Intakes and sources of fat, free sugars and salt amongst Lebanese children and adolescents

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Lara Nasreddine

Lamis Jomaa

Samer Kharroubi

American University of Beirut,

Department of Nutrition and Food Sciences

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Abstract

Background: Lebanon, like most other Eastern Mediterranean countries, has been witnessing the nutrition transition, characterized by an increased consumption of energy, fat, added sugars and salty foods. Through their distinctive metabolic effects, high intakes of fat, sugar and salt in childhood, may work individually or synergistically to increase the risk for NCDs later in life.

Objective: This study aimed at determining the intakes and sources of fat, sugar and salt amongst Lebanese children and adolescents, and to investigate the association of these intakes with demographic, socioeconomic and anthropometric factors in this age group.

Methodology: Secondary analysis of data stemming from two cross-sectional national surveys performed in 2012 and 2014, on underfive children (*survey 1*) and 5-18 year old children (s*urvey 2*), respectively, was performed.

Results: The total sample included 896 children aged less than five years and 1106 subjects aged between 5 and 18 years. The mean age of children participating in *survey 1* was of 29.47±months and the mean age of those participating in *survey 2* was of 11.53 ±3.6 years. Mothers' education level was distributed between primary school or less (15-21.7%), and intermediate or high school (59.5-64.3%), with only 18.8-29.8% having university degrees (32.9%). Approximately 42% of the households had an income below 1,000,000 L.L. Based on the anthropometric characteristics of the participating children, it was found that 26.4% of underfive children were at risk of overweight, 8.3% were overweight and 2.7% were obese, with no significant differences between genders. Amongst 5-18 year old children, 21.1% were overweight, 20.5% were obese and 21.9% had an elevated waist circumference, with no significant differences between genders.

As expected, energy intakes were the lowest amongst underfive children (1326.47 ± 19.16 kcal/d) increasing to close to 2000 kcal/d amongst 9-18 year old children and adolescents. Amongst underfive children, the contribution of macronutrients was as follows: 49.4% from CHO; 12.56% from protein and 39% from fat. Amongst older children, carbohydrates' contribution to EI ranged between 48.8-50.4%, while protein and fat contributed 12.09-13.3% and 38.9-40.06%, respectively. The contribution of free sugar to energy intake was estimated at 14.6% amongst underfive children and at 15.4-16.06% amongst older children. Saturated fat was found to contribute 12.6% of EI amongst underfive children and 9.9-10.7% amongst children aged 5-18 years. When examining gender differentials, the intake of carbohydrates (%EI) was significantly higher amongst girls aged 6-8 years as compared to boys, while the intake of fat was higher amongst boys of the same age group. No significant differences were found between gender for the other macronutrients and across the different age groups

Overall, 65.6% of underfive children and 73-78% of 5-18 year old children had a free sugar intake exceeding the WHO upper limit of 10% of EI. The proportions of children exceeding the WHO upper limit for fat and saturated fat were also high ranging between 63 and 85%. In addition, 20% of underfive children and 40-56% of 5-18 year old children were found to exceed the upper limit for sodium intake.

When examining the contribution of the various macronutrients to energy intake by BMI status, no significant differences were noted amongst underfive children. Amongst older children,

significant differences were observed in free sugar intake, the highest intake level being noted amongst normal weight children in the 6-8 years and the 14-18 years age groups (≈17%), while obese children had intakes in the range of 14-15% EI. The results have also documented significant differences in protein intakes amongst 9-13 year old children, the highest intakes being noted amongst obese children in this age group (13.4%EI).

To examine the association between dietary intakes in children and socioeconomic status (SES), two indicators of SES were selected: 1) maternal education and 2) family income. Lower maternal education was associated with higher free sugar intakes and lower saturated fat intakes. In addition, based on family income as an indicator of socioeconomic status, significant differences were noted in the intakes of energy, CHO, total sugar, free sugar, fat, saturated fat and sodium, with lower intakes being observed amongst families with higher incomes (>3,000,000 L.L).

Non-sweetened milk was found to be the major contributor of fat and saturated fat (28.69% and 37.68% respectively) amongst underfive children, while desserts were the major sources of fat (20.17-21.38%) and saturated fat (25.79-27.29%) intakes amongst children and adolescents. The major contributors to free sugar intakes amongst underfive and 6-8 year olds were sweetened juice beverages, biscuits and wafers, followed by regular soft drinks. Amongst 9-18 year olds, the major contributors were found to be regular soft drinks, sweetened juice beverages, followed by biscuits and wafers.

Conclusion: The intakes of fat, saturated fat and free sugar are high amongst Lebanese children and adolescents, exceeding the WHO upper limits. These results highlight the need for culture-specific, multicomponent interventions aiming at fostering healthier diets amongst children in Lebanon, a country where NCD-related death is high, being estimated at 84%. The major contributors to fat, saturated fat and sugar intakes, as identified in this study, should be targeted by these multi-component interventions.

1. Background:

The burden of non-communicable diseases (NCDs) in the Eastern Mediterranean region represents a major public health challenge, compromising social and economic development in its countries [1]. Overall, it is estimated that NCDs account for over 50% of annual deaths (2.2 million deaths) and 60% of the disease burden in the EMR [2]. According to the WHO, it is projected that deaths from NCDs would increase by 25% in the region between 2008 and 2018 , recording the second highest projected increase among the six WHO regions [3, 4].

Shifts and changes in development, mechanization, and urbanization, diet, physical activity, and body composition provide an understanding of the multidimensional phenomenon of the nutrition transition, which is characterized by an increase in the intakes of energy, fat (especially of animal origin), added sugars, and salty foods [5-7]. The population group that may be the most vulnerable to the societal changes taking part are children and adolescents. In fact, compared to adults, younger generations tend to have greater exposure to new and "fashionable" food products [8] , that are typically energy dense, nutrient-depleted and rich in fat, sugar and salt [8, 9].

Through their distinctive metabolic effects, high intakes of fat, sugar and salt in childhood, may work individually or synergistically to increase the risk for NCDs. The relationship between high sugar intakes and chronic disease risk may be mediated by the increase in body weight and adiposity [10], or by other weight- independent metabolic and glycemic effects that may decrease insulin sensitivity, contribute to cell dysfunction and inflammation [11, 12], and increase the risk for high blood pressure and dyslipidemia [11, 13]. Similarly, high dietary fat intakes have been suggested to increase the risk of NCDs, a relation that may be explained by the role of fat in increasing dietary energy intake and unhealthy weight gain [14, 15], as well as by other metabolic effects attributed to dietary fat. For instance, high intakes of saturated and trans fat were suggested to increase the levels of LDL-C, decrease insulin sensitivity and fatty acid oxidation and increase inflammation [16, 17]. High salt intakes have also been associated with a number of NCDs, including hypertension, cardiovascular disease and stroke, an association that may be at least partially explained by the effects of salt on blood pressure [18-20].

Acknowledging the health risks associated with high intakes of fat, sugar, and salt throughout the lifecycle, the WHO has developed guidelines and issued recommendations targeting the intakes of these nutrients [19, 21]. Building on these recommendations, the regional office of the Eastern Mediterranean Region has recently issued policy statements and recommended a set of actions for the reduction of salt, fat and sugar intakes with the aim of curbing the NCD epidemic in countries of the region [22-24]. The three policy statements shared a common recommended action: advocating for national studies examining the intake levels and the major food sources of each of the targeted dietary factors (salt, fat and sugar). In fact, given the culture-specificities of dietary and eating practices, information on intake levels and the major food sources of fat, sugar and salt cannot be merely obtained from studies conducted in other countries or other parts of the world.

In Lebanon, a small country of the Eastern Mediterranean basin where NCD-related death was estimated at 84% [1], little is known about the intake levels and specific food sources of fat, sugar and salt in the pediatric population. To address this knowledge gap, we propose to evaluate the dietary intakes and the major sources of fat, sugar and salt among Lebanese children and adolescents. For this purpose, secondary analysis of data stemming from two recent national surveys will be performed: **1)** national food consumption survey that targeted underfive children *(survey 1*) and **2)** national food consumption survey targeting 5-18 year old children and adolescents (*survey 2)* in Lebanon. The study will also benchmark the intake levels of these dietary factors against the WHO recommendations. Given that dietary practices and food consumption habits may differ between gender and between various socio-economic groups, this study will investigate the association of demographic and socioeconomic characteristics with the dietary intakes of fat, sugar and salt.

2. Objectives:

2.1: General Objective

This study aims to determine the intake levels and identify the main sources of fat, sugar and salt among Lebanese children and adolescents, and to benchmark the intake levels against the WHO recommendations.

2.2: Specific Objectives

1. Based on nationally representative food consumption data for Lebanese children and adolescents, dietary energy intake are determined and the intake levels of total fat, saturated fat, trans fat, sugar and salt are estimated (g/d and percent of energy intake when applicable), and compared to the benchmarks set by the WHO.
2. Differences in intakes of total fat, saturated fat, trans fat, sugar and salt are examined by age, gender, socioeconomic and anthropometric characteristics.
3. The main food sources of dietary fat, saturated fat, trans fat, sugar and salt are identified by age group, gender and socioeconomic-status.

Methodology

3.1 Study population

The research activities that were conducted between May 24 and July 31, 2017 focused on objective one and the study population aged 0-18 years, based on two cross-sectional national surveys conducted in all of the six governorates in Lebanon.

The first survey in 2012 entitled "*Early Life Nutrition and Health*", included underfive children and their mothers, and aimed at evaluating feeding and dietary practices and at assessing the prevalence of underweight and overweight. In this survey, the study sample included 1029 children. Sample size calculation was performed based on a prevalence of 13% of preschool overweight and obesity [25], a 2% error and a 95% confidence interval. Children were excluded if they were of a non-Lebanese nationality, were born preterm (<37 weeks) or suffered from any chronic illness, inborn errors of metabolism or physical malformations that may alter normal dietary intake or body composition.

The second survey in 2014 entitled "*Dietary Intake, Lifestyle, and Food Security Status of Lebanese children and adolescent in relation to overweight and obesity",* included 5-18 year old children and their mothers, and aimed at evaluating food security, dietary practices and the prevalence of overweight and obesity. In this survey, the study sample included 1118 children. Sample size calculation was performed based on prevalence of 10.9% of obesity [26], 1.8% error and a 95% confidence interval. Children were excluded if they had any medical conditions that impair his/her growth or if the child's mother had any chronic disease.

In both surveys, the primary sampling unit was the household. The selection of households followed a stratified cluster sampling strategy, whereby the strata were the six Lebanese governorates and the clusters were selected further at the level of districts.

3.2 Data Collection

One hour face to face interviews were conducted by trained research nutritionists in the households. The presence of the mother, as a proxy, was needed for children under the age of 10. For those above 10 years, the interview was conducted directly with the child and with the mother being present for assistance. Prior to enrollment, written informed consents were obtained from mothers and assents were obtained from children aged 6 years and above.

Age -specific multi-component questionnaires covering information on demographic, socioeconomic, eating habits and dietary intakes were collected. The content validity of the survey instrument was confirmed by an expert panel consisting of a clinical nutritionist, a nutrition epidemiologist and a community nutritionist. Anthropometric measurements were obtained using standard protocols.

Dietary intake data was obtained using the United States Department of Agriculture (USDA) multiple pass 24-hr recall (24-HR) [27]. The steps followed included 1) quick food list recall, 2) forgotten food list probe 3) time and occasion at which foods were consumed, 4) detailed overall cycle and 5) final probe review of the foods consumed. While collecting the dietary data, specific reference was made to solicit information about food that were consumed at daycare or school.

3.3 Data Analysis

We have excluded infants aged less than 6 months from the analyses given that the diet of these children is mostly based on milk (breast or formula).

Crowding index, one of the indicators of socioeconomic status, was calculated as the total number of co-residents per household divided by the total number of rooms, excluding the kitchen and bathrooms. Anthropometric characteristics were interpreted using the WHO-2006

criteria for underfive children [28] and the WHO 2007 growth standards for those aged 5-18 years [29]. The Nutritionist Pro software (version 5.1.0, 2014, First Data Bank, Nutritionist Pro, Axxya Systems, San Bruno, CA) was used for the analysis of the dietary intake data and for estimating the energy and macronutrients' intakes. Recipes of composite and mixed dishes were added to the Nutritionist Pro software using single food items. Within the Nutritionist Pro, the USDA database was selected for analysis (version 5.1.0, 2014, SR 24, First Data Bank, Nutritionist Pro, Axxya Systems, San Bruno, CA, USA). Food composition of specific Lebanese foods, not found in the Nutritionist Pro software database, were obtained from food composition tables for use in the Middle East [30]. Dietary data was analyzed for average protein, total fat, saturated fat, trans fat, MUFA, PUFA, carbohydrates, total sugars, and salt. Intakes of macronutrients were also expressed as percent of energy intake.

Mean intakes of salt and average intakes of energy, fat, saturated fat, trans fat, sugar (as %EI) were presented by age group, gender, and anthropometric characteristics. Comparisons of intakes against WHO recommendations were performed. Analyses were examined using Statistical Package for Social Sciences 24.0 (SPSS for Windows, 2013, Chicago: SPSS Inc.). *P*-value less than 0.05 was considered statistically significant.

4. Results:

4.1: *Descriptive Characteristics of the Study Population*

The socio-demographic, parental and household characteristics of the study subjects are shown in **Table 1**. The total sample included 896 children aged less than five years and 1106 subjects aged between 5 and 18 years. The mean age of children participating in survey 1 was of 29.47±months and the mean age of those participating in survey 2 was of 11.53 ±3.6 years. As expected, mothers of underfive children were younger than mothers of children aged 5-18 years (mean age = 31.78±6.27 y vs. 40.26±7.52 y). In both surveys, the majority of mothers were housewives and unemployed (83.3% in survey 1 and 76.2% in survey 2). Mothers' education level was distributed between primary school or less (15-21.7%), and intermediate or high school (59.5-64.3%), with only 18.8-29.8% having university degrees (32.9%), and 4.2-5.8% specializing in a health-related major. Less than 15% of the fathers had university level

education, and approximately 87-90% of the households had a crowding index greater than 1. It was also shown that 46.9-62.2% of the children living in the households attended private schools, and that 42.4% of the households had an income below 1,000,000 L.L.

4.2: Anthropometric Characteristics of Children Participating in the Study

The anthropometric characteristics of the participating children are shown in **Table 2**. There were no significant differences in anthropometric characteristics between boys and girls, except for head circumference which was significantly higher in underfive boys compared to girls (48.82±4.22 as compared to 47.72±3.68).

Table 3 shows that 26.4% of underfive children were at risk of overweight, 8.3% were overweight and 2.7% were obese, with no significant differences between genders. Stunting was noted amongst 5.9% of underfive children. Amongst 5-18 year old children, 21.1% were overweight, 20.5% were obese, 21.9% had an elevated waist circumference, and 32.1% had an elevated waist to height ratio, with no significant differences between genders.

4.3: Intakes of energy, macronutrients and sodium amongst Lebanese children and adolescents

<u>Intakes of energy and macronutrients by age group and gender:</u>

Mean intakes of energy (kcal/d), macronutrients (g/d) and sodium (g/d) amongst children underfive years of age and children aged 5-18 years are shown in **Table 4**, by gender.

As expected, energy intakes were the lowest amongst underfive children (1326.47 ± 19.16) increasing to close to 2000 kcal/d amongst 9-18 year old children and adolescents (**Table 4**). Amongst underfive children, boys had significantly higher intakes of energy, carbohydrates, total sugar, free sugar, protein and saturated fat, as compared to girls. Gender differentials were also observed amongst children aged 5-18 years old, particularly in the intakes of energy, carbohydrates, fiber, protein, fat, and sodium, total sugar and free sugar, which were higher in boys compared to girls. Gender differences were also observed in the intakes of polyunsaturated fatty acids amongst

5-18 year old children, with girls having significantly higher intakes of linoleic acids and boys having significantly higher intakes of linoleic acid.

Table 5 shows the contribution of the various macronutrients to energy intake (%EI) amongst Lebanese children, by gender. Amongst underfive children, the contribution of macronutrients was as follows: 49.4% from CHO; 12.56% from protein and 39% from fat. Amongst older children, carbohydrates' contribution to EI ranged between 48.8-50.4%, while protein and fat contributed 12.09-13.3% and 38.9-40.06%, respectively. Total sugar intake was found to contribute 23.4% of energy intake amongst underfive children and 16.4-17.4% of EI amongst children aged 5-18 years. The contribution of free sugar to energy intake was estimated at 14.6% amongst underfive children and at 15.4-16.06% amongst older children. Saturated fat was found to contribute 12.6% of EI amongst underfive children and 9.9-10.7% amongst children aged 5-18 years. Intakes of trans fat was very low, ranging between 0.15 and 0.23% of EI.

When examining gender differentials, the intake of carbohydrates (%EI) was significantly higher amongst girls aged 6-8 years as compared to boys, while the intake of fat was higher amongst boys. No significant differences were found between gender for sugar intakes or other macronutrients across the different age groups.

Intakes of energy and macronutrients by age group and BMI status:

When the intakes of energy (kcal/d) and macronutrients (g/d) were analyzed by BMI status and age group (**Table 6**), the intake of trans fat amongst underfive children was found to be significantly lower amongst normal weight children, while the intake of sodium was significantly higher in obese children, in the same age group. Significant differences were also observed in the intakes of protein amongst 5-9 year old children and the intakes of free sugar in 14-18 year old children. No other differences were noted.

When examining the contribution of the various macronutrients to energy intake by BMI status, no significant differences were noted amongst underfive children (**Table 7**). Amongst older children, significant differences were observed in free sugar intake, the highest being noted amongst normal weight children in the 6-8 years and the 14-18 years age groups (≈17%), while obese children had intakes in the range of 14-15% EI (**Table 7**). The results have also

documented significant differences in protein intakes amongst 9-13 year old children, the highest being noted amongst obese children in this age group (13.4%EI).

Intakes of energy and macronutrients by age group and socio-economic status:

To examine the association between dietary intakes in children and socioeconomic status (SES), two indicators of SES were selected: 1) maternal education and 2) family income.

Table 8 shows mean intakes of energy (kcal/d) and macronutrients (g/d) by age group and maternal education (**Table 8**). In the age groups 5-9 year, significant differences were observed for linoleic acids, the highest intakes being noted amongst children whose mothers had a primary education level or less. Similarly, significant differences in CHO intakes were observed amongst 9-14 year old children, the highest intake being noted amongst children having mothers with primary education or less. These observations were no longer significant when the mean daily intakes of macronutrients were adjusted for energy intake (**Table 9**). In addition, **Table 9** shows that, amongst underfive children, significant differences in free sugar intake and saturated fat were observed: the intakes of free sugar were the highest amongst children whose mothers had lower education levels, while the opposite was observed for saturated fat. Significant differences in saturated fat intakes were also noted amongst aged 9-14 year old, the lowest intakes being observed amongst children having mothers with low education levels.

Considering family income (**Table 10**), significant differences were noted in the intakes of energy, CHO, total sugar, free sugar, fat, saturated fat and sodium, with lower intakes being observed amongst families with higher incomes (>3,000,000 L.L)

Table 11 shows the contribution of various macronutrients to energy intake, by family income and age group. As such, not all the significant differences observed in table 10 were retained. Amongst underfive children, a higher income (>3,000,000 L.L) was associated with lower intakes of free sugar and higher intakes of Linoleic acid. Amongst 5-18 year old children and adolescents, the intakes of saturated fat increased with income. In contrast, the intake of Linoleic acid was found to decrease with income amongst 9-13 year old children.

Proportions of children exceeding the WHO benchmarks:

Table 12 displays the percentage of children and adolescents exceeding the WHO upper limit recommendations, by age group, gender and BMI status. Overall, 65.6% of underfive children and 73-78% of 5-18 year old children had a free sugar intake exceeding 10% of EI. The proportions of children exceeding the WHO upper limit for fat and saturated fat were also high ranging between 63 and 85%. In addition, 20% of underfive children and 40-56% of 5-18 year old children were found to exceed the upper limit for sodium intake. Amongst 14-18 year olds, a higher proportion of boys exceeded the UL of sodium compared to girls (79% vs. 59%), and a higher proportion of boys had a free sugar intake contributing more than 5% to EI (96.9% vs. 90.6%). No other gender-based differences were observed.

When split based on BMI, significant differences were noted in the proportions of children exceeding the 10% UL of free sugar, with this proportion being the highest amongst normal weight children in both the 6-8 y and the 14-18 y age groups. In addition, amongst 6-8 year old children, the proportion of children exceeding the UL for sodium was the highest in obese children.

Contribution of various food groups to fat and sugar intake:

The contribution of different food groups to the intakes of fat and saturated fat are shown in **Tables 13 and 14**, respectively. These results are also displayed in **Figures 5-12.** Non-sweetened milk was found to be the major contributor of fat and saturated fat (28.69% and 37.68% respectively) amongst underfive children, while desserts were the major sources of fat (20.17-21.38%) and saturated fat (25.79-27.29%) intakes amongst children and adolescents.

The major contributors to free sugar intakes (%) amongst underfive and 5-18 year old children are shown in **Figures 1-4**. The major contributors amongst underfive and 6-8 year olds were sweetened juice beverages, biscuits and wafers, followed by regular soft drinks. Amongst 9-18 year olds, the major contributors were found to be regular soft drinks, sweetened juice beverages, followed by biscuits and wafers.

Discussion:

This is the first study in the EMR to determine the intakes and sources of fat, sugar and salt amongst children and adolescent, and to examine the association of these intakes with demographic, socioeconomic and anthropometric factors in this age group.

Our results showed that the observed intakes of total sugar (23.4% of energy amongst underfive and 16.4-17.4% amongst 5-18 year olds), free sugar (14.6% of energy amongst underfive and 15.4-16.1% amongst 5-18 year olds), fat (39.2% of energy amongst underfive and 38.9-40.1% amongst 5-18 year olds) and saturated fat (12.6% of energy amongst underfive and 9.9-10.7% amongst 5-18 year olds) are high and beyond the WHO upper limit, thus raising concerns about the risk for cardiometabolic abnormalities and NCDs later in life. The observed high intakes of sugar amongst Lebanese children are in line with what has been reported from other parts of the world. For instance, Louie et al [31] showed that 14% of the daily energy intake was provided by free sugars in 2-16 year old Australian children and Gibson et al showed that 11.8-15.4% of energy intake was derived from free sugars in 1.5-18 year old British children [32]. The observed high intakes of fat amongst Lebanese children and adolescents confirm the findings of previous studies conducted in Lebanon. In fact a national study conducted in 2008 has also shown that fat intakes were high amongst 6-19 year olds, representing 36% of energy intake [33].

This study showed that gender differentials were found with the intake of carbohydrates being significantly higher amongst girls aged 6-8 years as compared to boys, while boys had higher fat intakes. However, differences in sugar intakes were not found between gender. Similar to our findings, Gibson et al and Farajian et al found no significant difference in the mean daily intakes of free sugar across gender [32, 34], while Mesana et al, showed that 12.5-17.5 year old European girls consumed significantly lower free sugar intakes as compared to boys [35].

The findings of our study have shown that the major contributors to free sugar intakes were sweetened juices beverages, biscuits and wafers, and regular soft drinks across age groups. This is in agreement with findings reported by Gibson et al, who found that fruit juices and soft drinks were two of the major contributors, along with sugar confectionary, amongst British children aged 1.5-18 year olds [32]. Moreover, Mesana et al identified sweetened beverages (soft drinks and fruit/vegetable juices) as the main contributors to intakes of free sugars amongst 12.5-17.5

year old Europeans [35], which is similar to our findings, where regular soft drinks and sweetened juice beverages were identified as the main sources of free sugars specifically amongst 9-18 year olds. On the other hand, Farajian et al showed that 100% natural packaged and freshly fruit juice and sweets (chocolate, chocolate bars, ice cream and pastries), followed by nectar fruit juices, contributed mostly to free sugar intakes amongst 10-12 year old Greek children [34]. These discrepancies in study findings highlight the differences that may exist in food consumption practices between countries, thus underling the importance of conducting local investigations allowing for the development of culture-specific interventions adaptable to the national context.

In this study, we did not observe any association between overweight/obesity and intakes of free sugar, fat or saturated fat. Similar findings have been reported by other studies. For instance, Farajian et al showed that free sugars intake was not associated with overweight/obesity [34]. It is necessary to keep in mind that obese children tend to underreport food consumption, an observation that has been frequently discussed in the literature [38]. This may explain why normal weight children in the 6-8 and 14-18 years age groups had the highest intake of free sugar.

The results of this study document significant associations between certain socioeconomic characteristics and dietary intakes amongst children and adolescents. In fact, lower maternal education was associated with higher free sugar intakes and lower saturated fat intakes. Maternal education may in fact be one of the modulators of the family environment, which can have a direct influence on children's lifestyles, physical activity, and eating habits (33). In addition, the study findings showed that, based on family income as an indicator of socioeconomic status, significant differences were noted in the intakes of energy, CHO, total sugar, free sugar, fat, saturated fat and sodium, with lower intakes being observed amongst families with higher incomes (>3,000,000 L.L). These findings highlight the role of the household's socioeconomic status in modulating the family's lifestyle, economic and cultural resources, all of which may bear ramifications on nutritional and behavioral choices and in childhood (33).

The findings of this study should be considered in light of the following limitations. The dietary assessment conducted in this study was based on one 24-hour dietary recall (24-HR), which may not be representative of dietary intakes at the individual level. Yet, at the population level, the 24-HR was found to provide accurate and reliable estimates of energy intakes in spite of its limitations, such as dependence on memory and day-to-day variations [36]. Moreover, the multiple pass 24-HR approach used in this study provides accurate dietary intake estimates amongst children [37]. Efforts to reduce interviewer errors, resulting from the collection of recalls, were made by training the research nutritionists extensively. Inter-observer measurement errors in anthropometric assessment were also reduced via training the research nutritionists to follow up and thus ensure a proper quality of measurement amongst the research nutritionists. It is necessary to keep in mind that obese children tend to underreport food consumption, an observation that has been frequently discussed in the literature [38]. This helps explain why normal weight children in the 6-8 and 14-18 years age groups had the highest intake of free sugar. It is also important to note that the very low trans fat intakes observed in this study (0.15 and 0.23% of energy intake), may be due to the fact that food composition databases often lack data on the content of TFA in various food items, which hinders the comprehensive estimation of the daily intake of trans fat in the population. Finally, this study is based on surveys with a cross-sectional design, thus enabling us to test associations instead of assessing any causal relationships.

Conclusion:

The intakes of fat, saturated fat and free sugar are high amongst Lebanese children and adolescents, exceeding the WHO upper limits. These results highlight the need for culture-specific, multicomponent interventions aiming at fostering healthier diets amongst children in Lebanon, a country where NCD-related death is high, being estimated at 84%.

The study findings call for community-based intervention programs that involve multi-sectorial partnerships and that are responsive to the sociocultural norms of the population. The development of healthier eating habits in children and adolescents would require systems-level approaches and environmental support across all sectors of society to achieve sustained dietary behavior change. The major contributors to fat, saturated fat and sugar intakes, as identified in this study, should be targeted by these multi-component interventions.

Family-focused interventions and behavioral strategies are needed to instill healthy lifestyle and dietary habits early in life. School-based interventions should integrate behavioral and environmental approaches that focus on dietary intake. Policy interventions aimed at limiting the marketing of high fat high sugar foods are recommended as sustainable ways to support healthful lifestyles for children and families and to ensure that all youth have the opportunity to achieve and maintain a nutritious diet that is optimal for health.

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Table 1. Socio-demographic, parental and household characteristics of Lebanese children and adolescents, based on two nationally representative surveys (*survey 1*: underfive children; *survey 2*: 5-18 year old children and adolescents)

	Survey 1	**Survey 2**
	6 months – 5 years Total (896)	**>5 – 18 years Total (1106)**
	Mean ± SD	
Child's age (months; years)	29.47 ± 15.08	11.53 ± 3.6
Mother's age (years)	31.78 ± 6.27	40.26 ± 7.52
	N (%)	
Mother's education		
Primary school or less	134 (15)	240 (21.7)
Intermediate, High school or Technical diploma	576 (64.3)	658 (59.5)
University degree	186 (20.8)	208 (18.8)
Mothers who specialized in a health-related major	37 (4.2)	36 (5.8)
Mothers' employment status		
Employed	150 (16.7)	247 (23.8)
Housewife	746 (83.3)	791 (76.2)
Father's education		
Primary school or less	187 (21.2)	310 (28.4)
Intermediate, High school or Technical diploma	566 (64.1)	633 (58)
University degree	130 (14.7)	149 (13.6)
The house that you live in is		
Self-owned	539 (60.2)	783 (70.8)
Other	357 (39.8)	323 (29.2)
Crowding index		
>=1 person/room	779 (86.9)	995 (90)
<1 person/room	117 (13.1)	110 (10)
Number of children in the family		
1-2	502 (56)	350 (33.7)
3-5	353 (39.4)	631 (60.7)
>5	41 (4.6)	58 (5.6)
Type of school that children in the household attend		
Private school	419 (46.9)	682 (62.2)
Public school	124 (13.9)	294 (26.8)
Both	5 (0.6)	97 (8.8)
None	345 (38.6)	24 (2.2)
Infants who attend day-care	51 (5.7)	N/A

Do you have a paid helper?		
No	746 (83.6)	N/A
Yes	146 (16.4)	N/A
Monthly income		
<1,000,000 L.L.	307 (42.4)	433 (42.4)
1,000,001-3,000,000 L.L.	343 (47.4)	498 (48.8)
>3,000,000 L.L.	74 (10.2)	90 (8.8)

Table 2. Anthropometric characteristics of Lebanese children aged less than five years (survey 1) and of children and adolescents aged 5-18 years (survey 2), by gender.

Survey 1 Children 6 month to 5 years old				
	Total (N= 896)	**Boys (N= 460)**	**Girls (N= 436)**	**P-value**
Mean ± SD				
Weight (kg)	13.5 ± 4.51	13.76 ± 3.5	13.24 ± 5.4	0.9
Height (cm)	90.22 ± 45	89.14 ± 13.1	91.4 ± 63.2	0.46
Head Circumference (cm)	48.3 ± 4	48.82 ± 4.22	47.72 ± 3.68	**<0.001**
MUAC[#] (cm)	16.46 ± 3.3	16.59 ± 3.68	16.32 ± 2.8	0.225
Survey 2 Children 5 -18 years old				
Mean ± SD				
	Total (N= 1106)	**Boys (N= 527)**	**Girls (N= 579)**	**P-value**
Weight (kg)	45.15 ± 20.04	45.01 ± 21.13	45.28 ± 19.01	0.83
Height (cm)	144. 3 ± 18.79	144.36 ± 20.2	144.25 ± 17.43	0.92
Waist Circumference (cm)	69.33 ± 14.31	69.91 ± 15.17	68.8 ± 13.47	0.2

[#]Mid upper arm circumference

Table 3. Nutritional status of Lebanese children aged less than five years (survey 1) and of children and adolescents aged 5-18 years (survey 2), based on WHO standards.

Survey 1 Children 6 month to 5 years old*				
	Total (N= 896)	**Boys (N= 460)**	**Girls (N= 436)**	**P-value**
Length/height for age N (%)				
Severely stunted & Stunted [c]	52 (5.9)	26 (5.7)	26 (6)	0.361
Normal height [d]	832 (94.1)	430 (94.3)	402 (93.9)	0.361
BMI for age N (%)				
Severely wasted & Wasted [e]	13 (1.4)	8 (1.7)	5 (1.1)	0.837 one cell one p
Normal weight [f]	543 (61.1)	271 (59.3)	272 (63.1)	0.837
At risk of overweight [g]	234 (26.4)	123 (26.9)	111 (25.8)	0.837
Overweight [h]	74 (8.3)	42 (9.2)	32 (7.4)	0.837
Obese [i]	24 (2.7)	13 (2.8)	11 (2.6)	0.837
Survey 2 Children 5 -18 years old**				
	Total (N= 1106)	**Boys (N= 527)**	**Girls (N= 579)**	**P-value**
Height for age N (%)				
Severely stunted & Stunted [c]	46 (4.2)	27 (5.1)	19 (3.3)	0.12
Normal [d]	1059 (95.8)	499 (94.9)	560 (96.7)	0.12
BMI for age N (%)				
Severe thinness & Thinness [e]	15 (1.4)	9 (1.7)	6 (1.1)	0.082
Normal [f]	630 (57.1)	283 (53.8)	347 (60)	0.082
Overweight [g]	233 (21.1)	109 (20.7)	124 (21.5)	0.082
Obese [j]	226 (20.5)	125 (23.8)	101 (17.5)	0.082
Elevated WC>= 90th percentile [$] N (%)	227 (21.9)	108 (22)	119 (21.9)	0.99
WC/Ht_>=0.5 N (%)	353 (32.1)	169 (32.3)	184 (31.9)	0.9

[a.] WAZ score < -2, [b.] -2=< WAZ.

[c.] HAZ score <-2, [d.] -2=< HAZ.

[e.] BAZ score <-2, [f.] -2 < BAZ <=1, [g.] 1< BAZ <=2, [h.] 2 < BAZ<=3, [i.] BAZ > +3.

[j.] BAZ score > +2.

*World Health Organization. Training Course on Child Growth Assessment. Geneva, WHO,2008.

** World Health Organization. Growth reference data for 5-19 years. 2007.

***Weight-for-age reference data are not available beyond age 10 – WHO 2007.

[$]Elevated waist circumference>= 90th percentile. Fernandez; 2006.

Table 4. Mean daily intakes of energy and macronutrients among Lebanese children and adolescents by age group and gender.

Intake/day	6 months-5 years (N=888)	5.01 – 8.9 years (N=312)	9 – 13.9 years (N=473)	14 – 18.9 years (N=320)
		Mean ± SE		
Energy (Kcal)				
Total	1326.47 ± 19.16	1694.1 ± 40.41	2003.86 ± 38.47	1933.32 ± 56.65
Boys	1362.72 ± 26.41	1791.23 ± 56.7	2156.6 ± 54.62	2315.14 ± 95.13
Girls	1288.36 ± 27.73	1604.17± 56.71	1835.52 ± 51.84	1675.44 ± 63.56
P-value	**0.052**	**0.02**	**<0.001**	**<0.001**
CHO (g)				
Total	162.81 ± 2.46	212.15 ± 5.49	240.86 ± 4.85	232.97 ± 7.01
Boys	167.84 ± 3.48	218.93 ± 7.38	259.66 ± 7.12	277.35 ± 12
Girls	157.52 ± 3.45	205.87 ± 8.07	220.15 ± 6.23	202.99 ± 7.8
P-value	**0.036**	0.24	**<0.001**	**<0.001**
Total Sugar (g)				
Total	72.91 ± 1.22	72.93 ± 2.81	80.86 ± 2.34	78.93 ± 2.95
Boys	75.63 ± 1.76	73.12 ± 3.4	85.01 ± 3.52	94.13 ± 5
Girls	70.05 ± 1.69	72.75 ± 4.42	76.28 ± 3	68.66 ± 3.46
P-value	**0.023**	0.95	0.06	**<0.001**
Free Sugar (g)				
Total	48.54 ± 1.22	67.4 ± 2.77	76.39 ± 2.27	75.88 ± 2.91
Boys	50.89 ± 1.82	67.4 ± 3.36	80.56 ± 3.4	90.25 ± 4.83
Girls	46.08 ± 1.62	67.4 ± 4.34	71.8 ± 2.94	66.17 ± 3.45
P-value	**0.049**	0.99	0.05	**<0.001**
Fiber (g)				
Total	9.32 ± 0.24	13.87 ± 0.5	15.61 ± 0.43	15.64 ± 0.58
Boys	9.36 ± 0.33	14.05 ± 8.53	16.68 ± 0.64	17.8 ± 0.99
Girls	9.28 ± 0.34	13.7 ± 9.16	14.43 ± 0.54	14.19 ± 0.68
P-value	0.86	0.72	**0.007**	**0.003**
Protein (g)				
Total	42.13 ± 0.78	50.04 ± 1.35	60.14 ± 1.42	62.24 ± 2.23
Boys	44.03 ± 1.11	52.52 ± 1.95	65.61 ± 2.05	76.55 ± 3.85
Girls	40.13 ± 1.08	47.76 ± 1.85	54.11 ± 1.88	52.57 ± 2.46
P-value	**0.012**	0.08	**<0.001**	**<0.001**
Fat (g)				
Total	58.1 ± 0.97	74.29 ± 2.12	91.6 ± 2.14	86.26 ± 2.97
Boys	59.03 ± 1.31	80.91 ± 3.16	97.88 ± 2.97	102.75 ± 5.01
Girls	57.12 ± 1.43	68.15 ± 2.78	84.68 ± 3.03	75.12 ± 3.44
P-value	0.33	**0.03**	**0.002**	**<0.001**
Linoleic Acids n-6 (g)				
Total				
Boys	11.06 ± 0.26	14.4 ± 0.54	19.08 ± 0.59	19.18 ± 0.93
Girls	11.05 ± 0.34	15.87 ± 0.8	20.54 ± 13.2	23.12 ± 1.74

P-value	11.08 ± 0.38 0.94	13.05 ± 9.12 **0.009**	17.47 ± 12.31 **0.009**	16.52 ± 0.99 **0.001**
Linolenic Acids n-3 (g)				
Total	0.7 ± 0.01	0.81 ± 0.03	1.02 ± 0.03	1.02 ± 0.05
Boys	0.71 ± 0.02	0.88 ± 0.53	1.08 ± 0.04	1.21 ± 0.09
Girls	0.7 ± 0.02	0.76 ± 0.5	0.95 ± 0.04	0.9 ± 0.05
P-value	0.75	**0.04**	**0.03**	**0.003**
Saturated Fat (g)				
Total	18.33 ± 0.35	20.41 ± 0.75	23.76 ± 0.68	21.75 ± 0.85
Boys	19.07 ± 0.52	21.85 ± 1.2	24.94 ± 0.99	25.74 ± 1.41
Girls	17.55 ± 0.48	19.07 ± 0.92	22.46 ± 0.91	19.05 ± 1.02
P-value	**0.032**	0.07	0.07	**<0.001**
Trans Fat (g)				
Total	0.26 ± 0.02	0.37 ± 0.03	0.53 ± 0.03	0.51 ± 0.04
Boys	0.24 ± 0.02	0.41 ± 0.06	0.56 ± 0.05	0.58 ± 0.08
Girls	0.27 ± 0.03	0.33 ± 0.04	0.49 ± 0.043	0.46 ± 0.05
P-value	0.4	0.24	0.23	0.15
Sodium (g)				
Total	1.36 ± 0.03	1.95 ± 0.06	2.31 ± 0.06	2.21 ± 0.09
Boys	1.43 ± 0.04	2.07 ± 0.1	2.45 ± 0.08	2.75 ± 0.15
Girls	1.3 ± 0.04	1.84 ± 0.08	2.16 ± 0.08	1.84 ± 0.1
P-value	0.04	0.08	**0.01**	**<0.001**

Values in **Bold** are significantly different by gender

Table 5. Mean daily intake of percentage (%) of energy of macronutrients among Lebanese children and adolescents by age group and gender.

Intake/day	6 months-5 years (N=888)	6 - 8 years (N=312)	9 - 13 years (N=473)	14 - 18 years (N=320)
		Mean ± SE		
CHO (%)				
Total	49.44 ± 0.29	50.39 ± 0.54	48.82 ± 0.43	48.9 ± 0.58
Boys	49.44 ± 0.41	49.26 ± 0.74	48.52 ± 0.57	48.32 ± 0.81
Girls	49.44 ± 0.42	51.43 ± 0.76	49.14 ± 0.66	49.29 ± 0.8
P-value	0.99	**0.04**	0.48	0.41
Total Sugar (%)				
Total	23.36 ± 0.31	17.43 ± 0.48	16.37 ± 0.36	16.68 ± 0.46
Boys	23.44 ± 0.42	16.8 ± 0.65	15.84 ± 0.48	16.65 ± 0.6
Girls	23.28 ± 0.46	18.02 ± 0.71	16.96 ± 0.52	16.69 ± 0.65
P-value	0.81	0.21	0.12	0.96
Free Sugar (%)				
Total	14.59 ± 0.31	16.06 ± 0.47	15.4 ± 0.35	16.01 ± 0.46
Boys	14.7 ± 0.44	15.45 ± 0.63	14.97 ± 0.48	15.96 ± 0.58
Girls	14.48 ± 0.42	16.64 ± 0.69	15.88 ± 0.51	16.05 ± 0.66
P-value	0.73	0.21	0.19	0.93
Protein (%)				
Total	12.56 ± 0.14	12.09 ± 0.23	12.35 ± 0.21	13.29 ± 0.33
Boys	12.78 ± 0.2	11.97 ± 0.34	12.56 ± 0.29	13.73 ± 0.5
Girls	12.32 ± 0.19	12.21 ± 0.32	12.12 ± 0.31	12.98 ± 0.44
P-value	0.1	0.61	0.31	0.27
Fat (%)				
Total	39.19 ± 0.26	38.88 ± 0.48	40.06 ± 0.42	39.05 ± 0.51
Boys	38.93 ± 0.36	40.06 ± 0.67	40.06 ± 0.57	38.98 ± 0.78
Girls	39.47 ± 0.38	37.78 ± 0.67	40.06 ± 0.62	39.1 ± 0.68
P-value	0.31	**0.017**	0.99	0.91
Linoleic Acids n-6 (%)				
Total	7.31 ± 0.11	7.45 ± 0.2	8.21 ± 0.19	8.54 ± 0.26
Boys	7.19 ± 0.15	7.77 ± 0.27	8.32 ± 0.26	8.49 ± 0.43
Girls	7.44 ± 0.16	7.17 ± 0.29	8.09 ± 0.27	8.58 ± 0.33
P-value	0.24	0.14	0.54	0.87
Linolenic Acids n-3 (%)				
Total	0.49 ± 0.01	0.43 ± 0.01	0.45 ± 0.01	0.47 ± 0.01
Boys	0.49 ± 0.01	0.43 ± 0.01	0.44 ± 0.01	0.45 ± 0.02
Girls	0.5 ± 0.01	0.42 ± 0.02	0.46 ± 0.01	0.48 ± 0.02
P-value	0.5	0.68	0.19	0.32
Saturated Fat (%)				
Total	12.57 ± 0.15	10.74 ± 0.27	10.46 ± 0.21	9.89 ± 0.24

Boys	12.78 ± 0.23	10.76 ± 0.4	10.16 ± 0.26	10.02 ± 0.37
Girls	12.36 ± 0.2	10.72 ± 0.38	10.8 ± 0.32	9.81 ± 0.31
P-value	0.18	0.93	0.12	0.67
Trans Fat (%)				
Total	0.15 ± 0.01	0.18 ± 0.01	0.23 ± 0.01	0.23 ± 0.02
Boys	0.14 ± 0.01	0.19 ± 0.02	0.24 ± 0.018	0.22 ± 0.02
Girls	0.16 ± 0.01	0.17 ± 0.02	0.22 ± 0.02	0.24 ± 0.02
P-value	0.29	0.5	0.6	0.71

Values in **Bold** are significantly different by gender

Table 6. Mean daily intakes of energy and macronutrients among Lebanese children and adolescents by age group and BMI.

Intake/day	6 months-5 years (N=888)	5.01 – 8.9 years (N=312)	9 – 13.9 years (N=473)	14 – 18.9 years (N=320)
		Mean ± SE		
Energy (Kcal)				
Normal	1309.94 ± 24.54	1651 ± 54.59	2011.7 ± 52.06	1949.96 ± 75.24
At risk of overweight	1387.27 ± 37.46	N/A	N/A	N/A
Overweight	1315.4 ± 59.41	1683.94 ± 87.24	1995.12 ± 74.6	1810.78 ± 119.5
Obese	1401.4 ± 144.85	1849.4 ± 80.49	1992.25 ± 89.58	1948.13 ± 129.16
P-value	0.33	0.16	0.98	0.6
CHO (g)				
Normal	161.41 ± 3.17	211.26 ± 7.52	241 ± 6.57	238.42 ± 9.54
At risk of overweight	171.26 ± 4.8	N/A	N/A	N/A
Overweight	158.22 ± 7.7	207.02 ± 12.6	264.21 ± 9.68	209.4 ± 14.52
Obese	162.16 ± 16.16	222.47 ± 9.96	234.5 ± 10.9	232.67 ± 15.07
P-value	0.33	0.65	0.73	0.26
Total Sugar (g)				
Normal	71.91 ± 1.59	75.75 ± 3.93	81.67 ± 3.13	84.66 ± 4.23
At risk of overweight	76.82 ± 2.34	N/A	N/A	N/A
Overweight	75.63 ± 4.22	68.83 ± 6.79	82.81 ± 4.71	68.02 ± 5.75
Obese	63.74 ± 8.14	70.35 ± 4.41	76.1 ± 5.4	72.49 ± 5.79
P-value	0.18	0.55	0.58	0.052
Free Sugar (g)				
Normal	49.97 ± 1.6	70.19 ± 3.87	77.25 ± 3.01	81.89 ± 4.16
At risk of overweight	50.46 ± 2.39	N/A	N/A	N/A
Overweight	40.25 ± 3.71	63.83 ± 6.63	78.49 ± 4.6	65.02 ± 5.65
Obese	43.56 ± 7.28	64.3 ± 4.39	71.32 ± 5.3	68.71 ±5.73
P-value	0.14	0.56	0.52	**0.04**
Fiber (g)				
Normal	9.35 ± 0.31	13.71 ± 0.68	15.46 ± 0.58	16.08 ± 0.77
At risk of overweight	10.04 ± 0.5	N/A	N/A	N/A
Overweight	8.41 ± 0.68	14.39 ± 1.09	15.85 ± 0.82	14.25 ± 1.25
Obese	8.28 ± 1.15	14.16 ± 1.05	15.84 ±1.02	15.47 ± 1.29
P-value	0.27	0.15	0.91	0.45
Protein (g)				
Normal	42.04 ± 1.01	**47.95 ± 1.78**	59.35 ± 1.92	61.5 ±2.73
At risk of overweight	43.98 ± 1.51	N/A	N/A	N/A
Overweight	40.3 ± 2.44	48.61 ± 2.99	59.09 ± 2.71	64.09 ± 5.62
Obese	42.43 ± 0.79	**57.77 ± 2.72**	64.17 ± 3.4	62.6 ± 2.27
P-value	0.61	**0.01**	0.38	0.9

Fat (g)				
Normal	57 ± 1.23	70.84 ± 2.78	92.72 ± 2.9	86.33 ± 3.92
At risk of overweight	60.29 ± 1.91	N/A	N/A	N/A
Overweight	59.58 ± 2.99	76.35 ± 4.04	88.71 ± 4.17	81.38 ± 5.82
Obese	66.04 ± 8.21	83.32 ± 5.08	91.41 ± 5	87.83 ± 7.25
P-value	0.26	0.07	0.75	0.75
Linoleic Acids n-6 (g)				
Normal	10.79 ± 0.32	13.6 ± 0.68	19.43 ± 0.78	19.38 ± 1.29
At risk of overweight	11.61 ± 0.5	N/A	N/A	N/A
Overweight	11.34 ± 0.75	15.28 ± 1.23	18.67 ± 1.3	17.17 ± 1.42
Obese	12.5 ± 2.71	16.14 ± 1.29	18.6 ± 1.3	19.9 ± 2.17
P-value	0.43	0.14	0.78	0.56
Linolenic Acids n-3 (g)				
Normal	0.68 ± 0.018	0.79 ± 0.04	1.05 ± 0.4	0.97 ± 0.06
At risk of overweight	0.75 ± 0.027	N/A	N/A	N/A
Overweight	0.77 ± 0.05	0.85 ± 0.08	0.99 ± 0.06	0.94 ± 0.08
Obese	0.66 ± 0.09	0.86 ± 0.06	0.98 ± 0.06	1.21 ± 0.15
P-value	0.11	0.56	0.58	0.13
Saturated Fat (g)				
Normal	17.93 ± 0.44	19.8 ± 1.02	23.81 ± 0.88	22.04 ± 1.17
At risk of overweight	19.23 ± 0.73	N/A	N/A	N/A
Overweight	18.37 ± 1.23	19.79 ± 1.18	24.49 ± 1.42	20.49 ± 1.63
Obese	21.63 ± 3.22	22.93 ± 1.78	22.66 ± 1.6	21.6 ± 1.93
P-value	0.2	0.25	0.66	0.77
Trans Fat (g)				
Normal	**0.22** ± 0.02	0.33 ± 0.04	0.54 ± 0.04	0.55 ± 0.06
At risk of overweight	**0.34** ± 0.06	N/A	N/A	N/A
Overweight	0.24 ± 0.05	0.43 ± 0.13	0.53 ± 0.07	0.38 ± 0.07
Obese	0.42 ± 0.15	0.42 ± 0.07	0.51 ± 0.07	0.52 ± 0.09
P-value	**0.03**	0.41	0.94	0.27
Sodium (g)				
Normal	1.35 ± 0.04	1.84 ± 0.08	2.33 ± 0.08	2.18 ± 0.11
At risk of overweight	1.46 ± 0.06	N/A	N/A	N/A
Overweight	**1.19** ± 0.08	1.99 ± 0.19	2.29 ± 0.12	1.94 ± 0.17
Obese	**1.78** ± 0.27	2.21 ± 0.15	2.3 ± 0.12	2.46 ± 0.22
P-value	**0.01**	0.08	0.95	0.15

Values in **Bold** are significantly different

Table 7. Mean daily intake of percentage (%) of energy of macronutrients among Lebanese children and adolescents by age group and BMI.

Intake/day	**6 months-5 years (N=888)**	**6 - 8 years (N=312)**	**9 - 13 years (N=473)**	**14 - 18 years (N=320)**
		Mean ± SE		
CHO (%)				
Normal	49.6 ± 0.38	51.5 ± 0.7	48.81 ± 0.6	49.64 ± 0.77
At risk of overweight	49.72 ± 0.54	N/A	N/A	N/A
Overweight	48.16 ± 0.96	48.58 ± 1.12	49.65 ± 0.79	46.36 ± 1.16
Obese	48.06 ± 2.08	49.03 ± 1.15	47.98 ± 1.04	49.14 ± 1.42
P-value	0.46	0.052	0.45	0.08
Total Sugar (%)				
Normal	23.33 ± 0.4	18.4 ± 0.62	16.53 ± 0.47	17.6 ± 0.62
At risk of overweight	23.37 ± 0.6	N/A	N/A	N/A
Overweight	24.09 ± 1.01	16.42 ± 1.19	16.67 ± 0.75	15.22 ± 0.95
Obese	20.21 ± 2.28	15.74 ± 1	15.61 ± 0.8	15.61 ± 1.05
P-value	0.35	0.058	0.55	0.07
Free Sugar (%)				
Normal	15.12 ± 0.4	17.04 ± 0.62	15.66 ± 0.47	17.01 ± 0.62
At risk of overweight	14.37 ± 0.56	N/A	N/A	N/A
Overweight	12.34 ± 1.03	15.12 ± 1.16	15.67 ± 0.72	14.45 ± 0.91
Obese	13.77 ± 2.2	14.22 ± 0.92	14.41 ± 0.76	14.88 ± 1.08
P-value	0.08	**0.04**	0.35	**0.04**
Protein (%)				
Normal	12.72 ± 0.18	11.9 ± 0.31	**11.99 ± 0.29**	13.09 ± 0.4
At risk of overweight	12.56 ± 0.26	N/A	N/A	N/A
Overweight	12.04 ± 0.44	11.82 ± 0.47	12.38 ± 0.43	14.19 ± 0.85
Obese	12.05 ± 0.71	12.85 ± 0.5	**13.39 ± 0.48**	13.3 ± 0.79
P-value	0.51	0.25	**0.04**	0.43
Fat (%)				
Normal	38.93 ± 0.34	37.99 ± 0.62	40.38 ± 0.55	38.62 ± 0.67
At risk of overweight	38.88 ± 0.5	N/A	N/A	N/A
Overweight	40.89 ±0.87	41.08 ± 1.09	39.23 ± 0.84	40.32 ± 1.13
Obese	40.76 ± 1.75	39.31 ± 1.07	39.93 ± 1.04	38.85 ± 1.21
P-value	0.14	0.054	0.54	0.42
Linoleic Acids n-6 (%)				
Normal	7.18 ± 0.14	7.24 ± 0.26	8.36 ± 0.24	8.46 ± 0.35
At risk of overweight	7.43 ± 0.21	N/A	N/A	N/A
Overweight	7.74 ± 0.36	7.96 ± 0.45	7.93 ± 0.38	8.74 ± 0.55
Obese	7.25 ± 1.01	7.64 ± 0.46	8.12 ± 0.46	8.61 ± 0.61
P-value	0.49	0.39	0.63	0.9
Linolenic Acids n-3 (%)				
Normal	0.48 ± 0.01	0.42 ± 0.01	0.46 ± 0.01	0.44 ± 0.02

At risk of overweight	0.5 ± 0.01	N/A	N/A	N/A
Overweight	0.54 ±0.03	0.45 ± 0.03	0.44 ± 0.02	0.48 ± 0.03
Obese	0.44 ± 0.04	0.41 ± 0.01	0.43 ± 0.02	0.53 ± 0.04
P-value	0.49	0.45	0.4	0.05
Saturated Fat (%)				
Normal	12.54 ± 0.19	10.6 ± 0.36	10.5 ± 0.26	9.98 ± 0.34
At risk of overweight	12.4 ± 0.29	N/A	N/A	N/A
Overweight	12.73 ± 0.56	11.04 ± 0.57	10.87 ± 0.48	10.15 ± 0.51
Obese	13.75 ± 1.32	10.85 ± 0.64	9.86 ± 0.48	9.4 ± 0.47
P-value	0.67	0.82	0.26	0.56
Trans Fat (%)				
Normal	0.14 ±0.01	0.17 ± 0.02	0.23 ± 0.02	0.26 ± 0.02
At risk of overweight	0.17 ± 0.23	N/A	N/A	N/A
Overweight	0.13 ± 0.18	0.19 ± 0.04	0.24 ± 0.03	0.17 ±0.02
Obese	0.2 ± 0.27	0.2 ± 0.03	0.22 ± 0.03	0.21 ± 0.03
P-value	0.24	0.72	0.83	0.08

Values in **Bold** are significantly different

Table 8. Mean daily intakes of energy and macronutrients among Lebanese children and adolescents by age group and maternal education.

Intake/day	6 months-5 years (N=888)	5.01 – 8.9 years (N=312)	9 – 13.9 years (N=473)	14 – 18.9 years (N=320)
		Mean ± SE		
Energy (Kcal)				
Primary or less	1412.4 ± 57.53	1712.36 ± 124.26	2144.47 ± 88.32	1992.02 ± 126.53
Intermediate, high school or technical diploma	1325.9 ± 23.64	1727.79 ± 48.32	1960.24 ± 48.56	1879.05 ± 67.64
University degree	1268.06 ± 38.35	1587.56 ± 80.38	1984.55 ± 88.22	2041.82 ± 152.07
P-value	0.09	0.37	0.16	0.51
CHO (g)				
Primary or less	172.73 ± 7.4	211.77 ± 16	**264.25 ± 11.79**	243.82 ± 15.69
Intermediate, high school or technical diploma	164.11 ± 3.05	215.49 ± 6.66	**234.42 ± 5.98**	227.08 ± 8.45
University degree	151.89 ± 4.68	203.3 ± 11.41	235.15 ± 10.89	236.54 ± 18.17
P-value	0.04	0.67	**0.04**	0.58
Total Sugar (g)				
Primary or less	71.79 ± 3.59	65.48 ± 6.91	87.52 ± 5.21	81.63 ± 6.62
Intermediate, high school or technical diploma	73.83 ± 1.51	75.01 ± 3.77	77.65 ± 2.84	76.92 ± 3.6
University degree	70.84 ± 2.49	73.05 ± 5.1	83.48 ± 6.11	81.93 ± 7.5
P-value	0.58	0.46	0.22	0.73
Free Sugar (g)				
Primary or less	57.12 ± 3.52	61.02 ± 6.74	84.18 ± 5.01	79.49 ± 6.55
Intermediate, high school or technical diploma	73.83 ± 1.51	69.51 ± 3.74	73.24 ± 2.76	74.07 ± 3.51
University degree	42.76 ± 2.45	66.59 ± 4.9	77.61 ± 5.97	76.44 ± 7.41
P-value	0.002	0.53	0.16	0.73
Fiber (g)				
Primary or less	9.8 ± 0.57	14.02 ± 1.61	16.77 ± 0.98	15.63 ± 1.17
Intermediate, high school or technical diploma	9.35 ± 0.32	13.9 ± 0.6	15.14 ± 0.53	15.24 ± 0.71
University degree	8.9 ± 0.42	13.52 ± 0.92	15.82 ± 1.02	17.29 ± 1.71
P-value	0.15	0.91	0.32	0.47
Protein (g)				
Primary or less	44.97 ± 2.4	47.73 ± 3.38	63.93 ± 3.25	64.67 ± 5.27
Intermediate, high school or technical diploma	41.43 ± 0.93	50.55 ± 1.72	57.69 ± 1.76	59.51 ± 2.64
University degree	42.27 ± 1.67	50.48 ± 2.85	63.57 ± 3.47	68.62 ± 5.25
P-value	0.29	0.73	0.11	0.3

Fat (g)				
Primary or less	62.4 ± 2.97	77.72 ± 6.87	95.56 ± 4.7	86.44 ± 6.07
Intermediate, high school or technical diploma	57.74 ± 1.18	76.2 ± 2.53	90.5 ± 2.73	84.27 ± 3.62
University degree	56.19 ± 1.98	66.36 ± 3.87	90.65 ± 5.13	93.83 ± 8.94
P-value	0.15	0.13	0.63	0.55
Linoleic Acids n-6 (g)				
Primary or less	12.7 ± 0.77	**16.23 ± 1.69**	21.3 ± 1.39	20.64 ± 2.23
Intermediate, high school or technical diploma	10.87 ± 0.32	**15 ± 0.65**	18.97 ± 0.77	18.64 ± 1.09
University degree	10.53 ± 0.5	**11.032 ± 0.91**	17 ± 1.16	18.65 ± 2.24
P-value	0.03	**0.006**	0.07	0.64
Linolenic Acids n-3 (g)				
Primary or less	0.76 ± 0.04	0.85 ± 0.08	1.05 ± 0.06	1 ± 0.08
Intermediate, high school or technical diploma	0.69 ± 0.02	0.84 ± 0.04	1.01 ± 0.04	1 ± 0.07
University degree	0.7 ± 0.03	0.72 ± 0.06	1.02 ± 0.07	1.18 ± 0.13
P-value	0.19	0.2	0.86	0.42
Saturated Fat (g)				
Primary or less	17.51 ± 0.85	19.24 ± 1.88	23.08 ± 1.26	22.12 ± 1.79
Intermediate, high school or technical diploma	18.63 ± 0.46	21.13 ± 1.03	23.26 ± 0.89	20.78 ± 0.97
University degree	17.97 ± 0.72	19.35 ± 1.23	26.04 ± 1.67	24.95 ± 2.79
P-value	0.48	0.5	0.26	0.23
Trans Fat (g)				
Primary or less	0.32 ± 0.05	0.36 ± 0.09	0.52 ± 0.06	0.61 ± 0.09
Intermediate, high school or technical diploma	0.24 ± 0.02	0.39 ± 0.049	0.52 ± 0.04	0.47 ± 0.05
University degree	0.26 ± 0.03	0.31 ± 0.04	0.57 ± 0.08	0.5 ± 0.1
P-value	0.4	0.64	0.81	0.3
Sodium (g)				
Primary or less	1.48 ± 0.09	2 ± 0.16	2.58 ± 0.14	2.13 ± 0.17
Intermediate, high school or technical diploma	1.37 ± 0.04	1.92 ± 0.08	2.23 ± 0.07	2.17 ± 0.11
University degree	1.28 ± 0.06	1.96 ± 0.17	2.27 ± 0.12	2.5 ± 0.25
P-value	0.17	0.9	0.47	0.4

Values in **Bold** are significantly different

Table 9. Mean daily intake of percentage (%) of energy of macronutrients among Lebanese children and adolescents by age group and maternal education.

Intake/day	6 months-5 years (N=888)	5.01 – 8.9 years (N=312)	9 – 13.9 years (N=473)	14 – 18.9 years (N=320)
		Mean ± SE		
CHO (%)				
Primary or less	49.54 ± 0.86	50.41 ± 1.32	49.57 ± 0.95	50.02 ± 1.18
Intermediate, high school or technical diploma	49.78 ± 0.37	50.07 ± 0.69	48.83 ± 0.57	48.85 ± 0.72
University degree	48.33 ± 0.57	51.24 ± 1.11	47.98 ± 0.97	47.02 ± 1.57
P-value	0.14	0.68	0.51	0.28
Total Sugar (%)				
Primary or less	21.76 ± 0.87	15.56 ± 1.2	16.62 ± 0.81	16.58 ± 0.91
Intermediate, high school or technical diploma	23.56 ± 0.37	17.49 ± 0.61	16.23 ± 0.45	16.67 ± 0.59
University degree	23.88 ± 0.7	18.73 ± 1.02	16.55 ± 0.81	16.86 ± 1.2
P-value	0.09	0.12	0.88	0.98
Free Sugar (%)				
Primary or less	**16.63 ± 0.87**	14.48 ± 1.19	16.02 ± 0.79	16.11 ± 0.92
Intermediate, high school or technical diploma	14.58 ± 0.38	16.14 ± 0.6	15.22 ± 0.44	16.03 ± 0.59
University degree	**13.21 ± 0.62**	17.09 ± 0.97	15.28 ± 0.81	15.78 ± 1.21
P-value	**0.004**	0.22	0.65	0.98
Protein (%)				
Primary or less	12.58 ± 0.45	11.43 ± 0.48	12.21 ± 0.52	12.89 ± 0.58
Intermediate, high school or technical diploma	12.36 ± 0.16	11.96 ± 0.3	12.11 ± 0.27	13.24 ± 0.45
University degree	13.15 ± 0.28	12.96 ± 0.51	13.23 ± 0.47	14.09 ± 0.88
P-value	0.07	0.1	0.13	0.48
Fat (%)				
Primary or less	39.2 ± 0.78	39.54 ± 1.2	39.54 ± 0.91	38.26 ± 0.99
Intermediate, high school or technical diploma	39.05 ± 0.32	39.26 ± 0.62	40.25 ± 0.57	39.23 ± 0.67
University degree	39.62 ± 0.51	37.33 ± 0.93	40.06 ± 0.86	39.8 ± 1.35
P-value	0.69	0.22	0.8	0.6
Linoleic Acids n-6 (%)				
Primary or less	7.64 ± 0.3	**8.14 ± 0.52**	8.71 ± 0.43	8.81 ± 0.55
Intermediate, high school or technical diploma	7.22 ± 0.14	**7.68 ± 0.26**	8.29 ± 0.24	8.63 ± 0.34
University degree	7.37 ± 0.23	**6.32 ± 0.39**	7.43 ± 0.37	7.74 ± 0.65
P-value	0.4	**0.007**	0.08	0.43
Linolenic Acids n-3 (%)				
Primary or less	0.48 ± 0.02	0.43 ± 0.03	0.43 ± 0.02	0.45 ± 0.03
	0.48 ± 0.01	0.43 ± 0.01	0.45 ± 0.01	0.47 ± 0.02

Intermediate, high school or technical diploma	0.52 ± 0.02	0.41 ± 0.03	0.45 ± 0.02	0.51 ± 0.04
University degree	0.16	0.7	0.69	0.48
P-value				
Saturated Fat (%)				
Primary or less	**11.57 ± 0.41**	9.75 ± 0.61	**9.64 ± 0.4**	9.67± 0.5
Intermediate, high school or technical diploma	**12.74 ± 0.2**	10.86 ± 0.36	10.4 ± 0.27	9.82 ± 0.3
University degree	12.74 ± 0.3	11.17 ± 0.55	**11.58 ± 0.52**	10.58 ± 0.64
P-value	**0.03**	0.23	**0.01**	0.48
Trans Fat (%)				
Primary or less	0.17 ± 0.02	0.18 ± 0.04	0.21 ± 0.03	0.26 ± 0.03
Intermediate, high school or technical diploma	0.14 ± 0.01	0.18 ± 0.02	0.23 ± 0.02	0.21 ± 0.018
University degree	0.15 ± 0.01	0.17 ± 0.02	0.27 ± 0.04	0.26 ± 0.06
P-value	0.38	0.9	0.36	0.29

Values in **Bold** are significantly different

Table 10. Mean daily intakes of energy and macronutrients among Lebanese children and adolescents by age group and family income.

Intake/day	6 months-5 years (N=888)	5.01 – 8.9 years (N=312)	9 – 13.9 years (N=473)	14 – 18.9 years (N=320)
		Mean ± SE		
Energy (Kcal)				
<1000,000	1298.7 ± 34.26	1713.05 ± 70.77	**2044.79 ± 56.19**	1902.64 ± 81.51
1000,000 – 3000,000	**1380.81 ± 29.34**	1764.62 ± 67.55	**2048.98 ± 58.02**	2012.36 ± 92.65
>3000,000	**1175.94 ± 57.33**	1515.53 ± 180.41	**1581.91 ± 117.54**	1724.52 ± 162.37
P-value	**0.01**	0.4	**0.003**	0.32
CHO (g)				
<1000,000	160.85 ± 4.49	212.12 ± 8.58	**250.27 ± 7.42**	232.92 ± 9.92
1000,000 – 3000,000	**169.41 ± 3.78**	224.42 ± 9.7	**243.68 ± 7.15**	242.95 ± 11.53
>3000,000	**141.27 ± 7.14**	193.68 ± 24.18	**179.26 ± 12.73**	185.95 ± 18.05
P-value	**0.009**	0.38	**<0.001**	0.07
Total Sugar (g)				
<1000,000	**69.74 ± 2.12**	66.71 ± 3.75	**82.9 ± 3.56**	75.46 ± 4.09
1000,000 – 3000,000	**77.12 ± 2.02**	81.28 ± 5.37	**83.62 ± 3.49**	84.54 ± 4.9
>3000,000	**65.29 ± 3.22**	73.24 ± 11.24	**57.09 ± 6.12**	64.83 ± 7.99
P-value	**0.006**	0.1	**0.007**	0.11
Free Sugar (g)				
<1000,000	46.94 ± 1.98	62.5 ± 3.59	**79.24 ± 3.51**	73.22 ± 4.07
1000,000 – 3000,000	52.94 ± 2.14	76.32 ± 5.34	**78.44 ± 3.36**	81.14 ± 4.82
>3000,000	36.9 ± 3.1	63.86 ± 9.96	**52.43 ± 5.57**	61.05 ± 7.45
P-value	**0.002**	0.1	**0.005**	0.12
Fiber (g)				
<1000,000	8.78 ± 0.42	14.16 ± 0.87	15.75 ± 0.66	15.25 ± 0.82
1000,000 – 3000,000	10.14 ± 0.41	14.2 ± 0.72	16.11 ± 0.63	16.53 ± 0.96
>3000,000	8.56 ±0.64	10.4 ± 1.53	12.97 ± 1.42	13.68 ± 1.45
P-value	**0.04**	0.18	0.15	0.31
Protein (g)				
<1000,000	**40.54 ± 1.43**	48.47 ± 2.22	59.62 ± 2.28	59.72 ± 3.51
1000,000 – 3000,000	**45.03 ± 1.17**	49.74 ±2.14	61.78 ± 2.04	64.14 ± 3.31
>3000,000	39.48 ± 2.51	49.02 ± 6.38	56.68 ± 4.64	65.42 ± 7.18
P-value	**0.023**	0.92	0.57	0.59
Fat (g)				
<1000,000	56.61 ± 1.7	77.05 ± 3.99	**92.4 ± 3.03**	83.75 ± 4.38
1000,000 – 3000,000	60.03 ± 1.53	77.07 ± 3.35	**94.66 ± 3.26**	90.14 ± 4.77
>3000,000	51.72 ± 2.72	62.23 ± 8.81	**72.82 ± 7.42**	81.71 ± 8.72
P-value	0.05	0.3	**0.02**	0.53

Linoleic Acids n-6 (g)				
<1000,000	10.87 ± 0.47	16.18 ± 1.09	20.81 ± 0.92	19.94 ± 1.4
1000,000 – 3000,000	10.98 ± 0.4	14.27 ± 0.77	18.71 ± 0.88	19.02 ± 1.5
>3000,000	10.26 ± 0.7	10.85 ± 1.47	13.88 ± 1.55	18.24 ± 2.49
P-value	0.76	0.06	**0.006**	0.84
Linolenic Acids n-3 (g)				
<1000,000	0.69 ± 0.02	0.83 ± 0.05	**1.04 ± 0.04**	0.98 ± 0.72
1000,000 – 3000,000	0.7 ± 0.02	0.85 ± 0.05	**1.05 ± 0.04**	1.05 ± 0.07
>3000,000	0.68 ± 0.4	0.72 ± 0.1	**0.75 ± 0.09**	1.09 ± 0.21
P-value	0.96	0.63	**0.02**	0.71
Saturated Fat (g)				
<1000,000	**16.85 ± 0.54**	19.02 ± 1.25	**22.37 ± 0.85**	20.09 ± 1.22
1000,000 – 3000,000	**20.19 ± 0.61**	22.06 ± 1.25	**25.47 ± 1.09**	23.86 ± 1.4
>3000,000	**15.92 ± 0.82**	20.61 ± 3.56	**20.54 ± 2.41**	20.43 ± 2.24
P-value	**<0.001**	0.24	**0.03**	0.1
Trans Fat (g)				
<1000,000	0.22 ± 0.03	0.36 ± 0.05	0.53 ± 0.05	0.53 ± 0.06
1000,000 – 3000,000	0.27 ± 0.03	0.38 ± 0.06	0.53 ± 0.05	0.53 ± 0.07
>3000,000	0.28 ± 0.07	0.38 ± 0.11	0.5 ± 0.08	0.33 ± 0.08
P-value	0.37	0.95	0.96	0.35
Sodium (g)				
<1000,000	1.33 ± 0.06	1.88 ± 0.09	**2.42 ± 0.09**	2.15 ± 0.14
1000,000 – 3000,000	**1.45 ± 0.05**	1.97 ± 0.1	**2.32 ± 0.09**	2.36 ± 0.13
>3000,000	**1.15 ± 0.09**	1.93 ± 0.33	**1.89 ± 0.12**	1.88 ± 0.19
P-value	**0.02**	0.82	**0.047**	0.23

Values in **Bold** are significantly different
Note: both values are only significant with >300,000

Table 11. Mean daily intake of percentage (%) of energy of macronutrients among Lebanese children and adolescents by age group and family income.

Intake/day	**6 months-5 years (N=888)**	**5.01 – 8.9 years (N=312)**	**9 – 13.9 years (N=473)**	**14 – 18.9 years (N=320)**
		Mean ± SE		
CHO (%)				
<1000,000	49.83 ± 0.52	50.36 ± 0.81	49.33 ± 0.68	**50.12 ± 0.87**
1000,000 – 3000,000	49.4 ± 0.46	50.85 ± 0.89	48.43 ± 0.61	48.65 ± 0.84
>3000,000	48.67 ± 0.93	51.18 ± 2.88	47.3 ± 1.68	**44.23 ± 1.8**
P-value	0.57	0.9	0.38	**0.01**
Total Sugar (%)				
<1000,000	23.17 ± 0.57	**15.88 ± 0.72**	16.48 ± 0.56	16.29 ± 0.68
1000,000 – 3000,000	23.36 ± 0.47	**18.4 ± 0.84**	16.59 ± 0.51	16.93 ± 0.69
>3000,000	24. ± 1.13	**20.71 ± 2.48**	14.84 ± 1.16	16.36 ± 1.68
P-value	0.79	**0.03**	0.41	0.8
Free Sugar (%)				
<1000,000	14.59 ± 0.53	14.93 ± 0.7	15.69 ± 0.56	15.78 ± 0.68
1000,000 – 3000,000	**15.14 ± 0.5**	17.13 ± 0.83	15.47 ± 0.49	16.24 ± 0.68
>3000,000	**12.22 ± 0.84**	18.6 ± 2.49	13.69 ± 1.14	15.43 ± 1.66
P-value	**0.04**	0.08	0.31	0.83
Protein (%)				
<1000,000	**12.19 ± 0.26**	11.49 ± 0.38	**11.84 ± 0.34**	12.82 ± 0.48
1000,000 – 3000,000	**13.02 ± 0.21**	11.57 ± 0.33	**12.43 ± 0.29**	13.32 ± 0.51
>3000,000	12.98 ± 0.41	13.09 ± 1.03	**14.87 ± 0.75**	15.21 ± 1.15
P-value	**0.03**	0.25	**0.001**	0.13
Fat (%)				
<1000,000	39.22 ± 0.47	39.47 ± 0.79	40.12 ± 0.64	38.32 ± 0.84
1000,000 – 3000,000	38.77 ± 0.41	39.06 ± 0.79	40.35 ± 0.6	39.27 ± 0.71
>3000,000	39.4 ± 0.77	36.84 ± 2.5	39.02 ± 1.63	41.51 ± 1.56
P-value	0.7	0.49	0.7	0.2
Linoleic Acids n-6 (%)				
<1000,000	7.29 ± 0.19	8.08 ± 0.37	**8.99 ± 0.31**	8.93 ± 0.4
1000,000 – 3000,000	7 ± 0.18	7.24 ± 0.29	**7.72 ± 0.25**	8.19 ± 0.38
>3000,000	7.78 ± 0.36	6.72 ± 0.8	7.37 ± 0.54	8.96 ± 1.02
P-value	0.16	0.11	**0.002**	0.38
Linolenic Acids n-3 (%)				
<1000,000	0.49 ± 0.01	0.42 ± 0.02	0.45 ± 0.01	0.45 ± 0.02
1000,000 – 3000,000	**0.47 ± 0.01**	0.43 ± 0.02	0.45 ± 0.01	0.47 ± 0.02
>3000,000	**0.54 ± 0.03**	6.72 ± 0.8	0.41 ± 0.02	0.54 ± 0.06
P-value	**0.02**	0.65	0.36	0.22
Saturated Fat (%)				
<1000,000	**12.06 ± 0.26**	**9.77 ± 0.46**	**9.83 ± 0.28**	**9.12 ± 0.34**
1000,000 – 3000,000	**13.11 ± 0.25**	**11.11 ± 0.42**	**10.96 ± 0.32**	**10.53 ± 0.38**

>3000,000	12.46 ± 0.43	**12.13 ± 1.29**	10.58 ± 0.71	10.74 ± 0.75
P-value	**0.01**	**0.04**	**0.04**	**0.01**
Trans Fat (%)				
<1000,000	0.13 ± 0.01	0.19 ± 0.02	0.23 ± 0.02	0.24 ± 0.02
1000,000 – 3000,000	0.15 ± 0.01	0.18 ± 0.02	0.23 ± 0.02	0.28 ± 0.03
>3000,000	0.18 ± 0.04	0.19 ± 0.05	0.27 ± 0.04	0.16 ± 0.03
P-value	0.19	0.98	0.63	0.4

Values in **Bold** are significantly different

Table 12. Percentage of Lebanese children and adolescents who exceed the upper limits recommendation of macronutrients by WHO.

N (%) exceeding WHO Upper Limits	WHO Upper Limit	6 months-5 years (N=888)	6 - 8 years (N=312)	9 - 13 years (N=473)	14 - 18 years (N=320)
		N (%)			
Free Sugar 10	**< 10%**				
Total		580 (65.6)	242 (77.6)	348 (73.6)	243 (75.9)
Boys		298 (66.1)	110 (73.3)	182 (73.4)	103 (79.8)
Girls		282 (65.1)	132 (81.5)	166 (73.8)	140 (73.3)
P-value		0.78	0.1	1	0.19
Free Sugar 10	**< 10%**				
Normal		364 (68)	157 (82.6)	194 (74.3)	145 (81)
At risk of overweight		155 (67.4)	N/A	N/A	N/A
Overweight		40 (54.1)	37 (69.8)	82 (74.5)	48 (69.6)
Obese		13 (54.2)	45 (70.3)	69 (70.4)	43 (67.2)
P-value		0.06	**0.04**	0.73	**0.04**
Free Sugar 5	**< 5%**				
Total		754 (85.3)	291 (93.3)	446 (94.3)	298 (93.1)
Boys		381 (84.5)	136 (90.7)	232 (93.5)	125 (96.9)
Girls		373 (86.1)	155 (95.7)	214 (95.1)	173 (90.6)
P-value		0.5	0.11	0.55	**0.04**
Free Sugar 5	**< 5%**				
Normal		468 (87.5)	181 (95.3)	249 (95.4)	173 (96.6)
At risk of overweight		197 (85.7)	N/A	N/A	N/A
Overweight		58 (78.4)	47 (88.7)	102 (92.7)	61 (88.4)
Obese		17 (70.8)	58 (90.6)	91 (92.9)	56 (87.5)
P-value		**0.03**	0.17	0.5	**0.01**
Total Fat	**35%**				
Total		641 (72.2)	224 (71.8)	346 (73.2)	218 (68.1)
Boys		327 (71.9)	108 (72)	190 (76.6)	85 (65.9)
Girls		314 (72.5)	116 (71.6)	156 (69.3)	133 (69.6)
P-value		0.88	1	0.08	0.54
Total Fat	**35%**				
Normal		376 (70)	129 (67.9)	199 (76.2)	124 (69.3)
At risk of overweight		168 (72.4)	N/A	N/A	N/A
Overweight		61 (82.4)	45 (84.9)	73 (66.4)	48 (69.6)
Obese		18 (75)	45 (70.3)	70 (71.4)	40 (62.5)
P-value		0.16	0.05	0.14	0.6
Saturated Fat	**8%***				
Total		438 (85)	212 (67.9)	323 (68.3)	203 (63.4)
Boys		231 (84.9)	101 (67.3)	165 (66.5)	80 (62)
Girls		207 (85.2)	111 (68.5)	158 (70.2)	123 (64.4)
P-value		0.93	0.9	0.43	0.72

Saturated Fat	**8%***				
Normal		276 (83.6)	128 (67.4)	180 (69)	111 (62)
At risk of overweight		116 (87.2)	N/A	N/A	N/A
Overweight		30 (88.2)	38 (71.7)	78 (70.9)	47 (68.1)
Obese		11 (84.6)	43 (67.2)	62 (63.3)	41 (64.1)
P-value		0.74	0.84	0.45	0.68
Trans Fat	**< 1%***				
Total		13 (1.5)	6 (1.9)	17 (3.6)	7 (2.2)
Boys		5 (1.8)	4 (2.7)	8 (3.2)	3 (2.3)
Girls		8 (3.3)	2 (1.2)	9 (4)	4 (2.1)
P-value		0.22	0.43	0.81	1
Trans Fat	**< 1%***				
Normal		8 (2.4)	3 (1.6)	9 (3.4)	6 (3.4)
At risk of overweight		4 (3)	N/A	N/A	N/A
Overweight		0 (0)	2 (3.8)	6 (5.5)	0 (0)
Obese		1 (7.7)	1 (1.6)	2 (2)	1 (1.6)
P-value		0.41	0.7	0.4	0.26
Sodium	**< 2 gr**				
Total		181 (20.2)	125 (40.1)	267 (56.4)	138 (43.1)
Boys		99 (21.8)	68 (45.3)	147 (59.3)	79 (61.2)
Girls		82 (18.9)	57 (35.2)	120 (53.3)	59 (30.9)
P-value		0.3	0.08	0.19	**<0.001**
Sodium	**< 2 gr**				
Normal		110 (20.5)	71(37.4)	147 (56.3)	78 (43.6)
At risk of overweight		51 (22)	N/A	N/A	N/A
Overweight		9 (12.2)	17 (32.1)	61 (55.5)	28 (40.6)
Obese		9 (37.5)	34 (53.1)	58 (59.2)	27 (42.2)
P-value		0.052	**0.04**	0.85	0.91

*Saturated Fat & Trans Fat Upper limits (8%; 1%) not include subjects under 2 years old.

Values in **Bold** are significant

Table 13. Mean % of fat from different food group consumed by infants, children and adolescents according to age.

Food groups	6 months-5 years (N=892)	5.01 – 8.9 years (N=312)	9 – 13.9 years (N=473)	14 – 18.9 years (N=320)
		Mean ± SE		
Desserts*	10.71 ± 0.57	20.17 ± 1.38	21.38 ± 1.06	20.87 ± 1.39
Dairy Products	11.59 ± 0.46	15.3 ± 1.03	12 ± 0.74	10.4 ± 0.86
Milk non-sweetened	28.69 ± 0.94	2.67 ± 0.34	1.7 ± 0.23	0.76 ± 0.18
Salty snacks	5.58 ± 0.36	11.07 ± 0.91	11.37 ± 0.72	8.86 ± 0.85
Fast foods	4.80 ± 0.35	6.9± 0.82	10.47 ± 0.79	10.44 ± 0.97
Meat, poultry & eggs	7.96 ± 0.47	9.30 ± 0.89	10.16 ± 0.71	11.48 ± 1
Biscuits, wafers & chocolate	4.64 ± 0.29	6.64 ± 0.64	5.89 ± 0.51	4.76 ± 0.55
Pasta, pasta-based dishes & noodles	3.22 ± 0.39	2.12 ± 0.49	2.08 ± 0.45	1.17 ± 0.34
Nuts &legumes	4.57 ± 0.4	4.88 ± 0.71	4.94 ± 0.59	5.34 ± 0.76
Main dishes**	4.53 ± 0.31	6.38 ± 0.63	7.26 ± 0.59	9.9 ± 0.9
Oils & fats	4.51 ± 0.32	6.17 ± 0.64	5.22 ± 0.46	5.82 ± 0.72
Rice & rice dishes	3.51 ± 0.3	3.6 ± 0.59	2.2 ± 0.38	4.1 ± 0.72
Other food group	4.49 ± 0.26	4.43 ± 0.42	4.76 ± 0.42	5.48 ± 0.46

*Desserts include: All desserts, Ice-cream, Cakes, Pastries, Pies, Traditional sweets and candies.

**Main dishes include: All cooked vegetables based on Lebanese traditional dishes, Mahashi, Starchy vegetables, Salad and raw vegetables.

Table 14. Mean % of saturated fat from different food group consumed by infants, children and adolescents according to age.

Food groups	6 months-5 years (N=892)	5.01 – 8.9 years (N=312)	9 – 13.9 years (N=473)	14 – 18.9 years (N=320)
		Mean ± SE		
Desserts*	12.07 ±0.65	25.79 ± 1.65	27.29 ± 1.28	25.89 ± 1.61
Dairy Products	12.52 ± 0.6	14.16 ± 1.29	10.62 ± 0.85	9.9 ± 1.05
Milk non-sweetened	37.68 ± 1	5.31 ± 0.63	3.64 ± 0.45	1.74 ± 0.4
Salty snacks	3.11 ± 0.24	6.14 ± 0.59	6.07 ± 0.47	4.81 ± 0.51
Fast foods	3.02 ± 0.25	5.81 ± 0.77	8.6 ± 0.73	8.37 ± 0.85
Meat & cured meat	4.05 ± 0.39	5.55 ± 0.78	5.7 ± 0.56	6.57 ± 0.82
Poultry & eggs	3.63 ± 0.28	4.66 ± 0.64	5.11 ± 0.53	5.38 ± 0.7
Biscuits, wafers & chocolate	6.57 ± 0.45	10.82 ± 1.03	10.68 ± 0.88	7.7 ± 0.86
Pasta, pasta-based dishes & noodles	2.73 ±0.36	2.08 ± 0.52	2 ± 0.48	1.3 ± 0.41
Animal fat	0.53 ± 0.11	0.26 ± 0.15	0.32 ± 0.09	0.2 ± 0.11
Nuts &legumes	2.43 ± 0.24	3.81 ± 0.64	3.82 ± 0.51	4.13 ± 0.65
Main dishes**	2.97 ± 0.23	4.86 ± 0.56	5.64 ± 0.52	8.47 ± 0.87
Oils	2.35 ± 0.2	3.83 ± 0.45	3.43 ± 0.35	4.22 ± 0.62
Rice & rice dishes	2.28 ± 0.23	2.92 ± 0.54	1.83 ± 0.35	3.3 ± 0.6
Other food group	3.04 ± 0.24	3.18 ± 0.35	3.96 ± 0.41	6.16 ± 0.62

*Desserts include: All desserts, Ice-cream, Cakes, Pastries, Pies, Traditional sweets and candies.
**Main dishes include: All cooked vegetables based on Lebanese traditional dishes, Mahashi, Starchy vegetables, Salad and raw vegetables.

Figure 1. The contribution of various food groups to free sugar intake (%) among Lebanese children (6 months - 5 years old).

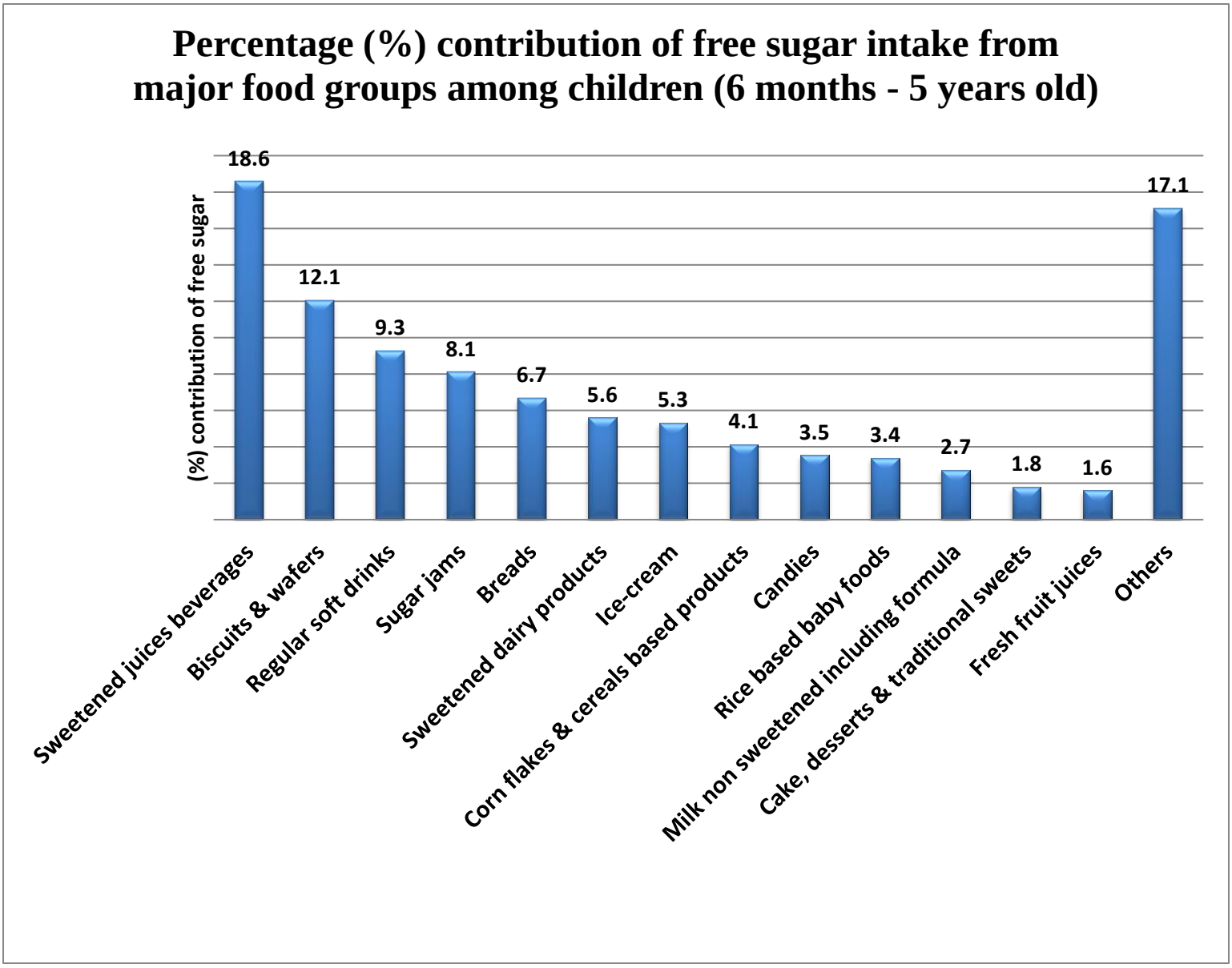


Figure 2. The contribution of various food groups to free sugar intake (%) among Lebanese children ((5-9 years old).

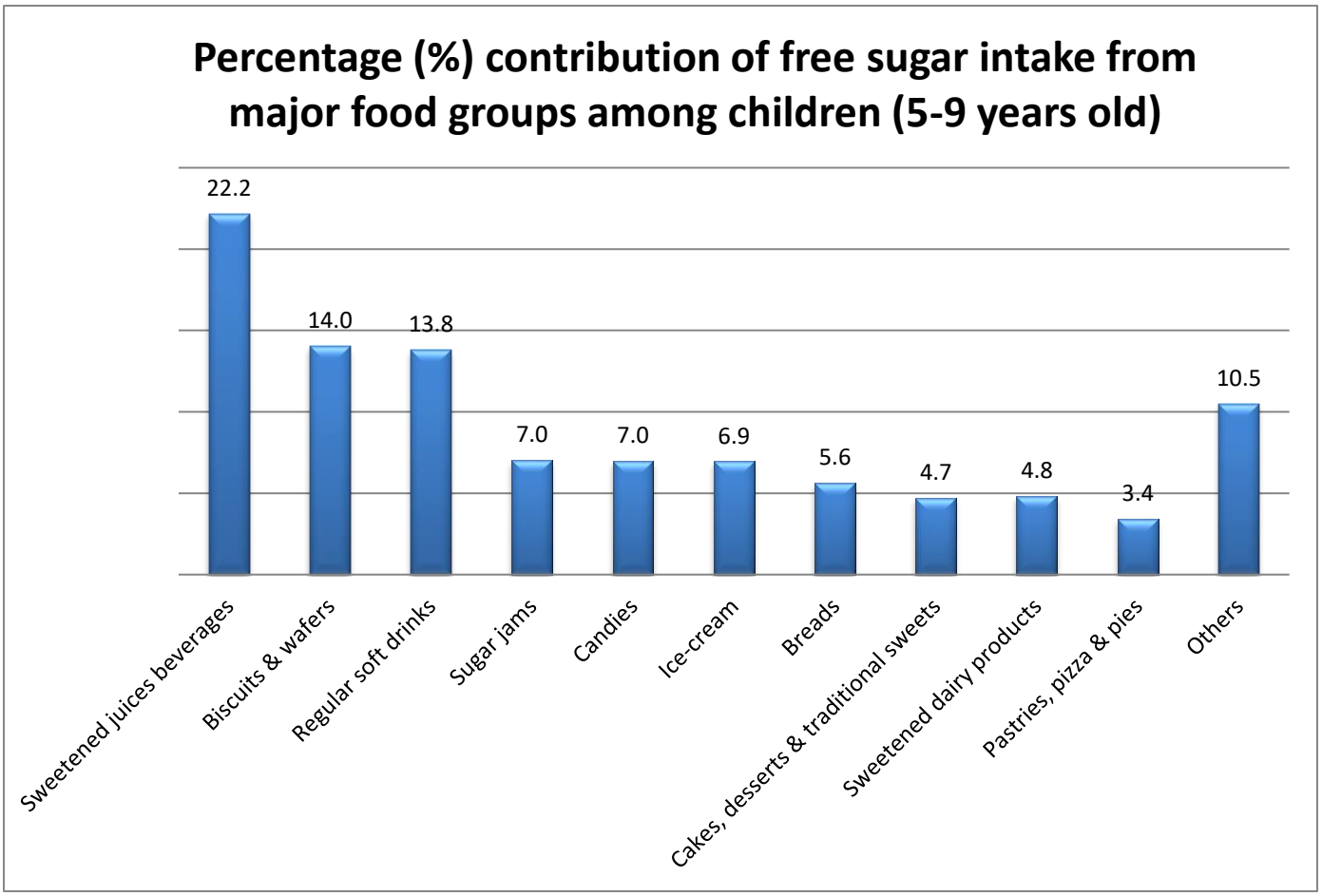


Figure 3. The contribution of various food groups to free sugar intake (%) among Lebanese children (9-14 years old).

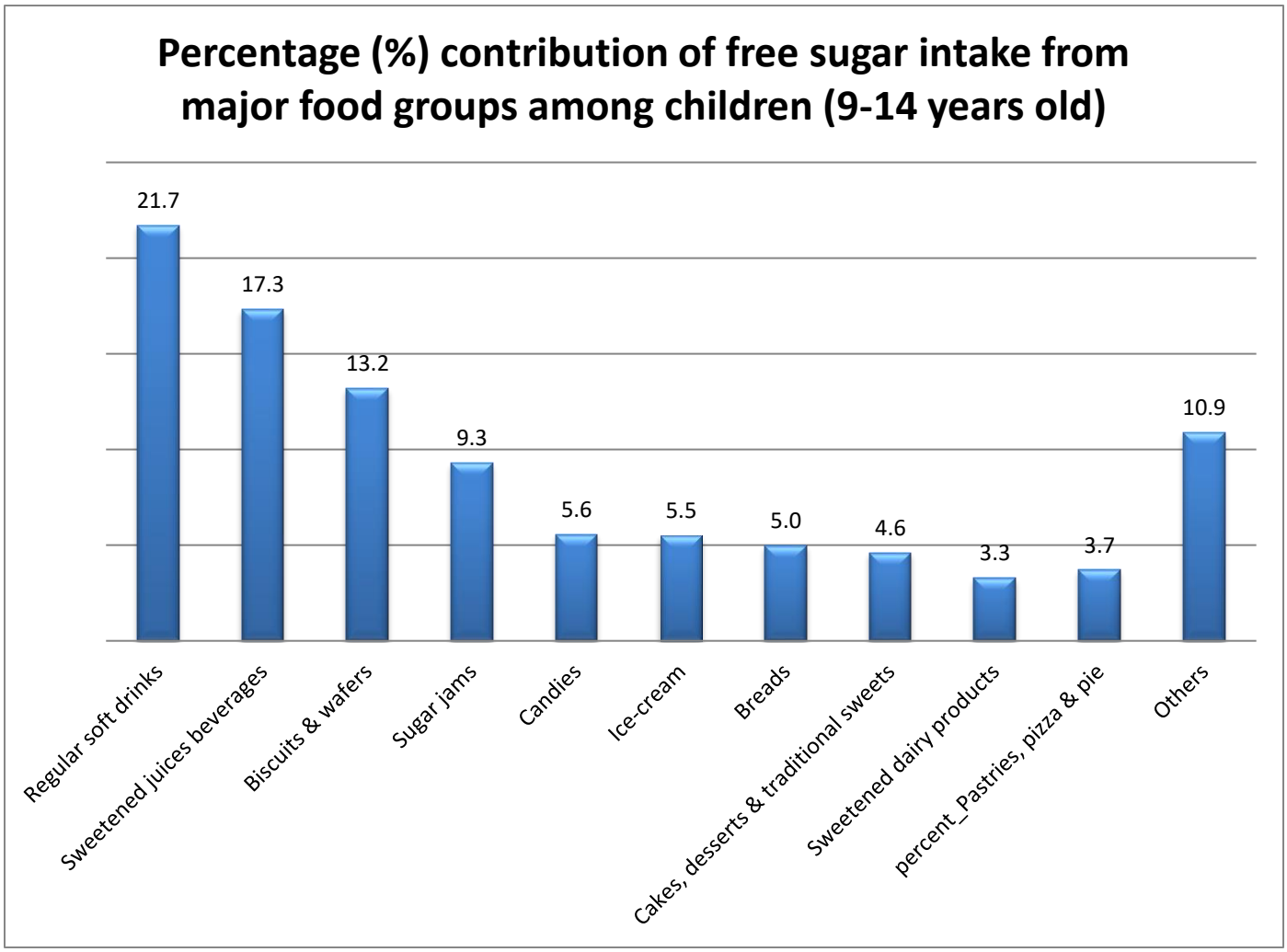


Figure 4. The contribution of various food groups to free sugar intake (%) among Lebanese adolescents (14-19 yrs).

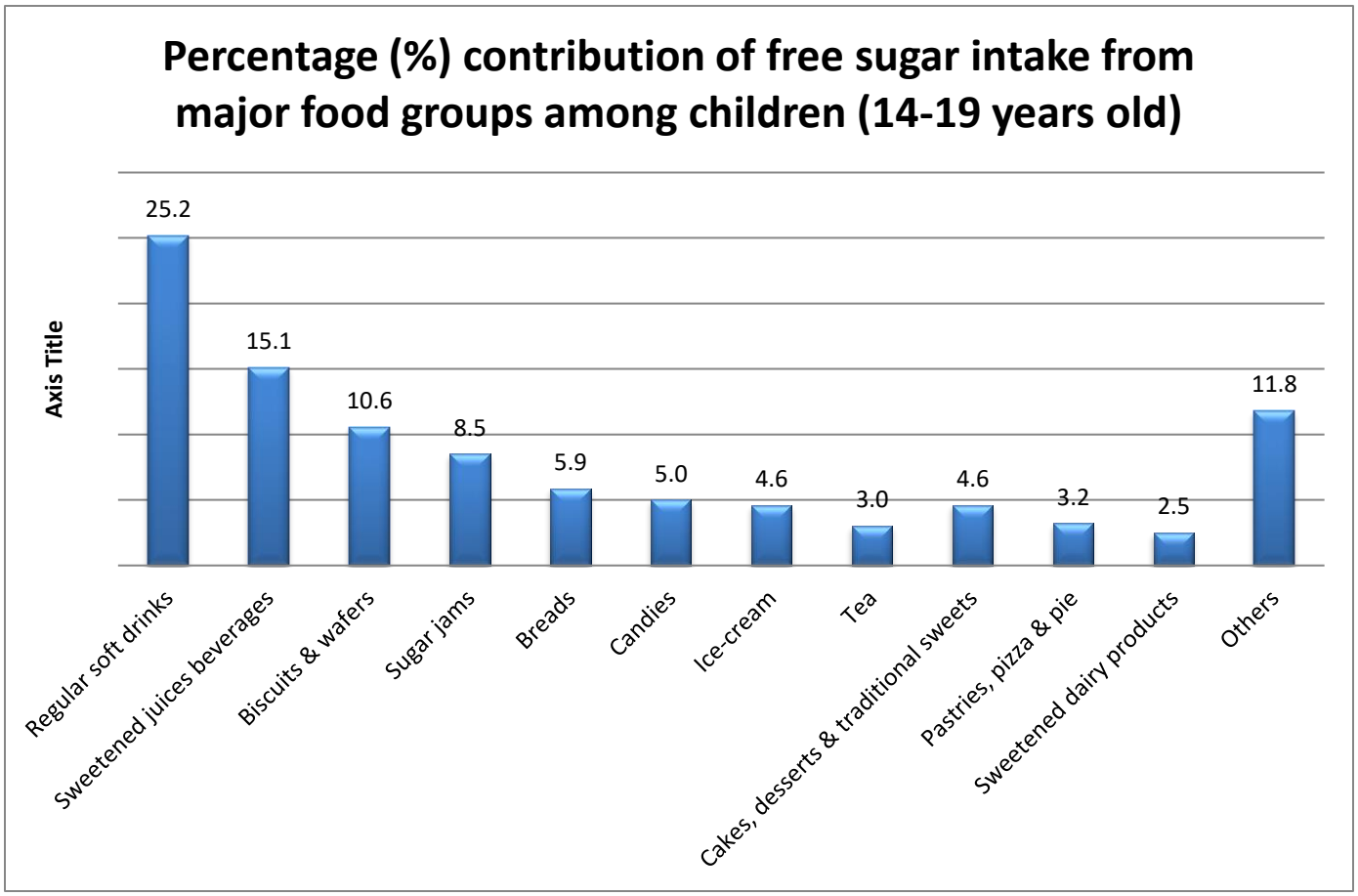


Figure 5. The contribution of various food groups to fat intake (%) among Lebanese children (6 months - 5 years old).

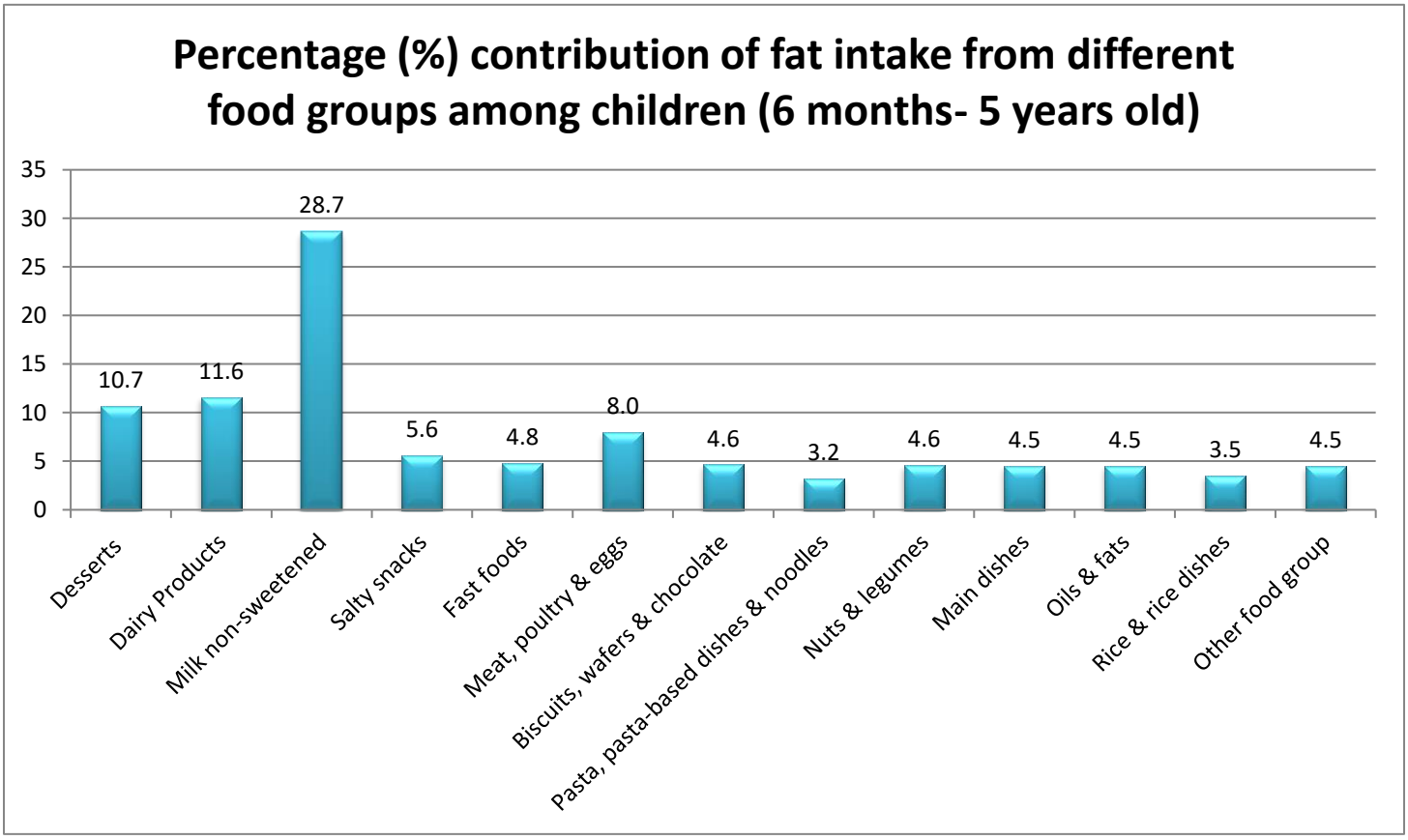


Figure 6. The contribution of various food groups to fat intake (%) among Lebanese children (5-9 years old).

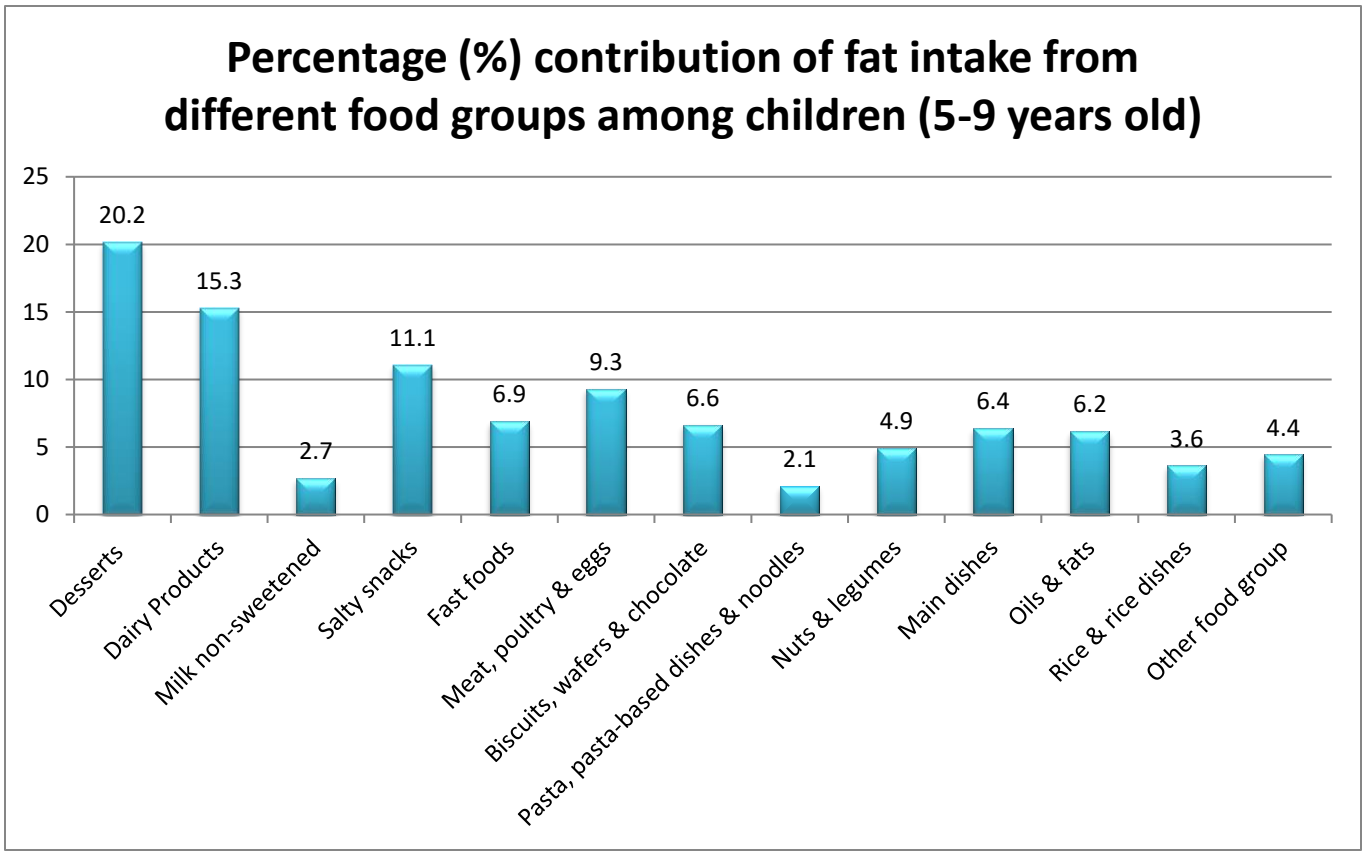


Figure 7. The contribution of various food groups to fat intake (%) among Lebanese children (9-14 years old).

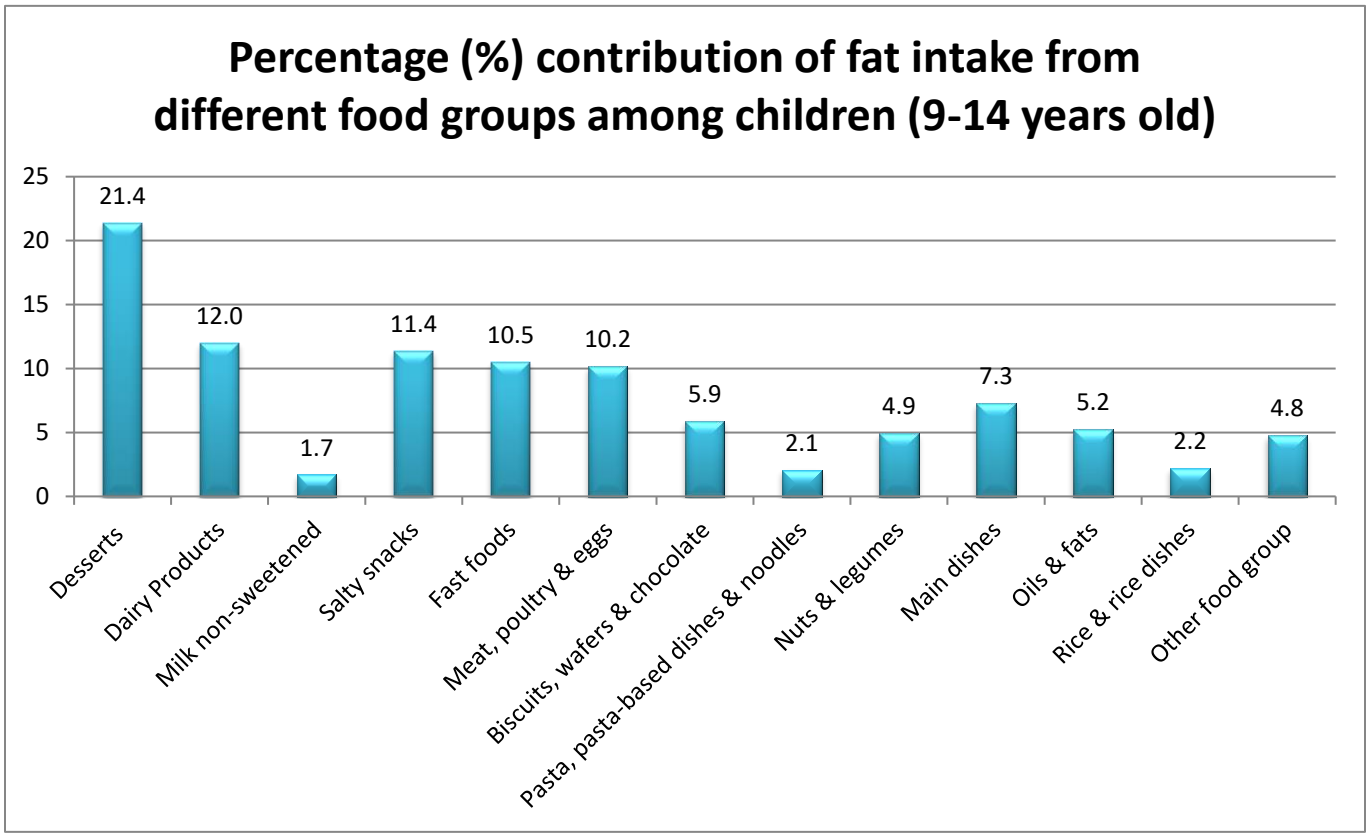


Figure 8. The contribution of various food groups to fat intake (%) among Lebanese children (14-19 years old).

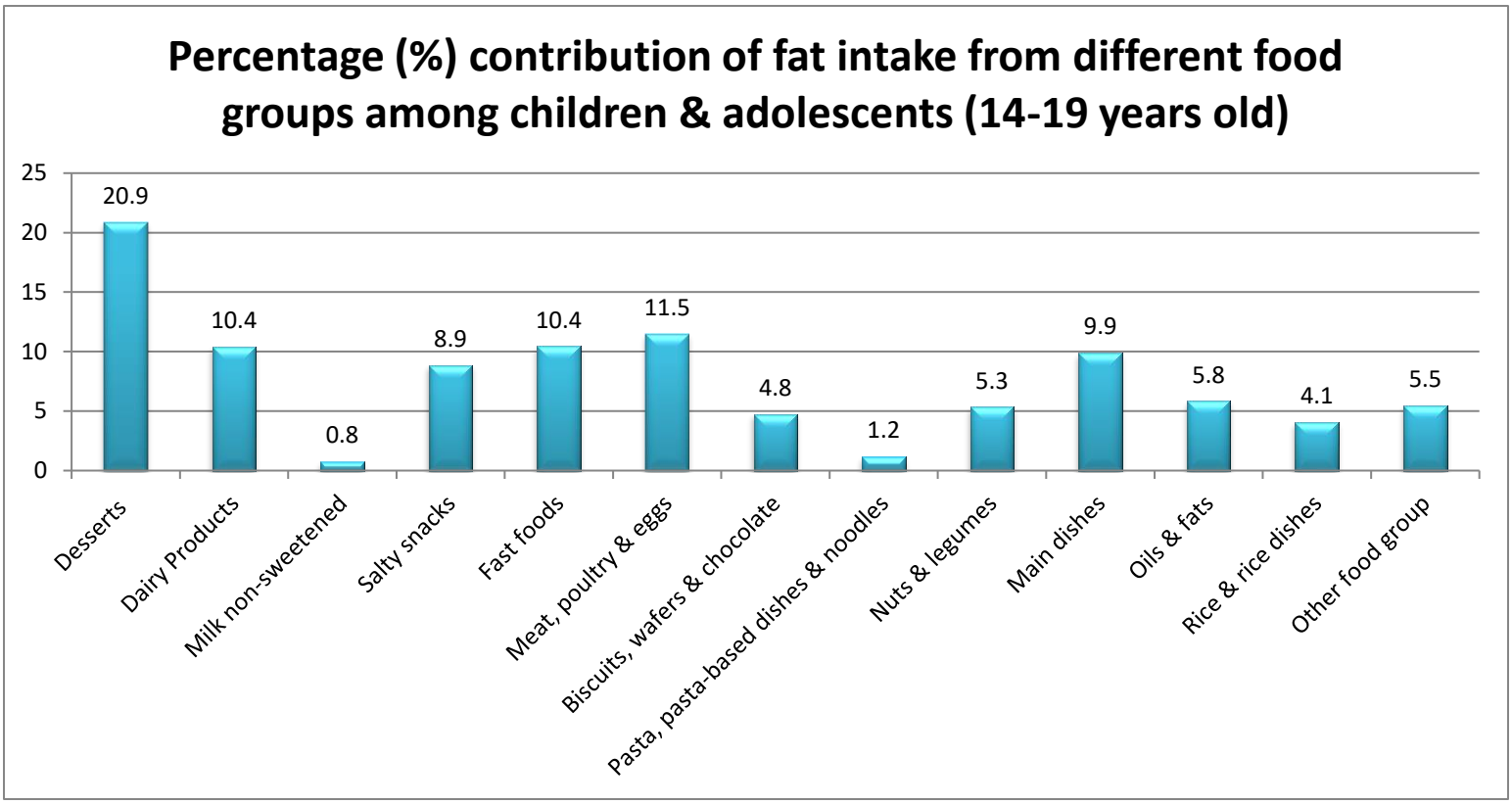


Figure 9. The contribution of various food groups to saturated fat intake (%) among Lebanese children (6 months - 5 years old).

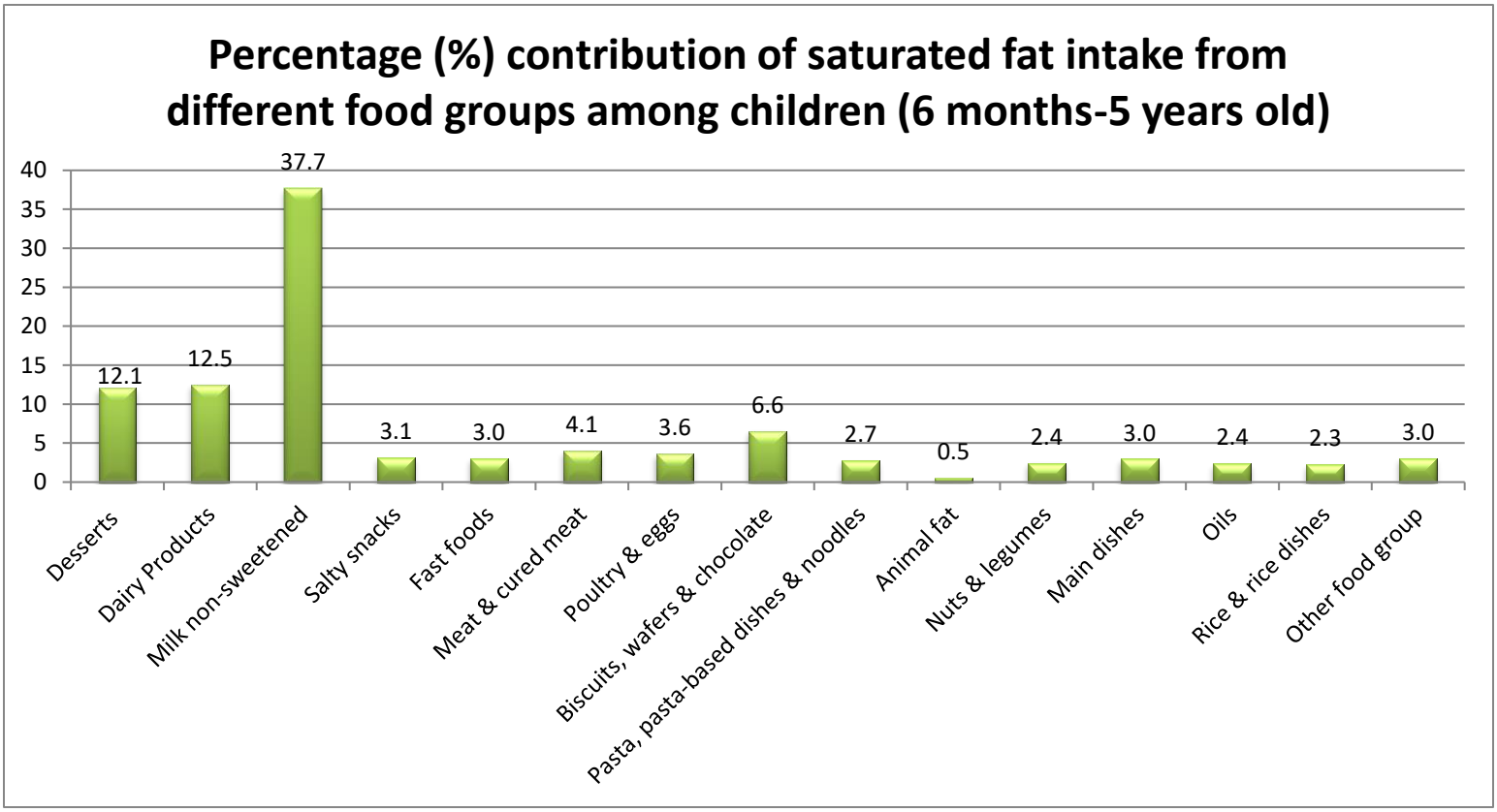


Figure10. The contribution of various food groups to saturated fat intake (%) among Lebanese children (5-9 years old).

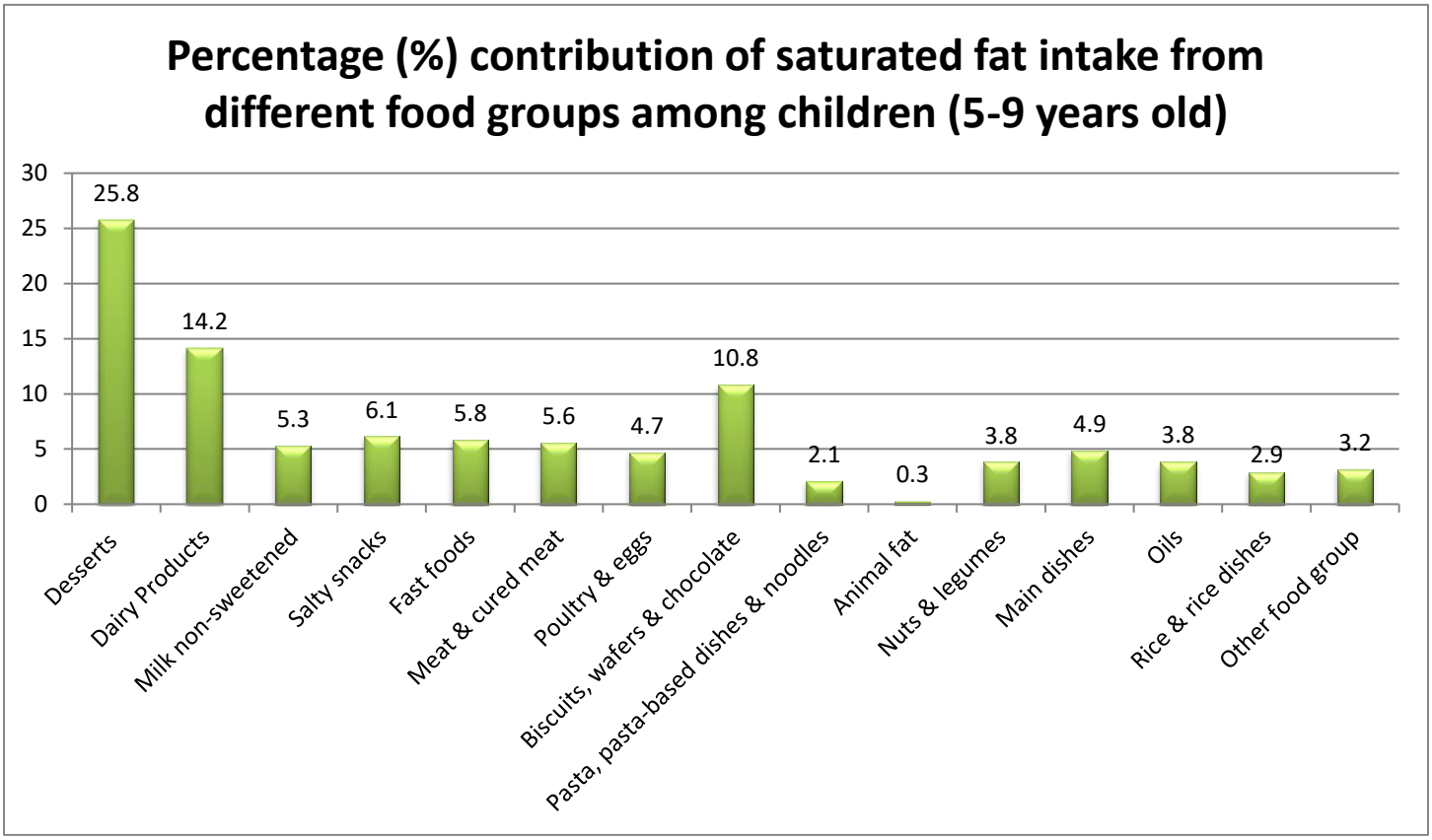


Figure 11 The contribution of various food groups to saturated fat intake (%) among Lebanese children (9-14 years old).

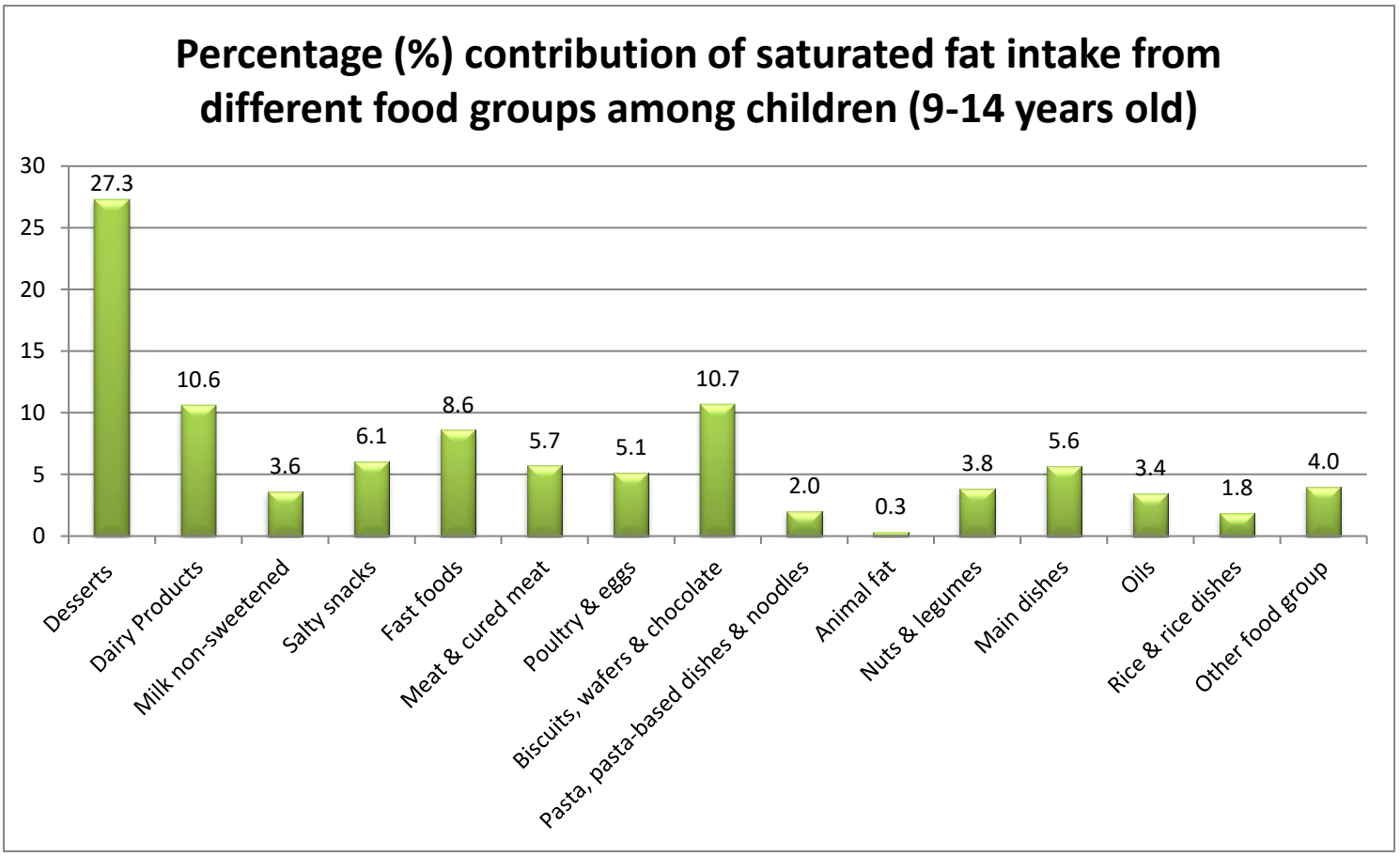
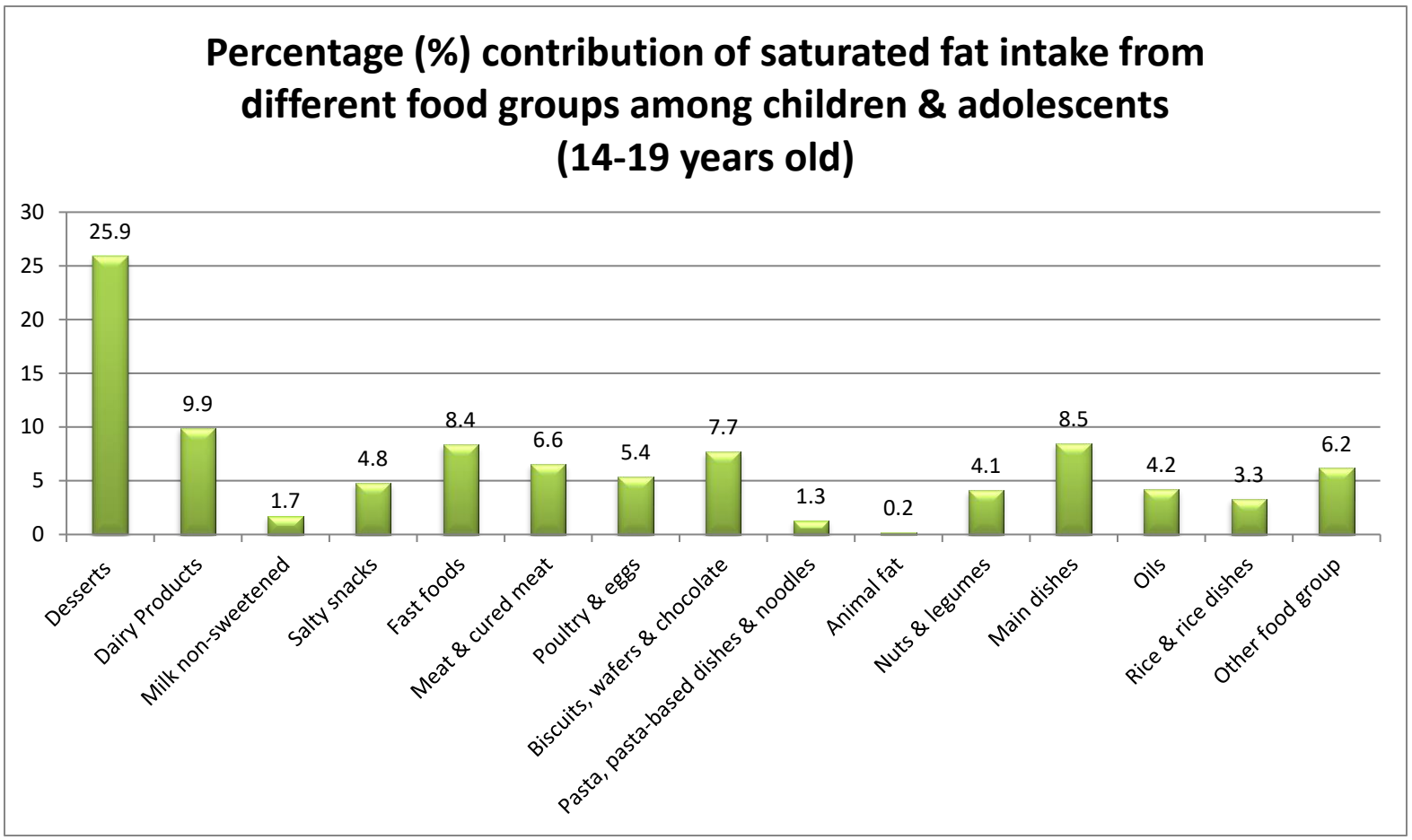


Figure 12. The contribution of various food groups to saturated fat intake (%) among Lebanese adolescents (14-19 years old).



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