http:// ijp.mums.ac.ir
Original Article (Pages: 9759-9772)

Investigation of some Factors Affecting Stunting and Wasting among the Under-Five Children in Eastern Mediterranean Region

Ali Almasi[1], *Shahram Saeidi[1], Alireza Zangeneh[1], Arash Ziapour[2], Maryam Choobtashani[3], Fariba Saeidi[3], Mohammad Reza Salahshoor[4], Farbod Ebadi Fard Azar[5]

[1]Social Development & Health Promotion Research Center, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran. [2]Ph.D Student, Health Education and Health Promotion, Kermanshah University of Medical Sciences, Kermanshah, Iran. [3]Kermanshah University of Medical Sciences, Kermanshah, Iran. [4]Department of Anatomical Sciences, Medical School, Kermanshah University of Medical Sciences, Kermanshah, Iran. [5]Department of Education and Health Promotion, School of Health, Iran University of Medical Sciences, Tehran, Iran.

Abstract

Background: Stunting and wasting, as two key health indexes in any society, are two major factors in children's physical and mental growth in the future, especially in developing countries. We aimed to investigate some factors affecting stunting and wasting among the under-five children in Eastern Mediterranean Region (EMR).

Materials and Methods: The statistical population of the present study consisted of the under-five children suffering from stunting and wasting in the EMR and natural factors from the website of World Meteorological Organization (WMO), based on the secondary data in the period 2005-2016. After that, the maps were extracted using the Geographical Information System (GIS). Finally, for data analysis, the regression, path analysis and cluster analysis techniques were employed in the SPSS Statistical Software (version 23.0).

Results: The highest rates of stunting were in Yemen, Afghanistan, Pakistan, and Sudan, whereas Djibouti, Yemen, Somalia and Sudan had the highest rates of wasting. Accordingly, the children's stunting was affected by their wasting (Beta=0.918), and reproductive, maternal, newborn and child health interventions economic status (Direct Impact= -0.323, R= 0.865, R2= 0.748, ADJR2=0.720, P<0.05). It was also observed that life expectancy at birth (Beta= -0.829, indirect impact= -0.323), average wind speed (Beta= -0.403, Indirect Impact= -0.369), prevalence of anemia in pregnant women (Beta=0.335, Indirect Impact= 0.307), births attended by skilled health personnel (Beta=0.226, Indirect Impact= 0.207), had indirect effects on the wasting of children.

Conclusion

Based on the results, five variables affected the children's stunting and wasting including reproductive, maternal, economic status, life expectancy at birth, average wind speed, prevalence of anemia in pregnant women, and births attended by skilled health personnel.

Key Words: Climate, Eastern Mediterranean Region, Stunting, Wasting.

*Please cite this article as: Almasi A, Saeidi Sh, Zangeneh A, Ziapour A, Choobtashani M, Saeidi F, et al. Investigation of some Factors Affecting Stunting and Wasting among the Under-Five Children in EasternMediterranean Region. Int J Pediatr 2019; 7(7): 9759-72. DOI: **10.22038/ijp.2019.40074.3403**

Corresponding Author:

Shahram Saeidi, Social Development and Health Promotion Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran.

Email: saedishahram@yahoo.com

Received date: Jan.15, 2019; Accepted date: Apr. 22, 2019

1- INTRODUCTION

Stunting, wasting and malnutrition, as the key health indexes in any society, are three major factors in children's physical and mental growth in the future (1), because wasting and malnutrition are among the most common causes of mortality in the under-five children worldwide (2). According to the World Health Organization (WHO), around 151 million children were suffering from malnutrition in the year 2017 (3), and within 2005-2016, 7.7% of children globally and 9.1% of children in the Eastern Mediterranean Region (EMR) were wasting (4). For example, 39% and 55% of malnourished children were short in stature in Africa and Asia, respectively (3). Malnutrition in developing and underdeveloped countries is referred to as "developmental deterrence syndrome", which encompasses a wide range of disorders such as growth impairment, delayed mental, brain and behavior development, increased disability and even mortality, thus rendering children unable to achieve their proper physical and mental abilities in the next periods of their lives (5). The results of other studies indicate that stunting, wasting and malnutrition are associated with biological, social and economic factors, health, poverty, education, and lack of appropriate access to health services (6-8).

Moreover, research has it that the levels of stunting, wasting and malnutrition are different in different geographical areas under different social-cultural conditions (9), since the patterns of food intake, cultural beliefs and access to health care vary in different regions. According to the results of separate studies conducted in Indonesia (10), and Vietnam (11), some differences exist between malnutrition in rural and urban children. Additionally, in a study performed in Nairobi, it was demonstrated that malnutrition in children born to illiterate mothers was four times higher than those born to mothers with higher education (12). On the other hand, in a study done in India, the difference between children born in wealthy and poor families was reported in terms of wasting (13). Monitoring the children's growth in a desirable health system is an essential part of everyday health care, and the timely identification of undernourished children without clinical symptoms is primarily important in defining a useful and effective program for the prevention of malnutrition (14), which requires up-to-date knowledge and information. To realize this goal, the use of modern information technology can be very effective, and information technology is a powerful tool and the most important factor in increasing the efficiency and effectiveness of health-related organizations (15). For instance, Geographical Information System (GIS) is one of the modern technologies that can be properly used towards health provision and promotion, health-related policymaking, and decision-making (16-18).

In addition to addressing the needs of all vulnerable groups, an efficient and effective health system should monitor the geographic areas under its coverage systematically and identify the progress of health projects and possibly the presence of new health issues in the shortest possible time. Maps, especially digital and computerized ones, play prominent roles in improving the efficiency of managerial decisions on health. Besides, GIS is one of the new technologies to facilitate the process of access to information, decision making about the system of health care and health promotion (19, 20).

In the meantime, performing spatial analysis using GIS is a method that can help identify high-priority areas and their effective factors. As reported in other studies, the spatial distribution and cluster analysis of wasting in children using GIS have been stressed (21, 22). As mentioned before, children form a vulnerable stratum

in all countries, especially in the EMR, that deserves more attention on the part of WHO and other relevant organizations due to their special conditions in the region, including the existence of proxy wars, terrorist groups and so forth (23). Hence, considering their health issues are of prime importance, the need for policies and programs to improve the nutritional status of children in the countries of this region is strongly felt. Furthermore, given the recommendations to conduct such studies based on the new WHO standards and given that some studies should be done on wasting , stunting and malnutrition regionally every few years (24); the present study aimed to investigate Health, Economic and Climatic Factors Affecting Stunting and Wasting among the under-five children in the countries in the Eastern Mediterranean Region (EMR).

2- MATERIALS AND METHODS

2-1. Study Design and Population

The statistical population of the present study consisted of the under-five children suffering from stunting and wasting in the EMR. To commence the study, the required data were first gathered through the official website of WHO (https://www.who.int/gho/publications/world_health_statistics/2017/whs2017_AnnexB.xlsx?ua=1), and Weather Geneva, Switzerland (https://www.accuweather.com/en/ch/geneva/313082/weather-forecast/313082). The indexes are provided by the WHO as an overall number for the period 2005 to 2016. It should be noted that the latest data of WHO was published to 2016. The initial data processing was conducted and a database was developed in Arc/GIS (version 10.6). After that, the data were entered into geographic information system (GIS) and the maps of stunting and wasting among the under-five children were extracted using some basic graphical statistical models. Finally, for data analysis, regression (Stepwise Method), path analysis and cluster analysis (Ward Method) were employed in the SPSS Statistical Software (version 23.0).

2-2. Methods

This cross-sectional study was conducted in the EMR for the period 2005 to 2016. In this study, prevalence of stunting in children under-five children (%), prevalence of wasting in children under-five children (%), births attended by skilled health personnel (%), current health expenditure (CHE), percentage of gross domestic product (GDP) (%), food safety, population using at least basic sanitation services (%), concentrations of fine particulate matter (PM2.5), neonatal mortality rate e (per 1000 live births), population using at least basic sanitation services (%), physicians density (per 1000 population), life expectancy at birth (years), nursing and midwifery personnel density (per 1000 population), infants exclusively breastfed for the first six months of life (%), reproductive, maternal, newborn and child health interventions economic status, early initiation of breastfeeding (%), prevalence of anemia in pregnant women (%), proportion of population using improved drinking-water sources (%) were reported.

Next, the indexes of natural factors, gathered through the official website of World Meteorological Organization (WMO), were average temperature, average high temperature, average low temperature, average precipitation, and average number of days with precipitation, average length of day, average relative humidity, average dew point and average wind speed. Based on the literature about the relationship between climatic variables, health and socio-economic evaluation was carried out in children with wasting. Also, wasting can play a role as an intermediate variable between the above variables and stunting, therefore, the path diagram was extracted. Considering

that the regression analysis only examines the direct effect of variables and it was not possible to calculate indirect effects, path analysis was used in this study. The indirect effect of variables was calculated by multiplying the coefficients of each path and in order to calculate the total effect of a variable on the other variable, it was obtained through the sum of the direct effect with the sum of its indirect effects.

3- RESULTS

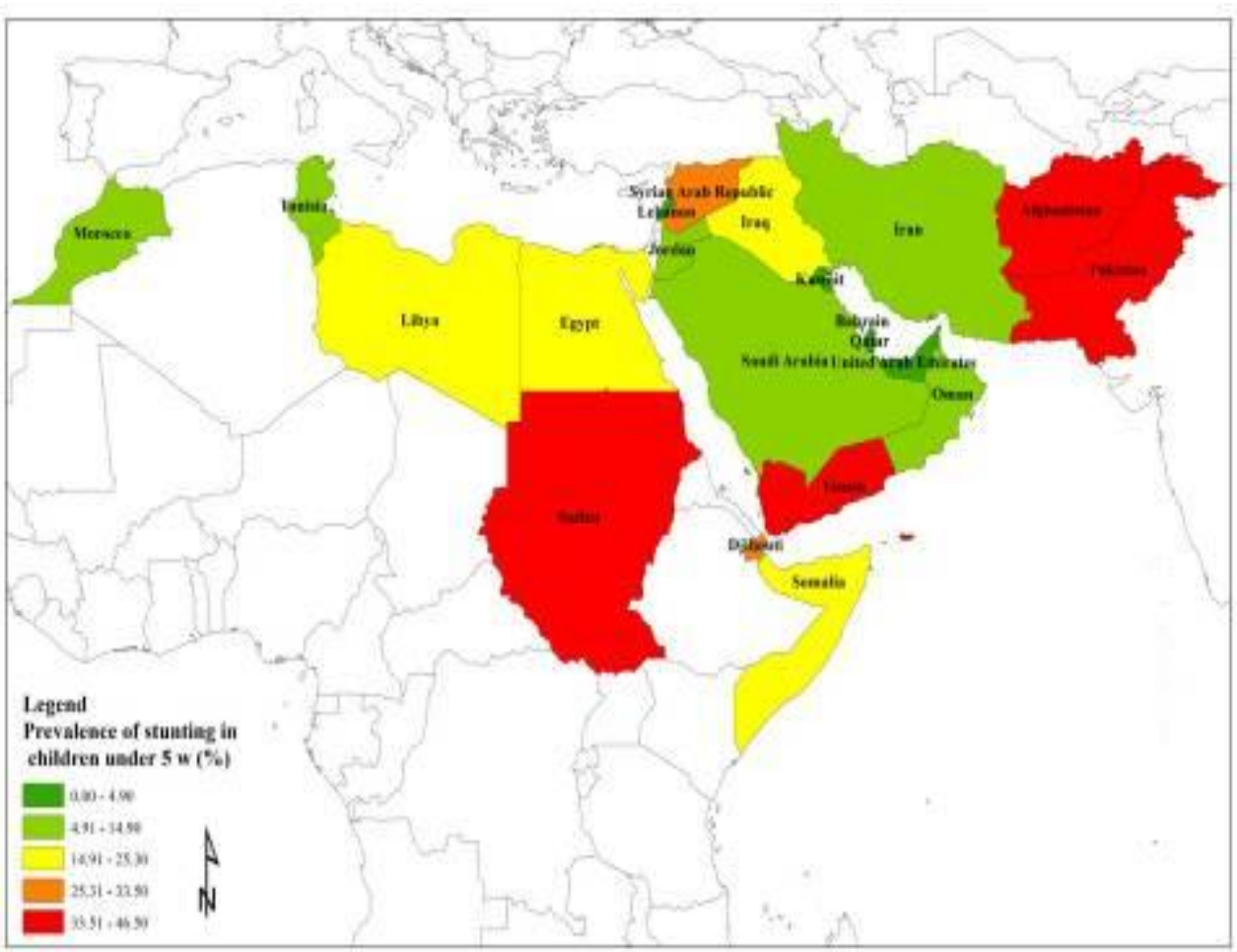
According to the findings of the present study, the highest percentages of stunting belonged to Yemen and Afghanistan while the lowest were in Kuwait and Iran. In terms of wasting, the results revealed that Djibouti and Morocco had the highest (21.5%), and lowest (2.3%) rates, respectively (**Table.1**).

Table-1: The Statistics on the Indices under Study in the EMR

Variables	Afghanistan	Bahrain	Djibouti	Egypt	Iran	Iraq	Jordan	Kuwait	Lebanon	Libya	Morocco	Oman	Pakistan	Qatar	Saudi Arabia	Somalia	Sudan	Syria	Tunisia	United Arab Emirates	Yemen
Prevalence of stunting in under-five-children (%)	40.9	-	33.5	22.3	6.8	22.1	7.8	4.9	-	21	14.9	14.1	45	-	9.3	25.3	38.2	27.5	10.2	-	46.5
Prevalence of wasting in under-five-children (%)	9.5	-	21.5	9.5	4	6.5	2.4	3.1	-	6.5	2.3	7.5	10.5	-	11.8	15	16.3	11.5	2.8	-	16.3
Births attended by skilled health personnel (%)	50.5	99.7	87.4	91.5	99	70.4	99.6	99.9	0	99.9	73.6	99.7	55	99.9	98	9.4	77.7	96.2	73.6	99.9	44.7
Current health expenditure (CHE) as percentage of gross domestic product (GDP) (%)	9.4	4.1	5.1	5.6	3.2	7.2	10.1	12.2	9.3	9.9	7.6	9.9	3.2	10.4	10.1	9.3	3.9	0	6.6	3.5	5.7
Food safety	24.7	88.2	63.5	84.8	88.2	61.6	87.7	91.6	75.6	76.7	94.7	84.1	44.1	81.8	94.1	0	40	72.8	75.1	81.8	34.7
Population using at least basic sanitation services (%)	30.9	100	51	92.8	87.8	81.1	97.8	100	83.9	100	76.4	94	45.1	87.1	99.2	19.5	26	93	87	100	49.6
Concentrations of fine particulate matter (PM2.5)	53.2	69	40.4	79.3	15.6	35.1	11.4	10.5	12.7	17.2	20.2	7	38.2	7.9	25.7	10.7	15.2	39.4	35.7	39.4	45
Neonatal mortality rate e (per 1000 live births)	35.5	1.1	33.4	12.8	9.5	18.4	10.6	3.2	4.8	7.2	17.6	5.2	45.5	3.8	7.9	39.7	29.8	7	8.2	3.5	22.1
Population using at least basic sanitation services (%)	30.9	100	51	92.8	87.8	81.1	97.8	100	83.9	100	76.4	94	45.1	87.1	99.2	19.5	26	93	87	100	49.6
Physicians' density (per 1000 population)	0.2	0.9	0.1	1.5	1.1	0.7	2.2	1.9	1.8	1.6	0.5	1.5	0.7	2.8	1.8	-	0.2	1.4	0.7	0.4	0.2
Life expectancy at birth b (years)	60.5	76.9	63.5	70.9	75.5	68.9	74.1	74.7	74.9	72.7	74.3	76.6	66.4	78.2	74.5	55	64.1	64.5	75.3	77.1	65.7
Nursing and midwifery personnel density (per 1000 population)	0.2	2.3	0.4	0.5	1.4	1.8	3.2	5.5	1.4	5.5	0.6	3.6	0.3	5.7	3.5	0.1	1.1	1.4	2.4	3.3	0.4
Infants exclusively breastfed for the first six months of life (%)	43.1	0	12.4	48.2	48.6	18.8	24.1	0	0	0	34.9	32.8	35.9	29.3	0	7.8	47.8	35.5	10.9	0	13.1
Reproductive, maternal, newborn and child health interventions Economic status	48.5	-	-	-	-	64.3	71.9	-	-	-	62.4	-	51.8	-	-	-	50.1	-	84.1	-	44.8
Early initiation of breastfeeding (%)	40.9	0	0	27.1	68.7	42.8	18.6	0	41.3	0	26.8	71.1	18	33.5	0	23.4	68.7	45.5	39.9	23.2	52.7
Prevalence of anemia in pregnant women (%)	38.2	42.8	37.6	22.6	34.1	33.5	37.1	31.2	35.2	38	40.4	41.8	51.3	33.4	45.5	46.8	34.1	36.1	36.7	33.2	63
Proportion of population using improved drinking-water sources (%)	55	100	90	99	96	87	97	99	99	-	85	93	91	100	97	-	-	90	98	100	-

Average Temperature (C)	14	26	30	21	62.8	22	17	26	20	20	17	28	21	27	26	27	26.7	17.5	18	27	20
Average High Temperature (C)	22.1	29	32	27	75.2	30	22	32	22	26	21	32	26	31	32	28	33.7	23.3	23	32	25
Average Low Temperature (C)	7.9	23	28	16	47.8	15	12	20	16	14	13	25	16	22	20	26	21.3	12.2	13	22	15
Average Precipitation (mm)	351.6	70	0	20	342.7	150	270	0	860	340	540	150	1090	80	100	410	1041.6	343.5	440	160	0
Average Number of Days With Precipitation (Days)	270	0	17	17	33.9	0	57	46	80	52	69	24	91	80	26	75	84.8	39	104	28	28
Average Length of Day (Hours)	12.6	12.6	12.5	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.5	12.6	12.6	12.5	12.5	12.5	12.6	12.7	12.6	12.5
Average Relative Humidity (%)	35	56	74	59.2	32.7	27	57.9	25	68.8	63.8	66	61.7	62.1	68.8	29.2	70	57.6	54.2	71.3	58.8	27
Average Dew Point (C)	0	18	21	11	33	6	9.8	6	13	12	13	18	11	16	1	22	17.8	5	12	9.7	3
Average Wind Speed (km/h)	12	20	14	12	18.6	14	16	19	12	14	9	12	9	19	14	25	7.2	14	16	14	17

In **Figure.1**, the spatial distribution of the indexes of stunting and wasting of children in the EMR is presented. Accordingly, as can be seen, the highest rates of stunting were in Yemen, Afghanistan, Pakistan, and Sudan whereas Djibouti, Yemen, Somalia and Sudan had the highest rates of wasting in the under-five children.



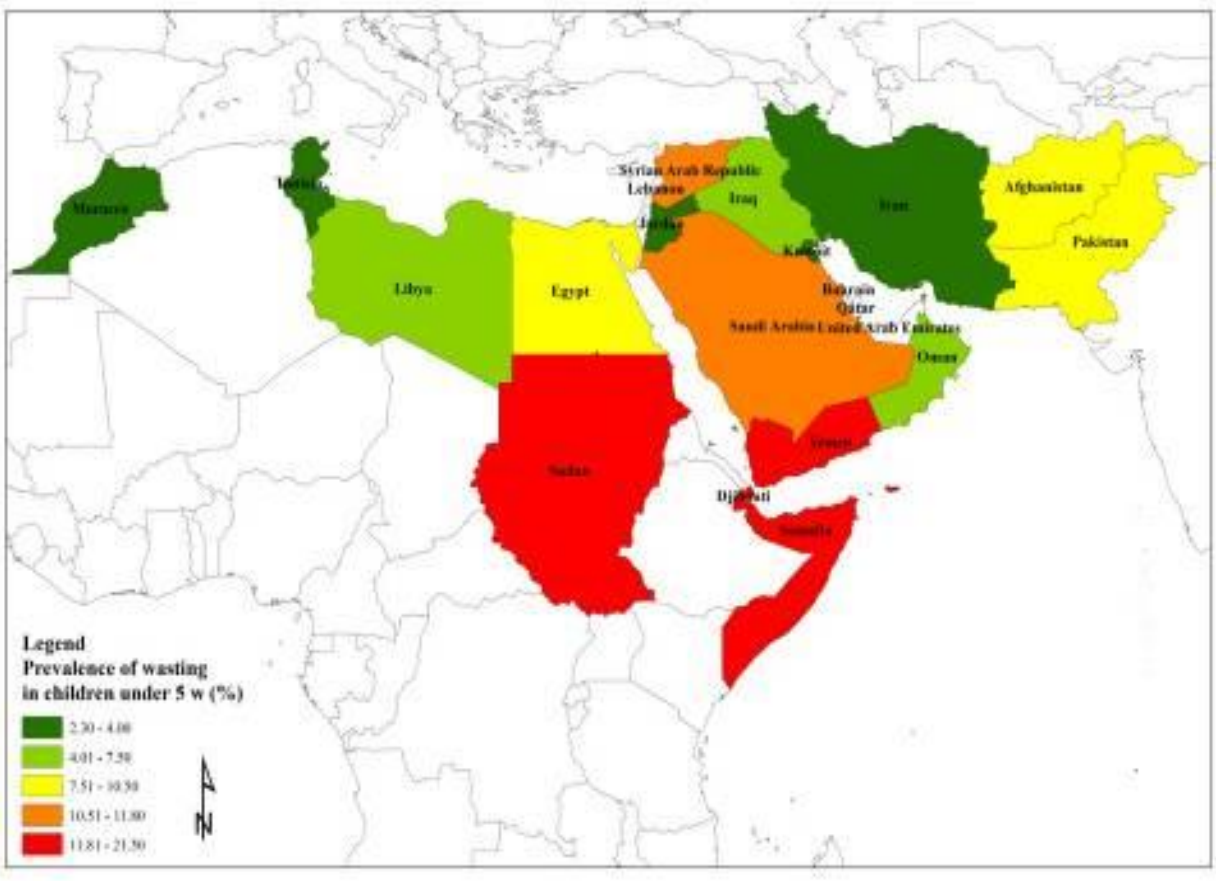


Fig.1: The Spatial Distribution of the Indexes of Stunting (A), and Wasting (B) among children in the Eastern Mediterranean Region.

In **Figure.2**, the status of cluster analysis in the EMR based on the two indices of stunting and wasting is shown. For each of the indices under study, three clusters were obtained. The first cluster included (Yemen, Sudan, Djibouti, Afghanistan, Pakistan), the second cluster comprised (Bahrain, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, United Arab Emirates, Tunisia), and the third cluster, consisted of (Somalia, Libya, Iraq, Egypt, Syrian Arab Republic) (**Figure.2**). Of the 25 variables in the regression model, only five variables remained (**Table.2**). Accordingly, the children's stunting was affected by their wasting (Beta=0.918), in addition, the children's stunting was affected by reproductive, economic status (R=0.865, R2=0.748, ADJR2=0.720, P<0.05). Moreover, the children's wasting was influenced by life expectancy at birth (Beta=-0.829), average wind speed (Beta=-0.403), prevalence of anemia in pregnant women (Beta=0.335), and births attended by skilled health personnel (Beta=0.226) (R=0.943, R2=0.889, ADJR2=0.861, P<0.05).

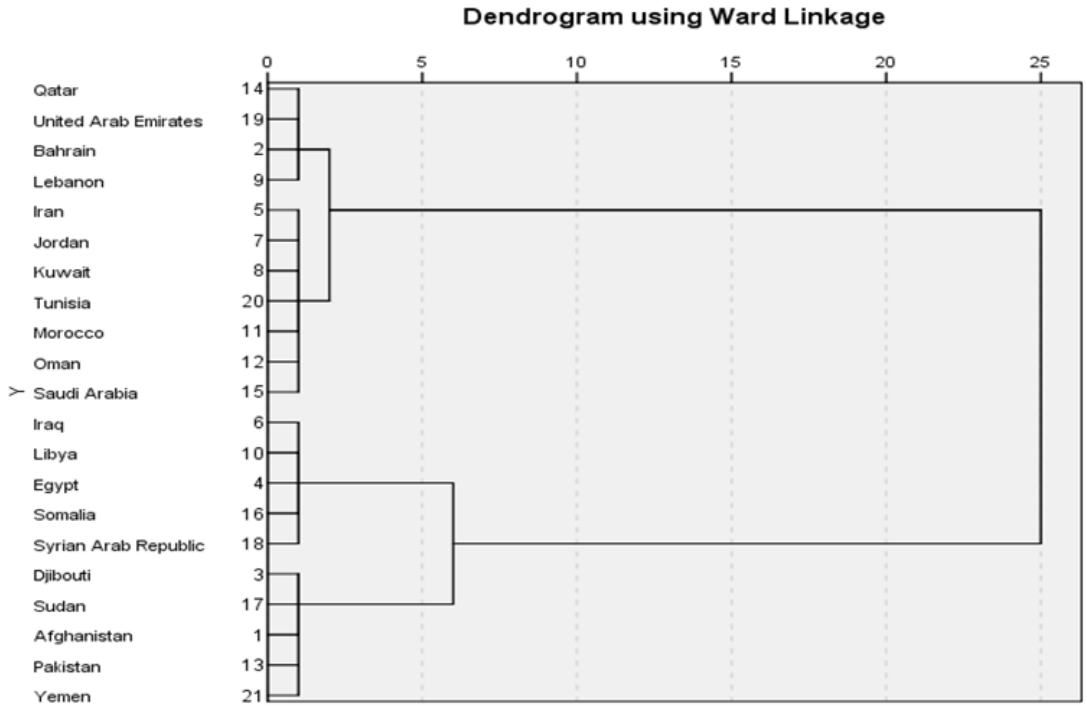


Fig.2: The Ward's Cluster Analysis of Stunting and Wasting in Children in the Eastern Mediterranean Region.

Table-2: Results of Regression Analysis about the Factors in Prevalence of stunting in under-five children in the EMR (2005–2016).

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t-test	P-value
		B	Std. Error	Beta		
a	(Constant)	2.012	1.185		1.698	.107
	Prevalence of wasting in children under 5 w (%)	.375	.051	.918	7.308	.000
	Reproductive, maternal, newborn and child health interventions Economic status	-.066	.026	-.323	-2.570	.019
b	(Constant)	148.110	18.286		8.099	.000
	Life expectancy at birth	-1.993	.239	-.829	-8.358	.000
	Average Wind Speed	-1.489	.310	-.403	-4.797	.000
	Prevalence of anemia in pregnant women	.626	.171	.335	3.666	.002
	Births attended by skilled health personnel	.116	.052	.226	2.217	.041
a. Dependent Variable= Prevalence of stunting in children under 5 w R= 0.865 R^2= 0.748 ADJR^2=0.720						
b. Dependent Variable= Prevalence of wasting in children under 5 w R=0.943 R^2=0.889 ADJR^2=0.861						

The results of path analysis revealed that children's stunting was directly affected by reproductive, maternal, economic status (Direct Impact=-0.323); while being affected indirectly by other variables such as life expectancy at birth (Indirect Impact=-0.323), average wind speed (Indirect Impact=-0.369), prevalence of anemia in pregnant women (Indirect Impact= 0.307), births attended by skilled health personnel (Indirect Impact=0.207) (**Table.3 and Figure.3**).

Table-3: Total Direct and Indirect Effects of the Variables Entered into the Model in under-five children in the EMR (2005 – 2016).

Prevalence of stunting in children under-five-children (%)	Direct impact	Indirect effect	Total impact
Reproductive, maternal, economic status	-0.323	-0.308	-0.631
Life expectancy at birth	-	-0.761	-0.761
Average Wind Speed	-	-0.369	-0.369
Prevalence of anemia in pregnant women	-	0.307	0.307
Births attended by skilled health personnel	-	0.207	0.207

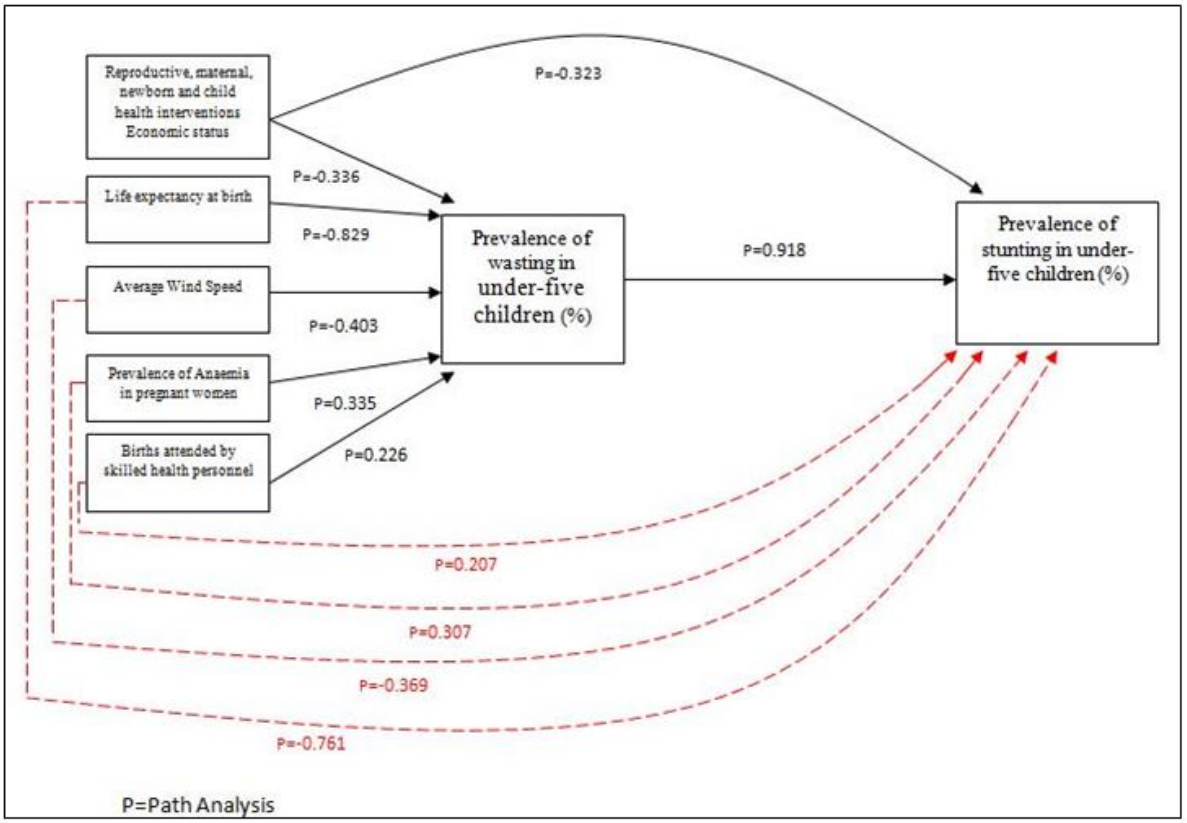


Fig. 3: Diagram of the Factors Affecting the Children's Stunting and Wasting in the Eastern Mediterranean Region.

4- DISCUSSION

The present article was the first study to investigate stunting and wasting among the under-five children in the EMR. The results of the present study demonstrated that the average prevalence of stunting and wasting among the under-five children in the EMR was higher than the global average level, but still far from those in developed countries. The present study aimed to contribute to the reduction of the prevalence of stunting and wasting among the under-five children in the region through identifying the status of the EMR. Our findings revealed that the prevalence of stunting among the countries of EMR was variable, with Yemen (46.5%), and Afghanistan (40.9%) having the highest percentages, while Kuwait (4.9%), and Iran (6.8%) have the lowest percentages. It is worth mentioning that in Yemen, almost one in two children is short in stature, which has been pointed out in a study conducted by Tran et al. (2019) (25).

Moreover, the results of the present study indicated that the prevalence of stunting among the countries of EMR (25.1%) exceeded that of the global average level (22.9%). This finding was consistent with the results of studies done by Yalew et al. (2014)(2), and Assefa et al. (2013) (26). Although stunting is observed in both poor and rich countries, there are significant differences between their rates and percentages of prevalence. For example, the prevalence of stunting in developed, African and Southeast Asian countries is 6.35%, 33.5% and 33.8%, respectively.

This may be a reflection of the economic problems, civil wars and armed conflicts in the EMR, as pointed out in a study performed by Tran et al. (2018) on the effects of these factors on children's stunting in Africa and Southeast Asia (25). Another factor which affects the stature of children is their non-sanitary place of residence (27), which has caused the EMR to become an unfavorable environment for children's health and well-being. Therefore, this situation is inconsistent with the goals of global organizations such as UNICEF, in which the availability of suitable environments for children is stressed (28). As for the prevalence of wasting, the results of the present study demonstrated that, Djibouti (21.5%), Yemen and Sudan (16.3%) had the highest percentages, as opposed to Jordan (2.4%) and Morocco (2.3%) with the lowest percentages. These findings were concurrent with the results of studies conducted in Southeast Asia (29, 30), and Africa (2, 12).

It should be noted that the prevalence of wasting in the EMR was lower than that in those regions, which seems to be due to their income and welfare conditions. For instance, Oreskovic et al. (2009) reported that wasting was prevalent in low-income cities (31). Moreover, the future of children can be influenced by wasting. For example, the results of studies performed on 17,506 American children have demonstrated that wasting results in the poor performance of children (32). Similarly, the results of studies conducted in Bangladesh have shown that wasting can cause adverse side effects on children's physical functioning, such as kidney failure (33), and teeth problems (34). According to the results of maps extracted from the GIS environment and spatial distribution of stunting and wasting, it was observed that Yemen, Afghanistan, Pakistan and Sudan had the highest percentages of stunting in children. On the other hand, the highest rates of wasting in children were reported for Djibouti, Yemen, Somalia and Sudan. Besides, the results of cluster analysis revealed that there were three clusters in the EMR for stunting and wasting.

The first cluster included (Yemen, Sudan, Djibouti, Afghanistan, Pakistan), the second cluster comprised (Bahrain, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, United Arab Emirates, Tunisia), and the third cluster consisted of (Somalia, Libya, Iraq, Egypt, Syrian Arab Republic). These findings were consistent with the results of a study done by Hughey et al. (2018), in which the spatial cluster analysis of children's wasting was conducted in Southeast United States; in their research, the wasting clusters were identified using the GIS software (Index = 0.04, $p < 0.001$), and their cluster analysis was associated with the level of urbanization in Eastern USA (35). As mentioned earlier, around 7.7% of children worldwide and 9.1% of the EMR are wasting. Besides, the results of comparing the statistics were indicative of the huge difference between the Eastern Mediterranean countries and each of North American (0.9%), and European countries (1.5%). However, the results of comparing this region with developing countries were indicative of this region's better situation compared to Southeast Asia (15.3%) (3).

Based on the results extracted from the model, with a rise in life expectancy at birth and reproductive, maternal, newborn and child health interventions economic status, there will be a decrease in stunting and wasting of children. This finding was concurrent with the results of studies done by Meshram et al. (2019) (36), and Zadka et al. (2019) (37). In the former, the Indian children's wasting and their low socioeconomic status were investigated (36), and in the latter, the Polish children's wasting was studied (37). It should be noted that improving the socioeconomic status of families can enhance the maternal nutrition during pregnancy, thus reducing wasting in children (36). The results of the present study also revealed that anemia in pregnant women was another variable that affected the wasting and stunting of children. This finding was consistent with the results of a study conducted by Chang et al. (2013), in which the effects of mother's anemia on Chinese children's mental development were pointed out (38).

Other studies have also shown that anemia in mothers can lead to anemia (39), and death in children (40). It must be mentioned that, in this study, other than the average wind speed, other climatic variables had no significant effects on children's wasting and stunting. In contrast, Ishida et al. (2014) (41) expressed that children's wasting and stunting were relatively affected by climatic variables, and Aguilera et al. (2009) (42), and Gong et al. (2018) (43) reported that children's wasting was influenced by all air pollutants. Accordingly, when comparing these results with those reported in studies conducted by Ishida et al. (2014) (41), Aguilera et al. (2009), and Gong et al. (2018), they should be treated with more caution. In this regard, the type of variables under study can be regarded as one of the justifications for this contradiction.

For example, Aguilera et al. (2009), and Gong et al. (2018) investigated the effects of pollutants on mother's pregnancy and children's wasting while in the present research, the effects of temperature, precipitation, humidity, and so on were studied. Although the climatic variables did not correlate with children's wasting and stunting, climate change could still be seen as a significant variable. As Lloyd et al. (2011) (44) predicted, due to climate change, there will be a 62% and 55% in children's wasting and stunting in South Asia and Eastern and Southern Africa by 2050, respectively. Hence, this situation can result in a 6.1-fold increase in child mortality (45).

According to the findings of the present study, children's stunting and wasting are affected by the variable of child delivery with the help of skilled health staff. This finding was consistent with the results of studies conducted by Akombi et al. (2017) (6), and Pramod Singh et al. (2009) (7). Children's wasting can be under the influence of many other factors as well, including biological factors (e.g., mother's age, pregnancy, the interval between births, preterm delivery, physical violence, diseases and parent's education), social and economic factors and health care (1, 7, 10, 14). Furthermore, children's wasting is also related to their age. As children gradually become less dependent on breast milk and become increasingly dependent on complementary foods, they are more likely to be exposed to infections, which are mostly found in war-stricken countries (46, 47).

4-1. Study Limitations

It should be mentioned that there were several limitations in the present study. First, given the lack of access to gender information, age of children and factors such as maternal age, pregnancy, interval between births and preterm labor, the effects of these variables could not be measured on children's stunting and

wasting. Second, given the lack of access to the data on children's stunting and wasting on a yearly basis on the official website of WHO, the year by year trends of these two variables in the Mediterranean countries were not assessed. Therefore, it is suggested that these statistics be recorded individually and annually at country levels towards better policymaking in this respect. In the end, it is recommended that some health plans be considered for each separate cluster relating to children's stunting and wasting based on the conducted clustering.

5- CONCLUSION

The results of the present study about the under-five children revealed that the highest rates of stunting were in Yemen, Afghanistan, whereas Djibouti and Morocco had the highest rates of wasting. Moreover, the results of cluster analysis in the EMR based on the two indices of stunting and wasting identified three clusters. In other words, the first cluster was located in (Yemen, Sudan, Djibouti, Afghanistan, Pakistan), the second cluster was in (Bahrain, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, United Arab Emirates, Tunisia), and the third cluster was based in (Somalia, Libya, Iraq, Egypt, Syrian Arab Republic). Moreover, of the 25 variables in the model, only five variables affected the children's stunting and wasting (reproductive, maternal, newborn and child health interventions economic status, life expectancy at birth, average wind speed, prevalence of anemia in pregnant women, and births attended by skilled health personnel). Finally, the stunting and wasting of children in the EMR require more attention on the part of health authorities and policymakers. In addition, some coordinated policies are required for both of the said indices in children because their stunting is directly affected by wasting.

6- CONFLICT OF INTEREST: None.

7- ACKNOWLEDGMENTS

The authors hereby bestow their gratitude to the staff of Kermanshah health center and the vice chancellery for treatment of Kermanshah University of Medical Sciences for their spiritual and financial support.

8- REFERENCES

1. Khalilian AR, Hamta A, Farhadi R, Ranjbaran H. Investigation factors of low birth weight infants with structural equation model approach. Journal of Mazandaran University of Medical Sciences. 2012;21(86):108-14.

2. Yalew B, Amsalu F, Bikes D. Prevalence and factors associated with stunting, underweight and wasting: A community based cross sectional study among children age 6-59 months at Lalibela Town, Northern Ethiopia. J Nutr Disorders Ther. 2014;4(147):2161-0509.1000147.

3. Organization WH. Global hunger continues to rise new UN report says 2018 [Available at: http://www.who.int/news-room/detail/11-09-2018-global-hunger-continues-to-rise---new-un-report-says.

4. Organization WH. World Health Statistics 2017: Annex B 2018 [Available at: http://who.int/entity/gho/publications/world_health_statistics/2017/en/index.html.

5. Gholami A, Shorvarzi L, Rastegari A, Taghavi Rad A. Prevalence of underweight among rural children aged 3 to 6 year old in Neyshabur. J Neyshabur Univ Med Sci. 2014;1(1):10-3.

6. Nazari B, Bakhshi S, Kaboudi M, Dehghan F, Ziapour A, Montazeri N. A Comparison of Quality of Life, Anxiety and Depression in Children with Cancer and Healthy Children, Kermanshah-Iran. International Journal of Pediatrics. 2017;5(7):5305-14.

7. Akombi BJ, Agho KE, Merom D, Hall JJ, Renzaho AM. Multilevel analysis of factors associated with wasting and underweight among children under-five years in Nigeria. Nutrients. 2017;9(1):44-52.

8. Pramod Singh G, Nair M, Grubesic RB, Connell FA. Factors associated with underweight and stunting among children in rural Terai of eastern Nepal. Asia Pacific Journal of Public Health. 2009;21(2):144-52.

9. Conklin AI, Ponce NA, Crespi CM, Frank J, Nandi A, Heymann J. Economic policy and the double burden of malnutrition: cross-national longitudinal analysis of minimum wage and women's underweight and obesity. Public health nutrition. 2018;21(5):940-7.

10. Soheylizad M, Ayubi E, Mansori K, Gholamaliee B, Sani M, Khazaei S, et al. Human development and related components with malnutrition in children: A global ecological study. International Journal of Pediatrics. 2016;4(8):2299-305.

11. Hoseini BL, Emami Moghadam Z, Saeidi M, Rezaei Askarieh M, Khademi G. Child malnutrition at different world regions in 1990-2013. International Journal of Pediatrics. 2015;3(5.1):921-32.

12. Poulimeneas D, Grammatikopoulou MG, Dimitrakopoulos L, Kotsias E, Gerothanasi D, Kiranas ER, et al. Regional differences in the prevalence of underweight, overweight and obesity among 13-year-old adolescents in Greece. International Journal of Pediatrics and Adolescent Medicine. 2016;3(4):153-61.

13. Pradhan A. Factors associated with nutritional status of the under five children. Asian Journal of Medical Sciences. 2010;1(1):6-8.

14. Hien NN, Hoa NN. under Three Years of Age in Nghean, Vietnam. Pakistan Journal of Nutrition. 2009;8(7):958-64.

15. Abuya BA, Ciera J, Kimani-Murage E. Effect of mother's education on child's nutritional status in the slums of Nairobi. BMC pediatrics. 2012;12(1):80-89.

16. Sengupta P, Philip N, Benjamin A. Epidemiological correlates of under-nutrition in under-5 years children in an urban slum of Ludhiana. Health and Population: Perspectives and Issues. 2010;33(1):1-9.

17. Ramazanpour M, Akaberi A, Khoshnoud Ostad E, Shoraka H. Investigation into malnutrition prevalence rate and effective factors on under–five–year–old children in Maneh–Semelghan city (2012-2013). J North Khorasan Univ Med Sci. 2013;5(2):365-73.

18. Reshadat S, Saedi S, Zangeneh A, Ghasemi S, Gilan N, Karbasi A, et al. Spatial accessibility of the population to urban health centres in Kermanshah, Islamic Republic of Iran: a geographic information systems analysis. EMHJ-Eastern Mediterranean Health Journal. 2015;21(6):389-95.

19. Khademi N, Reshadat S, Zanganeh A, Saeidi S, Ghasemi S, Zakiei A. Identifying HIV distribution pattern based on clustering test using GIS software, Kermanshah, Iran. HIV & AIDS Review. 2016;15(4):147-52.

20. Khademi N, Reshadat S, Zangeneh A, Saeidi S, Ghasemi S, Rajabi-Gilan N, et al. A comparative study of the spatial distribution of HIV prevalence in the metropolis of Kermanshah, Iran, in 1996− 2014 using geographical information systems. Hiv medicine. 2017;18(3):220-4.

21. Reshadat S, Zangeneh A, Saeidi S, Izadi N, Ghasemi SR, Rajabi-Gilan N. A Feasibility Study of Implementing the Policies on Increasing Birth Rate with an Emphasis on Socio-economic Status: A Case Study of Kermanshah Metropolis, Western Iran. Social Indicators Research. 2018;140(2):619-36.

22. Reshadat S, Zangeneh A, Saeidi S, Teimouri R, Yigitcanlar T. Measures of spatial accessibility to health centers: investigating urban and rural disparities in Kermanshah, Iran. Journal of Public Health. 2018:1-11 In press.

23. Reshadat S, Saeidi S, Zangeneh A, Ziapour A, Choobtashani M, Saeidi F. A Study of Children's Geographic Access to Health Services (Health Care Centers and Clinical Laboratories) in Kermanshah City, Iran. International Journal of Pediatrics. 2018;6(2):7241-51.

24. Hasan MT, Mamun AA, Williams GM, Magalhães RJS. Spatiotemporal heterogeneity of malnutrition indicators in children under 5 years of age in Bangladesh, 1999–2011. Public health nutrition. 2018;21(5):857-67.

25. Dalyot K, Dalyot S. Towards the Use of Crowdsourced GIS Data to Georeference Child Well-Being Globally. Social Indicators Research. 2018;139(1):185-204.

26. Zohreh Poustinchi, Pazan M. The Pattern of Crisis Management in the Light of the Middle East's Identical Gaps. World Politics. 2014;2(4):133-59.

27. Fesharakinia A, Sharifzadeh G. Prevalence of malnutrition in under 5-year old children in Birjand city in 2011. Journal of Birjand University of Medical Sciences. 2013;20(1):77-84.

28. Tran TD, Biggs B-A, Holton S, Nguyen HTM, Hanieh S, Fisher J. Co-morbid anaemia and stunting among children of pre-school age in low-and middle-income countries: a syndemic. Public health nutrition. 2019;22(1):1-9.

29. Assefa H, Belachew T, Negash L. Socioeconomic factors associated with underweight and stunting among adolescents of Jimma Zone, south west Ethiopia: a cross-sectional study. ISRN Public Health. 2013;2013.

30. Owino V, Ahmed T, Freemark M, Kelly P, Loy A, Manary M, et al. Environmental enteric dysfunction and growth failure/stunting in global child health. Pediatrics. 2016;138(6):e20160641.

31. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian S. Anaemia in low-income and middle-income countries. The Lancet. 2011;378(9809):2123-35.

32. Ahmed T, Mahfuz M, Ireen S, Ahmed AS, Rahman S, Islam MM, et al. Nutrition of children and women in Bangladesh: trends and directions for the future. Journal of health, population, and nutrition. 2012;30(1):1-11.

33. Agho KE, Inder KJ, Bowe SJ, Jacobs J, Dibley MJ. Prevalence and risk factors for stunting and severe stunting among under-fives in North Maluku province of Indonesia. BMC pediatrics. 2009;9(1):64-71.

34. Oreskovic NM, Kuhlthau KA, Romm D, Perrin JM. Built environment and weight disparities among children in high-and low-income towns. Academic pediatrics. 2009;9(5):315-21.

35. Miller S, DeBoer M, Scharf R. Executive functioning in low birth weight children entering kindergarten. Journal of Perinatology. 2018;38(1):98-106.

36. Ferdous F, Ma E, Raqib R, Wagatsuma Y. Birth weight influences the kidney size and function of Bangladeshi children. Journal of developmental origins of health and disease. 2018;9(4):386-94.

37. Abbass MM, Mahmoud SA, El Moshy S, Rady D, AbuBakr N, Radwan IA, et al. The prevalence of dental caries among Egyptian children and adolescences and its association with age, socioeconomic status, dietary habits and other risk factors. A cross-sectional study. F1000Research. 2019;8.

38. Hughey SM, Kaczynski AT, Porter DE, Hibbert J, Turner-McGrievy G, Liu J. Spatial clustering patterns of child weight status in a southeastern US county. Applied Geography. 2018;99:12-21.

39. Meshram II, Rao KM, Balakrishna N, Harikumar R, Arlappa N, Sreeramakrishna K, et al. Infant and young child feeding practices, sociodemographic factors and their association with nutritional status of children aged< 3 years in India: findings of the National Nutrition Monitoring Bureau survey, 2011–2012. Public health nutrition. 2019:1-11.

40. Zadka K, Pałkowska-Goździk E, Rosołowska-Huszcz D. Relation between Environmental Factors and Children's Health Behaviors Contributing to the Occurrence of Diet-Related Diseases in Central Poland. International journal of environmental research and public health. 2019;16(1):52-60.

41. Dadipoor S, Mehraban M, Ziapour A, Safari-Moradabadi A. Causes of Maternal Mortality in Iran: A Systematic Review. International Journal of Pediatrics. 2017;5(12):6757-5770.

42. Chang S, Zeng L, Brouwer ID, Kok FJ, Yan H. Effect of iron deficiency anemia in pregnancy on child mental development in rural China. Pediatrics. 2013:peds. 2011-3513.

43. Ntenda PA, Nkoka O, Bass P, Senghore T. Maternal anemia is a potential risk factor for anemia in children aged 6–59 months in Southern Africa: a multilevel

analysis. BMC public health. 2018;18(1):650-59.

44. Patel A, Prakash AA, Das PK, Gupta S, Pusdekar YV, Hibberd PL. Maternal anemia and underweight as determinants of pregnancy outcomes: cohort study in eastern rural Maharashtra, India. BMJ open. 2018;8(8):e021623.

45. Ishida H, Kobayashi S, Kanae S, Hasegawa T, Fujimori S, Shin Y, et al. Global-scale projection and its sensitivity analysis of the health burden attributable to childhood undernutrition under the latest scenario framework for climate change research. Environmental Research Letters. 2014;9(6):064014.

46. Aguilera I, Guxens M, Garcia-Esteban R, Corbella T, Nieuwenhuijsen MJ, Foradada CM, et al. Association between GIS-based exposure to urban air pollution during pregnancy and birth weight in the INMA Sabadell Cohort. Environmental health perspectives. 2009;117(8):1322-28.

47. Gong X, Lin Y, Bell ML, Zhan FB. Associations between maternal residential proximity to air emissions from industrial facilities and low birth weight in Texas, USA. Environment international. 2018;120:181-98.

48. Lloyd SJ, Kovats RS, Chalabi Z. Climate change, crop yields, and undernutrition: development of a model to quantify the impact of climate scenarios on child undernutrition. Environmental health perspectives. 2011;119(12):1817-26.

49. Black RE, Allen LH, Bhutta ZA, Caulfield LE, De Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. The Lancet. 2008;371(9608):243-60.

50. Megabiaw B, Rahman A. Prevalence and determinants of chronic malnutrition among under-5 children in Ethiopia. International Journal of Child Health and Nutrition. 2013;2(3):230-6.

51. Rahman A, Chowdhury S. Determinants of chronic malnutrition among preschool children in Bangladesh. Journal of Biosocial Science. 2007;39(2):161-73.