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The Relationship Between Socio-demographic Factors and the Prevalence of Childhood Obesity in Egypt

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علاقة العوامل الاجتماعية والديموجرافية وانتشار سمنة الأطفال في مصر

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Abstract

Due to the alarming status of childhood obesity in Egypt, this paper seeks to examine the association between socio-demographic factors and obesity among children from birth until those aged 18 years in Egypt. The study employs both qualitative and quantitative approaches to analyze this relationship by providing both descriptive and empirical analyses of childhood obesity, where a multivariate logistic regression model is estimated using the 2014 Demographic Health Survey (DHS) data. The findings of the study indicated that child age and gender, maternal nutritional status, place of residence, and the interaction of wealth and region among children aged less than 5 in certain regions were found to have a significant impact on childhood obesity. On the other hand, wealth score, maternal education, the interaction of wealth and region for children aged (5-18) years, and wealth and maternal education did not have a significant impact. Based on these results, it is recommended to work on impacting the food choices of Egyptian households to be healthier through spreading awareness among the different economic classes, whether rich or poor, and especially among women. Furthermore, policies should target promoting better and affordable access to healthier food choices, especially among the poorest segments of the population, along with encouraging physical activities within schools. Although several studies have investigated this relationship, to the best of the authors' knowledge, this is the first attempt to analyze this relationship for children from birth until those aged 18 years, using the 2014 DHS. Moreover, the study aimed at exploring the impact of the interaction between wealth and each of maternal education and place of residence on childhood obesity in Egypt.

Keywords: Childhood, obesity, Egypt, Demographic Health Survey, Logistic Regression

مستخلص

نظرًا للوضع المقلق لمعدلات سمنة الأطفال في مصر، تهدف هذه الدراسة إلى تحليل العلاقة بين العوامل الاجتماعية والديموجرافية ومعدلات السمنة بين الأطفال منذ الولادة وحتى سن 18 عامًا في مصر. تستخدم الدراسة كلًا من التحليل الوصفي والتطبيقي لتحليل هذه العلاقة؛ حيث تم تقدير نموذج الانحدار اللوجستي متعدد المتغيرات باستخدام بيانات المسح الصحي الديموجرافي في مصر لعام 2014. وأشارت نتائج الدراسة إلى أن عمر الطفل ونوعه، بالإضافة إلى حالة تغذية الأم، ومكان الإقامة، وتفاعل الثروة مع مكان الإقامة بين الاطفال الذين تقل أعمارهم عن خمس سنوات في مناطق معينة لهم تأثير معنوي على السمنة لدى الأطفال. كما أنه لم يكن للثروة، وتعليم الأم، وتفاعل الثروة ومكان الإقامة للأطفال الذين تتراوح أعمارهم ما بين (5 – 18) سنة من ناحية والثروة وتعليم الأم من ناحية أخرى تأثير معنوي. وبناءً على هذه النتائج، توصي الدراسة بالعمل على التأثير على الخيارات الغذائية للأسر المصرية لتكون أكثر صحة من خلال نشر الوعي بين الفئات الاقتصادية المختلفة سواء كانت غنية أو فقيرة، وخاصة بين النساء. علاوة على ذلك، ينبغي أن تستهدف السياسات تعزيز فرص أفضل وبأسعار معقولة للحصول على خيارات غذائية صحية، لا سيما بين السكان الأكثر فقرا، إلى جانب تشجيع الأنشطة البدنية بداخل المدارس. وعلى الرغم من أن العديد من الدراسات قد قامت بدراسة هذه العلاقة، على حد علم المؤلفين، فإن هذه الدراسة هي المحاولة الأولى لدراسة تلك العلاقة للأطفال منذ الولادة وحتى سن 18 عامًا باستخدام المسح الصحي الديموجرافي لعام 2014. وبالإضافة لذلك، قامت الدراسة باستكشاف تأثير التفاعل بين الثروة وكل من تعليم الأم ومكان الإقامة على سمنة الأطفال في مصر.

الكلمات الدالة: الأطفال، السمنة، مصر، المسح الصحي الديموجرافي، الانحدار اللوجستي

Introduction

Childhood obesity is an emerging global health problem worldwide, as recent estimates by the WHO in 2016 showed that around 41 million children under the age of 5 years were overweight or obese. In 2016, the prevalence of overweight and obesity among children aged (5-19) years increased from 4% in 1975 to more than 18% with more prevalence among boys compared to girls in around 124 million children. Children who suffer from obesity are most likely to experience psychological disorders, such as depression, anxiety, and low self-esteem. This shall increase the risk of their suffering from non-communicable diseases in adulthood, such as cardiovascular and metabolic illnesses, diabetes, and musculoskeletal diseases which might lead to disability and premature death (Di Cesare et al., 2019; World Obesity Federation, 2022a).

In Egypt, the nutritional aspect of children's well-being is gaining increasing importance, in light of the launching of the extension of the School Feeding Program in 2021 to provide meals to around 12.2 million public school students. Moreover, Egypt is committed to achieving the Sustainable Development Goals (SDGs) wherein the third goal is concerned with promoting good health and well-being[1] in which the risk of obesity could be positioned (Ralston et al.,2020; Sheldon, 2022).

The indicators provided by national and international sources point to an alarming status of obesity prevalence among children in Egypt. According to the Global Obesity Observatory, the probability of Egypt meeting the World Health Organization (WHO) target of "no increase in childhood obesity" in 2025 is only 2%. Furthermore, the risk score, postulated by the observatory, regarding having a high percentage of obese children in Egypt in the next decade is 9.5 on a scale of 11.

On the national level, the 2015 Egypt Health Issues survey indicated that obesity and overweight prevalence among the studied sample of males aged (15-19) years was 29.5%, compared to approximately 41.5% for females within the same age group (Ministry of Health and Population [Egypt], El-Zanaty and Associates, & ICF International, 2015a). Given the highlighted importance of the issue, this paper aims at examining the association

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[1] United Nations Department of Economic and Social Affairs – SDGs Goal three. Available at: https://sdgs.un.org/goals/goal3 (Accessed: 15 January, 2022).

between socio-demographic factors and obesity among children from birth until those aged 18 years in Egypt. The paper is structured as follows: The first section reviews the prevailing literature on the impact of different socio-demographic factors across different countries on childhood obesity. The second section discusses the methodology employed, the variables used, and the data sources. The third section provides a descriptive analysis of child obesity in Egypt. The fourth section displays the empirical results. The fifth section provides policy implications and the final section concludes the paper.

Literature review

The relationship between socio-demographic factors and childhood obesity has been studied extensively in both developed and developing countries using qualitative and quantitative approaches. Most of the studies have used the body mass index (BMI) as an indicator of obesity, while the socioeconomic indicators included a wide variety of factors, such as parental education, place of residence, child's origin, family size, parental age, parental occupation, child age, child sex, and family type,[2] among others.

In developed countries, Júlíusson et al. (2010) studied this relationship among Norwegian children during the period (2003-2006) using logistic regression, which revealed that prevalence was higher among primary school children with lower parental education, while parental employment status and single-parent families or origin were found to have no impact on children's obesity. Furthermore, the interaction between age and sex was found to have a significant impact on obesity, and it was more prevalent among girls aged (2-5) years compared to boys within the same age group.

Also, in Norway and using the same methodology, Andersen et al. (2005) explored the changes witnessed in fourth and eighth-grade children's overweight and obesity during the period (1993-2000). Obesity increased significantly across the study period among eighth-grade students, especially boys. Social class, time spent watching TV, or using the computer, and the frequency of having breakfast were found to be positively associated with obesity in contrast to the consumption of sweets.

In Switzerland, the socioeconomic determinants of overweight and obesity among public school children aged (5-14) years during the 2011-2012 school year were analyzed

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[2] Single or two-parent family.

using a multivariate logistic regression. Overweight and obesity were found to be highly prevalent among the selected sample, especially among girls, where the fastest increase in overweight and obesity was found between ages (1-5) years. Also, citizenship, place of residence, parental employment status, and socio-professional class were found to have a significant impact on a child's overweight and obesity (Jeannot et al., 2015).

Similarly, obesity was found to be more prevalent among girls in Portugal between March 2009 and January 2010, where the impact of socio-demographic factors on childhood overweight and obesity was analyzed among children aged (3-10) years using logistic regression. Childhood obesity among the studied sample was found to be significantly affected by parental occupation, education and obesity, physical activity, and eating while watching television (Bingham et al., 2013).

In contrast, obesity was found to be more prevalent among boys aged (10-12) years in Greece using a survey conducted during the period (October-May 2009). Using logistic regression, the mother's age, parental nutritional status, and father's occupation were found to be the key predictors of child obesity, while the place of residence did not have any impact on the latter (Farajian et al., 2012).

Similarly, in France, obesity was found to be more prevalent among boys aged (11-18) years from middle and high schools during the period (2004-2005). Low parental socioeconomic status, physical activity, and increased parental obesity played a key role in the obesity of children (Thibault et al., 2010)

Using the same methodology, obesity among 11-year-old boys and girls in the United Kingdom was negatively associated with maternal education, while it was negatively associated with the socioeconomic status of the family for the latter only. In contrast, in Brazil, obesity among similarly aged boys and girls was positively associated with maternal education, while it was negatively associated with the family's socioeconomic status for the former and positively associated with the latter (Matijasevich et al., 2009).

In the city of Catalonia in Spain, De Bont et al. (2020) studied the time trends associated with overweight and obesity in children and adolescents over the period (2006-2016) through employing a qualitative approach. During the study period, they found out that the

incidence rate of overweight and obesity was the highest among six to seven years old children, while it declined for children above 7. Also, obesity was more prevalent among children in urban areas (especially the most deprived areas in terms of employment and education) compared to rural areas and with non-Spanish nationality.

Regarding developing countries, quantitative analysis has been employed by most studies mainly through estimating multivariate logistic regression models in contrast to the situation in Egypt. Dieu et al. (2007) studied the socio-demographic factors associated with the overweight and obesity of 670 preschool children aged (4-6) years in the city of Ho Chi Minh in Vietnam in 2005 using univariate and multivariate Poisson regression analyses. Differences in the wealth index across different households did not have a significant impact on the prevalence of obesity. Parental weight, father's education, child's sex, duration of breastfeeding, higher birth weight, and shorter sleeping hours at night had a significant impact on obesity.

In Nigeria, obesity among 1,187 school pupils aged (6-11) years was found to be positively affected by gender, the family's socioeconomic status, and being a student at a private school (Adetunji et al., 2019).

The interaction between a father's higher education and the wealth index was found to have a significant impact on child obesity in China using a sample of fourth, fifth, and sixth-grade students from 26 elementary schools during the period (17 May-23 June, 2017), while mothers with the same level of education had no significant impact (Liu et al., 2018). Also, in China, Andegiorgish et al. (2011) found that parental obesity, physical activity, male gender, parental educational level, mother's history of gestational diabetes, birth weight, urban residence, motorized transportation, and eating junk food had a significant impact on the obesity of school children aged (7-18) years. In Turkey, using a sample of 165 adolescents aged (11-17) years, obesity was found to be significantly affected by gender, father's occupation, participation in physical activities in addition to food preferences, and the number of meals (Güven et al., 2008). Furthermore, obesity in Nepal was more prevalent among children aged (6-13) years if their families had less than 2 children, with a high level of income, belonged to an advantaged ethnic group and had a large weight at birth (Koirala et al., 2015).

In Egypt, the impact of the socio-demographic factors on child obesity has been extensively studied using a qualitative approach in most studies. Hassan et al. (2016) investigated this relationship among a sample of 154 children and adolescents aged (5-18) years during the period (2013-2016), using the qualitative approach to examine the relationship between the BMI of the child and his parents in relationship with the socioeconomic variables of the child. Obesity was found to be more prevalent in urban areas, and among children whose mothers are housewives, whereas overweight was more prevalent in rural areas and with the father's education of college or above.

The same relationship was analyzed at different governorate levels, such as Sohag, Alexandria, Assiut, Port Said, and Fayoum, among others. In Sohag, a studied sample of 711 school children aged (6-14) years during the period (February-May 2016), revealed that 14.6% of the sample was obese. Obesity was found to be more prevalent in urban areas compared to rural areas, among children with obese parents and a low level of maternal education. Diets without fresh vegetables and fruits and early life factors represented in formula feeding during the early years of life were also found to have a significant impact on child obesity. However, maternal occupation, frequency of fast food consumption, and sugary juices, in addition to the practice of physical exercises did not have a significant impact on a child's overweight and obesity (Hadhood et al., 2017).

Similar results were reached in Alexandria, Assiut, and Port Said. In Alexandria, a study on 3,500 children aged (6-12) years enrolled in public and private schools reached that obesity was more prevalent in urban areas, private schools, high socioeconomic standard families, and among girls (El-Shafie et al., 2014). In Assiut, primary school children's obesity was found to be affected by eating fast food and between meals, irregular physical activity, the number of meals consumed, and non-consumption of vegetables (Saleh et al., 2020). Badawi et al. (2013) examined child obesity in Port Said among children aged (6-12), years where it was found to be more prevalent among children aged (7-8 years), however, it decreased with age. According to the study, the risk factors of obesity were socioeconomic factors, bad dietary habits, physical inactivity, and family history of obesity.

In Fayoum, Hassan et al. (2018) examined the impact of socio-demographic and lifestyle factors on the nutritional status of 736 rural school children aged (6-17) years, during the period (October 2014-April 2015), using logistic regression. It was found that a negative relationship existed between obesity and age, and it was more prevalent in boys (17%) compared to girls (12.1%). Father's educational level and his regular employment status were found to have a significant positive impact on the child obesity. The bad lifestyle factor of watching TV while eating was also found to have a positive impact on the level of obesity, while the family size, eating fruits and vegetables, socioeconomic class of the student,[3] and regular exercise did not have any significant impact on the child obesity.

The risk factors for child obesity in Qena were explored using a sample of primary school children aged (6-12), years where obesity was more prevalent among girls, children living in urban areas and those with obese parents. In addition to that, maternal education, fast food consumption, lack of breakfast intake and physical inactivity were found to have a significant impact on obesity (Hamed at al., 2019). Similar results were reached in the Menoufia governorate among the same age group, where two studies were conducted on the districts of Menouf (Bahbah et al., 2015), and El-Bagour (Salem et al., 2016), the latter was conducted during the period (2013-2014). However, in El-Bagour, obesity was positively associated with high-income levels, and in Menouf it was affected by being enrolled in private schools and the socioeconomic level. During the period (2017-2018), the same relationship was revisited in the Menoufia governorate and similar results were reached (Morad, & Allam, 2018).

In the urban Sharkia governorate, obesity was found to be more prevalent among children aged (14-15) years due to the significant impact of parental education level, skipping breakfast, snack taking, fast food consumption, watching television for more than a couple of hours, eating while watching television, and physical activity (Talat, & El Shahat, 2015). Similar studies were conducted in Alexandria, Mansoura and Minia governorates, as well (Kamel et al., 2020; Hossein, & Almarhomy, 2017; El-Gilany and El-Masry, 2011; Salama, & Tayel, 2018). It was found that obesity was more prevalent

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[3] It is measured using 5 indicators which are: crowding index (persons per room); occupation of the father or mother; education of the father or mother; family income; and sanitation.

among girls, public school students, children in low socio-economic classes, children with university-educated fathers and mothers, regular consumption of carbohydrates and sweets, skipping breakfast and low physical inactivity in Minia governorate. Similar results were reached in Mansoura and Alexandria in addition to having a positive family history of obesity, living in a small family size and having a non-working mother.

In addition, Salazar-Martinez et al. (2006) used multivariate logistic regression to compare the levels of overweight and obesity in Egypt and Mexico among children aged (11-19) years who attended public schools in 1997 school year in the former and 1998-1999 school year in the latter. Obesity was found to be more prevalent among girls in the former, and it was found more prevalent among boys in the latter. In the former, obesity was affected by age and rural residence, while it was affected by age, years of education, smoking, vitamin intake, and physical activity in the latter. Using the same methodology, Hjij (2022) investigated the socioeconomic determinants of the obesity of 12,258 children aged less than 5 years using the DHS. He found that there was no significant impact of the wealth index, maternal education and occupation, and place of residence on obesity.

Furthermore, systematic reviews were conducted on the association between socioeconomic status and child obesity in both developed and developing countries (Vazquez, & Cubbin, 2020; Fruhstorfer et al., 2016; Dinsa et al., 2012; Mirmiran et al., 2010; Sobal, & Stunkard, 1989). Results varied across countries where the impact of the socioeconomic status on child obesity was not definite in developed countries in contrast to the situation in developing countries, where most of the studies found a direct relationship, and it was found to be more prevalent among the rich in low-income, middle-income, and the Middle East countries in contrast to the situation in the high-income countries.

Hence, it is apparent that the impact of the socio-demographic factors on child obesity has been analyzed extensively in the literature across both developed and developing countries, while the impact of the factors differed across countries. Although both the qualitative and quantitative approaches have been used in the analysis, most of the studies in Egypt used the former and have been applied on a governorate level. Furthermore, from the previous analysis, it is obvious that only a few studies have used interaction terms in

analyzing the risk factors of childhood obesity. Hence, this paper shall analyze the impact of the socio-demographic factors on childhood obesity across different regions of residence by using the 2014 DHS covering children from birth until the age of 18 years, which shall give more conclusive results regarding the risk factors of child obesity. In addition, the interaction between wealth and both maternal education and the place of residence shall be employed in the analysis.

Methodology

The impact of the socio-demographic factors on childhood obesity in Egypt will be analyzed through a secondary analysis of the 2014 Demographic Health Survey (DHS) in addition to estimating a multivariate logistic regression model. The outcome or dependent variable of the model is the child obesity. The benchmark for determining whether the child is obese or not is based on the growth standards set by the WHO. Those standards assigned BMI standard deviations greater than 3 as a cut-off point for children aged less than 5 to be considered obese, above 2 standard deviations for children aged 5 to 18 and a BMI greater than or equal to 30 for adults (World Health Organization, 2021).

The independent variables employed in the model are child age, child gender, wealth score, maternal education, place of residence, and mother's nutritional status (represented by maternal obesity) in addition to the interaction between wealth, and both the place of residence and maternal education, similar to previous studies already presented in the previous section. Table 1 provides a description of the variables used in the study.

Table 1

Description of Variables

Variable	Definition
Child obesity	A dummy variable that takes the value of 1 if the child is obese and the value of 0 if the child is non-obese
Child age	Age of children in years (0-18)
Child gender	A dummy variable that takes the value of 1 if the child is female and 0 if the child is male
Wealth score	A score is calculated based on the wealth index which is a composite measure of a household's cumulative living standard.

	The wealth index is calculated using easy-to-collect data on a household's ownership of selected assets; such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities.
Maternal education	A categorical variable that takes the following values (no education – primary education – secondary education – higher education)
Place of Residence	A categorical variable that represents the different regions (urban governorates – urban Lower Egypt – rural Lower Egypt – urban Upper Egypt – rural Upper Egypt – frontier governorates)
Maternal obesity	Dummy variable that takes the value of 1 if the child's mother is obese and 0 if she is non-obese

Source: Ministry of Health and Population [Egypt], El-Zanaty & Associates, & ICF International, 2015c.

The data source is the Demographic Health Survey (DHS) which was first implemented in Egypt in 1988. Its main focus is furnishing key health and population-related measures for the following six regional blocks (urban governorates – urban Lower Egypt – rural Lower Egypt – urban Upper Egypt – rural Upper Egypt – frontier governorates). The key figures provided by the survey help decision makers evaluate the status of the currently implemented health-related interventions and articulate new policies in this respect.

The 2014 DHS round comprised questionnaires for both households and married women. The households' questionnaire is composed of two parts, in addition to the inclusion of special modules. Questions related to age, gender, educational level, and marital status were addressed in the first part, whereas the second part focused on the ownership status of consumption-related goods, along with elements related to the housing status, such as how big its size is, and the source of water it depends on. Finally, questions related to child labor and discipline were addressed in the special modules. As for married women's questionnaire, it focused on areas like fertility measures, mothers' nutritional status, children's health, and domestic violence.

Out of the random sample of the 29,172 households that were selected for this round of the DHS (15,015 households were residing in urban areas, and 14,157 residing in rural areas, distributed over the different governorates), the number of households who actually got interviewed was 28,175, whereas the number of interviewed ever-married women was 21,762.

The study is limited to 32,985 children whose ages range from 0 to 18, and the respondents of the ever-married women who have children in this age range only are considered (Ministry of Health and Population [Egypt], El-Zanaty and Associates, & ICF International, 2015b, 2015c).

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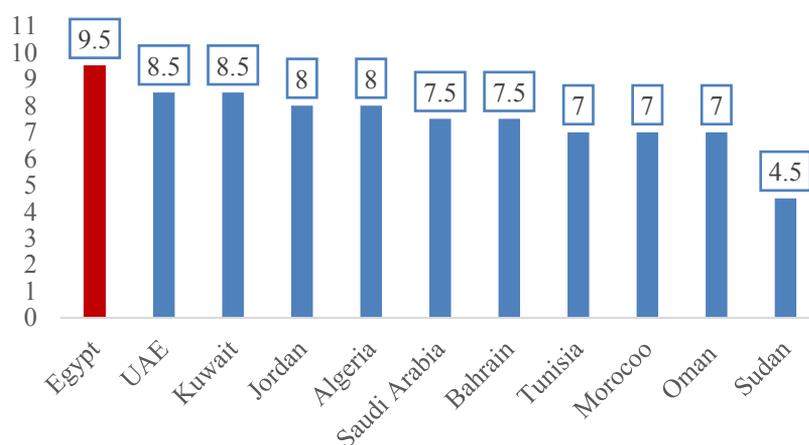
Childhood Obesity in Egypt

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The objective of this section is twofold: highlighting the severity of the child obesity problem in Egypt and drawing some descriptive statistics about the characteristics of the sample in the 2014 DHS.

As per the latest figures released by the WHO, Egypt made it to the 18th rank worldwide, concerning the prevalence of obesity on the national level. When it comes to the status of child obesity in the country, the child obesity risk score provides useful directions in this respect, due to the lack of availability of data on child obesity in specific. This risk score accounts for "the likelihood of having or acquiring a major childhood obesity problem during the 2020s taking into account current prevalence levels and risk for future obesity" (World Obesity Federation, 2022b).

The figure below illustrates Egypt's rank with regard to the child obesity risk score which was previously mentioned. The scores demonstrate Egypt's leading position among the MENA region countries with a score of 9.5 out of 11, indicating the alarming situation in the country that needs to be carefully addressed.
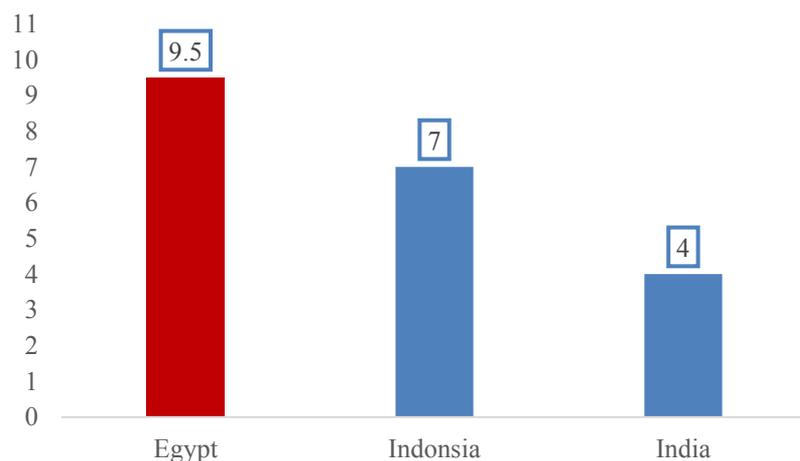
Figure 1

Obesity Risk Score by Country

Source: World Obesity Federation (2022b).

Another comparison is made to determine Egypt's position among a number of lower-middle-income countries. The figures again endorse Egypt's leading position in the risk of childhood obesity in the country.

Figure 2

Obesity Risk Score by Country

Source: World Obesity Federation (2022b)**.**

Based on Egypt 2014 DHS, the prevalence of obesity among children aged less than 5 years is 16.53% compared to 15.16% among those aged 5 to 18 years. As for the mothers of children aged 0 to 18, the prevalence of obesity was as high as 55.7%. Moreover, the Table 2 comprises the gender segmentation of the obese children in the survey, where boys demonstrated higher percentages in both age groups.

Table 2

Gender Classification of Obese Children

Gender	Obese aged (0-less than 5)	Obese aged (5-18)
Boys	17.73%	15.82%
Girls	15.23%	14.46%

Source: Ministry of Health and Population [Egypt], El-Zanaty and Associates, & ICF International, 2015c.

Another figure of interest is the mean BMI for the mothers acquiring different educational levels. The mean values in Table 3 demonstrate the fact that there is little

difference in the numbers estimated for each level and how they are very close to the obesity cut-off score which is equal to or greater than 30 for adults (World Health Organization, 2021). Accordingly, these figures highlight the severity of the problem among the children's mothers.

Table 3

Mean BMI For Mothers in Different Educational Levels

Level of Education/ BMI	BMI Mean Score for Mothers of Children Aged (0- less than 5)	BMI Mean Score for Mothers of Children Aged (5-18)
No education	28.9	30.6
Primary	29.4	30.9
Secondary	28.8	30.7
Higher	28.6	30.6

Source: Ministry of Health and Population [Egypt], El-Zanaty and Associates, & ICF International, 2015c.

Finally, Tables 4 and 5 show that there is a statistically significant association between childhood obesity and child's age, child's gender, maternal education, place of residence, and maternal obesity at 5% significance level using the chi-square test of independence.

Table 4

Prevalence of Obesity Among Children Aged Less Than 5 Years by Subgroups

Obesity of Children 0- less than 5	P -value
Age	0.000
Gender	0.000
Maternal Education	0.015
Place of Residence	0.000
Maternal Obesity	0.003

Source: Ministry of Health and Population [Egypt], El-Zanaty and Associates, & ICF International, 2015c.

Table 5

Prevalence of Obesity Among Children Aged (5-18) Years by Subgroups

Obesity of Children 5-18	P -value
Age	0.000
Gender	0.007
Maternal Education	0.040
Place of Residence	0.000
Maternal Obesity	0.000

Source: Ministry of Health and Population [Egypt], El-Zanaty and Associates, & ICF International, 2015c.

Empirical Results

Two separate logistic regressions are estimated for the age group 0 to less than 5 and that of 5 to 18, respectively, to determine the impact of the socio-demographic factors of child obesity in Egypt.

The results of the model represented in Table 6 indicate the existence of a relationship between child obesity and his/her gender and age. As the age of the child increases in both age groups, his/her odds of being obese decline, holding other factors constant. Also, the odds of being obese for girls are less than for boys by 22% and 25%, holding other factors constant in the age groups (0 to less than 5) and (5 to 18), respectively.

Table 6

Multivariate Logistic Regression

Variable	Children aged (0- less than 5)		Children aged (5-18)	
	Odds Ratio	S.E.	Odds Ratio	S.E.
Age	0.91*	(0.019)	0.93*	(0.009)
Gender (Reference Category: Male)	0.78*	(0.046)	0.75*	(0.04)
Wealth score	1	(0.000002)	0.99	(0.000002)
Maternal Education:				

Variable	Children aged (0- less than 5)		Children aged (5-18)	
(Reference Category: No Education)				
Primary	0.76	(0.11)	0.88	(0.1)
Secondary	0.93	(0.09)	0.97	(0.07)
Higher	0.98	(0.12)	1.03	(0.2)
Place of Residence:				
(Reference Category: Urban Governorates)				
Urban Lower Egypt	2.1*	(0.53)	1.23	(0.23)
Rural Lower Egypt	1.6*	(0.37)	1.38*	(0.23)
Urban Upper Egypt	1.8*	(0.42)	0.94	(0.16)
Rural Upper Egypt	1.2	(0.29)	0.68*	(0.125)
Frontier Governorates	1.3	(0.32)	1.04	(0.2)
Maternal Obesity	1.13*	(0.07)	0.69*	(0.03)
Wealth*Primary Education	0.99	(0.000002)	1	(0.000001)
Wealth * Secondary Education	0.99	(0.000001)	1	(0.000001)
Wealth*Higher Education	0.99	(0.000002)	1	(0.000001)
Wealth*Urban Lower Egypt	0.99	(0.000003)	1	(0.000002)
Wealth*Rural Lower Egypt	0.99*	(0.000003)	1	(0.000002)
Wealth*Urban Upper Egypt	0.99	(0.000003)	1	(0.000002)
Wealth*Rural Upper Egypt	0.99	(0.000003)	0.99	(0.000002)

Variable	Children aged (0- less than 5)		Children aged (5-18)	
Wealth*Frontier Governorates	0.99*	(0.000003)	0.99	(0.000002)

Source: Author's calculations based on the DHS data.
*Refers to odds ratios significant at the 5% level.

Regarding the wealth score, it was found to have an insignificant impact on the obesity of children across both age groups similar to the results reached by Mowafi et al. (2019), where no association was found between obesity in Cairo and the socioeconomic level. Similarly, maternal education did not have a significant impact on the obesity of children from birth until those aged 18 years.

At the regional level, the odds of being obese for children aged less than 5 years who reside in urban Lower Egypt is twice that of children in urban governorates, holding the other factors constant. Also, being a child aged less than 5 years living in rural Lower Egypt and urban Upper Egypt increases the odds of being obese by 60% and 80%, respectively, compared to children in urban governorates, holding the other factors constant. Whereas in the model for youth, the odds of being obese for children who live in rural Lower Egypt are 38% greater than those children in urban governorates, while the odds of being obese for children living in rural Upper Egypt are 32% lower compared to those living in Urban governorates, holding the other factors constant. Hence, it is apparent that children living in rural Lower Egypt have higher odds of being obese compared to those living in urban governorates regardless of their age group.

The odds of being obese for children aged 0 to less than 5 whose mothers are suffering from obesity is about 13% greater than those whose mothers are non-obese, holding the other factors constant. On the other hand, in the second model for children aged from 5 to 18, the odds of being obese for children whose mothers are suffering from obesity is about 31% less than those whose mothers are non-obese, holding the other factors constant. This might be explained by the increased self-awareness among the second group about weight gain and physical appearance compared to the first group, which is preschool children and hence rely mainly on being fed by their mothers, who might have a false belief that a fatter child is a healthy child and that as the child gets older, his baby fat will vanish (Gupta et al., 2012).

Finally, the interaction between wealth and maternal education, they were found to be insignificant in both models highlighting the prevalence of the problem across all educational levels. Furthermore, the interaction of wealth and region was found to be significant among children aged (0- less than 5) where the odds of being obese decrease by 1% when the wealth score increases by 1 unit for rural Lower Egypt and frontier governorates compared by the same effect for Urban governorates, holding other factors constant.

The findings of the study regarding the significant impact of child age, child gender, place of residence, and mother's nutritional status are consistent with previous studies (Adetunji et al. (2019); Hassan et al. (2017); Badawi et al. (2013); Farajian et al. (2012); Andegiorgish et al. (2011); Salazar-Martinez et al. (2006); Güven et al. (2008).

The insignificant impact of both maternal education and the interaction of wealth and maternal education across both age groups is similar to other studies (Liu et al., 2018). Regarding the impact of the interaction between wealth and place of residence on childhood obesity, it has not been examined by other studies.

Policy recommendations

Obesity is a multi-dimensional problem that has severe health and economic repercussions. Accordingly, adequately tailored policies need to be designed to combat the spread of this problem at the level of the society's youngest age group, which is the focus of this study.

Regarding the governmental efforts and interventions in the arena of combating obesity, the Ministry of Health and Population has articulated Egypt's national multi-sectoral action plan for the prevention and control of non-communicable diseases for the period (2017-2021) (Ministry of Health and Population, 2017). Although the plan highlighted the severity of the obesity problem in Egypt along with assigning targets for its eradication, those targets need to encompass measurable or well-defined indicators that could be accurately tracked.

Moreover, an initiative was established by both the Ministry of Health and Population and the Ministry of Education as a part of the 100 Million Healthy Lives initiative that aimed at detecting several diseases, including obesity, among many school students amounting to 11.5 million residing in Egypt's different governorates. Such an initiative

was announced in 2019 and was resumed again in 2021, successfully managing to examine about 7 million students (Daily News Egypt, 2021; Leila, 2019). However, official reports are yet to be released regarding the results of that initiative in terms of the prevalence of obesity and the treatment plans that should be executed.

Furthermore, the School Feeding Program, introduced by the Egyptian government in 1968 and extended to include all public schools in 2016, aims at enhancing children's nutrition, enhancing academic outcomes, and encouraging school enrolment through the provision of a free fortified meal for children while at school. However, that initiative did not have a significant impact on the nutritional status of the children receiving the meal compared to those that did not (Sheldon, 2022). Therefore, further efforts and policies need to be implemented on different fronts to effectively reduce the alarming childhood obesity levels in Egypt.

As per the results of the estimated logistic regression, some policies and interventions are recommended. Working on impacting the food choices of Egyptian households to be healthier through different channels. The first channel has to do with spreading awareness among the different economic classes, whether rich or poor. Awareness is a key factor in containing the spread of obesity, since evidence suggests that people are unaware of the interrelatedness between obesity and other life-threatening diseases like cancer and non-communicable diseases like diabetes (World Health Organization, 2022). Accordingly, it is very important to increase the levels of health literacy among children at schools and mothers across all socioeconomic classes and educational levels.

Increasing the awareness levels should not be only implemented through a bottom-up approach starting with neighborhoods, schools, and communities, but also through a top-down approach where legislative actions should be adopted by the government to encourage individuals and their children to adopt healthy lifestyles. Project Healthy Schools (PHS) initiated in 2004 by the University of Michigan in collaboration with the community and state was proven to be a real success. The project was an intervention by local authorities through introducing a middle-school-based health curriculum which led to notable improvements in the students' health behaviors and cardiovascular risk factors during four months of the start of the program. Due to its outstanding performance, this program is now implemented in 140 Michigan middle schools and is extended to high

schools, as well, through the Science of Wellness Program. This is a clear example of the importance of collaboration through both top-down and bottom-up approaches to dealing with the problem of childhood obesity (Project Healthy Schools, 2022; Rogers et al., 2015).

The second channel is focused on the poorest segment of society which is highly disadvantaged in this respect, when it comes to both the accessibility of healthier food choices and the affordability of these items for this segment. This channel has to do with availing fruits and vegetables and other healthier food products, such as olive oil and brown sugar at subsidized prices at the Ministry of Supply's outlets and distribution channels. This is instead of having the subsidized items limited to high-calorie food products that create an unbalanced and unhealthy diet for the huge number of beneficiaries who rely heavily on the subsidy system. The feasibility of this solution was investigated by resorting to the Ministry of Supply which indicated the possibility of granting different incentives for the merchants who avail fruits and vegetables in their shops. Awareness campaigns and posters about the benefits of healthier food items could be made available in those shops as well (Sedky et al., 2021).

Encouraging physical activities within schools is also of paramount importance in the arena of combating obesity. A specialized school health program in the US, known as CATCH (Coordinated Approach to Child Health) that focuses on both nutritional awareness and physical activities, helped in increasing the performance of physical activities within schools by up to 59% and was proven to help mitigate obesity among children (Centers for Disease Control and Prevention, 2011).

Finally, since mothers' obesity significantly affects the probability of their children being obese, as well, providing awareness among women at the primary health care units, which are geographically distributed in various governorates, is of crucial importance. It also implies that mothers in different regional blocs will have equal access to such awareness campaigns. Accordingly, this endorses the effectiveness of such campaigns.

Another integral part of these campaigns is designing nutritional plans for mothers suffering from obesity and providing follow-up services. Consequently, mothers' awareness would positively impact the consumption patterns and food choices of their children. This could help mitigate the prevalence of obesity among them. Table 7 presents a summarization of the recommended policies.

Table 7

Recommended Policies

Policy Maker	Proposed Policy
Ministry of Health	• Equip the staff at the primary health care units with adequate training on obesity detection and treatment. • Spread awareness among children's mothers and design nutritional plans for mothers who are suffering from obesity and provide follow-up services for them through the primary health care units.
Ministry of Education	• Increase the levels of health literacy among children at schools with particular emphasis on obesity and its negative repercussions. • Promote physical and athletic activities among school children. • Provision of healthy school meals that are balanced in their nutritional content. • Examples include the "CATCH" and "Project Healthy Schools" programs implemented in US schools.
Ministry of Supply	• Offer different financial incentives to the Ministry's grocery stores to provide subsidized fruits and vegetables to beneficiaries. • Provide healthier options such as subsidized brown sugar, brown rice, and olive oil to beneficiaries. • Avail awareness campaigns and posters about the benefits of healthier food items and the negative health repercussions associated with unhealthy food choices on children's and adolescents' obesity at the Ministry's grocery stores.

Source: Author's recommendation.

Conclusion

This study is an attempt to explore the association between different socio-demographic factors and the prevalence of obesity among children in Egypt. The importance of the topic stems from the fact that child obesity has prominent negative health consequences and the alarming level of childhood obesity in Egypt represented by having the highest child obesity risk score among the MENA countries. As for the results of the paper, they pointed out the significance of the child's gender, child age, mother's nutritional status, and region of residence, along with the insignificant impact of the different interactions included in the model on child obesity. Such results endorse the idea that childhood obesity is impacting all the social, educational and economic segments of society, and it has become rooted in the lifestyle and attitudes towards food consumption patterns of different classes.

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