Food groups consumed by Saudi Children during the poste weaning to preschool years, Jeddah, Saudi Arabia

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Introduction:

Healthy children are the building blocks of strong nations. Health and quality nutrition are basis for strength and intellectual vitality. The health level of the different stages of the child development determines the viability and strength of the following levels. Starting from the toddler's period the dependence on parents and their feeding practices largely defines the child food preferences and eating behavior. The traditional feeding practice of the parent outlines the nutritional health of the child familiarization, associative learning and observational learning(Birch 1999). These habits will carry on through adulthood and old age and will be a defining factor for economic, social and personal befits. Early childhood psycho-social development is a precursor to food consumption habits and nutritional status. Optimal health and physical growth reduces susceptibility to common diseases and improves resistance to cope with the disease process (Kudlová and Schneidrová 2012) (Duggan 2012). The child food consumption learning is strengthened by his association to positive interactive experience with parent's warmth. Parent's modeling of health nutritional habits and modifying the home nutritional environment is part of the observational learning done by the child (Golan, Weizman et al. 1998, Golan 2006). The maternal diet during pregnancy has an influence on flavor preferences in their childe through alteration in neural, metabolic and behavioral process. The behavioral process starts from the perinatal stage by affecting the fetus food and flavor preference (Birch and Doub 2014)

The infant brings a set of predispositions to early feeding interactions such as a preference for sweet and salty tastes (tastes that could predict the presence of nutrients), a tendency to reject bitter and sour tastes (which could be toxic), a neophobic rejection of novel foods and flavors (which might be dangerous)(Johnson, McPhee et al. 1991) (Spahn, Callahan et al. 2019) reviewed literature studies and summarized that 4 flavors—alcohol, anise, carrot, and garlic—transferred and were later recognized by infants. The results of the reviewed studies are supported by a combination of analytic methods chemical, sensory, and infant behavioral analyses. Thus, it's a common assumption that flavor preferences are learned, children can learn to like healthy foods if given enough repetition to be familiar(Anzman-Frasca, Savage et al. 2012). The length of the familiarity process is affected by positive and negative associative

learning. The association is influenced by food presentation and social environment of novel food(Aldridge, Dovey et al. 2009). For young children this highly modified by the availability of food in the household and is determined by the parent's nutritional practices and attitudes (Rodenburg, Oenema et al. 2012).

Health related decisions are mediated by cognitive function same as academic function. The process is called executive function (EF) or cognitive control, and it involves steps of modulation of goal oriented activity. As children mature EF is achieved by cognitive flexibility (switching concepts), inhibitory control, and working memory (retaining and organizing items before recalling them). These processes are partially independent and develop throughout childhood and adolescence and parallel with other developmental brain changes (Weintraub, Bauer et al. 2013). Diet is likely to play an important role in cognitive functioning and EF(Melbye, Øverby et al. 2012) results show a large portion of child intention to eat fruit and child fruit consumption was explained by child cognitions (29% and 25 %, respectively). This also applied to child intention to eat vegetables and child vegetable consumption (42% and 27 %, respectively). Parent-reported feeding practices added another 3% to the variance explained for child intention to eat fruit and 4% to the variance explained for child vegetable consumption. (Khan, Raine et al. 2015, Khan, Raine et al. 2015) work have provided evidence that higher total fat intake was associated with longer reaction times while performing tasks that require greater cognitive flexibility and high cholesterol intake brought difficulty to formalizing multiple cognitive set in working memory. Further, their results indicated that increased dietary fiber and water intake improves the childes performance on cognitive tasks requiring variable amounts of cognitive control.

Other concerns related to child nutrition are the energy balance of food intake and its causality to obesity and diabetes. A study of the gulf region by (Khali, Beshyah et al. 2018), indicated that the prevalence of obesity in GCC countries among children and adolescents ranges from 5% to 14% in males and 3% to 18% in females. In adult women, there is a significant increase of obesity with a prevalence of 8–36% in men and 17–48% in women. Causes of the prevalence increase are thought to be by an ever-increasing tendency for dining out and consumption of energy-dense food products. Another noticeable trend is skipping of breakfast both by school children and working adults. Children on the other hand could be picky eater and have and food neophobia which tend to consume fewer amounts of vegetables which may cause deficiencies in certain nutrients, such as vitamin E, Vitamin C, zinc and iron(Kutbi, Alhatmi et al. 2019).

The purpose of this study was to describe eating patterns and their changes from one to five years of age, a period when eating patterns that will influence health in later life-stages are constituted and to investigate selected factors which may influence them. The study was conducted within broader

Methods and subjects

The study subjects are a convenience sample of interviewed mothers concerning their children food intake. The sample was collected over two years starting 2017. As part of their course training, students were asked to collect data on childe food intake from mothers' contacts known to their house-holds. A food frequency questionnaire was developed by the course instructor and was administered by the students to the different mothers in house-holds in Jeddah, Saudi Arabia. Total samples of 551 cases were collected. The culture of our society being strongly conservative doesn't react well to female interviewers surveying random households. Therefore it is necessary to start with the least intrusive study design.

Food grouping:

Due the type of food available and sold in Saudi market, Analysis of food sub-groups required that we add additional categorization of subgroups. The milk group was further categorized to plain milk pasteurized and dry; non-sweetened milk products such as types of as yogurt, cream, cheese; Sweetened milk products such custard, crème caramel, blancmange, fruit yogurt. The grains group was further categorized to Whole grains as wheat bread, rusk, crocked wheat soup, oats, millet; White bread s such as local tames –similar to nan- bread, samooli-similar to soft dinner rolls; and rice and pasta such as white rice, macaroni, and instant noodles. The protein group was further categorized to red meat such as kabob, kofta, steak, lamb; chicken; fresh fish and tuna; eggs; and Pulses such as fava beans, lentil, beans, chickpeas. The fruit group was further categorized to vitamin c rich fruits such as orange, grapefruit, kiwi, strawberry, raspberry, pomegranates, plum, watermelon, guava; other Fruits such as grapes, pears, banana, apple, figs. The vegetable group was further categorized to dark green and beta-carotene containing vegetables such as molokhia, spinach, parsley, carrots, pumpkin, peas, lettuce; all other vegetables such as cucumber, okra, cabbage; and white potatoes. The final group is the high calories foods were was further categorized to sweets such as packaged cake and pastry, cookies, local labaniah, kinder chocolate, condensed milk; others such as pizza, fresh savory pastry; soft drinks; fried food. The above categorization was in the same direction of the food models used to developed the eating well Canadian food guideline(Katamay, Esslinger et al. 2007).

Statistical methods

Data analysis included stratification by age and maternal education. The stratification by children age-groups allowed the comparison of the proportional intake of the food sub-groups. The stratification by maternal education allowed for comparison of meals food environment across subgroups and their subcategories. The sub-group analysis included studying the proportion of groups intake derived only from whole plain or fresh, the proportion of processed

or cooked with addition of sugars and oils products within the food category, the proportion of the plain and fresh healthier food groups were compared to the proportion of processed less healthier food groups. Regression analysis was also used to measure the strength and the association of the childe gender, maternal education, house crowding on food group uptake and on the child food environment.

Results:

Descriptive statistics for the 2017-2019 participants appear in Table 1. The sample was evenly divided across age categories, but slightly more girls participated. A majority of the participant's mothers has the university level education. Household crowding was evenly distributed between categories with a slight increase towards the lower crowding.

Table1: study population demographics n=550

	Number	Proportion
Child age distribution		
Post-weaning (12–27	172	32.4%
Toddler (28–43	195	36.7%
Preschool (44–60	164	30.9%
Child sex		
Male	258	46.9%
Female	292	53.1%
Home crowding index		
Low (0.2 – 0.78)	200	36.6%
Medium (0.8-1.17)	182	33.3%
High (1.2- 2..3)	164	30.0%
Maternal education		
0 to Middle school	48	8.8%
High school	77	14.2%
University	419	77.0%

Food uptakes of post-weaning to preschool aged children for different food groups reported by mothers in their home are presented in Table 2. In general it shows higher uptake of foods from the milk, grain, and fruits groups, and low uptake for the protein and the least for the vegetable group. Also the amount offered by the mother and consumed by the childe increased as the child grew to the preschool stage. Poste weaning children aged 2 years were repeatedly offered per day 2.6 of the milk group, 2.2 of the grain, 2.3 of the fruits, 1.5 of the proteins, 1.2 of the vegetables. As these children reach their toddler stages the repeated offering of the food groups increase only slightly. A noticeable increase in the number of repeated offering of the food groups especially milk and snack high in fat and sugar occurs by the preschool stage. Consumption of food high I fat and sugar starts at the post weaning stage and is offered 1.19 per day and increases to 2.03 per day at the preschool stage. The effect of child gender and maternal education on food intake shows mostly no significance at our present sample size. The regression coefficient direction of the semi strong association, shows

favoring boys when offering milk, protein, and grains. Also, a decrease in maternal education favors offering of milk and protein group; and an increase in maternal education favors offerings of food high in fat and sugar.

Table 2: Mean daily frequency food offered daily to the childe intake by age group*

	Mean(SD)of child ages months			Regression coefficients/sig.	
	12-27	28-43	44-60	Child gender	Maternal education
Milk group	**2.6 (1.9)**	**2.87(1.9)**	**2.99(1.7)**	**-0.39/0.7**	**-0.15\0.9**
Milk pasteurized and dry	1.13(0.7)	1.24(.63)	1.28(.64)		
Milk products (yogurt, cream, cheese)	1.14(.97)	1.27(.97)	1.5(0.85)		
Milk products sweetened (custard, crème caramel, blancmange, fruit yogurt,)	0.74(.88)	0.79(.97)	0.62(.80)		
Meat, egg, pulses group	**1.51(1.5)**	**1.66(1.4)**	**1.92(1.5)**	**-0.48\0.6**	**-0.45\0.7**
Red meat (kabob, kofta, steak, lamb)	0.24(.58)	0.24(.53)	0.25(.52)		
chicken	0.83(.38)	0.91(.29)	0.91(.29)		
Fish fresh and tuna	0.37(.59)	0.34(.51)	0.70(.67)		
Eggs	0.84(.37)	0.86(.35)	0.88(.32)		
Pulses (fava, lentil, beans, chickpeas)	0.22(.63)	0.29(.67)	0.31(.63)		
Fruit group	**2.33(2.8)**	**2.46(2.4)**	**2.89(2.5)**	**0.14/0.5**	**.07/.12**
Fruits vitamin c rich(orange, grapefruit, kiwi, strawberry, raspberry, pomegranates, plum, watermelon, guava)	1.29(1.7)	1.25(1.5)	1.3(1.6)		
Fruits other (grapes, pears, banana, apple, figs)	1.08(1.3)	1.27(1.2)	1.61(1.2)		
Vegetable group (except potato)	**1.26(1.8)**	**1.18(1.4)**	**1.57(1.7)**	**0.45/.06**	**0.008/.86**
Vegetables dark green and beta-carotene (molokhia, spinach, parsley, carrots, pumpkin, peas, lettuce)	0.79(1.3)	0.74(1.1)	0.98(1.3)		
Vegetables all other (cucumber, okra, cabbage)	0.49(.66)	0.49(.55)	0.68(.63)		
Potatoes	0.69(.46)	0.76(.43)	0.96(.21)		
Grains group	**2.21(1.5)**	**2.37(1.4)**	**2.59(1.5)**	**-0.04/.8**	**0.0005/.8**
Whole grains(wheat bread, rusk, soup, oats, millet)	0.79(1.1)	0.76(1.0)	0.64(1.0)		
White bread (local tames, samooli)	0.67(.55)	0.81(.48)	0.99(.49)		
Rice and pasta(white rice, macaroni, instant noodles)	1.02(.68)	1.11(.63)	1.24(.71)		
Snacks high in fat and sugar	**1.19(1.2)**	**1.6(0.4)**	**2.03(0.8)**	**0.14/0.9**	**0.07/0.4**
Sweets (packaged cake and pastry, cookies, local labaniah, kinder chocolate, condensed milk)	1.41(1.3)	1.71(3.4)	1.65(1.2)		
Others (pizza, fresh savory pastry,	0.5(.72)	0.69(.69)	0.74(.69)		
Soft drinks	.05(.22)	0.18(1.3)	0.16(.37)		
Fried food	0.29(.45)	0.43(.49)	0.51(.51)		

* Childe food intake is indicated by any amount of consumption

Meal time environment with its usual focus on maternal involvement is shown in table 3. Mother preparing fresh food was high across the three major daily meals. Child age had most influence on mothers preparing fresh food especially for breakfast and lunch. Mothers' presence during the meals is the key to most of the critical effect on the child eating habits and future health outcomes. This was not influenced by her education or the childe age or gender. Increased household crowding influenced the mother to be present in all three major daily meals. Also crowding influenced her to prepare fresh breakfast food for her child.

Table 3: The child meal environment of availability of fresh prepared food and of mother presence during the meals.

	breakfast	lunch	dinner
Meal freshly prepared	Yes 79.9%	Yes 84%	Yes 75.6%
*Relatedness to	Logistic regression	Logistic regression	Logistic regression
Child sex	B=0.4 sig=0.07	B=-0.2 sig=0.4	B=0.53 sig=0.01
child age	B= -0.02 sig=.002	B=-0.02 sig=0.01	B=0.009 sig=0.17
mother education	B=-0.06 sig=0.14	B=0.08 sig=0.09	B=-0.02 sig=0.59
crowding index	B=-1017 sig=0.005	B=0.07 sig=0.8	B=0.48 sig=0.07
Accompanied by mother	Mother 69.7%, other 24.2% alone 6.1%	Mother 63.8% Other 34.9% alone 1.3 %	Mother 60.6% Other 36.1% alone 3.3%
*Relatedness to	Logistic regression	Logistic regression	Logistic regression
Child sex	B=0.07 sig=0.7	B=-0.9 sig=0.6	B=-0.06 sig=0.7
child age	B= 0..006 sig=0.3	B=-0.006 sig=0.3	B=-0.006 sig=0.3
mother education	B=-0.02 sig=0.96	B=0.005 sig=0.8	B0.000 sig=0.98
crowding index	B=0.085 sig=0.7	B=0.51 sig=0.03	B=0.54 sig=0.02

*Relatedness was test using logistic regression

This research has a number of limitations and the results of this study must therefore be interpreted with caution. Respondents were a convenience sample in which the households of children living in Jeddah were overrepresented and the children from regions were underrepresented. As the mothers were recruited by contacts of our university students, the children included into the study were healthier than the portion of low socioeconomic children. This has undoubtedly influenced the prevalence of food uptake. While recognizing that the sampled population is not representative of the Saudi household population, it's also important to note, that deduced nutritional deficiencies of this study can extrapolated to lesser demographically favorable stratus and should be used as the 'tip of the ice-burg". The dietary information was mother-reported and therefore associated with the reporting biases inherent in dietary reporting. The intake frequency of foods perceived as healthy may have been overestimated and that of foods perceived as not healthy underestimated.

Some of the statistically significant findings reported here may have been due to chance.

Discussion:

Eating habits important for one's long term health status develop early in life (Vandeweghe, Moens et al. 2016). Parents and caregivers play an important role in forming the dietary habits in early childhood. A child at this age is still fully dependent for food on his or her carers who thus influence his or her future eating habits and through them his/her health. The result indicating the amount offered by the mother and consumed by the childe increased as the child grew to the preschool stage, speaks to establishing food consumption habits and preferences of these children. Feeding practices and environmental context at the early stages has a lasting effect and caries on to later life stages. Our study population milk group consumption ranged (2.6-2.99) times per day with a noticeable choice shift towards the sweetened products. This suggests that levels of calcium and vitamin D could be adequate in the Saudi children. Protein, vegetable, and fruit group consumption was widely dispersed away from the mean evident by the large standard deviations. This means that some scattered Saudi children consume a large number of these groups per day, while many other have very low consumption per day. The consumption for protein ranged from(1.5 -1.9) times per day with choices highly shifting towards chicken and eggs; and for fruits ranged from (2.3-2.9).times per day; and for vegetable the range was the lowest of (1.2-1.5) times per day. The small exposure to these food groups, point towards a possibility of these children not seeking these nutrient dense foods in the future. These food groups need to be further studied to explore which of the childe behavioral and maternal parenting factors cause a normally distributed increase in the population. The grains group consumption was as normal as the milk consumption and the range was (2.2-2.5) times per day with the choices shifting towards rice and pasta and white bread. Thus we can suspect that these children could be missing some of the important micronutrients found in whole grains. Finally the calories intense food groups of high fat and sugar was introduced in the earlier stages and ranged from (1.2-2.0) times per day with the choices favoring processed prepackaged sweets and pastry.

The general pattern of food consumption for this study group seems to parallel that of picky eaters. Their food groups consumed is characterized as a common theme of a reduced intake of vegetables, and to a lesser extent fruits, and reductions in the consumption of whole-grain products, fish and seafood, meat, and unsweetened cereals and increases in savory snacks and confectionary cereals and French. Also our populations, like the picky eater have a lower total number of foods. Therefore it could beneficial that future studies of food patter assess also the micronutrients of magnesium, calcium, and vitamin A, C, D, and B-12 intakes which is prevalent in the picky eater children (Taylor, Emmett et al. 2016) (Kutbi, Alhatmi et al. 2019). Obesity and its related diabetes are also two factors to guard against the future. AS per the WHO, death causing chronic diseases related to dietary factors with a strong evidence link are coronary heart disease, hypertension, stoke, cancer, diabetes, and osteoporosis, and 80% of the

prevalence occurs in low to middle income countries of the world. Prevention nutrition goals included levels of total carbohydrate, complex carbohydrates, protein, total fat and saturated and polyunsaturated fatty acids, and fruits and vegetable(1990)
For future Saudi food uptake studies portions consumed by the children should be assessed and perhaps could be compared to the Eating Well with Canada's Food Guide (CFG) outlines According to these guidelines, each day children aged four to eight should consume five servings of vegetables and fruit, four servings of grain products, two servings of milk and alternatives, and one serving of meat and alternatives(Katamay, Esslinger et al. 2007, Kutbi, Alhatmi et al. 2019).

In an effort to shed some light on the social and cultural factors or meal time environment, our study indicate that 80% of mothers prepared fresh food for the child meals and 60% were present in those meals. Factors modifying food preparation and meal presence indicated the house crowding had the most influence. Child gender, maternal education, and childe age had the least influence on meal time environment. Asking these questions is in line with the American national nutrition research map which focuses into the understanding of the different factors that influence food choices and hence nutritional intake are the necessitating shifting the of researchers form nutrition deficiency focus, factors controlling wellness and food choices such as behavioral aspects, social, and economic aspects(Shao, Drewnowski et al. 2017). The results of our study show that approximately 80% of the mothers prepared fresh food for the three daily meals, while only approximately 60% were present for the meal with their children. Fresh food preparation of the childe meals could show in future research her feeding practices. These include the control of food smell and taste, variation, and repeated exposure to healthy food. Maternal involvement and presence during the meal could show if she uses rewarding preferably intrinsic rewarding, or if she used modeling food consumption with the child, and if the atmosphere of the meal was cozy, light hearted and peaceful. All these factors stress critical and important is her role in developing the child eating behavior(Vandeweghe, Moens et al. 2016).

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