

The Impact of Maternal Employment on Infant Weight-, Length- and BMI-for-Age Based upon WHO Growth Chart Standards

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Abstract: *Background:* The infancy is a time of phenomenal growth and development. Infant of working mothers have a special concern as they have less time for their infant care.

Objective: The present study aims to assess length, weight and BMI of Jordanian infants in nursery in reference to WHO growth chart standard for age Z-score and to study the impact of mothers' work on their infant's growth.

Methods: A cross-sectional observational study was conducted on 92 infants aged between 3-12 months randomly and recruited from nurseries in Amman, Jordan. All selected infants their mothers are employed and working for at least 8 hour per day. The participants were divided according to gender (male; female) and age group as the following: 3-6 months; 7-9 months; and 10-12 months.

Results: The prevalence of overweight or obesity was 15.2% in all studied infants. Overweight or obesity was more prevalent among female infants aged 3-6 months and among male infants aged 7-12 months. No infant (0.00%) regardless of gender or age group was underweight, stunting nor wasting per WHO standards of BMI for age z-score.

Conclusion: Most infants of Jordanian working mothers seemingly have normal growth in weight and length and few of them were overweight or obese according to WHO standard of BMI for age z-score. These indicated that Jordan work polices support working mothers and their infants to have better health and development.

Keywords: Infant anthropometry, working mothers, nursery, z-score, overweight, obesity.

INTRODUCTION

Infancy (the first 12 months of life) is a time of phenomenal growth and development. In this critical period, infants need special care to ensure the optimal growth and development. It is expected that infants of working mothers will have a problem in their growth since their mothers have less time for infant feeding and care comparing with unemployed mothers [1-3].

In the United States, more than half of mothers with young children are working [4]. In Jordan, the percentage of working women including mothers was 13.2% [5]

The impact of maternal employment on children growth and development have been shown by many studies [6-12]. The infants of working mothers usually cared by adults other than their parents like relatives especially in early infancy or sometimes nursery homes [6]. Mothers continue to work because they want to

improve the socio-economic status of themselves and their families [8-10]. Some recent studies have linked maternal work to children's weight and BMI and they found positive association [11,12]. This positive association was found to be more correlated with educated worker mothers [13,14]. Although, the mechanisms that may mediate these associations are still unknown. In 2006, WHO released new standards for children growth [15] and growth charts are still an essential component in evaluating children's nutritional status and to ensure that physiological needs are met [16]. In many countries, growth charts are used at national level to evaluate populations' general well-being, establish health care policies in parallel with interventional planning and monitoring programs [16]. Up to date, there are no previous studies that investigate the impact of maternal work on infant growth in reference to WHO growth chart standard for age Z-score. Recently, a brief policy was declared by the Higher Population Council (HPC) and the Jordanian National Commission for Women (JNCW) in corporation with other national and international sectors [17]. This brief concentrate on the situation of women's economic participation and the obstacles that face women in labor market. Accordingly, the rate of

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women's participation in the labor market was 14.9% in 2009 and in 2013 it was declined to 13.2% [17]. One of the reason for this decline is the lack of work environment that facilitate child care especially for infants. . Based on these information, the objectives of this study were to assess nursery home infants growth in terms of length, weight and BMI for Jordanian employed mothers in reference to WHO growth chart standard for age Z-score and to evaluate the impact of mothers work on their infant's growth.

METHODS

Study Population and Design

A cross-sectional observational study was conducted on 92 infants (56 male; 36 female) aged between 3-12 months and randomly recruited from nurseries in Amman, Jordan. The infants included in the study must belong to mothers working at least 8 hour per day. The participants were divided according to gender into males and females and to three groups according to age as the following. (1) 3-6 months; (2) 7-9 months; (3) 10-12 months. The infant was excluded if she or he has acute or chronic medical illness, or serious congenital abnormalities that require specialist care or if the caregiver rejects to participate in the study. Anthropometric, medical, nutritional and socio-demographic data were collected by the principal investigator through a structured valid and reliable questionnaire. In addition, this study was conducted according to the Declaration of Helsinki (2008, including 2013 amendments) and an informed consent form was obtained from each infant's mother agreed to participate in the study.

Anthropometric Measurements

Body weight of the infant was measured with minimal clothing and clean disposable diaper by using electronic pan-type pediatric balance-beam scale and it was recorded to the nearest 0.01 kg. Standard techniques were applied in measuring BMI and length. Infant's length was measured in recumbent position using calibrated length board to the nearest 0.5 cm Body mass index (BMI) for-age from birth to 2 years old was based on the measured length not height. Thus, infant's length was used in Quetelet's formula: $BMI = \text{weight (kg)} / \text{height (m)}^2$ instead of height for calculating BMI [17].

Weight, height and BMI were transformed to age-sex standardized z-score based on the WHO Child

Growth Standard reference [16]. The infants' nutritional status were assessed based on anthropometry for the risk of wasting (BMI for age z-score below -2), stunting (height or length for age z-score below -2), underweight (weight for age z-score below -2), and overweight (BMI for age z-score over 2) in reference to WHO Child Growth Standard [16].

Statistical Analysis

All statistical analyses were performed using SPSS version 16.0 (SPSS Inc., Illinois, US). Collected data were entered twice in data sheets, checked and analyzed. Descriptive statistics were performed using means and standard error of the means (SEM) to describe the numeric data, respectively. Student t-test for independent samples was used to compare means of the normally distributed numeric variables. Z-score method relative to the WHO child growth standard [16] was used to calculate standard deviation score (SDS) of mean weight, length and BMI of the studied infants. Chi-square (χ^2) and Fisher's exact tests were applied to assess the associations among dichotomous and categorical variables and p-value ≤ 0.05 was considered significant.

RESULTS

Characteristics of the Study Sample

The study sample consisted of 92 infants (56 males and 36 females) aged from 3 to 12 months. The means of birth weight, current body weight and BMI were 2.87 kg, 7.97 kg, 0.50 kg/m² respectively. The mean birth weight and BMI for male infants was 2.9 kg and 0.54 kg/m² and 2.82 kg and 0.47 kg/m² for female infants. The frequency of breast fed infants was (38.1%) compared to (61.9%) was bottle fed, 38% of infants over 6 months consumed food with added salt and (41.3%) consumed food with added spices. The frequencies of the study sample per age group and gender are shown in Table 1.

Comparing Means of BMI, Birth and Current Weight

The mean and the related confidence intervals with p-values of birth weight, current weight and BMI per age group and gender are shown in Table 2. The difference between the means of the aforementioned variables among male and female infants in each age category was tested for significance and stated as p-values. Results showed that there was a statistical difference between males and females birth weight of infants aged 7-9 months (p=0.066), but it did not reach

Table 1: Frequency Distribution of the Study Sample Per Age Group and Gender (N=92)¹⁻²

Age category (Months)	Gender				Total	
	Males		Females			
	n	%	n	%	n	%
3 - 6	20	47.6	22	52.4	42	45.6
7 - 9	18	72.0	7	28.0	25	27.2
10-12	18	72.0	7	28.0	25	27.2
total	56	60.9	36	39.1	92	100

¹Values are presented as frequency (n) and percentages (%).

²The male and female percentage is computed from the total of the age category.

Table 2: Means and the Related Confidence Intervals of Birth Weight, Current Weight and BMI Per Age Group and Gender (N=92)

Variables	Age category (Months)	Males (n=56)			Females (n=36)			P-Value
		n	Mean	95 % CI	N	Mean	95 % CI	
Birth weight (kg)	3 - 6	20	2.73	2.50 - 2.95	22	2.91	2.52 - 2.91	0.220
	7 - 9	18	3.07	2.81 - 3.32	7	2.66	2.71 - 3.22	0.066
	10 - 12	18	2.92	2.56 - 3.18	7	2.90	2.56 - 3.11	0.954
	Total	56	2.90	2.50 - 3.32	36	2.82	2.52 - 3.22	0.884
Current weight (kg)	3 - 6	20	6.35	6.02 - 6.68	22	6.33	6.02 - 6.71	0.942
	7 - 9	18	8.23	7.83 - 8.53	7	8.53	7.93 - 8.43	0.278
	10 - 12	18	9.33	9.03 - 9.44	7	10.20	9.13 - 9.54	0.017
BMI (kg/m ²)	3 - 6	20	16.73	15.83 - 17.64	22	16.99	15.73 - 17.54	0.658
	7 - 9	18	17.90	17.17 - 18.63	7	17.75	17.27 - 18.61	0.819
	10 - 12	18	18.41	17.45 - 19.33	7	17.83	17.25 - 19.43	0.442

¹Values are presented as means and 95% confidence intervals.

²p-value ≤ 0.05 is statistically significant for independent sample t-test.

³Abbreviations: BMI: body mass index (kg/m²).

the significant level. Nevertheless, there was a statistical significant difference regarding the current weight of infants aged 10-12 months, where female infants have higher current weight than males (10.2 vs 9.33 kg). On the other hand, there were no statistical significant ($p > 0.05$) difference between both groups in the 3 age categories regarding BMI.

The means and the related confidence intervals for z-score of current weight, length and BMI per age group and gender in reference to WHO child growth standard are shown in Table 3. Results showed that there was only statistical ($p = 0.033$) significant difference between the current weight of male and female infants aged 7-9 months. Meanwhile, no statistical significant ($p > 0.05$) differences were found between males and females regarding the infants' length and BMI in all age categories.

Status of Infants According to WHO Standard of BMI for Age Z-Score

The weight status of infants according to WHO standard of BMI for age z-score are shown in Table 4. In general, the percentage of normal weight males aged 3-6 months was higher compared with females (90% vs 86.4%) and females have a higher percentage of overweight compared to males (13.6% vs 10.0%) which causes a statistical significant ($p \leq 0.05$) difference between both genders. On the contrary, among the 7-9 months and 10-12 age categories male infants had significantly ($p \leq 0.05$) higher percentages of overweight compared to females. Results showed that 83.9% of male infants had normal weight and 16.1% were overweight or obese. On the other hand, 86.1% of female infants had normal weight and 13.9% were overweight or obese. No statistical significant ($p > 0.05$) difference was found between the two groups

Table 3: Means and the Related Confidence Intervals for Z-Score of Current Weight, Length and BMI Per Age Group and Gender¹⁻⁴

Variables	Age category (Months)	Males (n=56)			Females (n=36)			P-Value
		n	Mean	95 % CI	n	Mean	95 % CI	
Weight	3 - 6	20	0.10	- 0.04 – 0.24	22	0.00	-	0.135
	7 - 9	18	0.44	0.19 – 0.70	7	0.00	-	0.033
	10 - 12	18	0.67	0.43 – 0.91	7	0.57	- 0.15 – 1.30	0.715
Length	3 - 6	20	- 0.95	- 1.44 – -0.46	22	-1.55	- 2.09 – 1.00	0.100
	7 - 9	18	- 0.89	- 1.5 – - 0.28	7	- 1.14	- 2.27 – 0.02	0.647
	10 - 12	18	- 0.83	- 1.52 – - 0.15	7	- 0.14	- 1.13 – 0.85	0.248
BMI	3 - 6	20	0.45	0.13 – 0.77	22	0.27	- 0.03 – 0.58	0.414
	7 - 9	18	0.67	0.25 – 1.08	7	0.57	- 0.15 – 1.30	0.798
	10 - 12	18	0.50	0.11 – 0.89	7	0.57	- 0.15 – 1.30	0.840
	Total	56	0.54	0.11- 0.89	36	0.47	-0.15- 1.30	0.521

¹Reference to the WHO child growth standard (de Onis *et al.*, 2006).

²Values are presented as means and 95% confidence intervals.

³P- value ≤ 0.05 is statistically significant for independent t test.

⁴Abbreviations: BMI: body mass index (kg/m²).

Table 4: Weight Status of Infants According to WHO Standard of BMI for Age Z-Score¹⁻⁴

Age category (months)	Males (n=56)		Females (n=36)		Total (N=92)	
	Normal weight	Over weight	Normal weight	Over weight	Normal weight	Over weight
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
3 – 6	18 (90.0)	2 (10.0) ^a	19 (86.4)	3 (13.6) ^a	37 (88.1)	5 (11.9)
7 – 9	14(77.8)	(22.2) ^{a 4}	6 (85.7)	1 (14.3) ^b	20 (80.0)	5 (20.0)
10 - 12	15(83.3)	3 (16.7) ^a	6 (85.7)	1 (14.3) ^a	21 (84.0)	4 (16.0)

¹Reference to WHO child growth standard (de Onis *et al.*, 2006).

²Values are presented as frequencies (n) and percentages (%).

³Values in rows with different superscripts are significantly different among males and females ($p \leq 0.05$).

⁴Abbreviations and definitions: BMI: body mass index (Kg/m²); WHO: World Health Organization. Normal weight: BMI for age z-score ≥ -2 and ≤ 1 ; overweight or obese: BMI for age z-score > 2 .

regarding overweight or obesity. The overall prevalence of normal weight and overweight or obese among both genders was 84.8% vs 15.2% respectively.

Finally, the proportions of underweight, stunting and wasting infants according to WHO standards of BMI for age z-score showed that there were zero percentages of infants either underweight, stunting or wasting (not shown).

DISCUSSION

In Jordan, women compose half of the Jordanian society and its productive capacity. However, about 87% of the Jordanian women are unemployed [5]. Furthermore, the rate of women's participation in the labor market fell from 14.9% in 2009 to 13.2% in 2013 [17]. One of the reasons for this decrease in the rate of

women participation in labor market is the need of mothers for a work environment with accessibility to provide care for their children especially infants. Therefore, in this study we tried to find if maternal employment impacts infants' growth and health. This study revealed that, no infant (0.00%) regardless of gender or age group was assessed to be underweight, stunting nor wasting per WHO standards of BMI for age z-score. Our result come to be better and disagree with Hong Kong infants and young children feeding survey [19] which found that the prevalence of the underweight, stunting and wasting infants up to 12 months was ranged between (0.6%-2.9%), (1.1%-3.5%) and (1.8%-2.8%) respectively. This may indicate that infants of our working mothers aged 3-12 months were not exposed to nutritional risk of underfeeding either due to better nursery care during mothers working time or giving mothers one hour during work

for nursing their infants during their first-year age or they allow for mothers having infants to leave work one hour early to feed their infants.

Similarly, other studies [20-22] have shown that mothers work positively affects their children's life through improving the financial status of the family which in turn helps in improving child health and well-being [20]. Furthermore, Whyte and Kariuki [21] highlighted the importance of knowledge and attitude of caregivers on childcare while Cooksey and his colleagues in 2009 highlighted the positive impact of adequate maternity leaves and part-time employment of mothers on their young children's growth and development. However, in contrast Nair *et al.* [9] in a study aimed to understand the impact of mothers' employment on infant feeding and care have found that mothers' employment appears to be negatively affecting infant feeding and care. Accordingly, this could be due to long work hours, lack of adequate alternative care, low and delayed payments compared with the offered services [9]. One of the reasons for these differences in study results might be due to differences in mother's attitudes, perceptions and behaviors towards infant care and the diversity of the national work polices.

The prevalence of overweight or obesity was 15.2% in all studied infants, 16.1% in male infants and 13.9% in female infants with no statistical significant difference between both groups. Overweight or obesity was more prevalent among female infants aged 3-6 months and among male infants aged 7-12 months. In 2009-2010 Ogden and her colleagues [23] estimated obesity prevalence in United States (US) children and adolescents for 2009-2010 and investigated trends in obesity prevalence and BMI among children and adolescents between 1999-2000 and 2009-2010. They revealed that 9.7% (95% CI, 7.6%-12.3%) of infants and toddlers had a high weight-for-recumbent length which is inconsistent with our study result. Also, Ogden *et al.* [24] at the national level in the US, studied the prevalence of infants and toddlers (<2 years) with ≥ 97.7 th percentile weight-for-recumbent length and found it was 11.4% in 1999-2000 and 7.1% in 2011-2012 [25]. The prevalence in Hispanics/Latinos of the same age group was 1.2 times higher during the same time periods [24,25]. Our prevalence is higher than this prevalence for US infants and toddlers in year 2000, 2010 and 2012 but it is almost like the prevalence in Hispanics/Latinos of the same age group.

In a, cross sectional study conducted between 2012-2013 on a total of 1357 child from migrant and

seasonal, migrant head start (MHS) enrollees, multirace parents and aged 0-6 years, the overall overweight (BMI ≥ 85 th and < 95 th percentile) prevalence (n = 167 out of 1357) was 16.1% and at 1 year enrollment (n = 92 out of 638) it was 19.1%. Meanwhile, the overall obesity (BMI ≥ 95 th percentile) prevalence (n = 157 out of 1357) was 15.1% and at 1 year enrollment (n = 62 out of 638) it was 12.9%. Thus, the overweight prevalence at 1 year enrollment is higher than our infants and these results disagreed with our results. One of the good reasons for this disagreement is the variant ethnicity [26]. Lim *et al.* (2017) reported that 7% of infants and toddlers had a BMI ≥ 97.7 th percentile weight-for-recumbent length [27] which is lower than our infant's prevalence.

The mean birth weight and BMI in present study was respectively 2.9 kg and 0.54 kg/m² for male infants and 2.82 kg and 0.47 kg/m² for female infants with no significant difference between them in respect to birth weight. Taveras *et al.* [28] studied 559 infants and examined the associations of weight-for-length at birth and at 6 months with obesity at 3 years of age and their results were inconsistent with our results. They found that the mean infants birth weight was 3.55 kg which is higher than our infants mean birth weight (2.9 kg). Nonetheless, our infants BMI was slightly higher (0.50 kg/m²) than the previous study infant's BMI which was 0.44 kg/m². The differences in results could be due to different ethnicity, sample size or sampling technique. The Taveras *et al.* results may indicate a problem of overfeeding which can be resolved by nutrition education for both working mothers and nursemaid in term of quality and quantity of healthy feeding for infants in such critical periods of growth.

STUDY LIMITATIONS

The study has some limitations including the small sample size, the findings do not include certain unmodifiable sociodemographic, biological, and psychological health determinants of overweight/obesity. The design was cross-sectional observational study and the study setting was Amman the capital city of Jordan. It will be better if we take a large representative sample size from the north, middle and south of Jordan and use case control design to compare between the infant's growth of employed and non-employed mothers.

CONCLUSION

Most infants of Jordanian working mothers seemingly have normal growth in weight and length

and few of them were overweight or obese according to WHO standard of BMI for age z-score. These indicated that Jordan legislations, rules and work polices support working mothers and their infants to have better health and development. Nevertheless, alarming nutrition education programs are necessary to avoid the increase in the prevalence of overweight and obesity among infants.

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FINANCIAL DISCLOSURE

None declared.

CONFLICT OF INTEREST

None declared.

AUTHOR'S CONTRIBUTIONS

Safaa A. Al-Zeidaneen contributed to the conception and design of the research; Safaa A. Al-Zeidaneen and Nahla S. Al-Bayyari contributed to the interpretation and analysis of the data drafted the manuscript, critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript; Marowa A. Al-Zidaneen helped conceive of the study and contributed to collection of the data.

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