

FINAL REPORT

on

“The Impact of Food Trade and Commerce on Overweight, Obesity and Nutritional Behaviour Among Children and Adolescents in a Small Island Developing State, Mauritius”

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1. Introduction

Globally, there are more than 1 billion overweight adults, and at least 300 million of them are clinically obese (Edelman M, Ficcorelli C.T., 2012). On this trend it is forecasted that by 2030, close to half adult population in the world will be either overweight or obese (McKinsey Global Insitute, 2014). It is a global public health concern that carries significant health risks leading to other simultaneous medical conditions (Affenito S.,G., Franko,D.,L., Streigel-Moore,R.,H., and Thompson,D, 2012). The World Health Organisation (WHO) defines a person to be overweight if his BMI is greater than or equal to 25 and obese if his BMI is greater than or equal to 30.

More than fifty percent of mortality rate around the world is due to chronic non-communicable diseases (CNCDs) which keep on increasing at an alarming rate and has almost doubled death related causes linked to all infectious diseases, maternal and pre natal conditions, and nutritional deficiencies combined (M.S, Elkind, 2011)

Overweight and obesity are caused by accumulating abnormal or excessive fat in the body whereby several health problems are aroused. Obesity is strongly linked to type 2 diabetes, and is major risk factor not only for type 2 diabetes, but other chronic conditions such as hypertension, cardiovascular disease, dyslipidaemia, some cancers and arthristis. The most serious form of obesity is of central (abdominal) rather than peripheral form, as it is associated with substantially higher risks for diabetes and cardiovascular (Olokoba,A.B.,Obateru,O.A.,Olokoba,L.B, 2012).

Overweight and obese children are more likely to suffer from obesity, premature death and disability in adulthood and the risk of developing NCDs at an earlier age is higher. Furthermore, these children tend to have breathing difficulties, higher risk of fractures, hypertension, insulin resistance, psychological effects and early markers of cardiovascular disease. Elaborating further on growth of bones, the growth plate-the area of developing cartilage tissue at the end of the body's arm, leg and other long bones can be damaged with excess weight. Other problems such as having difficulties with their coordination are also faced, (AAOS, 2014)

Statistically, more than one third of U.S adults are obese, 17 % of children and adolescents are obese as in 2010. The total cost of overweight and obesity to the US economy in 1995

dollars was \$992 billion, approximately \$51.5 billion in direct costs and \$47.6 billion in indirect costs (Kumar,S.,Han,J.Li T.,Qureshi AA., Oct 12). This problem is not only faced by Westernized nations but also becoming more and more as an emerging problem for small islands developing states (Pearlman,D.N.,Dowling,E.,Bayuk,C.,Cullinen,K.,Thacher,A.K.,, 2005)It is a driving factor in the global CNCD epidemic.

For example, the problems of CNCDs have been reported to be contributing enormously to increase the rate of mortality and morbidity. In the Caribbean and Jamaica for the past 25 years there has been an epidemiological shift in morbidity and mortality from communicable to chronic non communicable diseases. CNCDs account for 56 % of deaths in Jamaica (Henry, 2011). The Caribbean has some of the highest rates of obesity. In Jamaica, 52 % of persons 15-74 years old are overweight/obese. Women bear the greatest burden of this epidemic with 64.7 % overweight/obese (Ferguson, 2011)

Being overweight or obese in childhood has been shown to have significant impact on both physical and psychological health across the life span (15-20). Overweight children are at risk at 9 conditions once thought only to affect adults, for example, type 2 diabetes, high blood pressure and high cholesterol (15-20). Approximately one half of overweight adolescents and over one-third of overweight children will remain obese as adults (19-20 with continued negative impacts on their health (Sikorski, 2012).

Overweight or obese children have a significant likelihood of having multiple risk factors for chronic health and early mortality related to their excessive weight before or during early adulthood (15-20). In addition to physical illnesses, psychological disorders such as depression are reported as occurring with increased frequency in obese children (World Health Organisation, 2006a)

Studies also show that from 1980 to 2014, the global prevalence of obesity has more than doubled. And according to the WHO, in 2014, 39% and 13% of the world's adult population were overweight and obese, respectively.

Besides the adults, overweight and obesity in children have become an alarming health problem across the world. In 2013, the WHO estimated about 42 million children aged less than 5 to be overweight or obese, and of these nearly 31 million are from developing countries. For instance, the number of overweight children in the USA has doubled since 1980 and that for the adolescents has trebled.

The problems are not different in the small island state of Mauritius with a population of around 1.3 million inhabitants. The Non Communicable Diseases report (MOH & QL, 2009) showed that obesity was prevalent among an estimated population of 477,000 people between 25 and 74 years of age. According to the National Nutrition Survey conducted in 2004, the following has been deduced in Mauritius:

(5 – 11 years old)	Boys	Girls	(12 – 18 years old)	Boys	Girls
Overweight	7.9%	7.5%	Overweight	8.2%	6.5%
Obese	8.5%	7.8%	Obese	8.4%	8.4%

Recent reports by the Ministry of Health showed that childhood obesity has increased from 16 % in 2004 to 28 % in 2011 (Bignoux, Rising juvenile obesity worries mauritius port-louis, 2012).

The NCD report (2009) highlighted the fact that apart from the escalating rate of diabetes, there is also a high prevalence of pre-diabetes, a condition associated with increased risk of heart disease and subsequent diabetes. The high rates of diabetes and pre-diabetes, coupled with those of obesity, dyslipidaemia and hypertension, constitute a significant threat in terms of the future social and economic burden of cardiovascular disease and diabetes complications for Mauritius.

However it is to be highlighted that the NCD findings were solely based on clinical, biochemical as well as anthropological data and did not lay emphasis on the issue of the link between food consumption and obesity among the population. In view of the present eating style behaviour among the Mauritian population, there are increasing risks that the problem of obesity attains epidemic proportion in the future.

The problem is further compounded with the introduction of fast food outlets and the impact of local and cable networks that advertise fast foods heavily. The island has some of the international fast- food restaurants whereby there is also a high consumption of soft drinks that are high in sugar content. It is also noted that the consumption of soft drinks is also on the rise on the island.

Over the past decades consumption of the local and imported food and beverage has grown exponentially. Based on a survey via World Wide Web, Subratty et al, (2002) reported

adolescents' perceptions of the importance of healthy foods were more likely to be influenced by the way they feel generally. Adolescent girls perceived their diets in the light of appearance and body shape, while boys were more concerned by fitness and general wellbeing. With age and maturity, adolescents give less importance to fitness and become more conscious about health issues. However almost after a decade, the NCD findings (MOH & QL, 2009) have highlighted that obesity is on rise.

Although there are policies to regulate the food and beverage industry, the regulations are not exhaustive and adequate pertaining to the promotion, labelling of food and also the use of trans fatty acids in certain foods. Furthermore with the impact of climatic change on agriculture associated with economic downfalls, there are not sufficient incentives for the local production and consumption of fruits and vegetables whereby the consumption keeps on decreasing drastically (Subratty,A.H.,Jowaheer,V., 2001)

Furthermore, we have recently reported that fruits and vegetables intake is associated with ethnicity and socio-demographic factors in Mauritius (Badurally Adam,B.T., Mahomoodally,M.F, Subratty A.H, Ramasawmy,D, 2012). We have also previously reported that many less healthy food choices are offered to Mauritian school children, thus undermining their health and nutrition status Of Mauritian school children. It was recommended that there was need for urgent action to change the school food environment in order to prevent obesity among school children for a healthier Mauritius (Sun,M. Chan, Laisng,Y.,Subratty,A.H., 2009).

It is noted that changes have been brought in the legislation to the type and quality of food that should be made available at school levels however the obesity problems among the youngsters in the country are on increase.

In view of the above situations, the main aim of the present study is to explore the impact of food trade and commerce in Mauritius and possible relationship with overweight, obesity and among children and adolescents in Mauritius. The findings will contribute towards enhancing appropriate policy decisions that will have impact on the health of present and future generations of Mauritius.

- **Rationale for this study**

There is a rise in the rate of diabetes among the Mauritian population as well as the disturbing figures that show that too many young people are overweight and obese, not meeting physical activity or have not adopted healthy dietary behaviours, are showing increasing tendency towards alcohol consumption and smoking.

This project therefore proposes to acquire further information on the lifestyle of youngsters and dig out possible association between the impact of the trade and commerce on the incidence of rising rate of obesity in Mauritius.

- **Aims and Objectives**

To assess the nutritional behaviour and physical activities among the children and adolescents of Mauritius.

To explore the impact of food trade and commerce in Mauritius and possible relationship with weight issues and among children and adolescents in Mauritius.

2. Trends in Food Trade and Obesity in developing countries.

2.1. Globalization and obesity in developing countries

Globalization is characterized by increasing international economic interaction and global market integration over more than twenty-five years. It is mainly an economic activity where processes drive it and affects it as well. These processes are globalization policies aiming in some ways to integrate local, national or regional economies into the global market place.

There have been two clear nutrition trends with the advent of economic globalization since early 1980's to the present. The first one being a considerable decline in the proportion of under nourished people and the second one being a significant rise in the number of overweight/obese people. The latter was seen rapidly increasing in the developing countries (Hawkes, 2007).

2.2. Trade liberalization in Food

Liberalization of trade has been a major catalyst of globalization. The key element of trade liberalization is the negotiation of international trade, investment agreements and treaties between governments either on a bilateral, regional or multilateral level. In this context, the Uruguay round of trade talks and establishment of the World Trade Organization (WTO) in 1995 was the first international trade agreements to put forward food and agriculture as trade concerns globally. These agreements outlined commitments from WTO member countries to reduce tariffs, export subsidies and domestic supports, to remove or amend national regulations and standards that created barriers to trade, to harmonize standards pertaining to animal, plant and human health hazards from trade, to implement measures to liberalize trade in services, to grant minimum protection of IP rights for investors and to conduct open competitive government procurement along with procedures for trade disputes resolution.

Following the trade liberalization of food and agriculture under WTO, food trade has become a key component of global, regional and domestic food systems. Three important changes has been brought about in the food system as a consequence of liberalization of trade and foreign direct investment, namely the opening of the domestic market towards international food trade and FDIs, the entry of transnational food corporations (TFCs) and their global market expansion and the global food advertising. In principle, liberalization of trade brings economic growth, helps in poverty reduction and raises standard of living with more opportunities for export and access to international markets, attracting lower imports cost and inward FDI. All of these have the potential to benefit health by extending the spread of technology and medical advances (Friel, 2013)

2.3. Trade liberalization effect on food consumption

Although trade liberalization is supposed to benefit the nutritional status of populations by increasing availability, accessibility and affordability of food in various countries, this does not seem to be the case. There is evidence that trade liberalization policies have worsened inequalities between regions, countries and social groups. This has brought an emergence of new dietary habits and dietary outcomes that are contributing to the global pandemic of obesity and non-communicable diseases (Friel, 2013). There is major concern that trade liberalization in food has contributed towards obesity by altering food availability, nutritional quality as well as price and promotion of foods in various geographical locations more

precisely in the consumer food environments (Friel, 2013) Trade and FDI allows a large scale flow of foodstuffs and diffusion of Western Fast-Food restaurants in developing countries explaining changes in consumption leading to unhealthy diets (Gereffi, 2008).

2.4. Trade and obesity emergence in island nations

A recent study by McLennan and Ulijaszek (2014) shows a disproportionate prevalence of obesity in island nations including those in the Caribbean and Pacific. Attempts to explain the high obesity rates in island nations focused mainly on two of their physical attributes. Firstly, their geographical isolated location and risk of food shortage have enhanced the islanders' genetic predisposition to increase weight. Secondly, the islands relative small size and their limited productive capacity make them very dependent on imported foods and rather powerless in international trade policy negotiations. These two characteristics disproportionately expose islanders to the global food system and abundance of modern food products. On the other hand, to feed the growing population of islands having limited capacity to produce enough food locally, import of food is often the only solution. In this situation little can be done in regional level trade policies dominated by much bigger political actors from large nations and economic actors who are the transnational corporations. The governments of island nations have very limited resources to negotiate trade policies and their impacts on their populations. The relevance of this issue to obesity is seen in the close links between people's diet changes and changes in the food supply in the region (Snowdown, 2013). It is clear that once again the globalization of food supply has an impact on increasing prevalence of obesity among people in developed, developing and island nations (Friel, 2013).

2.5. Trade and Food habits

Food habits can be guided by emerging social values and lifestyles that have very little to do with food itself (McLennan, A. K., and Ulijaszek, S. J., 2014). Consumption of obesity prone foods may contribute to a sense of social belongingness, as foods aligning with the capitalist economic rationale are low cost high volume and restaurants food save time and therefore money. This is considered fair so far as no extra person has invested more effort than others in the food preparation. Contemporary lifestyles favor foods requiring minimal investment of time, money or effort for maximal gain. These values are further reiterated by mainstream media through Television, Internet and food marketing campaigns that have an influence on

accelerated social behavior changes in food habits. Furthermore, globalization's effect on rising income, urbanization and employment lead to different lifestyles and more money is available for people to demand a variety of different foods (Regmi, A., Ballenger, N., & Putnam, J., 2004).

2.6. Changing food supply

Globalization is changing the food resources available to people in terms of availability, accessibility, quality, price and desirability by drastically altering the nature of food systems (Hawkes, 2007). Transnational food companies (TFCs) are more and more involved in all aspects of food supply from food production to distribution and marketing on a global scale. TNCs are growing and vertically integrating their production processes including distribution and sales to benefit from low cost of production and from economies of scale. The major foreign affiliates of TFCs in developing countries are mostly food companies engaged in some type of processed foods. This brings greater availability, increased accessibility, lower prices, and greater desirability for energy-dense processed and fast foods. The growing number of fast food outlets is one measure showing change in food supply within developing countries. There is growing evidence that TFCs deliberately push for consumption of more industrial food such as snacks and ready meals where they are slowly replacing agricultural products by the former (Chopra, M. & Darnton-Hill, I., 2004)

2.7. Food categories

It is important to differentiate between food categories that are healthy and those ultra processed, energy-dense and/or high-fat foods that are readily available and consumed leading to increase obesity risks (Friel, 2013). Under healthy food categories that have nutritional value are fresh fruits, fresh vegetables including fresh staple root crops, pulses, nuts and seeds and staple whole-grain cereals.

With the changing food systems and supplies globally, the ready-to-consume food and beverages supplies are substituting traditional dietary patterns of wholesome freshly prepared meals. Food processing has become a very important determinant of dietary patterns, dietary quality, and impact on body weight, diet-related diseases, health and well-being. A comprehensive food classification has been devised based on the role of industrial food processing in nutrition and human health known as NOVA. It defines industrial. It defines

industrial food processing as ‘the methods and techniques used by food manufacturers and associated industries to make unprocessed or “raw” foods less perishable, easier to prepare, consume or digest, or more palatable and enjoyable, or else to transform them into food products’ (Moubarac, 2014). This classification method entails food and products according to their nature, extent and purpose of industrial food processing in three main groups and their respective subgroups. The first group consists of unprocessed or minimally processed foods. The second group consists of processed culinary ingredients. The third group involves ready-to-consume products, which is further split in two sub-groups of processed food products and ultra-processed products (Moubarac, 2014).

2.8. Nutrition transition in developing countries

The nutrition transition phenomenon is being experienced in the developing world with rapid shifts in food availability and consumption (Thow, A.M. & Hawkes, C., 2009). Local diets based on local staple foods are giving way to increasing consumption of fats, animal products and sweeteners, simultaneously coupled with a drop in levels of physical activity. The effects of this dietary and sedentary lifestyle change are constantly being seen in developing countries in rapidly increasing obesity level, diabetes and associated non-communicable disease. The factors of this dietary transition are numerous while individual lifestyle choices are determining. But the macro factors are crucial in shaping the food environment through easy availability of food at affordable prices. Here again the core driver of the nutrition transition is globalization through the reductions of trade barriers, growth of transnational food companies, FDI and liberalization of media advertising. These types of trade liberalization agreements have resulted in a more open cheaper global food marketplace that have enabled people access to various types of high-calorie, processed foods (Harvard School of Public Health, 2013). The literature on globalization, diet, obesity and chronic disease accepts that trade liberalization boosts imports of high calorie processed western foods, whereby changing food consumption patterns and health (Thow, A.M. & Hawkes, C., 2009).

2.9. Childhood Obesity

Childhood obesity has reached epidemic levels not only in emerging countries but also in developing ones. (Mahshid Dehgan, N.A. & Merchant, A.T., 2005) Diet in the 1970’s began to shift toward increased reliance upon processed foods, increasing rate of staying from home intake and greater use of sugar-sweetened beverages. Nowadays food is available everywhere

and has become more affordable to large numbers of people as the price has decreased substantially relative to income. Further, the concept of 'food' has changed from a means of nourishment to a marker of lifestyle and a source of pleasure.

Clearly, increases in physical activity are not likely to offset an energy rich, poor nutritive diet. It will take between one to two hours of extremely vigorous activity to counteract a single large-sized at a fast food restaurant. But that does not seem to scare any child and thus consumption of junky foods is getting higher among them. It is believed that the sedentary lifestyle lead by young people such as watching television, playing computer games or spending time on social network sites make them devote less time on physical activities and thus contribute more to the pandemic. For some cases, childhood obesity can be due to genes such as leptin deficiency or side effects due to drugs taken on a daily basis. However, the main causes that significantly influence obesity is the child's personal lifestyle choices and cultural environment.

It is understood that the world rising rate in childhood obesity is mostly due to their nutritional behaviour. Children have the tendency to eat more energy-dense foods or snacks with large portion sizes contributing to higher risk of become obese. As previously mentioned, it will take several hours of physical activities to counteract the number of excess calories, fat and sugary contents found in these processed foods. Dr. Mercola in his article, (Mercola, 2014) mentioned that in order to increase sales, packaged foods are either hyper palatable or hyper rewarding. Food companies regulate the combinations of three elements namely fat, salt and sugar with other chemical additives and flavour enhancers so as these mixtures altogether override our satiety mechanisms and cause us to make poor food choices (Thow, A.M. & Hawkes, C., 2009). These junky foods encourage weight gain and chronic diseases due to their low content in essential nutrients and fiber. Furthermore, children are being affected as the consumption of certain food groups, especially plant based are being less. One important factor that Mauritians tend to ignore is that our culture. Most of them is from the Indian and African origin making them more insulin resistant and putting them in a higher risk of becoming a diabetic.

Another factor that seems to arise mostly the prevalence of childhood obesity is food trade liberalization. Food imported to developed countries is strongly related to the nutritional habits of young people and have high implications. The cause is simply due to the daily interaction with the brands and products via the advent of new technologies. Today, powerful

and intense promotions on food and beverages have been integrated into young people's life whom are unable to understand the consequences of their impulsive decision.

In 2007, therefore, Mauritius strengthened its laws in banning the sales of fizzy soft drinks in school canteens and three years later, fatty snacks were also restricted (Bignoux, 2013). Recent research in 2011 showed that out of 841 participants aged 9-10 years, 22.4% were either obese or overweight. This rate is frightening even though packaged foods and beverages are prohibited in school canteens.

3. Survey on the Nutrition

3.1. Data Collection

A proposed research on the impact of food trade and commerce on the nutritional behaviour of young people has been carried out for Mauritius. A questionnaire has been set up to analyse the nutritional habits of young Mauritians aged 5-17 years. A food recall paper is also included so as to avoid wrong responses and biasness in results. Sample size has been calculated using the following formula below:

$$S = \frac{X^2 NP(1 - P)}{d^2(N - 1) + X^2 P(P - 1)}$$

Where

S = Required sample size

X^2 = Table value of chi-square for 1 degree of freedom at desired confidence interval (usually taken as 3.841 for 95% CI)

N = Population Size

P = Population Proportion (taken to be 0.15)

d = degree of accuracy expressed as proportion (taken to be 0.05)

This formula has been in several research papers such as to calculate sample size for clinical trials, (Kadam, P. & Bhalerao, S., 2010). So in Mauritius, the population of young Mauritians aged 6-11 years is approximately 103,642 and those aged 12-19 is 114,311. Hence the approximated sample size turns out to be around 196 children. It is important to note that as

population size increases, sample size increase at a diminishing rate and remains relatively constant at around 3800 cases (Krejcie, R. V. & Morgan, D.W., 1970).

The questionnaire entitled 'Food Habits' has been distributed to students both in the primary and secondary schools in Mauritius for the purpose of collecting data which will be hereafter used for analysis. This questionnaire consists of 6 sections with a total of 51 questions, on *Personal Details, Packaged Snacks Consumption, Beverage Consumption, Availability & Accessibility, Awareness* and also a *Food Recall* section where participants have been asked about their food and beverage consumption over the last three days. Out of 200 questionnaires, only 182 were considered since the rest contain anomalies. The data has then been analysed using IBM SPSS v21 to study the nutritional behaviour among these participants.

3.2. Descriptive Analysis

A descriptive analysis is carried out for all quantitative and qualitative variables. The results of some main ones are highlighted below:

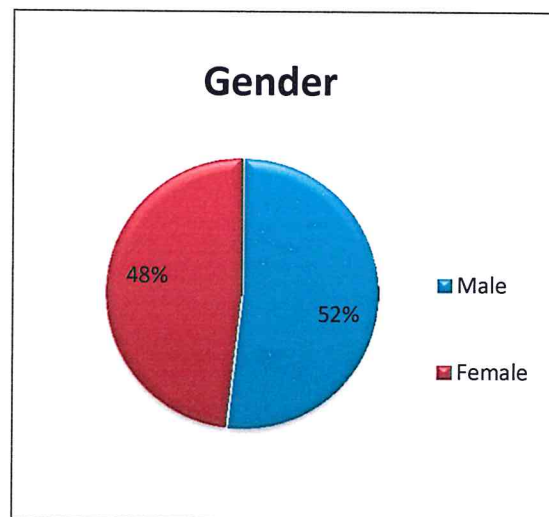


Figure 3.1 : Gender

As far as gender is concerned, it is seen that among the participants, most of them were females representing 52% against the males with 48%. However, the difference between the number of males and females is relatively small.

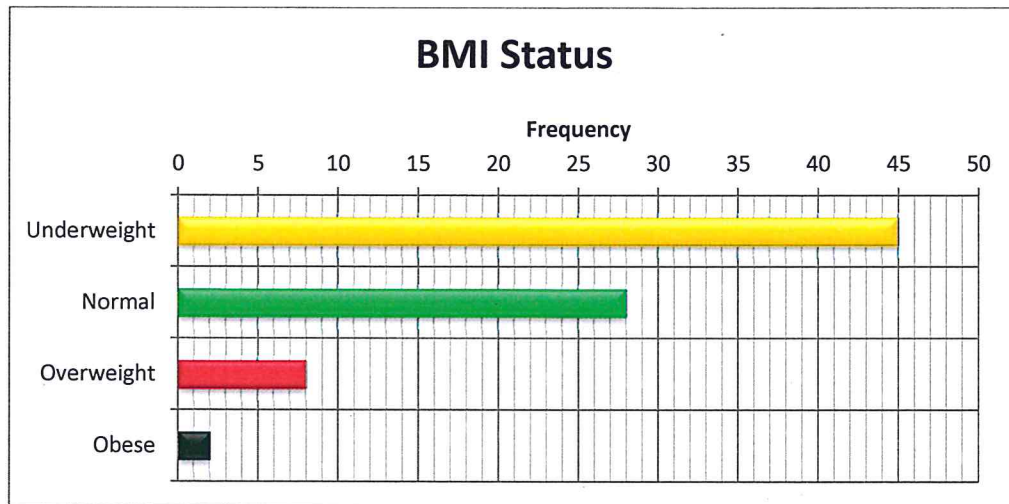


Figure 3.2 : BMI Status

After obtaining the heights and weights of the participants, their respective BMI has been computed based on the BMI status definition of the World Health Organisation. We notice that 54.2% of the participants are actually underweight and that only 12.0% are overweight and obese.

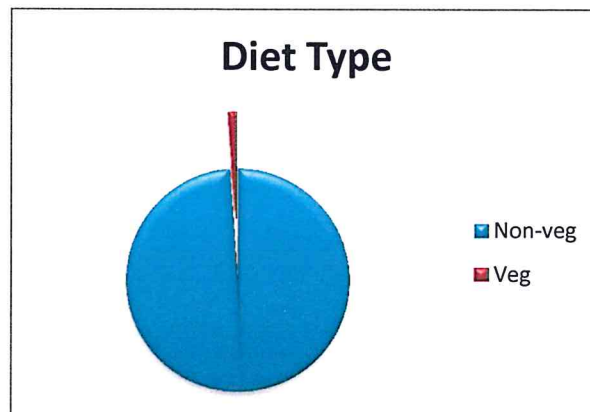


Figure 3.3 : Diet Type

Different people adopt different lifestyles also implying different eating habits. Some of them are vegetarians, that is, they do not consume meat, fish or poultry. Some of them are vegans, that is, in addition to being as vegetarian they do not use other animal products and by-products such as eggs, dairy products, etc. The remaining are non-vegetarians, that is, they do eat meat, fish and poultry. Hence, from the participants we deduce that majority of

them are non-vegetarians representing a total of 98.8% and only 1.2% are vegetarian. None are found to be vegans.

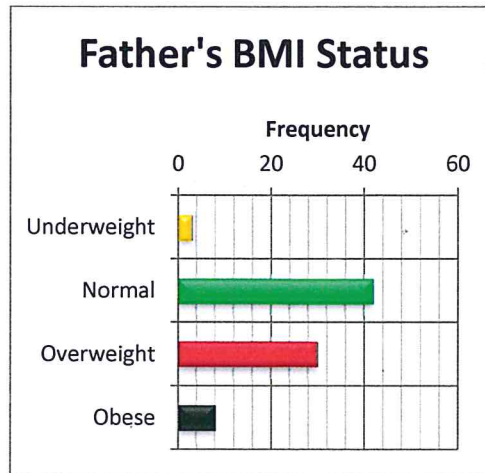


Figure 3.4 : Father's BMI Status

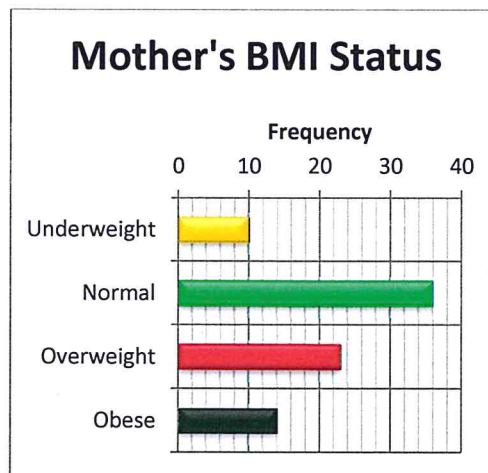


Figure 3.5 : Mother's BMI Status

The figures above clearly show that the majority of the parents have a normal BMI. But we also note that there are 36.1% of fathers and 27.7% of mothers in the overweight category. In addition, we obtained 7.3% more obese mothers than fathers, which represent only 9.6% from the sample analysed. Given that overweight and obesity are actually on the rise globally, it is not surprising to see more overweight and obese than underweight parents.

The questionnaire was mainly designed to learn about the food habits of children/adolescents. According to the data received, 74.7% have 3 meals per day which implies that the majority

are having the basic meals of the day but the question remains whether they are having proper or improper meals. Also, snacking in between meals has become a habit for almost every child/adolescent and we see that 44.6% of them consume snacks 2 times in between meals. Furthermore, we are surprised that 1.2% of the participants claim that they eat snacks 10 times in between meals, which is obviously not a good eating habit.

While fruits and vegetables are essentials in a healthy diet, 34.9% claim to consume fruits on a daily basis and 55.4% claim to consume vegetables every day. It is seen that the majority does consume fruits/vegetables at least once per week with 31.3% consuming vegetables 3 to 4 times a week. Very few claim that they consume none. Hence, we can deduce that overall consumption of fruits/vegetables per week is still good so far.

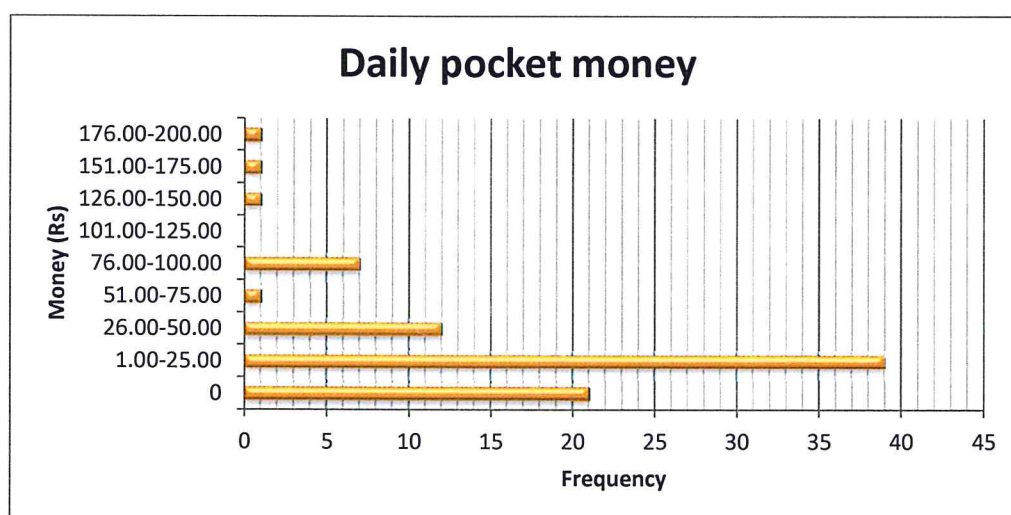


Figure 3.6 : Daily pocket money

Pocket money plays an important role in the school life of children/adolescents as they tend to use it to buy snacks, be it from the school canteen or from an outside shop when they leave for school. According to our study, we notice that the maximum pocket money received by the participants is currently Rs200.00 while the minimum being zero. From this bar chart, it can be deduced that 71.1% receive Rs 1.00-100.00 per day while 25.3% still receiving none. We also notice that 3.6% of the participants receive Rs150.00 onwards as daily pocket money.

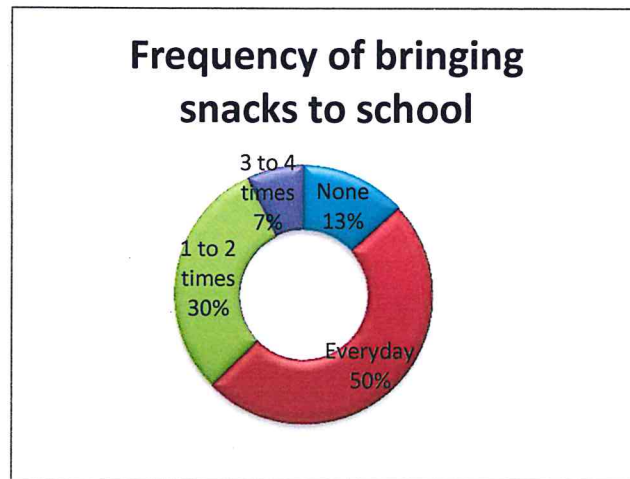


Figure 3.7 : Frequency of bringing snacks to school

From this particular chart, it appears that 50% of the participants bring snacks to school on a daily basis while another 30% bring 1 to 2 times per week. This can account for the fact that a large percentage of participants consume snacks in between meals.

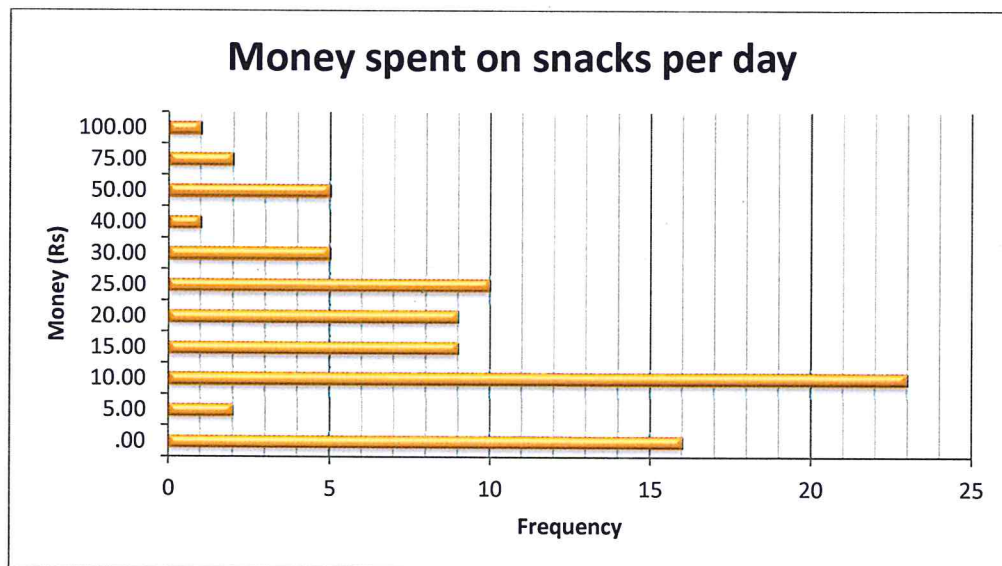


Figure 3.8 : Money spent on snacks per day

This particular bar graph shows that there still exist children/adolescents who spend no money at all on snacks per day. In our study, we deduce that they represent 19.3% but this does not strictly imply that they are not consuming snacks at all. They might represent some of those who bring their snacks from home, thus the need of not buying at school. We also notice a high percentage of 27.7% who spend Rs10.00 daily on snacks. Furthermore, 39.8%

of them spend Rs15.00-Rs30.00 per day on snacks. It is also surprising to see that 9.6% spend Rs50.00 onwards on snacks on a daily basis.

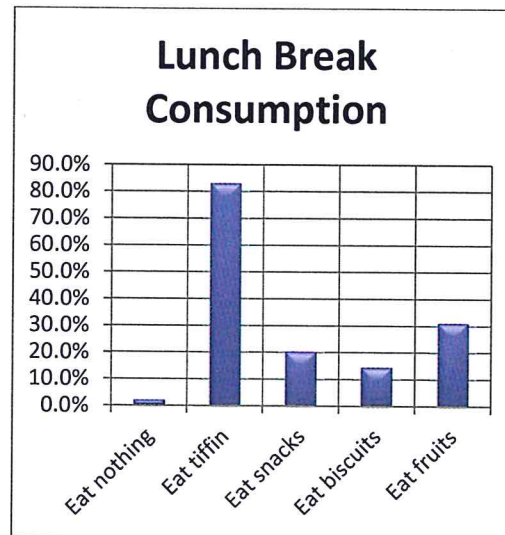


Figure 3.9 : Lunch Break Consumption

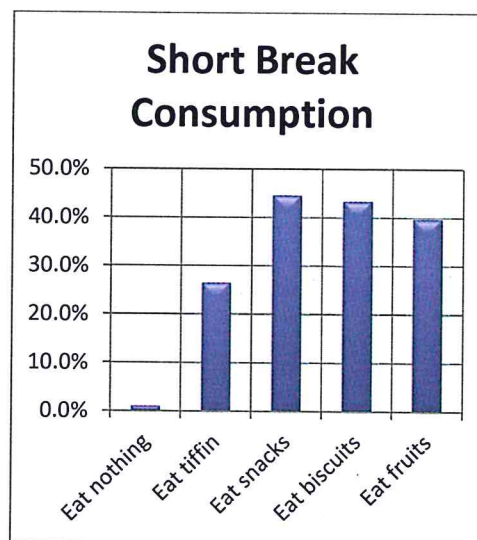


Figure 3.10 : Short Break Consumption

During the lunch break at school, 59.6% of the participants eat their tiffin while 10.9% also consume snacks. As for the short break, 17.1% eat their tiffin and 29.3% eat snacks. Therefore, we notice that the percentage consuming snacks during the short break is more than twice the case for lunch break.

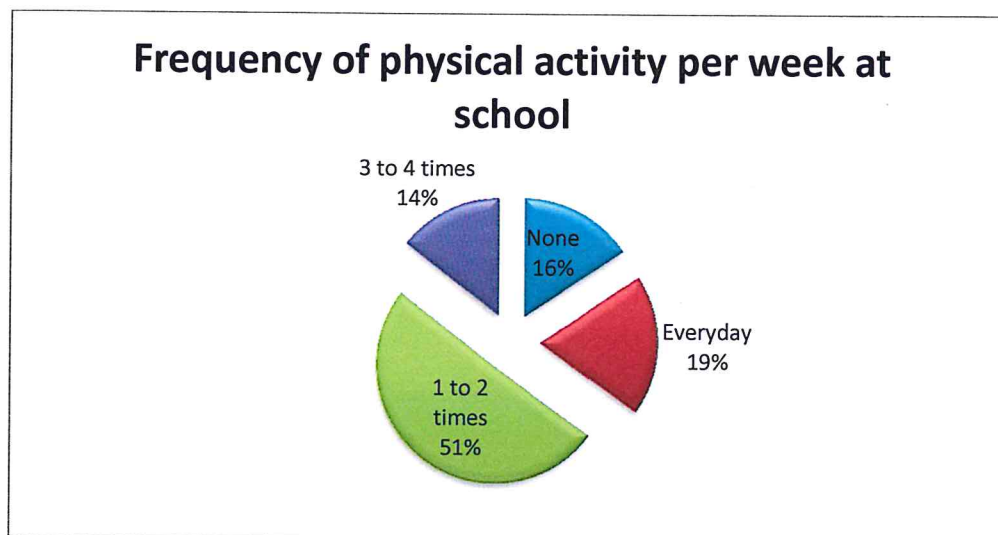


Figure 3.11 : Frequency of physical activity per week at school

Different schools have different schedules for physical activity periods during a week. According to the above figure, 51% of the participants practice physical activity only once or twice per week. This frequency of performing physical activities, compared to daily consumption of snacks, can be regarded as not enough for those children/adolescents. Unfortunately, there are 16% of them who claim to have no physical activity period at all, which is quite unfortunate as practising physical activities weekly helps to maintain not only a good figure but most importantly a good health. We also noted that only 36.1% practice any physical activity at home on a daily basis.

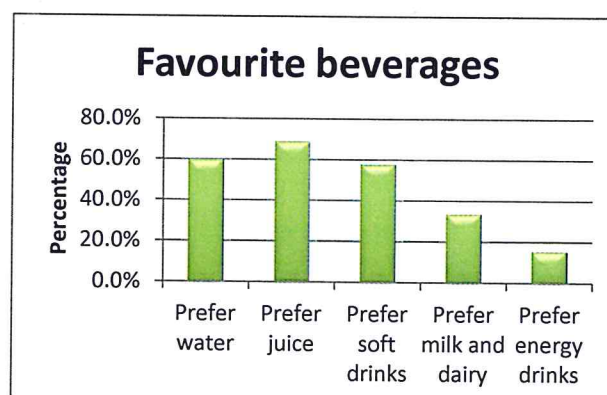


Figure 3.12: Favourite beverages

This bar graph shows that instead of water, 68.7% prefer juice and 57.8% prefer soft drinks as beverages. Considering the amount of sugar present in the latter, it is definitely not a good fact to have so many children/adolescents preferring that.

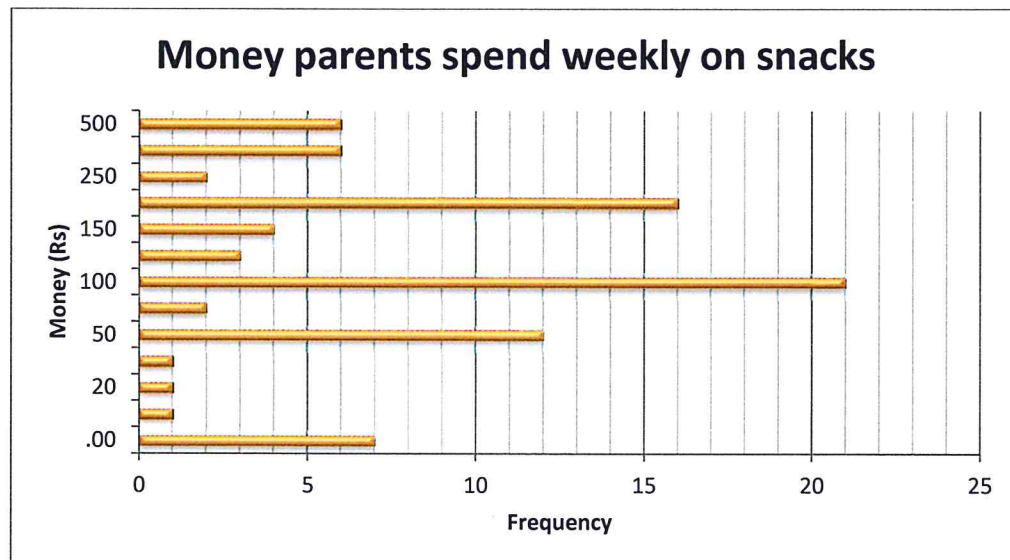


Figure 3.13 : Money parents spend weekly on snacks

This bar graph indicates how much money the parents spend on snacks per week. While 8.4% claim to spend nothing on snacks, we also come across 69.9% who claim to spend Rs50.00-200.00 on snacks per week. Furthermore, 16.9% claim to spend Rs250 onwards and surprisingly, 1.2% claim to spend Rs600.00 on snacks per week, which is a considerable amount to be spent on snacks.

Snacks and beverages do not form part of a healthy diet thus they have negative impacts on the health of the individuals who consume these. Upon asking, the majority of the participants, 94%, responded positively while only 6% are still unaware of this fact. Also, among them 81.9% claim to be aware of the consequences of overweight and obesity.

4. Statistical Modelling of Data

In this section, we proceed to develop a Structural Equation Model (SEM), in order to measure the relationships between the variables in our data and identify the significant factors with respect to BMI in children.

4.1. Background of SEM

SEM is a statistical technique that enables to model a set of relationships between independent and dependent variables to be analysed (B.Ullman, 2006). The major advantage of SEM is that a series of separate interdependent relationships can be examined simultaneously. It is a powerful tool to quantify the correlation between observed variables as well as latent variables.

The five main steps in SEM are 1) Specification and Identification of the model, 2) Data preparation and screening, 3) Estimation of the model, 4) Evaluation of the model, 5) Model modification. Until an optimal SEM is obtained, the initial model is usually modified several times.

Every identified model needs to be eligible. To test the eligibility of the model, fit measures such as CFI (Comparative Fit Index), RMSEA (Root Mean Square Error of Approximation), SRMR (Standardized Root Mean Square Residual), AGFI (Adjusted Goodness of Fit Index), GFI (Goodness of Fit Index) are used as criteria. The criteria for an eligible model are $CFI \geq 0.90$, $AGFI \geq 0.90$, $GFI \geq 0.90$, $RMSEA \leq 0.06$ and $SRMR \leq 0.08$ (Hu, L.T., Bentler, P, 1999).

4.2. Construction of SEM model

After screening the data for missing values and anomalies, we have 21 variables which are a mixture of counts, categorical and continuous.

The 21 variables are: Body Mass Index(BMI); Age; Time spent on physical activity (T_PhyAct); Number of vegetables weekly (VegWF); Father's BMI (F_BMI); Mother's BMI (M_BMI); Number of snacking between meals (Snacks); Gender; Beverage consumption (Bev); number of meals daily (meals); Number of fruits weekly (Num_FruitW); Whether they are aware of health consequences (Diet_Aware); Status of mother's education (Mother_Edu); Status of father's education (Father_Edu); class; Time spent on social

- **Optimal SEM**

The optimal model has CFI= 0.938, AGFI = 0.992, GFI =0.996, RMSEA =0.058 and SRMR =0.075.

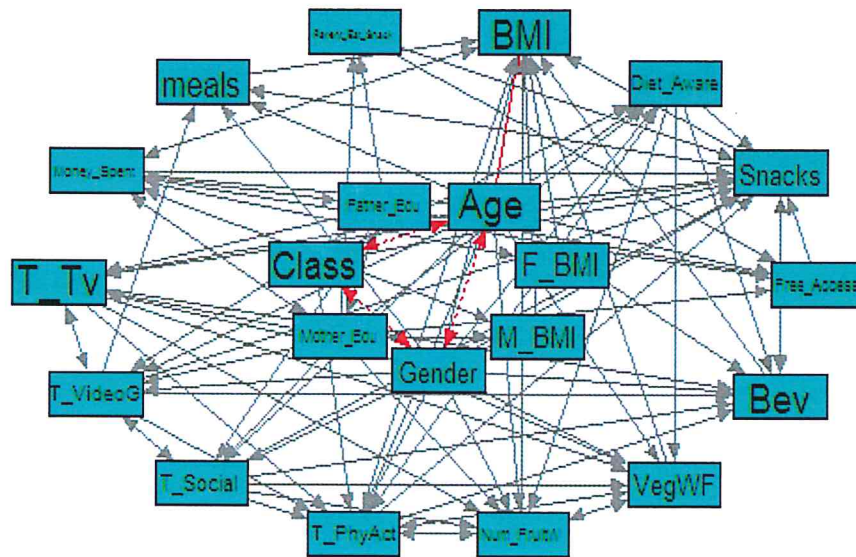


Figure 4.2 : Path Diagram for optimal SEM

In order to have a clear view of this path diagram (Figure 4.2), the sections of this diagram are provided below:

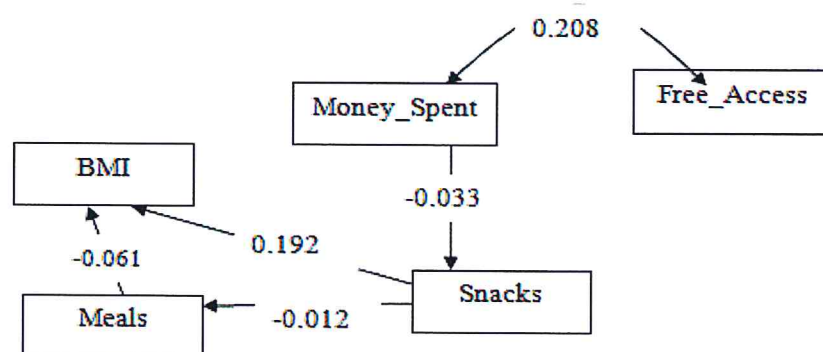


Figure 4.3: Paths connecting “Free_Access” to “BMI”

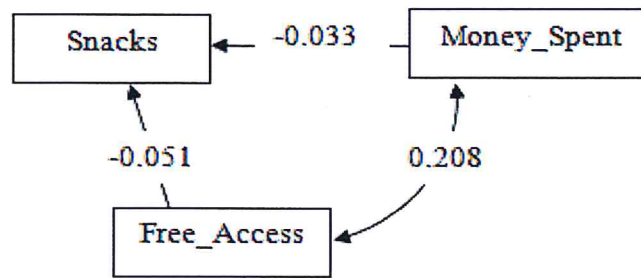


Figure 4.4 : Paths connecting “Free_Access” to “Snacks”

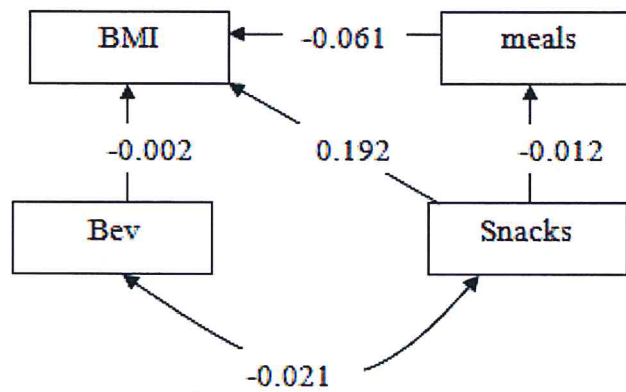


Figure 4.5 : Paths connecting “Bev” and “Snacks” to “BMI”

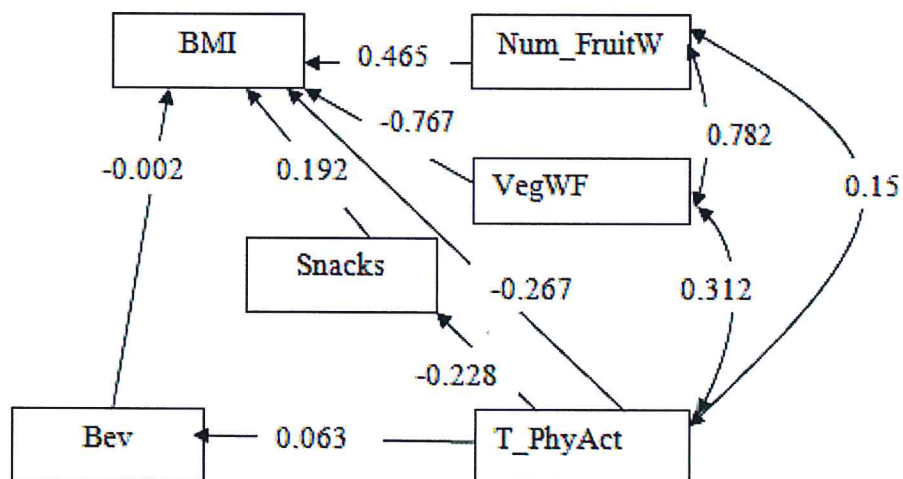


Figure 4.6 : Paths connecting “Num_FruitW” and “VegWF” to “BMI”

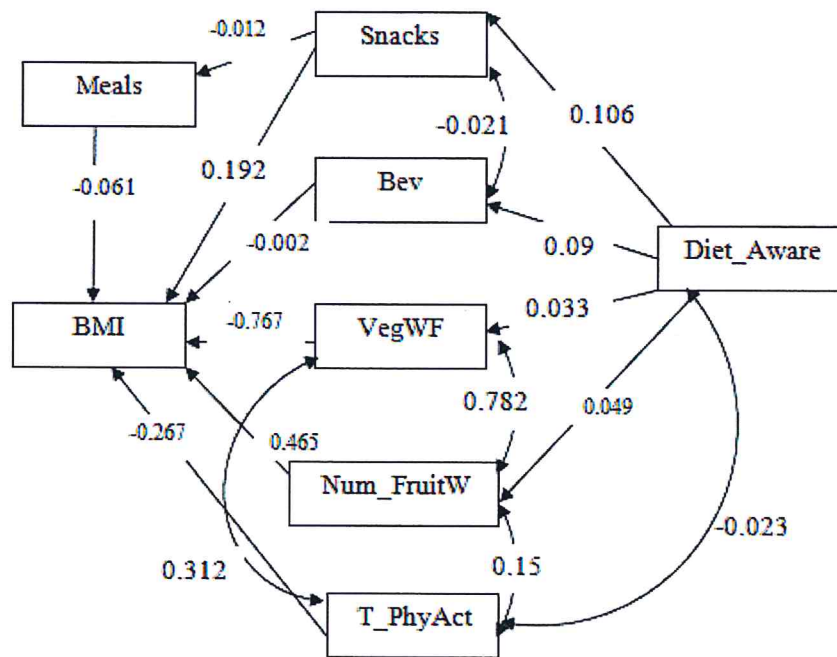


Figure 4.7 Paths connecting “Diet_Aware” to “BMI”

4.3. Output of Optimal SEM fit

R-Square values for the endogenous variables are tabulated below.

Table 4.1: R-Square values for the endogenous variables

BMI	Diet_Aware	Snacks	Bev	VegWF
0.634	0.190	0.245	0.068	0.096
T_PhyAct	T_Social	T_Tv	T_VideoG	Num_FruitW
0.083	0.14	0.022	0.069	0.070

Direct effects

- **Endogenous Variable : BMI**

Table 4.2: Standardized coefficients of the variables directly affecting “BMI”

BMI ~	Estimated Effects	Standard Error	P-value
Age	0.150	0.007	0.002
T_PhyAct	-0.267	0.015	0.000
VegWF	-0.767	0.019	0.000
F_BMI	0.201	0.058	0.000
M_BMI	0.088	0.040	0.059
Snacks	0.192	0.018	0.000
Num_FruitW	0.465	0.025	0.000
Gender	-0.140	0.042	0.003
meals	-0.061	0.043	0.341
Bev	-0.002	0.053	0.966

- **Endogenous Variable : Diet_Aware**

Table 4.3 : Standardized coefficients of the variables directly affecting “Diet_Aware”

Diet_Aware ~	Estimated Effects	Standard Error	P-value
Gender	0.411	0.064	0.000
Age	0.648	0.058	0.062
Mother_Edu	0.073	0.052	0.274
Class	-0.638	0.058	0.054

- **Endogenous Variable : Snacks**

Table 4.4 : Standardized coefficients of the variables directly affecting “Snacks”

Snacks ~	Estimated Effects	Standard Error	P-value
Diet_Aware	0.106	0.205	0.169
Free_Access	-0.051	0.196	0.479
Parent_Et_Snck	-0.045	0.199	0.498
T_Social	0.104	0.080	0.142
T_Tv	0.065	0.096	0.319
T_VideoG	0.226	0.102	0.002
T_PhyAct	-0.228	0.059	0.000
Money_Spent	-0.033	0.049	0.562
Gender	-0.143	0.189	0.054
Age	0.023	0.144	0.945
Class	0.197	0.147	0.534

- **Endogenous Variable : Free_Access**

Table 4.5 : Standardized coefficients of the variables directly affecting “Free_Access”

Free_Access ~	Estimated Effects	Standard Error	P-value
Mother_Edu	0.054	0.070	0.554
Father_Edu	0.016	0.064	0.858
Parent_Et_Snck	0.075	0.084	0.317
Age	0.223	0.011	0.001

- **Endogenous Variable : Bev**

Table 4.6 : Standardized coefficients of the variables directly affecting “Bev”

Bev ~	Estimated Effects	Standard Error	P-value
T_PhyAct	0.063	0.022	0.390
Diet_Aware	0.090	0.059	0.220
Age	-0.176	0.010	0.022
Gender	-0.045	0.053	0.506
T_Social	-0.024	0.030	0.784
T_VideoG	0.100	0.030	0.155
T_Tv	-0.131	0.035	0.098

- **Endogenous Variable : VegWF**

Table 4.7 : Standardized coefficients of the variables directly affecting “VegWF”

VegWF ~	Estimated Effects	Standard Error	P-value
Diet_Aware	0.033	0.315	0.668
Age	-0.158	0.057	0.058
Gender	0.083	0.308	0.295
Mother_Edu	0.050	0.231	0.491
T_Social	-0.125	0.119	0.067
T_Tv	-0.156	0.169	0.038

- **Endogenous Variable : Num_FruitW**

Table 4.8 : Standardized coefficients of the variables directly affecting “Num_FruitW”

Num_FruitW ~	Estimated Effects	Standard Error	P-value
Diet_Aware	0.049	0.207	0.532
Age	-0.204	0.035	0.011
Gender	0.069	0.206	0.395
Mother_Edu	0.093	0.150	0.196
T_Social	-0.043	0.078	0.532
T_Tv	-0.063	0.104	0.372

- **Endogenous Variable : T_PhyAct**

Table 4.9 : Standardized coefficients of the variables directly affecting “T_PhyAct”

T_PhyAct~	Estimated Effects	Standard Error	P-value
T_Social	-0.130	0.095	0.110
T_VideoG	0.109	0.110	0.152
T_Tv	-0.113	0.110	0.121
Age	-0.286	0.143	0.365
Class	0.201	0.150	0.524
Gender	-0.189	0.199	0.014

- **Endogenous Variable: T_Social**

Table 4.10 : Standardized coefficients of the variables directly affecting “T_Social”

T_Social ~	Estimated Effects	Standard Error	P-value
Age	0.367	0.025	0.000
Gender	-0.172	0.158	0.014
Mother_Edu	-0.013	0.173	0.887
Father_Edu	0.075	0.174	0.462

- **Endogenous Variable: T_VideoG**

Table 4.11 : Standardized coefficients of the variables directly affecting “T_VideoG”

T_VideoG ~	Estimated Effects	Standard Error	P-value
Age	0.190	0.024	0.014
Gender	-0.185	0.133	0.012
Mother_Edu	0.030	0.176	0.775
Father_Edu	0.099	0.160	0.396

- **Endogenous Variable: T_Tv**

Table 4.12 : Standardized coefficients of the variables directly affecting “T_Tv”

T_Tv ~	Estimated Effects	Standard Error	P-value
Age	0.103	0.021	0.139
Gender	-0.125	0.129	0.094
Mother_Edu	0.030	0.109	0.698
Father_Edu	0.016	0.109	0.844

- **Endogenous Variable: Parent_Et_Snck**

Table 4.13 : Standardized coefficients of the variables directly affecting “Parent_Et_Snck”

Parent_Et_Snck	Estimated Effects	Standard Error	P-value
Mother_Edu	0.061	0.065	0.523
Father_Edu	-0.19	0.059	0.039

- **Endogenous Variable: meals**

Table 4.14 : Standardized coefficients of the variables directly affecting “meals”

Meals ~	Estimated Effects	Standard Error	P-value
Snacks	-0.012	0.044	0.883
T_VideoG	-0.094	0.080	0.377
Age	0.025	0.021	0.773
Gender	-0.015	0.101	0.845

- **Endogenous Variable: Money_Spent**

Table 4.15 : Standardized coefficients of the variables directly affecting “Money_Spent”

Money_Spent ~	Estimated Effects	Standard Error	P-value
Age	0.157	0.034	0.016

- **Covariances among the Variables**

Table 4.16 : Covariances estimates for the variables

Covariances	Estimated Effects	Standard Error	P-value
Free_Access ~ Money_Spent	0.208	0.040	0.001
Mother_Edu ~ Father_Edu	0.607	0.035	0.000
BMI ~ Money_Spent	0.081	0.024	0.173
Diet_Aware ~ T_PhyAct	-0.023	0.040	0.764
M_BMI ~ Mother_Edu	-0.115	0.022	0.096
Money_Spent ~ M_BMI	0.059	0.051	0.373
Money_Spent ~ F_BMI	-0.114	0.042	0.105
Snacks ~ Bev	-0.021	0.032	0.788
VegWF ~ T_PhyAct	0.312	0.175	0.000
VegWF ~ Num_FruitW	0.782	0.175	0.000
Num_FruitW ~ T_PhyAct	0.150	0.105	0.030
T_Social ~ T_VideoG	0.137	0.076	0.104
T_VideoG ~ T_Tv	0.240	0.066	0.008
F_BMI ~ M_BMI	0.277	0.018	0.001
Money_Spent ~ Father_Edu	0.176	0.081	0.036
Money_Spent ~ Mother_Edu	0.238	0.075	0.004

Total Effects

Based on path tracing rules, all the possible routes that connect the two variables are traced. The routes consist of direct paths, indirect paths and unanalysed associations. The total effects of the variables are given in Table 4.17 and are calculated using the path diagrams labelled as Figure 4.3 up to Figure 4.7.

Table 4.17 : Estimated values of the total effect

Total Effect of :	Estimated value
“Free_Access” on “Snacks”	-0.058
“Free_Access” on “BMI”	-0.001
“Snacks” on “BMI”	0.193
“Bev” on “BMI”	-0.006
“VegWF” on “BMI”	-0.500
“Num_FruitW” on “BMI”	-0.100
“Diet_Aware” on BMI	-0.004

4.4. Interpretation of the Output

The fitted model is explaining 63.4% of variation in BMI; 24.1% of variation in number of snacking; 19% of variation in the diet awareness; 6.9% of variation in the beverage consumed; 9.3% of variation in the number of vegetables consumed per week; 6.7% of variation in the number of fruits consumed daily; 8.6%, 14.0%, 6.9% and 2.2% of variation in the time spent on physical activity, social network, video games and TV respectively.

Estimates of the total effects indicate that those not having access to snacks at home tend to snack more between meals, access to snacks at home does not significantly increase or decrease the BMI, snacking between meals cause the BMI to increase significantly, beverage has insignificant effect on BMI, consumption of vegetables will cause the BMI to decrease while the consumption of fruits will cause the BMI to decrease. It can also be seen that consuming more vegetables than fruits cause a greater decline in the BMI. Also, those being health conscious tend to have lower BMI than those being unaware of the health consequences.

4.5. Discussion

One of the direct effects of a country's openness to international trade is the expansion of the availability of commodities, especially food, and the level of consumption due to enhanced income and Mauritius is considered as a net food importing country that imports nearly 77% of its food requirements valued at 36.4 Billion Mauritian Rupees. [Ministry of Agro-Industry and Food Security (2016) Strategic Plan for the Food Crop, Livestock and Forestry Sectors. Republic of Mauritius.

The increase in income is most beneficial in accessing food but with the consequent increase in body size. International trade has not only increased food access but has also reshaped consumption patterns of people worldwide (World Health Organisation, 2002). Economic development and urbanization have significantly redefined consumption culture including the rise of fast food chains, emergence of instant food preparation, significant increase in the consumption of fats, meat and processed food, and the rise of alcohol intake and smoking (Popkin, B. M., Horton, S. H., & Kim, S., 2001). Moreover, various studies have evidenced the association of pediatric and adolescent obesity with obesity in adults. Children with overweight conditions are more likely to turn into overweight adults, especially at higher BMIs (16) or if one of the parents is obese. Deshmukh-Taskar et al (2006) found that almost half of overweight adults were overweight as children, and two thirds of children in the highest BMI quartile transitioned into the highest BMI quartile as young adults. Adolescents with obesity face many adverse health consequences. Their dietary habits, lack of physical activity as well as their rates and extent of obesity worsens with the transition from teen years to young adults. Obesity during the adolescent years is associated with many adverse health consequences and dietary habits, physical inactivity, and rates and degree of obesity become worse with the transition from the teen years into the young adult years.

The emergence of the new NCDs profile will place a heavy burden on the government as it is costly to manage with expensive medications and surgeries and it negatively affects productivity in terms of cost of lost workdays.

In this study there were more female than male respondents and the difference is quite insignificant. It is noted that 12% of the population sample are overweight and obese while about 55% were underweight. This can be attributed to the fact that even though respondents of the survey were having their three basic meals per day, they may not be consuming highly nutritious food. Children having at least one parent overweight or obese have the tendency to

become fat. Mauritian families are knowledgeable about the benefits of incorporating fruits and vegetables in the diet as the data analysis shows almost 40% of the respondents mention eating fruits everyday while about 55% state they have vegetables everyday. Culturally, snacking is part of the Mauritian eating habits and very often high fat, starch, salt and sugary content snacks are preferred. The trade liberalization due to globalization has made imported snacks readily accessible in stores and supermarkets. It is also seen that the respondents do spend a minimum of Rs 10 to a maximum of Rs 50 on snacks daily outside their basic meals. Besides, even parents indulge in spending between Rs 50 and Rs 200 on snacks weekly. Children on their own can afford high energy, refined processed with chemical food enhancers snacks which makes them prone to NCDs in the long run. The study also highlights the sedentary lifestyles of children/adolescents who do not have enough physical exercise to level off their habits of daily consumption of snacks.

The rationale behind having a trade liberation policy caters for an open market that benefit the population. Such policy endeavours to perpetuate a cycle of economic development and growth. This furthermore will increase trade thereby lowering the prices of consumer goods (notably food which constitutes a larger percentage of the expenditure for the people).

It is obvious that liberalization of trade policy on food will undoubtedly have implications on public health that will need for measures to be adopted to protect the human health accordingly.

According to the WHO /FAO Technical report 916, consideration was given to trade issues and the need for consideration to improve diets in light of trade liberalization.

Based on the SEM model used in this study, it is clear that there is a case of so called “unbundling” of a pattern of transition in nutritional habit from a single process into three potential different categories, namely, diet, the behavioural pattern including the physical environment and culture and also a need to recognize that giving the multi-ethnic composition of the Mauritian population, there is indeed an overlap whereby each cluster will lead to an implication of each other by a combination process.

There is a need for an approach that warrants a separation that will help to conceptualize the space and the relevant policy.

Our main focus in this report has been the diet transition among our adolescents and its possible cofounding impact as a risk factor towards increasing rate of obesity among the young population of Mauritius.

Our findings have shown that the changes in dietary patterns among our adolescent whereby there are resorting to more and more snacking of products of imported origin is reflective of the dietary changes which is occurring worldwide.

This is also an outcome of the effect of liberation and the global changing trade patterns internationally that is becoming immensely complex as the development of a country is progressing and quality of life of the population thereby is improving. Undoubtedly with these changing patterns of the availability of a huge panoply of products mainly snacks, will lead to adolescents indulging on such easily not expensive available products.

However one needs to point out that whilst considering the impact of liberalization of trade policy on its implications on diet, one needs to be aware that it is rather difficult to pinpoint the exact relationship between trade and the style of dietary changes as well as its impact on health among a population although it is clear from our study that there are some correlations between some factors. There is need for future work in this area to understand further how trade liberalization can impinge on the risk factors contributing to obesity as well as spread of diet related disorders among the population. The aspect of advertising also warrants a deeper scrutiny since the latter adds to the level of complexity of parameters that could be contributing as an important but not palpable parameter that is involved in further adding to the role of trade in the changes of cultural expectations in our local Mauritian population that is continuing to witness an improvement in their quality of life and yet positively associated with increasing risk factors to diet related disorders and diseases which is starting primarily with the impressing presence of obesity among our adolescents. We will need to add emphasis on the liberation of trade and its impact and its association to diet related disorders/diseases because Mauritius having over the years been a free National Health Care system provider.

4.6. Conclusion

This study was conducted to shed light on causes of obesity in children and adolescents. The first objective was to assess the nutritional behaviour and physical activities among of the children and adolescents of Mauritius. The second one was to explore the impact of food trade and commerce in Mauritius and possible relationship with weight issues among children and adolescents in Mauritius. Data analysis using Structural Equation Model explained about 60% of the variation in Children and adolescents BMI. It is interesting to note that snacking alone as a variable explained close to 25% of variation on BMI, making it the strongest factor responsible for overweight and a tendency towards obesity. This is bound to happen as Mauritius being a net food importing country exposes its citizens to foreign highly processed foods distributed through the supermarket shelves. The relatively easy access to a variety of imported affordable snacks is not necessarily an important source of nutritional food necessary for the development of healthy children and adolescents. The current hectic lifestyles of children and adolescents constantly under pressure to perform academically juggling between school and private tuitions leave them less time to indulge in physical activities adding to the predisposition to become overweight and obesity. On the other hand, children and adolescents are expected to contribute to the economy as young adults by being active and productive in the future work force. So their nutrition, healthy lifestyle is of utmost importance.

4.7. Recommendations

The globalization trends and trade liberalization will continue to affect the Mauritian economy as a SIDS country. The comparative advantage of engaging in importation of food cannot be argued. But what the Mauritian Government need to do with respect to trade of food are:

1. Review its trade policies on food imports.

Trade policies that relate to quality of food imported that meet a minimum standard of chemically processed food.

2. Give more incentives to import healthy, bio, organic food.

Healthy food are expensive in Mauritius. Only a few importers locally are importing nutritious organic food.

3. Create greater awareness on overweight/obesity.

More parents, children/adolescents should be aware of health consequences of obesity as one of the root cause of other serious NCDs.

4.8. Acknowledgements

We wish to acknowledge the Mauritius Research Council for financial support for this project. We extend our thanks to the University of Mauritius for facilitating this project work. We sincerely acknowledge the help provided by the Research Assistants: Miss Navinam Soopramanien (15 Sept 2015 - 30 Oct 2015), Miss Haseena Banu Badulla (03 Nov 2015 – 25 Mar 2016) and Miss Yona Mohes (14 Mar 2017 – till date).

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