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Determinants of High Blood Pressure in Relation to Early Feeding Practices among Children under-Five Years of Age in Egypt

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ABSTRACT
Background: Elevated blood pressure (EBP) in preschool children due to unhealthy early feeding practices can track into later years leading to hypertension (HTN) and cardiovascular disease (CVD).
Objectives: To identify the determinants of high blood pressure in relation to early breastfeeding, commercial milk formula feeding (CMF) and marketed baby foods. **Subjects and methods:** 150 children aged 2-5 years were recruited by feeding practices and divided into three groups, (breastfeeding, no breastfeeding and mixed fed groups). All children were subjected to anthropometric measurements of weight, height and blood pressure (BP), which was interpreted using BP standards. **Results:** EBP both systolic and diastolic were inversely correlated with the early and intense breastfeeding. They were positively correlated with CMF feeding for longer duration and at shorter intervals, pacifier use, sugar or starch added to bottle feeds and high salt and sugar intake, fast foods, snacks of chips and Indomie. Lack of mother's awareness of unhealthy food intake and poor tracking abilities of these practices were prevalent in the groups who consumed more frequent unhealthy foods. **Conclusion:** EBP is associated with not breastfeeding, CMF, pacifiers, weaning foods and unhealthy marketed foods. Promoting breastfeeding and maternal awareness on healthy feeding practices supported by strict regulations are needed to control and prevent HTN and CVD.
Keywords: Pediatric hypertension, Infant feeding, Cardiovascular disease, Breastfeeding, milk formula, Unhealthy foods.

INTRODUCTION

The prevalence of pediatric hypertension has increased significantly in the recent decades. The cause of this is likely multifactorial, related to increasing childhood obesity, high dietary sodium intake, sedentary lifestyles, perinatal factors, familial aggregation, socioeconomic factors, and ethnic blood pressure (BP) differences. Pediatric hypertension represents a major public health threat. Uncontrolled pediatric hypertension is associated with subclinical cardiovascular disease (CVD) and adult-onset hypertension (HTN). The global prevalence of HTN in children aged 6 years and 14 years was 4.32% and 7.89%, respectively. A meta-analysis that included more than 300 000 children and adolescents reported a 10% prevalence of elevated BP (EBP), and a study reported that the prevalence of HTN in children and adolescents in 2015 was 19.2%. Children with EBP are more likely to have HTN as adults. EBP is an established risk factor for later CVD and atherosclerosis originating in childhood from poor nutritional practices [1]. Obesity and EBP in children are significant public health problems. Much attention has focused on prevention, especially during the earlier stage of life. Breastfeeding is considered a possible protective factor for obesity or higher BP during childhood or adulthood. **Rito *et al.*** [2] reported that breastfeeding reduced childhood obesity risk by up to 25% in Europe, and **Eidelman *et al.*** [3] claimed a 15–30% reduction in adolescent and adult obesity. However, the evidence that breastfeeding can have a protective effect on later having a healthy body mass index (BMI 18.5 to < 25) remains controversial. Also, its effect on a subsequent healthy waist circumference (WC) is still very limited.

Also, **Dong *et al.*** [4] reported the impacts of breastfeeding on measured values of BP but without clear disease diagnosis as EBP or HTN. At the same time, it is worth noting that nearly all the previous studies on the long-term consequences of breastfeeding and childhood obesity or BP values have been carried out primarily on Western populations living in developed nations. Also, **Miliku *et al.*** [5] supported that breast-milk consumption was associated with lower later BP in children born prematurely, the effects for full term children remain unclear.

Early dietary practices significantly affect the likelihood of developing adult diseases, starting in fetal life and continuing through early human development. The so-called metabolic programming that occurs during intrauterine life is greatly influenced by nutrition. HTN, obesity, insulin resistance, and dyslipidemia all hasten the atherosclerotic process and raise the risk of CVD. The increasing burden of unhealthy food intake by infants and young children calls for revisiting these practices in relation to the above health risks. The World Health Organization has developed additional infant feeding indicators of unhealthy diet that include: Sugar-sweetened beverage (SSB) consumption defined as the percentage of children 6-23 months who consumed SSB during the previous day); Junk food consumption defined as the percentage of children 6-23 months of age who consumed sweet or savory junk foods during the previous day; and Zero fruit and vegetable consumption defined as the percentage of children 6-23 months of age who consumed no fruits or vegetables during the previous day. To date, limited pediatric hypertension research has been conducted to help address these challenges [6]. Considering that Egyptian people are more susceptible to metabolic diseases and the epidemic of CVD in Egypt is growing. Moreover, the effect of early feeding practices on blood pressure has not been studied in Egypt in details. Although the prevalence of EBP was studied in school children, yet studies among the under-five of age

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population studies are scarce especially in relation to early feeding practices [6].

Hence, the aim of this work was to examine the BP and BMI status of preschool children aged 3-5 years in Damanhour City in Egypt in relation to their retrospective early feeding practices, with a focus on breastfeeding practices and commercial milk formula (CMF) practices in the first two years of life, together with their current unhealthy dietary practices.

SUBJECTS AND METHODS

Study Design and Setting

This study was designed as a cross-sectional, descriptive study and was conducted at the Pediatric Department of Damanhour Medical National Institute. The study included a total of 150 healthy children, divided into three distinct groups based on their feeding practices. The first group consisted of 50 children who were exclusively breastfed, the second group included 50 children who were fed with an alternative formula, and the third group comprised 50 children who received either breastfeeding or formula feeding and were also exposed to an unhealthy diet.

Inclusion and Exclusion Criteria

To be eligible for the study, children had to be between 3 to 5 years old, free from neurological disorders, and generally healthy. Additionally, the presence of the mother was required. Children who were either younger than 3 years or older than 5 years, those with chronic diseases or neurological disorders, and those whose mothers refused to participate were excluded from the study.

METHODS

The study involved both historical data collection and clinical evaluation. A comprehensive history was taken for each child, including demographic information such as the child's name, age, sex, residence, and parental income level. The presence of a family history of hypertension was also assessed, along with the child's nutritional and physical habits. Information regarding whether the child received breastfeeding or formula feeding was also collected.

Clinical evaluation included screening for anemia and measuring various physical parameters. These included the child's weight, height, and waist circumference, as well as the calculation of BMI.

Mesuring children's blood pressure:

The blood pressure was measured using the standardized mercury sphygmomanometer as recommended with manually inflated cuff of suitable size and a stethoscope. The cuff used was suitable to the patient's arm circumference according to the NHBPEP recommendations. An appropriate cuff size is a cuff with an inflatable bladder width that is at least 40 percent of the arm circumference at a point midway between the olecranon and the acromion. The measurements were taken in a quiet room in the sitting posture with the arm resting on the table. Efforts were made to eliminate the factors, which may affect the blood pressure, e.g., anxiety, crying, exercise, etc. Blood pressure was determined by auscultation in right arm after a minimum rest of 5 minutes, using a stethoscope placed over the brachial artery pulse, proximal and medial to the cubital fossa, and below the bottom edge of the cuff (i.e., about 2 cm above the cubital fossa).

A cuff bladder was selected with a width that covered at least two-thirds of the upper arm (the distance between the olecranon and acromion) and a length beyond at best 80% of the biceps' circumference. The cuff was inflated to a level that occluded the pulse at the wrist, the stethoscope was placed over the antecubital fossa, and then the cuff was deflated. The onset of the first Korotkoff (K1) sound was used as a measure for systolic blood pressure (SBP); K4 diastolic blood pressure (DBP) was used as the standard for the participating children. Two readings were recorded with an interval of 5–10 min in-between and the mean was calculated for the final analysis.

Interpretation of blood pressure measurement:

El-Shafie *et al.* [7] established blood pressure nomograms representative of Egyptian infants and toddlers below 24 months and children and adolescents (aged 1-19 years) for both systolic and diastolic blood pressures. Their study used the percentiles, which were different for boys and girls. The children were considered hypertensive if the systolic or diastolic blood pressure was equal to or more than the 95th percentile for height for age and sex and prehypertensive if above 90th percentile.

The above standards were used in this study used for interpretation of the results [7]. We also used the international standards developed by **Banker *et al.*** [8] for comparison purposes.

Ethical considerations:

The study was done after being accepted by the Research Ethics Committee. All the mothers of the participants provided written informed consents prior to the enrolment of their children in the study. The consent form explicitly outlined their agreement to participate in the study and for the publication of data, ensuring protection of their confidentiality and privacy. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis:

Data were fed to the computer and analyzed using IBM SPSS software package version 26.0**. (**Armonk, NY: IBM Corp**).** Qualitative data were described using frequency and percent and were compared by Chi-square test. Significance of the obtained results was judged at the 5% level.

RESULTS

The sociodemographic data of the target population are shown in table (1). Tables (2) and (3) compares of the frequency distribution of BP values on the centiles of WHO [9] and Egyptian standard charts [7] for BP among boys and girls respectively in the groups under study.

Table (1): Comparison of parental socio-demographic characteristics of children by study group

	Group (A)	GROUP (B)	Group (C)	P value
	N = 50	N = 50	N = 50	
Mother education level				
Completed junior high school or less	14(28%)	9(18%)	17(34%)	**0.06**
Completed senior high school or technical certificate	7(14%)	10(20%)	16(32%)	
University and college degree	16(32%)	21(42%)	9(18%)	
Graduate degree	13(26%)	10(20%)	8(16%)	
Mother age				
<20 years	12(24%)	15(30%)	11(22%)	0.85
21-30 years	9(18%)	13(26%)	13(26%)	
31-40 years	19(38%)	15(30%)	18(36%)	
>40 years	10(20%)	7(14%)	8(16%)	
Mother working				
Worker	22(44%)	10(20%)	10(20%)	**0.009***
Not worker	28(56%)	40(80%)	40(80%)	
Father occupation				
Civil servant	11(22%)	12(24%)	5(10%)	0.07
Manual worker	8(16%)	4(8%)	12(24%)	
Not working	4(8%)	10(20%)	5(10%)	
Educable	9(18%)	7(14%)	7(14%)	
Seller	13(26)	8(16%)	7(14%)	
Other	5(10%)	9(18%)	14(28%)	
Father education				
Illiterate	11(22%)	7(14%)	6(12%)	0.61
1ry education (read and write)	6(12%)	10(20%)	7(14%)	
2ry education	21(42%)	22(44%)	20(40%)	
High education	12(24%)	11(22%)	17(34%)	

*: Significant

Table (2): Comparison of the frequency distribution of blood pressure values among boys of different groups

Blood pressure	Group (A)	Group(B)	Group (C)	P value
	N = 25	N = 23	N = 24	
SBP classification[8]				
Hypotension	0(0%)	1(4.35%)	1(4.2%)	0.21
Normal range	18(72%)	9(39.1%)	11(45.8%)	
Pre-hypertension	7(28%)	9(39.1%)	9(37.5%)	
Stage I hypertension	0(0%)	4(17.4%)	3(12.5%)	
Stage II hypertension	0(0%)	0(0%)	0(0%)	
SBP on Egyptian standards by percentile[7]				
<50th percentile	0(0%)	1(4.35%)	1(4.2%)	0.29
50-75th percentile	2(8%)	8(34.8%)	7(29.2%)	
75-90th percentile	16(64%)	9(39.1%)	12(50%)	
90-95th percentile	7(28%)	5(21.7%)	4(16.7%)	
>95th percentile	0(0%)	0(0%)	0(0%)	
DBP classification[8]				
Hypotension	2(8%)	1(4.35%)	1(4.2%)	**0.009***
Normal range	17(68%)	7(30.4%)	5(20.8%)	
Pre-hypertension	6(24%)	8(34.7%)	11(45.8%)	
Stage I hypertension	0(0%)	7(30.4%)	7(29.2%)	
Stage II hypertension	0(0%)	0(0%)	0(0%)	
DBP on Egyptian standards by percentiles[7]				
<50th percentile	2(8%)	1(4.35%)	1(4.2%)	**0.03***
50-75th percentile	14(56%)	6(26.1%)	4(16.7%)	
75-90th percentile	7(28%)	6(26.1%)	10(41.7%)	
90-95th percentile	2(8%)	10(43.5%)	9(37.5%)	
>95th percentile	0(0%)	0(0%)	0(0%)	

*: Significant, SBP: Systolic blood pressure, DBP: diastolic blood pressure

Table (3): Comparison of the frequency distribution of blood pressure values among girls of different groups

Blood pressure	Group (A)	Group(B)	Group (C)	P value
	N = 25	N = 27	N = 26	
SBP classification[8]				
Hypotension	0(0%)	1(3.7%)	2(7.7%)	0.10
Normal range	17(68%)	10(37%)	9(34.6%)	
Pre-hypertension	8(32%)	11(40.7%)	11(42.3%)	
Stage I hypertension	0(0%)	5(18.5%)	4(15.4%)	
Stage II hypertension	0(0%)	0(0%)	0(0%)	
SBP on Egyptian standards by percentile[7]				
<50th percentile	0(0%)	1(3.7%)	1(3.8%)	0.29
50-75th percentile	3(12%)	8(29.6%)	7(26.9%)	
75-90th percentile	14(56%)	10(37%)	13(50%)	
90-95th percentile	8(32%)	8(29.6%)	5(19.2%)	
>95th percentile	0(0%)	0(0%)	0(0%)	
DBP classification[8]				
Hypotension	0 (0%)	1(3.7%)	2(7.7%)	**0.04***
Normal range	17(68%)	9(33.3%)	6(23.1%)	
Pre-hypertension	7(28%)	12(44.4%)	13(50%)	
Stage I hypertension	1(4%)	5(18.5%)	5(19.2%)	
Stage II hypertension	0(0%)	0(0%)	0(0%)	
DBP on Egyptian standards by percentiles[7]				
<50th percentile	0 (0%)	1(3.7%)	2(7.7%)	**0.066**
50-75th percentile	4(16%)	6(22.2%)	5(19.2%)	
75-90th percentile	15(60%)	5(18.5%)	6(23.1%)	
90-95th percentile	6(24%)	12(44.4%)	10(38.5%)	
>95th percentile	0(0%)	3(11.1%)	1(3.8%)	

*: Significant, SBP: Systolic blood pressure, DBP: diastolic blood pressure

The relationship between SBP and DBP in the children who were breastfed is shown in table (4). The relationship between SBP and DBP with variables related to infant feeding practices and growth in all the children is illustrated in table (5). The type and frequency of unhealthy foods intake in the three groups is shown in table (6).

Table (4): Correlation of systolic and diastolic blood pressure among the children of the groups who were breastfed

	SBP of children		DBP of children	
	(r)	P value	(r)	P value
Cesarean section	0.09	0.27	0.14	0.06
Premature child	0.23	0.004*	0.04	0.56
Low birth weight	0.008	0.91	0.01	0.87
Full breastfeeding	-0.16	0.02*	-0.15	0.03*
Early initiation of breastfeeding <1 hour	0.2	0.01*	0.2	0.01*
Education about infant feeding	-0.15	0.05*	-0.16	0.04*
Frequency of breastfeeding per day	-0.22	0.01*	-0.13	0.05*
Age of stopping breastfeeding	-0.32	0.03*	-0.12	0.04*
Frequency of breastfeeding per night	-0.19	0.02*	-0.17	0.03*
Supplements given	-0.01	0.90	0.12	0.44
Frequency of decoction given	-0.05	0.53	0.18	0.02*
Pacifiers given	0.18	0.01*	0.25	0.005*
Age of offering pacifier	0.02	0.72	-0.18	0.02*
Age of stopping pacifier (duration)	0.004	0.95	-0.20	0.01*

*: Significant, SBP: Systolic blood pressure, DBP: diastolic blood pressure

Table (5): Correlation of systolic blood pressure and diastolic blood pressure in children with variables related to infant feeding practices in the non-breastfed group

	SBP of children		DBP of children	
	(r)	P value	(r)	P value
Age of starting formula	-0.11	0.26	-0.04	0.66
Age of stopping formula	0.19	0.05*	0.10	0.30
Frequency of formula feeding	0.14	0.04*	0.13	0.05*
Addition of sugar to formula	0.13	0.05*	0.15	0.01*
Age of start addition to formula	-0.18	0.01*	-0.22	0.009*
How cleaned bottle (non-hygienic)	0.18	0.04*	0.21	0.03*
Type of water used (boiled)	0.10	0.22	0.11	0.1
Other milk given	0.06	0.46	-0.01	0.89
Age of introduction of complementary food	-0.10	0.08	-0.05	0.47
Mode of introduction	-0.11	0.17	-0.02	0.74
Preparation of food 6-12 months (salt)	0.27	0.001*	0.24	0.009*
Preparation of food (salt) 12-24 months	0.16	0.04*	0.18	0.03*
Dietary diversity (high)	-0.07	0.28	-0.05	0.6
Frequency of intake of unhealthy diet	0.25	0.008*	0.21	0.01*
Chips	0.20	0.02*	0.18	0.03*
Freezing food	0.10	0.2	0.13	0.12
Fried	0.11	0.18	0.9	0.3
Packed sweet	0.07	0.4	0.12	0.08
Indomie	0.23	0.01*	0.19	0.61
Weight for age (1-5 years)	0.36	<0.001*	0.24	0.003*
Height for age (1-5 years)	0.03	0.69	-0.02	0.78
Weight for height	0.32	0.23	0.22	0.41
BMI for age	0.45	0.002*	0.52	0.04*

*: Significant, SBP: Systolic blood pressure, DBP: diastolic blood pressure

Table (6): Type and frequency of unhealthy foods intake in the three groups under study

Unhealthy food intake	Group (A)	Group(B)	Group (C)	P value
	N = 50	N = 50	N = 50	
Type				
Chips	25(50%)	24(48%)	39(78%)	**0.003***
Frozen ice-cream	23(46%)	27(38%)	36(72%)	**0.001***
Fast foods	22(44%)	20(40%)	34(68%)	**0.03***
Packed sweet	22(44%)	20(40%)	31(62%)	**0.06**
Indomie	24(48%)	25(50%)	38(76%)	**0.007***
Frequency of intake				
Once daily	15(30%)	14(28%)	12(24%)	**<0.016***
2-3 times daily	13(26%)	11(22%)	25(50%)	
Once daily	12(24%)	8(16%)	3(6%)	
2-3 times daily	10(20%)	17(34%)	10(20%)	

*: Significant.

DISCUSSION

In this study, the overall detection rate of elevated SBP (ESBP) was 14.67% and pre-ESBP or preHTN (i.e. between 90-95th centile) was 20% using the WHO BP standards. ESBP was 12% and pre-ESBP was 18% by Egyptian BP standards. Detection rate of ESBP was highest in children exposed to unhealthy foods) (24% and 20%) and lowest in the fully breastfed 8% and 6% by the WHO and Egyptian standards respectively for SDP. The detection rate of EDBP was (1.3%) and pre-EDBP was 2.7% by WHO standards and 0.06% and 2.0% respectively by the Egyptian standards for BP. EDBP was 2% in groups B and C but was not detected in the fully breastfed by the WHO and Egyptian BP standards. In Nigeria a study of preschool children detected pre-EBP in 1.4% and EBP 0.5%. It was mainly detected in the 5 year olds and not before this age [10].

Song *et al.* [11] showed that the global prevalence of childhood HTN was 4.3% among children aged 6 years and peaked at 7.89% among those aged 14 years. In China, a study [12] reported a HTN prevalence of 7.3% in children ages 6 to 11 years from 2010 to 2011. This indicates a rising trend in the prevalence rate of HTN in young children.

There was a significant correlation between breastfeeding practices and EBP. The duration of breastfeeding was significantly inversely associated with both SEBP and EDBP (r-0.16 and -0.15 respectively at <0.05. Our findings are in agreement with many other research investigators who reported that total breastfeeding duration was associated with a protective effect against ESBP which starts to appear in children aged around six years of age [13]. In Japan, **Hosaka *et al.*** [14] showed that breastfeeding leads to lower BP in 7-year-old children. They demonstrated that even a small reduction in BP was associated with any duration of breastfeeding, which could confer important benefits on health at a population level**.** Similarly, **Gopinath *et al.*** [15] showed that a 1% reduction in population SBP levels is associated with a 1.5% reduction in all-cause mortality.

A study [16] examined whether the type and duration of breastfeeding are associated with HTN in young school-aged children. They found that more than one-fifth of them had EBP, and more than one-tenth of them had HTN. They showed differences in the detection rate for systolic and diastolic HTN among the two groups of children who were ever or never breastfed, and the detection rate in children who were never breastfed was higher. At the same time, when children who were never breastfed were set as the reference group, they observed that children who were ever breastfed showed lower risks of having systolic EBP or HTN and diastolic HTN in their first grade.

However, our findings are not in agreement with other workers who did not find any relationship between breastfeeding and later EBP [17]. Also, **Liang *et al.*** [18] reported that the group of children with any duration of breastfeeding or longer than ten months had a higher prevalence of HTN in primary school. The PROBIT study in Latin America showed that children fed human milk exclusively for ≥6 mo followed by continued human milk feeding until ≥12 mo had significantly higher SBP at 6.5 y of age than children weaned at ≤1 month [19]. However, there were no significant mean differences in SBP or DPB at 11.5 y of age between children fed human milk 3–<6 mo or ≥6 compared with <3 mo and no significant trend across the 3 categories of duration (<3, 3–<6, and ≥6 month) [20]. Such contradictions in the findings between research workers could be attributed to the possibility of publication bias and residual confounding. Even if the observed reduction in BP is associated with breastfeeding may have been small, its public health implications are gross, especially in populations where early bottle feeding is common.

EBP in children when tracked into adulthood is strongly associated with increased rates of morbidity and mortality in later life. Early initiation of breastfeeding was negatively associated with ESBP (r = -0.18 at p = 0.04) but there was no correlation with EDBP. Frequent breastfeeding (on demand or to baby hunger cues) was inversely associated with both ESBP (r = -0.22 at p = 0.01) and EDBP (r = -0.13 at p = 0.05). Night feeding was inversely associated with both ESBP (r = -0.19 at p = 0.02) and EDBP (r = -0.17 at p = 0.03). Offering supplements in the form of herbal drinks was associated with EDBP (r = 0.18 at p = 0.02) but not ESBP.

Pacifier offered in infancy was associated with higher SBP and DBP in the children under five of age. This is consistent with the findings of other research who reported that sucking on a pacifier can increase BP by up to 10 mmHg attributed to increased sympathetic tone in infants as reported by **Yiallourou *et al.*** [21]. However, it appears that this effect can persist and track on later in life as shown in this study.

A research in Cairo by **Behairy *et al.*** [22] also examined early breastfeeding practices and their association with biomarkers of CVD risk in a group of preschool children. They found that high density lipoproteins (HDL), low density lipoproteins (LDL) and ratio of HDL to LDL were higher breastfed versus those who were never breastfed (on CMF). While highly sensitive C-reactive protein (hsCRP) was predictive of less risk to CVD among the breastfed compared to the artificially fed, despite that both were exposed to unhealthy diet. They also showed that protective biomarkers against CVD as HDL and hsCRP were high with early initiation of breastfeeding in the breastfed group, but not in the formula fed infants group. Supplements introduced before 6 months were inversely associated with the protective biomarkers. High intensity of breastfeeding and night feeding was associated with high levels of protective biomarkers in the breastfed group, while widely spaced formula feeds were more protective than closely spaced scheduled feeds in the CMF fed group. Other research in other countries has shown a significant suppression of lipid and inflammatory biomarkers in breast-fed subjects suggesting a long-term protective effect of breast-milk on future heart disease probably mediated by lower BMI [23].

In our study, mothers in the group who breastfed their children had lower SBP and DBP than those in the group who were formula fed. This was in agreement with **Behairy *et al.*** [22] who showed that HTN was more common in the never breastfed group of mothers.

A systematic review and meta-analysis study involving data from 8 studies showed that breastfeeding is associated with a reduced maternal risk of CVD outcomes with protective effect for durations up to 12 months or more [24].

In this study we found that earlier introduction of commercial milk formula (CMF) increased the risk of ESBP but not EDBP. Also, that longer and frequently fed CMF increased the risk of ESBP (r = 0.19 and r = 0.14 for ESBP). EDBP increased with higher frequency of CMF (r = 0.13; p = 0.05).

Almost one third of the children in the CMF fed were adding sugar or starch to the bottle feeds. This appears to be a potentially harmful practice as it was highly correlated with ESBP and EDBP (r = 0.13; p = 0.05 and r = 0.15; p = 0.01) respectively. Also, the age foods were added with CMF was inversely related to ESBP and EDBP (r = -0.18; p = 0.01; r = -0.22; p = 0.009, respectively). These concentrated feeds, introduced at an early age increase the osmolality of the feed which may consequently not only predispose to obesity, but also increases the osmolar load on the kidneys, increasing the risk of renal dysfunction and early activation of the renin-angiotensin II-aldosterone system which can speed the process of atherogenesis and thereby increasing the risk of HTN later in life [25].

He and MacGregor [26] found a significantly lower mean DBP in 6 year olds who were ever fed human milk (i.e., from a nonrandomized human milk-feeding group) than in 6 year olds who were fed standard CMF. The corresponding analysis for SBP was not significant. On the other hand, **Wilson *et al.*** [27] reported that 7 year olds who were never fed human milk had higher SBP and DBP than 7 year olds who were fed EBF.

Moreover, the addition of salt to weaning foods at age (6-12 months and 12-24 months) was significantly associated with both ESBP and EDBP. These findings were consistent with other research studies that show the detrimental effects of very high or very low salt diets on blood pressure [28]. These unhealthy food preparation and consumption practices have been shown to cause much harm and health hazards to children that track into adulthood increasing the burden of NCD particularly CVD.

Kramer *et al.* [19] **and Martin *et al.*** [20] also showed that early feeding practices that were linked to not breastfeeding were at risk to high BP in later life.

Preference of unhealthy foods was high among the children under study being highest for chips, Indomie, fast foods and sweets (58%, 58%, 50.7% and 48.7% respectively). There was a statistically significant difference between the groups. A favorite child's snack was the highly salted food (Indomie), which was also associated with ESBP and EDBP (r = 0.23; p = 0.01 and r = 0.19; p = 0.03 respectively. The highest intake of unhealthy foods was seen by group C (p value <0.05) as the majority of children in group C (68-78%) were eating unhealthy foods as chips, fast foods, frozen ice-cream and candy, sweets, and Indomie. One half of the children in group C consumed these foods 2-3 times daily only 6% consumed it once weekly.

WHO has issued a resolution that prohibits the marketing of such products to children, given their harmful effects on the health of children [29].

In Egypt, a study conducted in Qalubiya Governorate for over 1000 children aged 2-5 years showed that Egyptian children had a drastically or almost addictive inclination to fast foods (65%), canned sugary drinks (68%) and sweets, candy and chocolates (62.5%) and especially among overweight (99.4, 61.7 and 81.8 respectively) and obese children (95.2%, 73.8% and 97.6% respectively). Only one third consumed fruits and vegetables, while one half consumed fast foods. Marketing channels for fast foods through exposure to advertisements was highest by television (53.3%). The parents expressed that display in the shops was more attractive to children (28.5%) compared to healthy foods as fruits (17.5%) [22].

In Singapore, intake of sugar sweetened beverage (SSB) at age 18 months were not significantly associated with later adiposity measures and overweight/obesity outcomes. In contrast, at age 5 years, SSB intake increments were associated with higher BMI by 0·09 (95 % CI 0·02, 0·16) SD units, higher skin fold thickness and increased risk of overweight/obesity by 1·2 (95 % CI 1·07, 1·23) times at age 6 years. In conclusion, SSB intake in young childhood is associated with higher risks of adiposity and overweight/ obesity [30]. Furthermore, consumption of SSB was associated with increased adverse levels of cardiometabolic biomarkers and thereby risk of CVD.

Blood pressure measurements were significantly associated with the consumption of unhealthy foods. It was associated positively with ESBP and EDBP (r = 0.25; p = 0.02) and (r = 0.21; p = 0.01). In particular, the consumption of salted potato chips packs was a high-risk factor for ESBP and EDBP (r = 0.2; p = 0.02 and r = 0.18; p = 0.03 respectively). Also, addition of salt to diet at ages 6-12 months and 12 to 24 months was significantly positively associated with SBP and DBP measurements (r = 0.27; p = 0.001 and r = 0.16; p = 0.009 respectively for the 6-12 months age group) and (r0.16; p = 0.04 and r = 0.17; p = 0.03 respectively for age group 12-24 months). It appears that salt intake at this age plays an important role in up regulation of blood pressure. A study (35) demonstrated that a modest reduction of salt intake causes immediate falls in BP in children and if continued can decrease the subsequent rise in BP with age leading to major reductions in CVD.

According to the World Health Organization guideline for salt intake for adults and children, it is reported that children with elevated blood pressure are at high risk of CVD pathology during childhood, and are also at high risk for hypertension and CVDs as adults. Evidence shows that reducing sodium intake significantly reduces BP in adults and children [31].

The possible explanation of ESBP and EDBP with salt intake shown in our study would be the link between foods with high calories and salt leading to obesity, which leads to HTN in later life. A meta-analysis performed for outcomes of the sodium intakes demonstrated its link with HTN, overweight and obesity in children and adults [28].

The optimal sodium intake level would be probably about 1.5 g/day. Sodium intake recommended for children can be extrapolated from the recommended sodium intake for adults [31]. Diversity of a young child's diet is an important aspect for ensuring a nutritious meal for a growing child whose micronutrient needs are higher with the needs of growth at this age (3-5 years). Dietary diversity food group guidelines differ from one country to another from 4 in some to up to 30 in others [32].

In this study, only one half of the children were exposed to fruits, vegetables, meats and cereals. There was a significant difference between the groups regarding dietary diversity. However, there was a significant association between CMF feeding with respect to duration of CMF with SBP (r = 0.19; p = 0.05) but not DBP. A study that was concerned about dietary diversity adequacy of the non breastfed was conducted in the Filipino children [32].

Kennedy et al. [32] reported that use of indices for measuring dietary diversity is useful in quantifying adequacy of dietary diversity.

Additives of sugar and starch to CMF bottle feeds decreases dietary diversity and its adequacy. In our study it was significantly associated with SBP (r = 0.13; p = 0.05) and DBP (r = 0.15; p = 0.01). Earlier age of adding these additives was positively associated with increases in SBP and DBP (r = -0.18 and r = -0.22 at P<0.001) and the amount or frequency of formula feeds with SBP (r = 0.14; p = 0.04) and DBP (r = 0.13; p = 0.05). This practice can reduce the dietary diversity in type and amount.

In Singapore, **Quah et al.** [24] showed that excess sugar in beverages (SSB) was associated with adiposity, which would eventually lead to CVD.

In Iran, dietary diversity score for children aged 11-18 years showed that it was highly associated with overweight and obesity [33]. **Izadi et al.** [34] showed that high dietary diversity could be a powerful tool in reducing the HTN prevalence rate among Iranian schoolchildren.

In our study, mother's awareness of her child's unhealthy eating behavior and monitoring of her child intake of such foods showed significant differences between the groups. Other studies showed that mothers play an important role in regulating their child's intake of unhealthy foods. Several workers have shown that mother's educational level, and working hours as well as parenting practices influence child's eating habits and the consequent risk to overweight and obesity [35].

LIMITATIONS

The study groups were difficult to characterize as most of them introduced CMF, even the breastfed group. But the CMF fed were never breastfed. Also study groups were small in number. However, this is an exploratory study which open the path to more extensive investigation.

CONCLUSION

The quality of early feeding practices appear to be linked with protection or risk of HTN in children under five of age. Early intense breastfeeding is protective. While CMF, unhealthy food intake, offering pacifiers, additives of sugar and starch to CMF bottle feeds appear to increase the risk of HTN. Also, early complementary foods with added salt in the first two years of life, fast (fried) foods, sugar sweetened beverages (SSB), candy sweets and packed chips and in particular Indomie snacks are harmful practices that potentially build up the risk of high SBP and DBP, which could track to hypertensive disease later in life.

It is recommended that promoting early, intense breastfeeding practice and EBF in the first 6 months of life should be promoted from early school age and teen agers. Promoting healthy diet and avoidance of foods high in sugar and salt in family foods, particularly 'Indomie', is vitally important to disseminate in all public awareness campaigns. Labelling on the such packages should include warnings about the hazards of such products similar to tobacco labeling warnings. Member states should take active steps to restrict and monitor salt and sugar in packed marketed foods for children by devising laws and regulatory monitoring bodies that can control such practices and increase public awareness to them.

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