (71.3%), and school prepared foods (58.6%), while they only made up 12.7% of home prepared foods.
Table 5: Location of Production, Location of Consumption, and Consumption Based on Processing Levels by Place of Residence & Socioeconomic Status

<table>
<thead>
<tr>
<th></th>
<th>Rural Mean</th>
<th>Rural 95% CI</th>
<th>Urban Mean</th>
<th>Urban 95% CI</th>
<th>“Better Off” Mean</th>
<th>“Poor” Mean</th>
<th>“Better Off” 95% CI</th>
<th>“Poor” 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home (% of intake)</td>
<td>69.5</td>
<td>67.1-71.9</td>
<td>63.6</td>
<td>62.2-64.9</td>
<td>61.3</td>
<td>59.4-63.1</td>
<td>67.6</td>
<td>66.1-69.1</td>
</tr>
<tr>
<td>Out of Home (% of intake)</td>
<td>18.8</td>
<td>16.8-20.8</td>
<td>32.8</td>
<td>31.5-34.2</td>
<td>34.9</td>
<td>33.0-36.7</td>
<td>25.8</td>
<td>24.3-27.3</td>
</tr>
<tr>
<td>School (% of intake)</td>
<td>11.7</td>
<td>10.2-13.2</td>
<td>3.4</td>
<td>3.1-4.0</td>
<td>3.9</td>
<td>3.2-4.6</td>
<td>6.5</td>
<td>5.8-7.3</td>
</tr>
<tr>
<td>Location of Consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home (% of intake)</td>
<td>80.5</td>
<td>78.4-82.5</td>
<td>85.8</td>
<td>84.7-86.9</td>
<td>85.1</td>
<td>83.6-86.5</td>
<td>84.2</td>
<td>82.8-85.5</td>
</tr>
<tr>
<td>Out of Home (% of intake)</td>
<td>19.5</td>
<td>17.5-21.6</td>
<td>14.2</td>
<td>13.1-15.3</td>
<td>14.9</td>
<td>13.5-16.4</td>
<td>15.8</td>
<td>14.5-17.2</td>
</tr>
<tr>
<td>Level of Processing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonprocessed (% of intake)</td>
<td>58.6</td>
<td>56.8-60.4</td>
<td>50.1</td>
<td>49.0-51.2</td>
<td>48.2</td>
<td>46.7-49.6</td>
<td>54.9</td>
<td>53.6-56.2</td>
</tr>
<tr>
<td>Culinary Ingredients (% of intake)</td>
<td>13.4</td>
<td>12.5-14.2</td>
<td>12.6</td>
<td>12.2-13.0</td>
<td>12.4</td>
<td>11.8-12.9</td>
<td>13.1</td>
<td>12.6-13.6</td>
</tr>
<tr>
<td>Processed (% of intake)</td>
<td>2.5</td>
<td>1.9-3.1</td>
<td>4.2</td>
<td>3.7-4.7</td>
<td>4.3</td>
<td>3.7-4.9</td>
<td>3.4</td>
<td>2.9-3.9</td>
</tr>
<tr>
<td>Ultra-processed (% of intake)</td>
<td>25.5</td>
<td>23.6-27.3</td>
<td>33.0</td>
<td>31.9-34.1</td>
<td>35.1</td>
<td>33.6-36.6</td>
<td>28.5</td>
<td>27.3-29.8</td>
</tr>
</tbody>
</table>

Table 5 represents the dietary patterns based on location of food preparation, food consumption, and processing levels, based on the sociodemographic groups of the adolescents. Rural adolescents consumed a higher proportion of their daily energy intake through home prepared foods (69.5% vs. 63.6%) than urban adolescents, however they ended up consuming less of their food at home compared to urban adolescents (80.5% vs. 85.8%). Rural adolescents consumed a significantly higher amount of their daily energy intake from school prepared food compared to urban adolescents (11.7% vs. 3.4%). Rural adolescents also consumed more of their daily energy intake from nonprocessed foods than urban adolescents (58.6% vs. 50.1%), and less ultra-processed foods (25.5% vs. 33.0%).

Comparisons based on gender were not significant, unlike setting or socioeconomic status. The results of gender based comparisons were therefore excluded from the results section of this report.

“Better off” students consumed a lower daily energy intake from food prepared at home (61.3% vs. 67.6%), but this was not the case for the location of consumption where the differences were not significant. “Better off” students also consumed less of their daily energy intake from school prepared
foods (3.9% vs. 6.5%). Finally, “better off adolescents” consumed less of their daily energy intake nonprocessed foods (48.2% vs. 54.9%), and more from ultra-processed foods (35.1% vs. 28.5%).

Table 6: Location of Preparation by Designated Meal Times

<table>
<thead>
<tr>
<th></th>
<th>Home Produced</th>
<th>Out of Home Produced</th>
<th>School Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% Cl</td>
<td>Mean</td>
</tr>
<tr>
<td>Breakfast</td>
<td>72.1</td>
<td>69.8-74.4</td>
<td>27.8</td>
</tr>
<tr>
<td>Morning Snack</td>
<td>32.1</td>
<td>29.7-34.4</td>
<td>44.7</td>
</tr>
<tr>
<td>Lunch</td>
<td>74.0</td>
<td>72.0-76.0</td>
<td>23.9</td>
</tr>
<tr>
<td>Afternoon Snack</td>
<td>40.3</td>
<td>37.3-43.3</td>
<td>55.6</td>
</tr>
<tr>
<td>Dinner</td>
<td>76.9</td>
<td>74.9-79.0</td>
<td>22.9</td>
</tr>
<tr>
<td>Night Snack</td>
<td>58.6</td>
<td>53.7-63.6</td>
<td>40.9</td>
</tr>
</tbody>
</table>

Table 6 examines the location of food preparation for each meal the adolescents consumed. The trend is clear. Recognized meals (breakfast, lunch, and dinner) are mostly composed of home prepared foods, as seen with breakfast (72.1%), lunch (74.0%), and dinner (76.9%). While a higher amount of the snacks being prepared outside of home. The morning snack is 44.7% out of home prepared, and a high amount is school prepared (23.2%), while afternoon snacks are predominantly out of home prepared (55.6%).

Table 7: Level of Processing by Designated Meal Times

<table>
<thead>
<tr>
<th></th>
<th>Nonprocessed</th>
<th>Culinary Ingredients</th>
<th>Processed</th>
<th>Ultra-processed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% Cl</td>
<td>Mean</td>
<td>95% Cl</td>
</tr>
<tr>
<td>Breakfast (%)</td>
<td>42.7</td>
<td>40.4-44.9</td>
<td>17.5</td>
<td>16.4-18.6</td>
</tr>
<tr>
<td>Morning Snack (%)</td>
<td>33.7</td>
<td>31.6-35.8</td>
<td>9.6</td>
<td>8.8-10.4</td>
</tr>
<tr>
<td>Lunch (%)</td>
<td>64.3</td>
<td>62.8-65.7</td>
<td>14.3</td>
<td>13.5-15.1</td>
</tr>
<tr>
<td>Afternoon Snack (%)</td>
<td>31.7</td>
<td>29.0-34.3</td>
<td>8.9</td>
<td>7.8-9.9</td>
</tr>
<tr>
<td>Dinner (%)</td>
<td>58.5</td>
<td>56.6-60.3</td>
<td>15.3</td>
<td>14.3-16.2</td>
</tr>
<tr>
<td>Night Snack (%)</td>
<td>47.9</td>
<td>43.6-52.3</td>
<td>13.0</td>
<td>10.8-15.3</td>
</tr>
</tbody>
</table>

Table 7 measures by the meal times, similar to table 6, but instead by level the energy input based on processing levels. The least processed meals of the day were lunch and dinner, with only 18.9% and 22.9%, respectively, of energy consumed being from ultra-processed foods. This is in contrast with the snacks, by which morning and afternoon, respectively, were 52.6% and 55.1% ultra-processed. Breakfast was fairly even between nonprocessed, and ultra-processed foods (42.7% vs. 34.1%), but had the highest input from culinary ingredients (17.5%).

Table 8 compared consumer groups. Consumers were divided into quartiles based on the daily energy input from out of home prepared foods. Quartile one was for adolescents within the bottom ¼ of out of home prepared food consumers, while quartile four was for the highest ¼.
From the results we can see that consumers in the first quartile consumed an average of 10% of their energy from out of home prepared foods, while consumers in the fourth quartile consumed an average of 53.2% of energy from out of home prepared foods. High out of home prepared food consumers consumed higher energy density foods (P<0.01), less carbohydrates (P<0.01), more protein (P=0.01), more fat (P<0.01), more sodium (P<0.01), more sugar (P<0.01), however the fiber intake levels were no different.

Results differed once the adolescents were separated by sociodemographic categories. Once separated by settings, the rural adolescent consumer groups were no different in energy density of foods consumed (P=0.37), in carbohydrates consumption (P=0.93), or fat consumption (P=0.19). As well, different consumer groups did not consume different levels of sodium (P=0.65), or culinary ingredients (P=0.10). Urban adolescents categorized into quartiles had trend that were more similar to the overall group, only that consumer groups did not differ in protein intake (P=0.74).

Adolescents categorized by socioeconomic status, had less variety in results from the overall group compared with categorization by setting. However, there were some differences, “poor” adolescents did not differ in protein consumption by quartile (P=0.41), or sodium (P=0.05), but out of home food consumption was associated with lower fiber intake (P=0.02). “Better off” adolescents had no difference in protein consumption between consumer groups (P=0.80), while the rest of their results were similar to the overall group.

BMI, SBP, and DBP were tested across all categories with no significant results. Therefore adolescents consuming different levels of out of prepared foods showed no indication for cardiovascular risks through anthropometric testing.
Table 8: Diet Quality, processing consumption, and anthropometric results across consumer groups based on levels of out of home prepared food consumption

<table>
<thead>
<tr>
<th></th>
<th>Quartile 1</th>
<th>Quartile 2</th>
<th>Quartile 3</th>
<th>Quartile 4</th>
<th>P-value rural</th>
<th>P-value urban</th>
<th>P-value “poor”</th>
<th>P-value better off</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Cl</td>
<td>Mean</td>
<td>Cl</td>
<td>N=779</td>
<td>N=173</td>
<td>N=606</td>
<td>N=432</td>
</tr>
<tr>
<td>Energy from OH (%)</td>
<td>10</td>
<td>9.3-10.7</td>
<td>21.8</td>
<td>21.3-22.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy (kcal/g)</td>
<td>0.96</td>
<td>0.93-0.98</td>
<td>0.98</td>
<td>0.95-1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbs (% of kcal)</td>
<td>64.9</td>
<td>63.8-66.0</td>
<td>63.9</td>
<td>62.8-64.9</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Prot (% of kcal)</td>
<td>13.1</td>
<td>12.6-13.5</td>
<td>13.0</td>
<td>12.6-13.3</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fat (% of kcal)</td>
<td>22.0</td>
<td>21.1-22.9</td>
<td>23.0</td>
<td>22.2-23.8</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Fiber (% of kcal)</td>
<td>1.5</td>
<td>1.3-1.7</td>
<td>1.4</td>
<td>1.3-1.5</td>
<td></td>
<td></td>
<td>0.18</td>
<td>0.61</td>
</tr>
<tr>
<td>NA (mg/g)</td>
<td>1.2</td>
<td>1.1-1.3</td>
<td>1.3</td>
<td>1.2-1.3</td>
<td></td>
<td></td>
<td>0.01</td>
<td>0.65</td>
</tr>
<tr>
<td>Sugar (% of kcal)</td>
<td>12.9</td>
<td>12.1-13.6</td>
<td>15.0</td>
<td>14.3-15.6</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Nonprocessed (% of intake)</td>
<td>61.4</td>
<td>59.7-63.1</td>
<td>55.6</td>
<td>54.2-57.7</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Culinary Ingredients (% of intake)</td>
<td>14.3</td>
<td>13.5-15.0</td>
<td>13.5</td>
<td>12.8-14.2</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Processed (% of intake)</td>
<td>2.4</td>
<td>1.9-3.0</td>
<td>3.0</td>
<td>2.4-3.6</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Ultra-processed (% of intake)</td>
<td>21.9</td>
<td>20.2-23.5</td>
<td>27.9</td>
<td>26.5-29.3</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>BMI</td>
<td>20.4</td>
<td>19.9-20.8</td>
<td>20.1</td>
<td>19.7-20.5</td>
<td></td>
<td></td>
<td>0.69</td>
<td>0.65</td>
</tr>
<tr>
<td>SBP</td>
<td>100.8</td>
<td>92.3-102.3</td>
<td>101.7</td>
<td>100.3-103.0</td>
<td></td>
<td></td>
<td>0.20</td>
<td>0.31</td>
</tr>
<tr>
<td>DBP</td>
<td>61.7</td>
<td>60.4-63.0</td>
<td>62.3</td>
<td>61.6-62.9</td>
<td></td>
<td></td>
<td>0.68</td>
<td>0.54</td>
</tr>
</tbody>
</table>
5. Discussion

The findings demonstrate considerable associations with diet quality and the potential for cardiovascular risks of adolescents based on the location of food preparation. Levels of food processing, which indicate a significant association with the health benefits, or health risks of the foods, are strongly correlated with the location of food preparation as well. Foods high in sugar, sodium, refined grains, and fat, were positively associated with foods that are prepared outside of homes, and having undergone some degree of processing. While the setting is relatively homogeneous, trends indicated that urban, and ‘better off’ adolescents appeared to consume higher levels of processed foods, and out of home foods. However, the quality of those foods, in comparison to other sociodemographic groups, still needs to be considered.

5.1. Locations

The location of preparation has previously been shown to be a highly influential factor on the diet quality of foods, and this was further proven through this study (4). Results from foods prepared outside of the home were similar to previous findings, where out of home foods were significantly higher in energy density, and fat (4). As well in this study, out of home foods were associated with refined grains, sodium, and sugar. The foods prepared at school were considerably higher in energy density and fat, There is pressure for out of home food retail sellers to sell, and appeal significantly to the adolescent’s palate. This creates an environment where they push such food characteristics since sodium, fat, and sugar are major taste factors (27). Increased energy density per dollar is also an attractive measure considering the adolescents tend to have limited budgets and are attracted to the “bang for your buck” phenomenon (35).

5.1.1. Location of Preparation vs. Consumption

In comparison to location of consumption, the location of preparation was a better method of measurement. Due to the crossover of home prepared foods being taken out of the home, and vice versa, the results based on location of consumption were less significant. There was a general trend of foods being brought into the home after outside preparation. For rural adolescents the difference between daily energy intakes from location of preparation to location of consumption was from 69.5% home foods to 80.5%, and for urban adolescents this was even larger, from 63.6% to 85.8%. Something that brings into question the validity of measuring diet qualities based on location of consumption due to survey convenience.

5.1.2. Animal fat in school foods

One of the biggest sore thumbs in the data is the high level of contribution from animal fat that is seen in the school prepared foods that the students consume. The two biggest meals school prepared foods were consumed for morning snack, and afternoon snack, and therefore it is surprising to have a high level of animal fats in items considered snack foods. Due to this, there was further investigation into contributing sources of animal fats. Unexpectedly, but in connection with the results of testing, the most popular foods, as school prepared snacks, were items regularly considered for main meals. ‘Salchipapas’, empanadas, often with meat, hot dogs, and hamburgers were consistently consumed in this category, many of them containing meats, or fried with butter or lard. This raises the question of whether the
division of meal times with the labels of snacks and main meals is disregarding the potential impact if
snacks are treated like meals. It also brings up concerns about the types of foods students can access at
school.

Figure 7: Ecuadorian tortillas were a common snack to buy on the street (Yaghmaei, 2015)

5.2. Meal Times

The main meals were predominantly home prepared, while snacks were predominantly out of home
prepared, except for the night snack. In the case of the night snack, the majority of the energy (58.6%)
was from home prepared but there was still a large input from out of home. The morning snack, which
was usually eaten at school, had a higher input from school prepared foods (23.2%), and the afternoon
snack, which was eaten after school was dominated by out of home prepared foods (55.6%). These
findings are consistent with previous findings were breakfast and snacks had the higher out of home
influence, while lunch and dinner did not (4). These results give very good insight into the behaviour of
food consumption based on individual meal times. Considering the main meals of the day are
significantly home prepared, more whole food items and certain food groups can be expected. Snacks,
particularly for children, are often based as a treat, and require convenience. They are part of the “food
culture” and are highly stimulated through persuasive marketing (9). As well, the palatability is a big
consideration for snacks, so more sodium, sugar, and fats can be expected (28). The consumption of
snacks at school remains a big potential for dietary improvement considering the heightened controls, but
the use of that remains to be seen.

5.2.1. Breakfast Impact

Based on the knowledge of the associations between location of preparation, and levels of food
processing, and that meals are mostly nonprocessed, while snacks are mostly ultra-processed, it was
unexpected that breakfast results did not match these trends. Breakfasts were only 42.7% nonprocessed,
and 34.1% ultra-processed, with a relatively high level of culinary ingredients, at 17.5%. Previous studies
found that breakfast was actually eaten as a majority out of home (4). This indicates that although the
majority of breakfasts were prepared at home, there was a large influx of ultra-processed ingredients, and
a high use of culinary ingredients to complement nonprocessed foods, most likely added sugar for
sweetness, since we know the typical breakfast consists of refined grains, and sweetened dairy drinks (5).
Breakfasts in many diets have long been associated as the “sweet” meal, and the morning rush to add to
this, leaves very little in a ways of societal norms for a healthy breakfast (5). This is concerning
considering the importance of breakfasts, especially in cognitive skills of adolescents (36). Lunch and dinners were reduced in ultra-processed foods and higher in nonprocessed foods, the reverse was seen in morning and afternoon snacks, this follows previous findings (4).

5.3. Food Groups

Approximately a quarter of food by weight was from out of home prepared foods, while only 3.9% came from school prepared foods. These numbers did change based on sociodemographic groups, but that is to be discussed later. The influence of these two relatively small inputs is more than would initially seem, since it is known how high the potential impact of out of home foods is in certain settings (11).

5.3.1. Cardio Protective Foods

Compared to the overall weight distributions for food prepared out of home, seafood and fruits were consumed at a higher ratio. For the region of Azuay, this trend is understandable since markets and street stalls sell many seafood and fruit related snacks, with fruit juice being a popular choice (5). The higher consumption of fruit outside the home is a welcoming site, but also must come with the understanding that a portion of that intake is from fruit juice which are also packed with added sugars (5). Whole grains and particularly vegetables were by ratio consumed more in home prepared foods. The majority of out of home prepared foods do not contain vegetables, as well considering vegetables are viewed by many students as unpalatable, it is expected that given the choice they will be less likely to purchase them (27). It is important to analyze the overall picture, and using the same data a previous study indicated that the general population was low in consumption of fish, fruits, vegetables, and whole grains (5). Therefore, although trends are clear, the overwhelming pattern is that there is not enough consumption of cardioprotective foods (5). Looking at intake behaviours, the food group patterns make sense for fruits and vegetables. Out of home prepared foods are more likely as snacks, and home prepared foods are more likely as full meals. Fruits are primarily eaten as snacks therefore playing a relatively larger role for out of home prepared foods, while vegetables are eaten as ingredients in meals, therefore playing a relatively larger role in home prepared foods.

5.3.2. Cardiovascular Risk Foods

For cardiovascular risk foods, animal fats, refined grains, and snacks (as defined by the Mexican Health Department for processed snacks) were considered. In a previous study this group of adolescents was found overall to consume too much refined grains, sugars, and processed foods (5). In this study, the trends of consumption for these foods groups were further investigated. Out of home prepared foods, particularly school prepared foods were considerably higher in animal fats by weight ratio than for home prepared foods. This is concerning considering that the majority of meals through the day are home prepared, and school prepared foods contribute larger input through the morning snack. Refined grains followed the same trend and were present at a higher weight ratio in out of home prepared foods. Sugar consumption was considerably high, and the biggest source was out of home foods, in the form of ultra-processed foods, following up on previous findings on the influence of sugar from refined drinks in this population (5).
Snack foods, as could be expected, were highly present in out of home prepared foods and school prepared foods (9). These snack foods are usually packaged, cheap, ready to eat, and palatable food items (9). These food items are ultra convenient and can be kept for long periods of time. When comparing locations by place of consumption, these snack items are eaten in majority at home, indicating that a large number of snack items are bought out of home and brought home to be eaten.

![A wide variety of fruits on offer at local urban market (Yaghmaei, 2015)](image)

5.4. Processing Levels

Difference levels of food processing have previously been demonstrated to result in large differences in diet quality of the resulting foods. This investigation further demonstrated that, and gave insight into the dietary behaviours of adolescents and location of food preparation in relation to processing levels.

5.4.1. Nonprocessed Foods

Processing levels led to a wide variety of diet qualities between each category. Nonprocessed foods adhered to dietary recommendations and had cardio protective characteristics. Nonprocessed foods were very low in added sugar and sodium, high in fiber, and had acceptable to macro nutrient ratios.

5.4.2. Culinary ingredients

Culinary ingredients, which are not intended for independent consumption, were demonstrated to have unhealthy properties. Consumers that consumed high levels of nonprocessed foods also tended to consume more culinary ingredients for the purpose of cooking, and adding flavour, which is a factor that needs to be considered if the addition of culinary ingredients is done irresponsibly. Although culinary ingredients may not be seen as a large influence in a diet, they contribute over 17% of the energy in the average breakfast for the adolescent, these results were consistent with previous findings (9). This can be a critical input on the sugar and sodium consumption of an individual, something that has already been discussed as too high in the diet of the adolescents (5). It has been documented that as food systems...
industrialize, the use of culinary ingredients is reduced, and the level of processed foods increases (9). This is not considered a health beneficial shift however since the consumer loses control on the addition of items like sugar, sodium, and cooking oils, which they might themselves use relatively sparingly. These has already been seen in China, where development and industrialization led to a reduction in traditional diets, and an increase in the use of culinary ingredient, particularly cooking oils across all sociodemographic categories (35).

Attention should be paid on one of the results that do not follow the general trend. In the rural setting, there was no deviation in the level of culinary ingredients consumed across quartiles. This is an interesting indication, since culinary ingredients are tied with nonprocessed foods as they are used to provide flavour, texture, and are generally used in cooking and preparation. It is plausible that there is a high use of culinary ingredients for foods prepared out of home.

5.4.3. Processed Foods

Processed foods made up a limited level of input but were the most unique in terms of macronutrient properties, similar to previous studies (9; 37). Energy from processed foods was a majority from fat, followed by protein, and finally carbohydrates. They were also high in sodium, but less in sugar compared to ultra-processed foods. The levels of macronutrients in processed foods is different than other processing levels, this can be explained by the fact that in this study, and other studies, the largest contributors to the processed foods category were cheese, and types of processed meats (37). These items are low in carbohydrates, high in fat, and flavoured and preserved with salt, explaining the nutrient characteristic. Although on first glance, processed foods in Ecuadorian diets may seem quite harmful, it is important to remember that they, on average, make up less than 5% of adolescents diet, an amount similar to other regions of the world (9; 37)

5.4.4. Ultra-processed Foods

Ultra-processed foods were more energy dense, higher in sodium, and much higher in sugar, than nonprocessed foods, similar to previous findings (9). Ultra-processed foods were also lower in protein and fiber, and higher in fat than nonprocessed foods, essentially meaning that ultra-processed foods had also the characteristics of foods that pose risks for NCDs in comparison to nonprocessed foods. Therefore, it can be said that ultra-processed foods in this setting are deemed an unhealthy and a risky alternative to nonprocessed foods. Thereby, the pattern of consumptions of ultra-processed foods was investigated.

Based on locations of food preparation, ultra-processed foods were third in the most influential processing levels for home prepared foods, behind nonprocessed and culinary ingredients, something typical for developing countries, but quickly changing (39). Ultra-processed foods only made up 12.7% of foods prepared at home, but for out of home prepared foods this jumped to 71.3%. Ultra-processed foods were the most consumed food category in out of home prepared, and school prepared foods. This is not a positive result considering the growing influence of out of home prepared foods, and the spread of the industrialized foods into the region. When the location of consumption is considered instead of location of preparation, the input of ultra-processed for home is twice as much at 25.6%, indicating that a large portion of the out of home prepared food that is brought home is ultra-processed. Considering the diet quality of nonprocessed foods vs. ultra-processed foods, and the various inputs based on location of preparation, it is understandable that home prepared foods were observed as considerably healthier than
out of home prepared foods. As well, it is concerning that school prepared foods, which can be dictated in order to provide healthier diets are instead a majority ultra-processed foods

Figure 9: Chicken Soup, an example of a traditional food impacted by culinary ingredients (sodium), and ultra-processed ingredients (broth cube) (Yaghmaei, 2015)

5.5. Consumer Groups

Results from statistical testing of categorized consumer groups based on daily energy intake from out of home prepared foods proved to be a significant indication of the influence on dietary quality that out of home foods can have.

The comparisons of diet quality provided interesting results. Consumers of higher levels of out of home prepared foods had poorer diet qualities, consuming higher energy density, more fats, fewer carbohydrates, more sugar, and more sodium. A previous study that similarly separated consumer groups based on the same method found very similar results; however in that case carbohydrate influence remained the same (32). Also in our study, higher out of home consumers had higher levels of protein intake but no less fiber. Previous findings have shown a general trend that follows these results, however in certain settings, particularly in more traditional countries, out of home foods have been associated with higher diet diversity, and diet quality (8). It is easy to jump to conclusions using these results, but further steps were also taken to provide a deeper analysis. From this step however, it is clear though, higher consumption of out of home prepared foods is associated with a diet pertaining to higher levels of cardiovascular risk, and reduced diet quality.

5.5.1. Anthropometric Results

The anthropometric measurements provided no significant results. BMI, and blood pressures, were not associated with different levels of out of home prepared foods in the diet. This is an anticipated results since previous findings have shown little indication at an early age, and results of poor diet quality are expected to turn up later in life (37). Studies concerning entire populations, not just adolescents, have indicated positive associations of out of home eating with waist size and BMI (11). A study in Brazil indicated that with age the influence of out of home eating in men increased obesity, something that should be further examined in this setting (12). As much of the anthropometric measurements, and
metabolic factors can be dependent on other environmental factors, socioeconomic status, ethnicity, location, and genetics, a cross sectional study of this simplicity is perhaps a poor indicator for cardiovascular risk (10).

5.5.2. Other considerations

The data indicates a difference in the dietary consumption between sociodemographic groups, however in terms of results from anthropometric measures; there is little evidence in the sense of dietary influence. It is worth a reminder that the results come from a cross-sectional study, therefore limiting our scope of understanding; however there still remains some doubt on the differences observed in the health outcomes previously documented, and why dietary intake shows little association (5). An important factor is genetics and epigenetic influences. Rural and urban adolescents grow up in a different environment, and the degree to which the nutritional phenotype of an adolescent is influenced is yet to be measured in this setting (5). As, and perhaps more importantly, the genetic influences differ between sociodemographic in this study, particularly pertaining to the presence of indigenous adolescents in the rural setting (5). As well the rural setting has had previous influences of stunting, although less now, demonstrating that epigenetic factors may also be influential (39). Studies have indicated that indigenous populations in Latin America have different reactions to food systems than those of European decent(40). These important details are hard to ignore when making conclusions based on the lack of association between dietary qualities, particularly from out of home prepared foods. Simply said, there needs to be further investigation on the potential impacts of different diets on different groups of adolescents.

5.6. Sociodemographics

Overall, in comparison to other environments where studies on similar topics have been conducted, the region of Cuenca and Nabón, have a relatively more homogeneous setting for adolescent diets, with a larger difference occurring between urban and rural (5). However, there are still differences from person to person, and the resulting behaviours have impact on their diet quality, and cardiovascular risks.

5.6.1. Settings

As previously documented, rural adolescents were more likely to consume higher levels of carbohydrates, with less meat, and had higher levels of dyslipidaemia, while urban adolescents consumed more meats, more fats, and had higher levels of blood pressure (5). In terms of dietary behaviours in this study, rural adolescents consumed more foods prepared at home, but in terms of location of consumption, ate less at home than their urban counterparts. This demonstrates that urban adolescents purchase more out of home prepared foods and bring it home, or have more packaged food at home to eat. The input of school prepared foods was quite different by place of residence. Rural adolescent’s diet consisted of 11.7% of energy from school prepared foods, while for urban adolescent’s school prepared energy intake only made up 3.4% of the diet, an important factor to consider for school based policies. In connection, rural adolescents consumed higher levels of nonprocessed foods, approximately the same level of culinary ingredients, and less ultra-processed foods than urban adolescents. These results contradict some previous findings where urban youth were found to consume more fruits, vegetables, and micronutrients (4).
However, these findings were in a different setting than this study. The results did follow other findings that urban youth consume more out of home foods (4).

For further insight consumers divided into quartiles, were also separated by rural and urban settings. These results gave an indication of how different the out of home prepared foods in each environment might be. In the rural setting some of these associations were not found. There were no differences in terms of energy density, carbohydrate intake, fat intake, or fiber between consumer groups. This can be partially explained by the fact that higher levels of out of home prepared foods in rural regions are still traditional foods, as is common in developing countries (9). The other reason is the general homogeneity of the consumers; the majority of rural adolescents belonged to the “poor” socioeconomic income bracket, and had a higher level of consumption at home and school, creating a scenario of less variety (8). Out of home foods were associated with increased protein intake, most likely due to increased animal based foods availability, which has also been observed in other settings (6). Despite the lack of many significant differences for the rural setting, sugar and sodium intake were still positively associated with out of home foods, as expected since in this study culinary ingredients were still prominent in the diet of high out of home consumer groups. Out of home food producers, could therefore, be using more culinary ingredients, such as sugar and sodium, for more flavour in order to attract consumers based on taste, and temptations. Overall, it can be said that there is a significant difference between both out of home consumption patterns based on settings, and that the diet quality and impact of out of home foods also differ between rural and urban settings.

5.6.2. Urban Rural Divide

The divisions between urban and rural settings for dietary patterns is often viewed in an outdated manner, in which rural is viewed as a pure, pre-industrial area, and the urban is viewed as a post industrial “westernized” source for food(3). This type of rhetoric is inconsistent with the realities of the modern day food environments in many rapidly developing countries; it also loses some validity when examining foods through by processing levels. Rural areas are often designated by either the main occupation of the region being agriculture, or the geographic separation with an urban region. When it comes to diets, urbanized diets are considered to be based on processed foods, and industrialized packaged items, while rural diets are stereotyped as “fresh off the farm”, or more simple. This might be fully true in some settings, but it is not always the complete reality.

The characteristics of convenience for ultra-processed foods, and the ease for transport, make them potentially a larger part of the diet in rural regions depending on the season, or food items in question (41). As seen by results, the homogeneity of rural adolescent diets is present; however, they are not eating a diet that is untouched by industrialization. In further developed countries, such as the United States, rural regions are actually synonymous for higher levels of obesity, poor dietary quality, higher poverty, and lower food access (41). For considering processing levels in the manner that this investigation has, the rhetoric of rural foods being pre-industrial and less processed becomes even less valid, because by definition ultra-processed foods can be created at home if they are produced in a certain manner (9). Therefore, although a meal may be fresh off the farm, and locally sourced, if it undergoes heavy processing, and the diet quality of the meal is different from the original items, it will be considered an ultra-processed food, something that is normally considered an industrialized or “western” food. The reverse is also applicable to the rhetoric of urban environments being considered post industrial, and areas with higher access to processed foods, and reduced access to fresh nonprocessed foods. That does not necessarily hold true, particularly because urban areas have more spending power, creating more demand,
therefore, naturally more supply. Urban areas have more recently been places with more healthy choices available, and while rural regions still potential face transport issues for fresh products (4; 41). Many regions run on hub and spoke systems, where urban areas are the main transport centres of regions, meaning that many supplies actually arrive in urban areas before rural regions

5.6.3. Socioeconomic Status

The socioeconomic status of the family is also an influence on the diet quality and behaviour of an adolescent (5). Previously it has been demonstrated that ‘better off’ students tend to consume more meat, less rice, and more processed foods (5). In a sense, ‘better off’ adolescents tend to have a more industrialized diet (9). Based on the dietary behaviours of this study, these trends hold true. ‘Better off’ students consumed less home prepared, and school prepared foods, and more out of home prepared foods, similar to previous findings (4). But by location of consumption, socioeconomic status had no differences between the two groups. Indicating that ‘better off’ students were more likely to have their home consumed meals prepared out of home, an option that is usually more expensive. ‘Better off’ adolescents also consumed more ultra-processed foods, and less nonprocessed foods, than their “poorer” peers. Ultra-processed foods and out of home prepared foods tend to be more expensive, hold more a ‘cool factor’, and are considered better tasting by the adolescents, therefore it is expected that if financial costs are less of a limiting factor, students will lean towards out of home and ultra-processed foods (27). This trend also holds true towards place of residence, since urban adolescents have more access, due to their environment, for ultra-processed and out of home foods, making them more likely to choose that as an option.

Once adolescents were separated by socioeconomic status for categorization into quartiles for further analysis, there appeared an influence of economy on dietary quality. “Better off” adolescents followed the same trends as the overall group, except for protein, whose consumption was not associated with out of home foods consumption. However, with “poor” adolescents, the level of fiber intake was reduced as higher levels of out of home foods were consumed. This was not the case for any other group, perhaps signalling that the dietary quality of out of home foods that the “poor” adolescents consume is lower than that of the “better off” adolescents, which has also been previously documented (35).

Therefore, there is clear evidence that dietary behaviour, diet quality, and influence of out of home prepared foods is influenced by the sociodemographic groups that an adolescent belong to.
5.6.4. Cost Discrepancies

By initial examination, rural adolescents should be considered to consume healthier diets than urban adolescents, and that is partially true. As well, ‘poor’ adolescents, should, according to observed trends, also be healthier than their ‘better off’ counterparts (42, 12). However the environment is not as simple as these divisions currently made, there are other factors. It is important to consider that not all out of home prepared foods and ultra-processed foods are of the same diet quality. The difference within categories, particularly out of home prepared foods, can be quite drastic, and this often depends on the quality and location of the food preparation (8). The biggest influencer for this factor is the financial cost of the foods (35). Throughout the study environment there are wide ranges of out of home food producers, some being local fruit stands, others being industrialized fast food chains, all of which have within themselves a wide variety of foods. It is known that cheaper foods tend to be higher in energy density, sodium, fat, and sugar, and this hold true within the range of out of home foods in this study environment (35). An example in the environment would be that small portions of fruits, and relatively healthier processed foods would cost approximately $1, which is the same cost of “salchipapas”, a portion of fries with ultra-processed sausages covered in sauce. When in discussion with locals regarding the decision factors to consume “salchipapas” over a healthier or lighter option, the answer as almost always the same, “it is a cheap and tasty way to fill your stomach”.

There was also a difference in out of home prepared foods in rural regions vs. the urban setting. The city of Cuenca is an active cosmopolitan with many influences. There are a large variety of options for out of home prepared foods including markets, cafes, fast food locations, supermarkets, etc. In the rural regions these choices are reduced, and the out of home prepared foods tend to be simpler, and fewer options. Through direct observation locations where fried potatoes were fried in cooking oils were more observable in Cuenca, while in rural regions fried potatoes tended to be fried in animal lard) Similar observations have been made previously where different sources of out of home foods led to different diet quality results (11). Therefore it is clear that there are diet qualities differences between home prepared foods and out of home prepared foods, but factors such as the variety within, and between, out of home sources must be further investigated. Some of which were demonstrated in this study, however, there is certainly room for more knowledge in this area.

Figure 11: Potatoes being deep fried in animal fat in the rural market (Yaghmaei, 2015)
5.7. Future Outlook

5.7.1. School Food Programs

Throughout this report the potential for impacting school food programs has been mentioned. This is primarily because of the potential control that the school environment can implement. The school environment does not have a substantial impact on overall diets, however, it does impact rural and “poorer” students to a higher degree, and they can also be the ones most vulnerable to their environment due to less freedom of choice. As well, it was observed that school prepared foods are not exclusively eaten at school, but also taken home, so the impact reaches beyond exclusively the school setting. Finally, it is an opportunity to instill a behaviour shift, whether conscious or not, if the students will have higher levels of healthier foods in their surroundings. Adolescents have reported that they are aware of the negative health effects of many of the foods; however self efficacy, peer pressure, and temptation stand in the way (28). By providing an environment of healthy food options, students are less affected by temptation, and the convenience of ultra-processed foods is removed since they have to leave school grounds for it. Therefore, there is an initial recommendation for healthier, lighter and more cardioprotective foods as the best options for students within school. A particular location of production referred to as ‘afuera del colegio’, which means outside the school, was documented to provide almost exclusively ultra-processed foods like salchipapas, hamburgers, and processed sausages, making this area just outside the school, another target for consideration in future programs. Of course the recommendations of school programs also need to consider social, economic, and bureaucratic barriers, however at present that does not change this recommendation (30).

5.7.2. Environment

Ecuador’s economic growth is by no means finished, and as the financial prosperity has moved beyond the major cities, and throughout the country, the influence of industrialized diets will continue to increase (43). This is not something that can be stopped, and is not necessarily one that needs to be stopped, better yet, food systems need to adapt and grow in accordance to surroundings. For some time recommendations towards traditional diets have yielded very little impact, instead a focus should be turned on improving entire systems (43). Efforts till date have been referred to as a lack of effort to understand, and accept the nutrition transition (43). The impact of out of home prepared foods and ultra-processed foods will most likely increase in the coming years.

5.7.2.1. Behaviour Influences

The availability of tasty, affordable, convenient, and safe nutritious food is a global challenge, but one that needs to be met in order to realistically tackle the issue of NCDs and undernutrition. The safety of out of home foods is currently a concern in Ecuador, something that will diminish slowly as the industry develops, and regulations are increased (29). In terms of taste, healthy foods have a disadvantage in the battle against unhealthy foods since added sugar, sodium, and fats are extremely palatable, and in some amounts, addictive (31). However taste is not exclusive to food items themselves, but also learned behaviour and culture. Children with more exposure to fruits and vegetables tend to have an increased interest in their tastes, and a societal setting in which, for example fruits, are seen as a treat, influences
individuals in desiring healthy options as much as ultra-processed over stimulating foods (15). Learned behaviours tend to be overlooked in nutritional programs, particularly since the cause and effect is over long periods of time (30). However it is important that they are not overlooked, with early likes and dislikes determining so much of our dietary patterns, even within adulthood (44). As research into the field continues, findings suggest that food preferences commence in the fetus, depending on the dietary intact of mothers, further signalling the need for long term planning and societal changes (44). On top of this comes food cues, which are learned behaviours based on environmental surroundings, such as the temptation for popcorn in a movie theatre (45). This is perhaps the case in the consumption patterns of adolescents during morning snacks, or afternoon snacks, associating the break times, and the smells from the cafeteria and food stands, as time for eating ultra-processed foods like “salchipapas”, or hamburgers (45). Part of the issues of tastes are temptations, which Ecuadorian children reported as highly influential, therefore it is the responsibility of policy makers, education institutes, and families to ensure the input of these influences is responsible (28).

5.7.2.2 Availability

With the establishment of healthy foods as convenient comes the responsibility of the industry, city planners, and society.

The distribution of supermarkets, fresh foods markets, and reduction of food deserts goes a long way to ensuring readily available access to fresh nonprocessed foods (41). Supermarkets are trademarks of heightened development, and an industrialized food system, and they are becoming more common cities within Ecuadorian cities (46). However, there are some misconceptions, although supermarkets are associated with higher consumption of processed foods, and increased energy density, they are also associated with heightened food security, lower prices, and diet diversity (46). This is important since urbanization leads to busier lifestyles, particularly in females, naturally leading to a search for convenient and processed foods (34). The influence that supermarkets will continue to have on the Ecuadorian diet is part of the potential impact that the industry may provide. The city of Cuenca was littered with markets and fruit stands, while the Nabón region’s fresh food market is not open on a daily basis. This difference gives opportunity for consumers who wish to consume out of home to readily access nonprocessed or healthy foods, instead of choosing the more convenient option. A concern of lack of appropriately priced and readily available access to healthy foods has been previously documented, particularly in the rural setting (5). This is evident in the fact that rural adolescents consumed as much fruit as their urban peers, but significantly less whole fruits, instead it was in the form of sweetened fruit juices (5). Eating is a cultural activity, and for many highly enjoyable, therefore an environment where consumers can enjoy, interact with their surroundings, and gather with peers, without undermining their health, is one where choosing unhealthy foods becomes only optional, and less of a societal norm.

5.7.2.3. Industry

The access to ready to eat foods which are convenient and healthy can be developed within the food industry, as it has in other countries, but only under the influence of consumers who desire these products. The food industry is driven exclusively by volume, and efficiency, with the bottom line of focus being profit (47). As the health movement has recently become a norm in the United States, the industry is rapidly changing in order to appeal to the new demographic of consumers (47). In fact, Ecuadorian consumers have stated their desired for more options within processed foods, and therefore leading a lack
of convenience to eat healthy by resorting to nonprocessed, at home foods, which is sometimes not preferable (29). There remains a massive gap in the market for the food industry to explore in terms of healthier options for the newly urbanized developing world populations.

![Image](image.png)

Figure 12: An urban market with produce at the lower level, and cafeteria style food in the upper level (Yaghmaei, 2015)

5.7.3. Personal

It has been established that consumers who are under severe financial stress will improve their diets with an increase of income, but this is only the case with extreme lows of socioeconomic status (29). Otherwise it is evident that consumers will turn their financial attention to other options, such as items for social status, or comfort (29). The selection of healthy options and a ‘return to a less industrialized diet’ is a selection based on preferences, education, and a willingness to change.

Preferences, as discussed before can be connected to the environment with taste influences, and options available. The education and willingness to change is a challenge faced everywhere for nutritionists and health professionals.

5.7.3.1. Intervention

In the ACTIVAL intervention, students were involved in a health promoting environment. The effects were evident as intervention groups consumed fewer processed foods, less sugar, and more fruits and vegetables than the control groups (30). These significant results diminished in the second phase when the program was reduced, but then anthropometric results indicated an improvement in students (30). The study can be concluded as an appropriate demonstration of the benefit of nutrition interventions, however, the students within the intervention groups still did not meet adequate dietary needs, and the effects diminished soon after the program (30). It is said that part of the limitations of the study, other than participation from not just students, but also teachers and parents, was the lack of control on the student curriculum and school surroundings to convey similar messages as the intervention (30). Food behaviours are tough to change, and small environmental changes may not be enough to provide the radical shift that is needed. Societal and social norms are more significant factors than knowledge, particularly in adolescents, and until those factors are also addressed, then it can be expected that dietary behaviours will not be drastically changed (44).
5.7.3.2. Temptations

Temptations lurk around the corner, and the setting for adolescents is one where there are vast opportunities to overeat (45). Since many of the traits of ultra-processed foods have such enticing and addictive properties, perhaps it is the role of society to abstain systematically brandishing such items in the face of children if we are to ever expect a reduction in the current nutrition transition (31).

There is no question that knowledge needs to be increased in the students, particularly in the roles of food groups, considering students had no knowledge of the health benefits of whole grains (5). However, to manifest this knowledge into understanding, and eventually into implementation requires significant work. As previously mentioned, learned behaviours are hard to alter, and they must be conducted at a young age. It is not realistic to attempt to block all out of home foods, or processed foods, or even turn our heads to it. It is a wave that the health and nutrition field must ride, and work side by side with. Food education must start at an earlier age, in the formative years, when learned behaviours are being embedding in us, and from there a society will grow which appreciates whole foods, subtle flavours, and understands that out of home foods and food processing does not need to compromise health.
6. Conclusions

Overall, as nutritionists and health experts in such a dynamic field it is important to remain flexible and vigilant towards potential misconceptions. In this investigation there is evidence that there is need for reconsideration of the definition and identification of snack vs. meals, rural vs. urban, and the closer examination of varieties within out of home prepared foods, and within sociodemographic groups of adolescents.

This investigation provided a small insight into the influences of out of home prepared foods, and food processing on the dietary quality, and dietary behaviours of adolescents in Ecuador. It is clear from results that out of home prepared foods, and increased food processing has negative impacts on the dietary quality. Higher levels of out of home prepared foods were associated higher levels of ultra-processed foods, higher fat, sugar, and sodium intake, as well as higher energy density, and protein intake. However, anthropometric measurements of adolescents consuming more out of home foods indicated no significant difference, perhaps highlighting the need for longitudinal studies, and closer investigation.

Previous interventions on local adolescents have indicated improvements in diet, albeit with limited beneficial results (5). Therefore, the recommendation is made for further interventions on a larger and longer scale with the target of changing the obesogenic environment, and the epigenetic influences on the children of the region in order to make the changes drastic enough to manage the alarming increase in NCDs in the region. Although preferable, the transition to out of home foods and processed foods is not one that can be entirely stopped, however it is one that can be managed and manipulated to create a dynamic and diverse food system that caters to both consumers health and desires.

There remains the need for investigation into the variety of foods available outside of the home, as well as, the differences in sociodemographic groups among the adolescents observed.
7. References


## 8. Appendix

Table 1: Energy Density and Diet Quality by Location of Consumption

<table>
<thead>
<tr>
<th></th>
<th>Home Consumed</th>
<th></th>
<th>Out of Home Consumed</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% CI</td>
<td>Mean</td>
<td>95% CI</td>
</tr>
<tr>
<td>Energy (kcal/g)</td>
<td>0.96</td>
<td>[0.94; 0.97]</td>
<td>1.74</td>
<td>[1.66; 1.82]</td>
</tr>
<tr>
<td>Carbohydrates (% of kcal)</td>
<td>64.3</td>
<td>[63.1;64.3]</td>
<td>57.9</td>
<td>[56.4;59.3]</td>
</tr>
<tr>
<td>Protein (% of kcal)</td>
<td>13.6</td>
<td>[13.4;13.8]</td>
<td>10.1</td>
<td>[9.7; 10.7]</td>
</tr>
<tr>
<td>Fat (% of kcal)</td>
<td>22.4</td>
<td>[22.0;23.0]</td>
<td>32.7</td>
<td>[31.5;33.9]</td>
</tr>
<tr>
<td>Fiber (% of kcal)</td>
<td>1.4</td>
<td>[1.4;1.5]</td>
<td>1.4</td>
<td>[1.2;1.4]</td>
</tr>
<tr>
<td>Sodium (mg/g)</td>
<td>1.2</td>
<td>[1.2;1.3]</td>
<td>1.9</td>
<td>[1.8;2.0]</td>
</tr>
<tr>
<td>Sugar (% of kcal)</td>
<td>15.2</td>
<td>[14.8;15.7]</td>
<td>21.9</td>
<td>[20.4;23.4]</td>
</tr>
</tbody>
</table>

Table 2: Food Group Sources Distribution by Location of Consumption

<table>
<thead>
<tr>
<th></th>
<th>Home Consumed</th>
<th></th>
<th>Out of Home Consumed</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>95% CI</td>
<td>Mean</td>
<td>95% CI</td>
</tr>
<tr>
<td>Weight (%)</td>
<td>88.2</td>
<td>87.4-89.0</td>
<td>11.8</td>
<td>11.0-12.6</td>
</tr>
<tr>
<td>Seafood (% of weight)</td>
<td>83.2</td>
<td>79.3-87.1</td>
<td>16.8</td>
<td>12.9-20.7</td>
</tr>
<tr>
<td>Whole Grain (% of weight)</td>
<td>88.9</td>
<td>84.9-92.8</td>
<td>11.1</td>
<td>7.2-15.1</td>
</tr>
<tr>
<td>Fruit (% of weight)</td>
<td>87.0</td>
<td>85.3-88.7</td>
<td>13.0</td>
<td>11.3-14.7</td>
</tr>
<tr>
<td>Vegetables (% of weight)</td>
<td>89.1</td>
<td>87.8-90.5</td>
<td>10.9</td>
<td>9.5-12.2</td>
</tr>
<tr>
<td>Animal Fats (% of weight)</td>
<td>64.5</td>
<td>61.4-67.6</td>
<td>35.5</td>
<td>32.4-38.6</td>
</tr>
<tr>
<td>Refined Grains (% of weight)</td>
<td>74.7</td>
<td>70.0-79.3</td>
<td>25.3</td>
<td>20.6-30.0</td>
</tr>
<tr>
<td>Snacks (% of weight)</td>
<td>73.9</td>
<td>72.2-75.6</td>
<td>26.1</td>
<td>24.4-27.8</td>
</tr>
</tbody>
</table>
Table 3: Energy Input from Processing Levels by Location of Consumption

<table>
<thead>
<tr>
<th></th>
<th>Home Consumption</th>
<th></th>
<th>Out of Home Consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean 95% CI</td>
<td>Mean 95% CI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonprocessed (% of kcal)</td>
<td>56.3 55.7-57.3</td>
<td>23.4 21.2-25.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culinary Ingredients (% of kcal)</td>
<td>14.1 13.7-14.5</td>
<td>5.9 5.1-6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processed (% of kcal)</td>
<td>4.0  3.6-4.5</td>
<td>2.9 2.2-3.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultra-processed (% of kcal)</td>
<td>25.6 24.6-26.6</td>
<td>67.8 65.2-70.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Location of Production, Location of Consumption, and Consumption Based on Processing Levels by Sex

<table>
<thead>
<tr>
<th></th>
<th>Boys Mean 95% CI</th>
<th>Girls Mean 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home Produced (% of intake)</td>
<td>63.5 61.8-65.1</td>
<td>66.2 64.5-67.9</td>
</tr>
<tr>
<td>Out of home Produced (% of intake)</td>
<td>31.7 30.0-33.4</td>
<td>28.0 26.3-27.9</td>
</tr>
<tr>
<td>School Produced (% of intake)</td>
<td>4.8  4.1-5.5</td>
<td>5.8  4.6-6.6</td>
</tr>
<tr>
<td>Location of Consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home Consumed (% of intake)</td>
<td>84.4 83.0-85.9</td>
<td>84.7 83.4-86.1</td>
</tr>
<tr>
<td>OH Consumed (% of intake)</td>
<td>15.6 14.1-17.0</td>
<td>15.3 13.9-16.6</td>
</tr>
<tr>
<td>Level of Processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonprocessed (% of intake)</td>
<td>51.5 50.1-52.9</td>
<td>52.3 50.9-53.4</td>
</tr>
<tr>
<td>Culinary Ingredients (% of intake)</td>
<td>12.5 12.0-13.0</td>
<td>13.1 12.6-13.7</td>
</tr>
<tr>
<td>Processed (% of intake)</td>
<td>3.8  3.2-4.3</td>
<td>3.8  3.3-4.4</td>
</tr>
<tr>
<td>Ultra-processed (% of intake)</td>
<td>32.2 30.8-33.7</td>
<td>30.8 29.4-32.1</td>
</tr>
</tbody>
</table>

Table 5: Location of Consumption by Designated Meal Times

<table>
<thead>
<tr>
<th></th>
<th>Home Consumed Mean 95% CI</th>
<th>Out of Home Consumed Mean 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast (%)</td>
<td>97.7 96.9-98.6</td>
<td>2.3 1.4-3.1</td>
</tr>
<tr>
<td>Morning Snack (%)</td>
<td>56.4 53.5-59.2</td>
<td>43.6 40.8-46.5</td>
</tr>
<tr>
<td>Lunch (%)</td>
<td>87.6 85.9-89.3</td>
<td>12.4 10.7-14.1</td>
</tr>
<tr>
<td>Afternoon Snack (%)</td>
<td>78.7 76.0-81.5</td>
<td>21.3 18.5-24.0</td>
</tr>
<tr>
<td>Dinner (%)</td>
<td>94.8 93.6-95.9</td>
<td>5.2  4.1-6.4</td>
</tr>
<tr>
<td>Night Snack (%)</td>
<td>91.2 88.2-94.2</td>
<td>8.8  5.8-11.8</td>
</tr>
</tbody>
</table>