

Childhood Overweight and Obesity in Morocco: A Systematic Review

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Abstract: *Introduction:* Childhood overweight and obesity have become pervasive forms of malnutrition affecting Moroccan children, exerting significant impacts on their physical growth and psychological development.

Objective: This study aims to conduct a comprehensive assessment of the epidemiological landscape surrounding childhood overweight and obesity in Morocco. Additionally, it seeks to evaluate the efficacy of national strategies and nutrition programs implemented by the Moroccan Ministry of Health.

Methods: This study gathered data from reputable sources, employing a systematic review approach, including Pubmed, Science Direct, Scopus, and Google Scholar databases. The selected articles focused on overweight and obesity within the Moroccan population, with the search period spanning from 2010 to 2020.

Results: The study unveiled many factors associated with childhood overweight and obesity. Intriguingly, overweight is not always synonymous with childhood obesity, though it remains a critical contributing factor.

Conclusion: Childhood overweight and obesity in Morocco show severe forms of malnutrition, eliciting significant concerns within the Moroccan academic community. An urgent imperative is to enhance existing strategic plans to address this issue effectively.

Keywords: Obesity, overweight, moroccan children, boys, girls, body mass index (BMI), waist circumference.

1. INTRODUCTION

Childhood obesity presents a significant concern for nutritionists and child health experts, as its prevalence is increasing at an alarming rate. This rise is closely associated with socio-economic development, urbanization, and the pervasive influence of globalization, including the emergence of "smart cities," which negatively impact lifestyles. In response to this critical situation, the World Health Organization has developed an international strategy and action plan to halt the alarming rates of childhood obesity worldwide [1].

In line with this global initiative, Morocco has established guidelines for the prevention of overweight and obesity in children as part of the national nutrition plan. Our work aligns with these efforts, aiming to identify past mistakes and enhance the current situation to create a more favorable environment and healthy ecology for Moroccan children, ultimately reducing the incidence of overweight and obesity [2].

Understanding the early factors that influence susceptibility to environmental conditions is crucial.

Beyond genetics, a significant and recent consideration is epigenetics, which has a profound impact on the development of obesity [3].

Childhood obesity in Morocco has become a pressing public health issue. Initial treatment efforts often encounter obstacles and consistent failure, necessitating a broader examination beyond genetic factors. It is vital to investigate the critical periods during which Moroccan children begin to gain weight and develop obesity. Studies have highlighted the relationship between the early years of a child's life and their growth in height and weight, emphasizing the impact of breastfeeding types, milk substitutes, and the manner and timing of food diversification, particularly before six months of age, on the risk of childhood obesity [4].

The main objective of this work is to analyze the evolution of weight gain and childhood obesity prevalence in Morocco over the last ten years using available national data. Secondary objectives include comparing these findings with data from national surveys conducted over the past decade.

2. MATERIALS AND METHODS

In order to address our research problem, we adopted a specific academic strategy. Firstly, we

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conducted a thorough review of the literature on the studied population, specifically Moroccan children with obesity or overweight. We utilized databases such as PubMed, Science Direct, Elsevier, and Google Scholar, accessed through the portal of the National Center for Scientific and Technical Research affiliated with Mohammed V University in Rabat.

We carefully selected the following keywords and combined them using the Boolean logical operator "AND":

"Childhood obesity & Morocco," "Overweight & child Morocco," "Childhood obesity & Morocco." We customized our search to include studies published from 2010 to 2020.

The choice of the period 2010-2020 was made for several reasons:

- **Availability of Data:** This decade marks a period where significant data on childhood obesity in Morocco began to emerge, providing a comprehensive basis for analysis.
- **Policy and Program Implementation:** During this period, several national policies and programs aimed at combating childhood obesity were implemented in Morocco. Evaluating studies within this timeframe allows us to assess the impact of these interventions.
- **Recent Trends:** Focusing on the most recent decade ensures that our analysis reflects current trends and factors influencing childhood obesity, making our findings more relevant to current public health strategies.
- **Completeness of Data:** The first official survey on child nutrition in Morocco, which provides detailed and comprehensive data, was published in 2019-2020. Including studies up to this year ensures that our review incorporates the latest available data.

By delineating our search for this specific period, we aimed to provide a focused and relevant analysis of the trends and factors influencing childhood obesity in Morocco.

2.1. Criteria Inclusions

Our articles were elected by the following conditions and criteria:

- ✓ Studies follow and respect the ethical rules in clinical research recognized in Morocco, which is approved by the Ethics Committee for Biomedical Research CERB.
- ✓ Studies published since 2010: Articles concerning childhood overweight and obesity in Morocco. We have chosen studies published since 2010 to have a relatively recent sample of articles.
- ✓ Surveys dealing with childhood obesity are in line with our problem and research topic.
- ✓ Surveys of articles written in French or/and in English for practical reasons operating.
- ✓ All studies that follow the IMRAD structure: Introduction, Materials, and Methods, Results, Analysis, and Discussion.
- ✓ Studies citing credible scientific references.

2.2. Criteria Exclusions

- ✓ We excluded all articles that dealt with childhood obesity in a non-Moroccan child population, even if the authors are Moroccan.
- ✓ Unaccessible articles and surveys were excluded.

2.3. Statistical Analysis

Two authors selected articles, extracted data, and assessed the methodological quality of the included articles. We downloaded and installed the Zotero software from the official site for storage and the creation of our bibliography under Vancouver standards [5]. Microsoft Excel 2016 software was used for numerical data entry. Statistical analysis was performed using SPSS software version 20.0 [6]. Prevalences were reported with a 95% confidence interval (95% CI). A value of $p < 0.05$ was considered significant for all statistical analyses.

3. RESULT

The total number of articles retained is 287. We excluded 21 theses because they did not meet the publication date criterion, which was fixed in 2010.

We removed 4 blog posts, knowing that these articles dealt with childhood obesity. However, the criterion of scientific results does not meet our criterion.

Finally, we could not access 8 articles due to their non-accessibility to certain medical search engines.

The final number of studies included in the selected sample is around 11791 divided between 9 articles. The flow chart shown in Figure 1 details the studies' recruitment strategy, as well as the surveys ultimately accepted for statistical analysis.

All selected articles are articles published in international scientific journals. We finally retained 9 articles. All these articles selected and chosen, along with the results found, are presented in explanatory tables (Tables 1, 2, 3)

The variables studied in this systematic review are the prevalence of overweight, prevalence of obesity, prevalence of overweight in boys, prevalence of overweight in girls, prevalence of obesity in boys, and prevalence of obesity in girls.

Once the selected articles are analyzed in response to the chosen judgment criteria, the results are compared with the data of the national surveys carried out on the theme [7].

3.1. Analysis of Data from Selected Articles

In order to facilitate the understanding of the results, we first presented a summary of the various articles selected, specifying for each survey the type and objective of the study and the population studied. Then, we extracted all the results that correspond to our Goals [8].

Our calculated averages of the studies selected from our review of indicators of the prevalence of overweight and obesity are 8.56% and 3.69%, respectively.

The last National Population and Family Health Survey of 2018 [18] stated that 10.8% of children under 5 are overweight, of which 2.9% suffer from obesity. This proportion of overweight children was 10.4% in 2003-2004 and 10.7% in 2011. These values are close to those recorded in our systematic review (Table 4).

The averages calculated from our literature review of the indicators of the prevalence of overweight in boys and girls are, respectively, 7.92% and 8.24%. As for obesity, it was 4.57% for boys and 3.93% for girls. In fact, according to the latest National Population and Family Health [2,18], overweight and obesity also affect Moroccan childhood, with 13.9% overweight and 3%

obese. The prevalence of overweight is much more widespread among girls 17.8% than boys 10.7%. This is consistent with the results of our systematic review (Table 5).

Indeed, our systematic review shows almost the same prevalence distributions and proportions reported in the last National Population and Family Health Survey of 2018 [18], whether overweight or obese (Figures 2, 3).

The bar chart shows a disparity in the prevalence of overweight between the studies in our systematic review, according to different regions and backgrounds of the kingdom of Morocco.

The significant value marked is 14.20% as the maximum and 4.10% as the minimum percentage.

The bar graph of the prevalence of obesity in the studies selected from our systematic review shows a disparity in the prevalence of obesity according to different regions and environments of the Kingdom of Morocco.

The large value marked is that of Kaoutar's study [11], which presented 7.20% as the maximum value, whereas 0.40% was marked as the minimum value in Kaoutar's survey [14] of our systematic review.

It emerges from the comparison of the studies selected from our systematic review that the prevalence of overweight is more remarkable than that of obesity, even though the latter shows worrying values within the Moroccan infant population.

The pie chart (Figure 5) reinforces what was said in

Figure 4 shows that 70% is occupied by a predominant representation of overweight 8.56%, and the average obesity is around 3.69%, representing only 30% of the sector diagram.

The average prevalence of overweight among boys is around 7.92%, while girls have a higher average of 8.24%; however, the indicator of obesity in girls is less compared to that observed in boys, respectively 3.93% and 4.57%.

Figure 7 shows the prevalence of obesity among boys and girls according to the studies included in our systematic review. The data indicate that in 4 out of the 8 studies, boys have a higher prevalence of obesity than girls, representing 50% of the cases. The highest

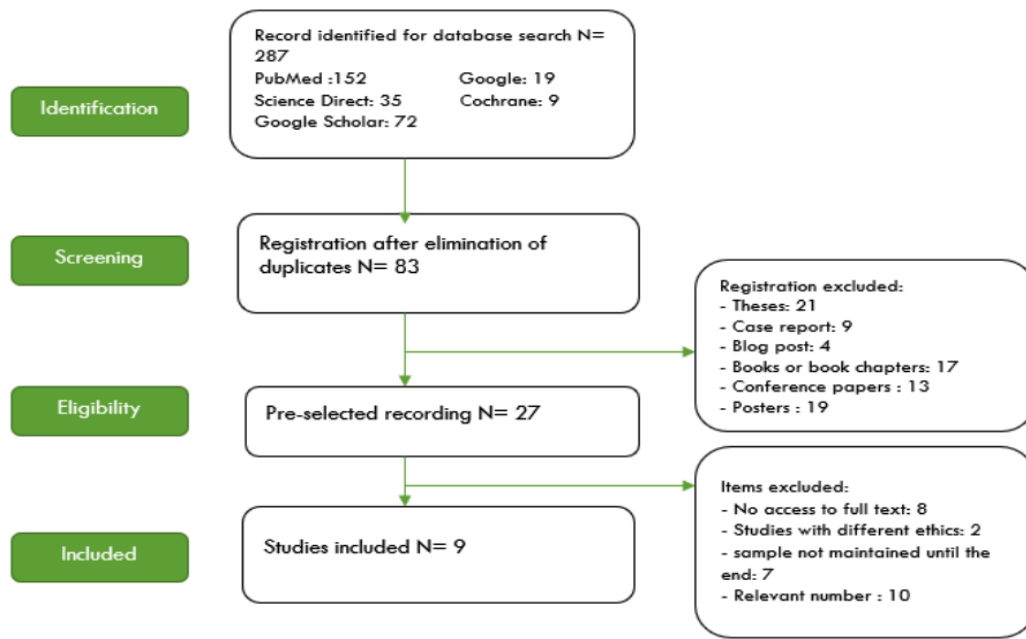


Figure 1: A flow charter of studies was elected for systematic review.

Table 1: The Description of the Selected Items

Items	Year	Type of Study	The purpose of the study	Degrees of study	Region	Period and population studied
Dekkaki, 2011 [9]	2011	Cross-sectional study	To assess the prevalence of obesity and overweight in government primary school children in the city of Rabat and the relationship between body mass index (BMI) and socio-economic level.	C-grade	Rabat-Sale-Kenitra. Geography code: 4	During the period from April 2010 to June 2010, a study was conducted among primary school children in the city of Rabat aged 7 to 14. The study included 1570 children, comprising 768 girls and 802 boys.
Sebbani, 2013 [10]	2013	Cross-sectional study	To estimate the prevalence of overweight and obesity among schoolchildren in Marrakech.	C-grade	Marrakesh-Safi. Geography code: 7	A sample of 1418 schoolchildren aged 8 to 15 from the public sector of the city of Marrakech during the month of May 2011.
Kaoutar, 2013 [11]	2013	Cross-sectional study	To study certain behaviors likely to influence the balance of the nutritional status of children and adolescents in the Wilaya of Marrakech.	C-grade	Marrakesh-Safi. Geography code: 7	1407 children from public and private schools in the city of and adolescents were surveyed 2008 in the Wilaya of Marrakech.
Sbai, 2014 [12]	2014	Cross-sectional study	To study obesity and nutritional status in children in Morocco.	C-grade	Rabat-Sale-Kenitra. Geography code: 4	247 preschool children from the city of Kenitra, located in the northwest of Morocco, from May to December 2012, including 9 private nursery schools.

(Table 1). Continued.

Sellam, 2015 [13]	2015	Cross-sectional study	The aim of our work is to assess the prevalence of malnutrition children under 5 in the prefecture from Oujda Angad.	C-grade	The Oriental. Geography code: 2	440 non-ill children aged 6 to 60 months, randomly selected from March 18 to June 30, 2013.
Kaoutar, 2017 [14]	2017	Cross-sectional study	The objective studied the prevalence of thinness, overweight and obesity in a group of school children and adolescents living in rural areas of the Wilaya of Marrakech, during the year 2010.	C-grade	Marrakesh-Safi. Geography code: 7	487 students, including 223 attending four colleges and high schools belonging to three rural communes: Amzmiz, Tahannaout, and Tamslohte, from the Wilaya of Marrakech in 2010.
El Haboussi, 2017 [15]	2017	Cross-sectional study	The present work proposes the study of the association that has the activity physical condition with overweight (obesity included) in adolescents schooled in the city of Marrakech and the province of Al-Haouz in Morocco.	C-grade	Marrakesh-Safi. Geography code: 7	720 adolescents aged between 15 and 17 in the city of Marrakech (urban area) and the province of Al Haouz (rural environment).
El Kabbaoui, 2018 [16]	2018	Cross-sectional study	To assess the prevalence of overweight and obesity in a representative sample of school-going adolescents aged 12-18 years in Fez, Morocco, and to examine potential risk factors associated with adolescent obesity.	C-grade	Fes-Meknes. Geography code: 2	An investigation was conducted among school-going adolescents aged 12 to 18 in Fez between September 2014 and March 2015 in public secondary schools. The study included 1818 adolescents, with 909 girls and 909 boys.
Azekour, 2020 [17]	2020	Cross-sectional study	Determine the prevalence of obesity and overweight in urban and rural schools in an oasis population.	C-grade	Draa - Tafilalet. Geography code: 8	3684 children enrolled in urban and rural public schools in the oasis of Tafilalet.

Table 2: The Prevalence of Obesity and Overweight in the Entire Child Population of Selected Studies

Items	Year	Sample number	Prevalence of overweight	Prevalence of obesity
Dekkaki, 2011 [9]	2011	1570	5.1%	3.6%
Sebbani, 2013 [10]	2013	1418	8%	3%
Kaoutar, 2013 [11]	2013	1407	7.2%	7.2%
Sbai, 2014 [12]	2014	247	14.2%	5.7%
Sellam, 2015 [13]	2015	440	11.8%	4.3%
Kaoutar, 2017 [14]	2017	487	4.1%	0.4%
El Haboussi, 2017 [15]	2017	720	---	---
El Kabbaoui, 2018 [16]	2018	1818	7.29%	3.41%.
Azekour, 2020 [17]	2020	3684	10.8%	1.9%
Total		11791		

Table 3: The Prevalence of Obesity and Overweight According to Sex: Among Boys and Girls in Selected Studies

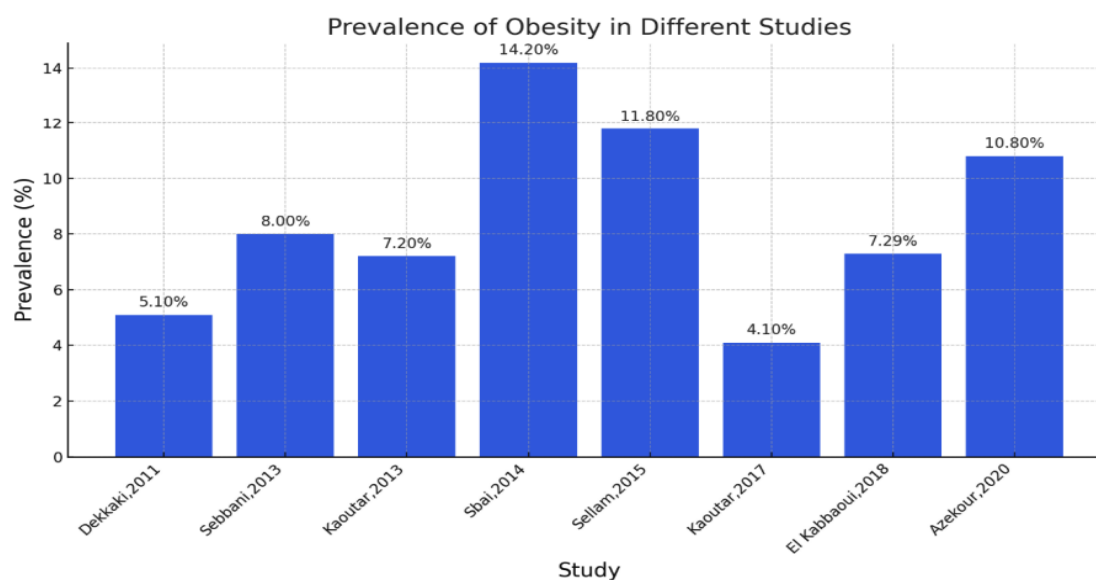
Items	Year	No. of sample	Prevalence of overweight among boys	Prevalence of overweight among girls	Prevalence of obesity in boys	Prevalence of obesity in girls
Dekkaki, 2011 [9]	2011	1570	3.7%	6.5%	3%	4.2%
Sebbani, 2013 [10]	2013	1418	9.1%	12.9%	2.3%	3.7%
Kaoutar, 2013 [11]	2013	1407	7.5%	7%	7.5%	7%
Sbai, 2014 [12]	2014	247	15%	13.4%	5.8%	5.5%
Sellam, 2015 [13]	2015	440	6.93%	8.13%	3.90%	4.78%
Kaoutar, 2017 [14]	2017	487	3.6%	4.6%	0.4%	0.4%
El Haboussi, 2017 [15]	2017	720	7.5%	11.5%	---	---
El Kabbaoui, 2018 [16]	2018	1818	7.15%	8.25%	2.86	3.96
Azekour, 2020 [17]	2020	3684	10.5%	11.1%	1.7%	2%

Table 4: The Means of the Indicators of the Studies Elected From our Systematic Review

	Prevalence of overweight	Prevalence of obesity
Average of selected studies	8.56%	3.69%

Table 5: The Averages of the Indicators by Gender of the Studies Selected from the Systematic Review

	Prevalence of overweight among boys	Prevalence of overweight among girls	Prevalence of obesity in boys	Prevalence of obesity in girls
Average of selected studies	7.92%	8.24%	4.57%	3.93%

**Figure 2: Prevalence of overweight from studies selected from our systematic review.**

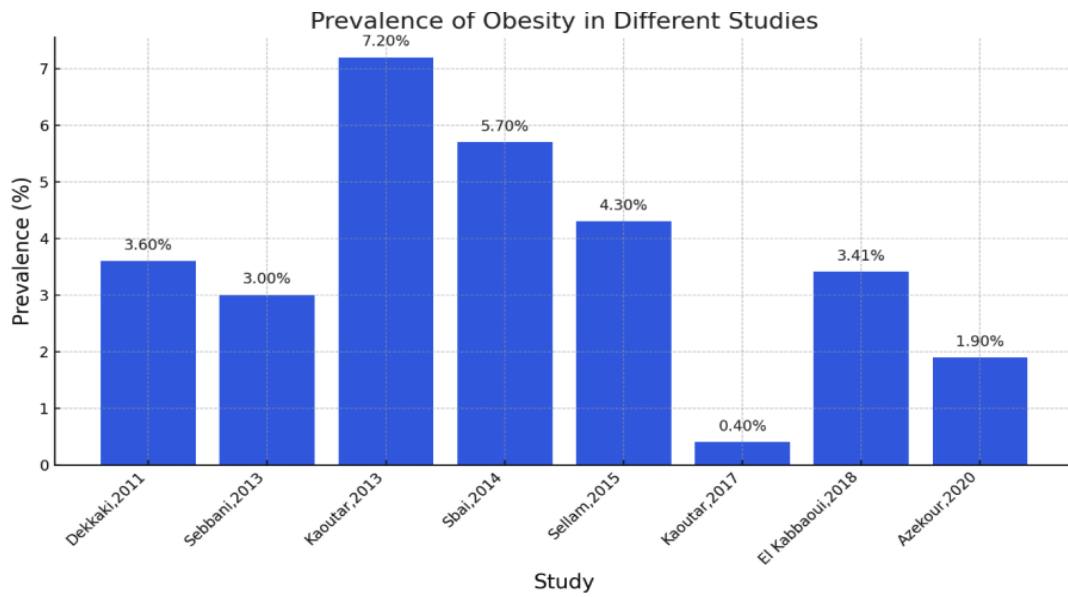


Figure 3: Prevalence of obesity from studies selected from our systematic review.

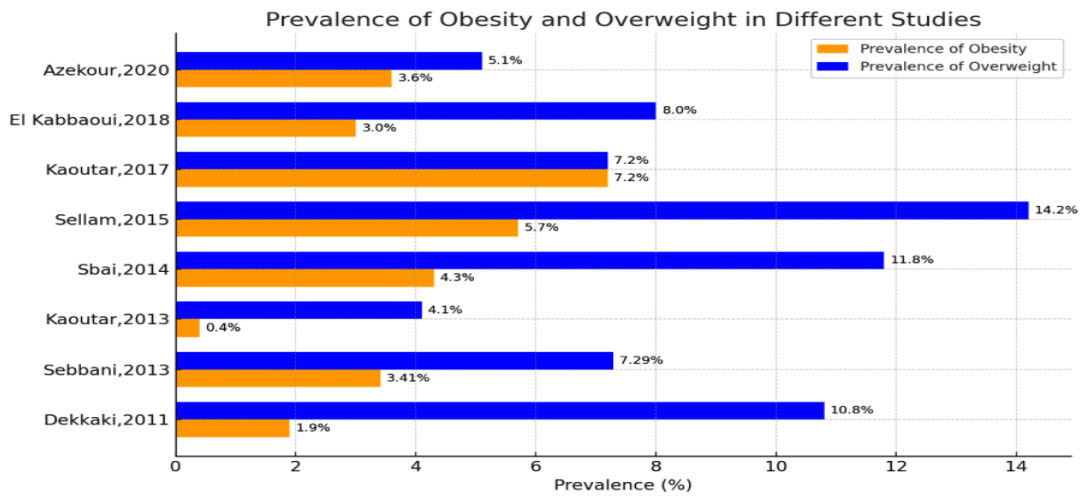


Figure 4: Comparison of prevalence of overweight and obesity from studies selected from our systematic review.

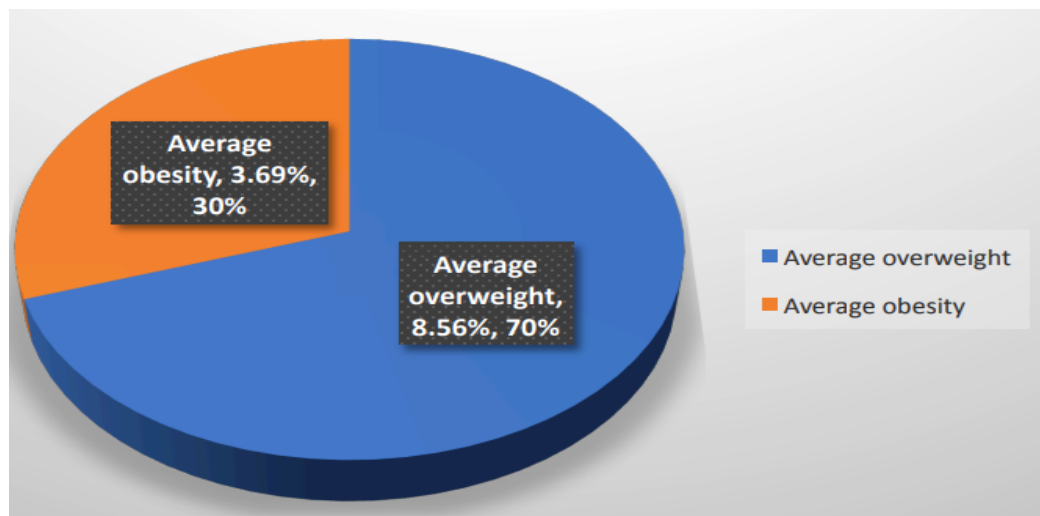


Figure 5: Mean pie chart of the prevalence of overweight and obesity from the studies in our systematic review.

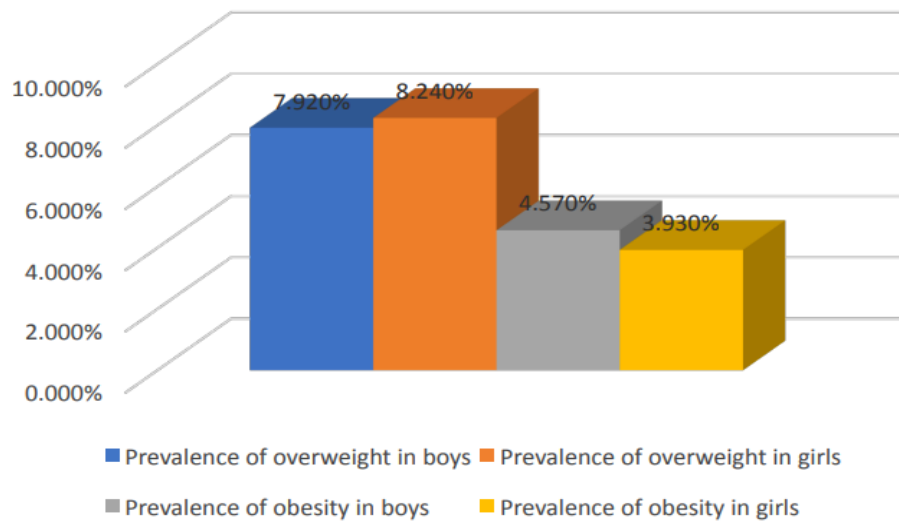


Figure 6: Averages of study indicators from our systematic review.

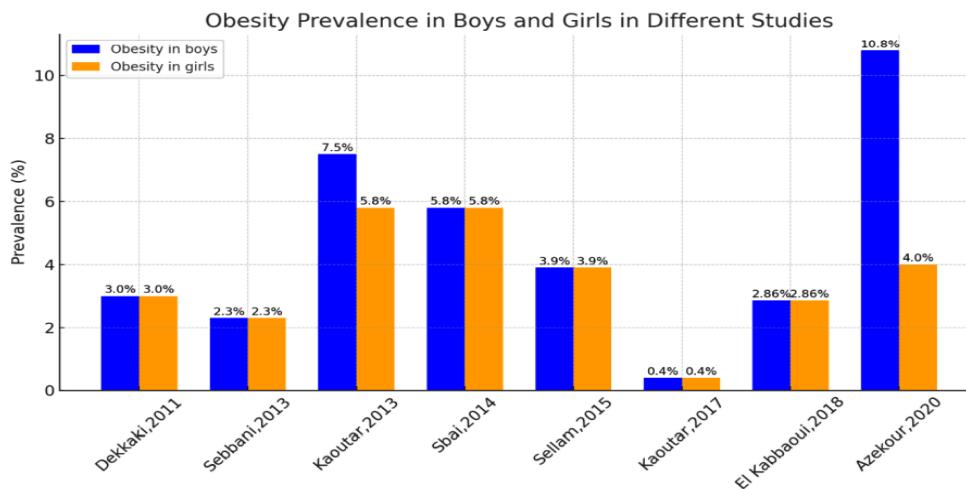


Figure 7: Prevalence of obesity in boys and girls from studies in our systematic review.

rate observed in boys was around 10.80% in Karima Azekour's study [17], while the highest rate in girls was 7% in Kaoutar's study [16], with boys exceeding girls by 0.5% in this particular study.

The prevalence of overweight by sex showed that girls are more overweight compared to boys, and almost all studies exceeded boys in the prevalence of overweight. In fact, 12.90% is the maximum prevalence among girls, while 1.90% is the minimum value.

This forest plot illustrates the prevalence of overweight and obesity among children across different studies. The blue dots represent the prevalence of overweight, while the red dots represent the prevalence of obesity. The horizontal lines around each dot indicate the 95% confidence intervals.

The prevalence of overweight and obesity among children varies significantly across the studies analyzed. The forest plot (Figure 10) shows the prevalence rates and their 95% confidence intervals.

The prevalence of overweight ranges from 4.1% (Kaoutar, 2017) to 14.2% (Sbai, 2014). Most studies report a prevalence between 5% and 10%. The confidence intervals indicate the precision of these estimates, with narrower intervals suggesting more precise estimates.

The prevalence of obesity ranges from 0.4% (Kaoutar, 2017) to 7.2% (Kaoutar, 2013). Similar to overweight, the prevalence of obesity shows considerable variation among studies. The confidence intervals help to understand the reliability of these estimates.

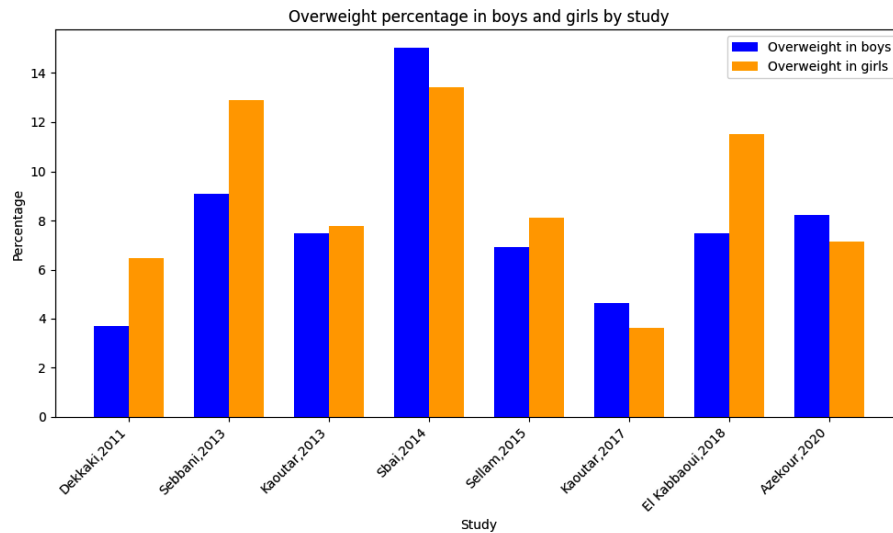


Figure 8: The prevalence of overweight among boys and girls was assessed using studies in our systematic review.

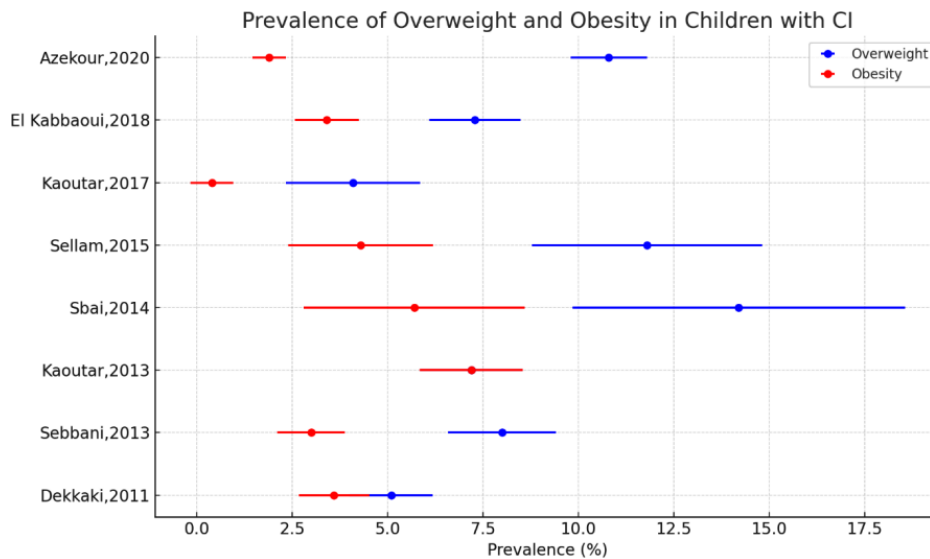


Figure 9: Forest plot of prevalence of overweight and obesity among children in our systematic review.

4. DISCUSSION

It should be emphasized that the number of overweight and obese infants worldwide has risen from 32 million in 1990 to 41 million in 2016. The prevalence of childhood obesity in developing countries among preschoolers is 30% higher. Consequently, the number of overweight infants is expected to reach 70 million by 2025. With this monstrous increase in overweight and obesity, most obese infants and children become obese adults according to the concept of the nutritional footprint. Childhood obesity is linked to a range of serious health complications and an increased risk of early-onset diseases, including diabetes and heart disease [21].

Dennison and his team have demonstrated a strong association between rapid weight gain during the first 2 years of a child's life and later obesity. Rapid weight gain in the first semester is significantly associated with overweight at 4 years. Several studies have proven that genetic factors significantly influence the speed of food intake and interest in food during the first months of life. The field of epigenetics is gaining ground, and early identification of over-hungry infants could help develop strategies to mitigate its expression. Chomto's team confirmed that body mass index (BMI), fat mass (FM), and abdominal circumference are positively correlated with weight velocity between 0 and 6 months. Excess BMI in adulthood for children with

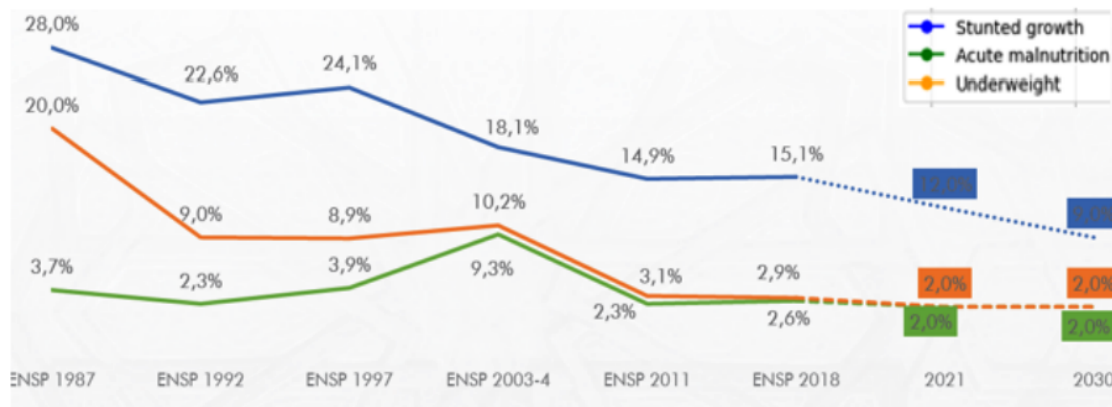


Figure 10: Evolution of the nutritional status of children under 5 in Morocco, 1987-2018.

rapid growth velocity during the first 4 months of infancy has been demonstrated in Stettler's work [22].

Studies have highlighted the risk in obese children and adults who became obese when their diversification began from the 3rd month, according to a scenario evoking the programming of fat cells. It is necessary to emphasize the quantity and quality of complementary foods offered to the infant, especially if one of the parents is obese. In the Moroccan context, eating habits linked to customs promote alarming weight gain, including Moroccan infants and children who eat too quickly and overconsume high-calorie and protein-dense foods even though their digestive systems are not yet ready [23]. Childhood obesity is closely linked to the first years of birth, specifically the first thousand days, which program nutritional equations in the infant's genome. This subsequently determines its stature-ponderal development during the neonatal period, characterized by the importance of breastfeeding and its parameters [7]. Thus, early food diversification, especially before 6 months, triggers a high risk of obesity in children. The correlation between food diversification and childhood obesity is well-documented [4,24,25].

Bar-Or's theory, which proved that 40% of obese children and 70% of obese adolescents remain so in adulthood, has been validated by several studies, noting that the problem of childhood obesity not only presents obstacles during childhood but can also accompany the individual into adulthood and worsen their health condition [26]. Even with growth-related changes in height and weight, children who are beyond the 97th percentile for BMI at 8 years old typically remain at this value later. Thus, more than half of overweight or obese children become obese adolescents and adults. The early adiposity rebound,

which normally occurs around age 6, is a strong predictor of lasting obesity, even if before this rebound, the child's corpulence could temporarily reach the average. Regular monitoring of growth reference curves can detect and potentially prevent the development of childhood obesity [27].

We must mention the heavy burden that malnutrition, overweight, and obesity pose on the Moroccan health system. Indeed, the Moroccan Ministry of Health spends more than 20 billion dirhams annually on the cost of obesity for Moroccan public finances. This cost represents 3% of Morocco's gross domestic product. Direct costs are linked to the treatment of hypertension, diabetes, and myocardial infarction, while indirect costs include productivity loss induced by obesity and its related diseases [2]. The calculated means from the studies selected in our systematic review for overweight and obesity prevalence indicators are 8.56% and 3.69%, respectively (Table 5). These values are consistent with those from the 2018 National Population and Family Health Survey, which stated that the proportion of overweight children is 10.8%, with 2.9% suffering from obesity. It should be noted that this proportion was 10.4% in 2003-2004 and 10.7% in 2011 [2,28]. Our results show a disparity in the prevalence of overweight and obesity between the studies in our systematic review (Figure 2, Figure 3). For overweight people, this difference is due to the various backgrounds and regions in each survey. The highest value marked is 14.20% [12], and the lowest is 4.10% [11], recorded in a rural environment, suggesting that rural settings do not promote weight gain in children. Indeed, the environment influences weight gain in Moroccan children. This is also observed for the obesity variable; the bar chart of obesity prevalence in the selected studies shows a disparity across different regions and

environments in Morocco. The highest value is 7.20% in Kaoutar's study [11], while the lowest is 0.40% in rural areas, as recorded in our systematic review [14]. Childhood obesity in the Moroccan context is influenced by the environment, likely due to the difference in lifestyle between rural and urban areas, with the latter promoting a more sedentary lifestyle. The risk of overweight and obesity is higher in urban areas compared to rural ones. This aligns with the work of Sellam and his team, which classifies the rural environment as a protective factor against overweight in our kingdom [13]. However, the increased prevalence of overweight in Moroccan urban areas can be explained by lifestyle and dietary habits, such as high dietary diversity, especially foods with high caloric energy and low fiber content [2].

There is also a real influence of Moroccan mothers' BMI on the prevalence of overweight in their children. Indeed, children of overweight mothers have a fourfold risk of obesity compared to children of normal-weight mothers, possibly due to nutritional habits and genetic predisposition [18]. Moreover, overweight is positively associated with mother's education level, which may be due to economic and social reasons. Excessive infant malnutrition among Moroccan children is higher in the age group between 6 and 25 months, corresponding to the weaning period and the introduction of complementary foods, which are often energy-dense [2,18,28,29].

In the same context, the prevalence of obesity in the Tafilalet oasis, a Moroccan region with a particular climate, is lower than national and international data, explained by the lifestyle and eating habits of the parents in this region, which directly influence the child population and appear to be protective factors against obesity and overweight, as detailed in the work of Karima Azekour and his team [17]. These findings are consistent with a similar study by K. Kaoutar on adolescents in the Marrakech Wilaya area and a study in Rabat on children aged 7 to 14 [9,11]. The prevalence of overweight among Moroccan adolescents in urban areas is higher than their rural counterparts, making them more exposed to health problems throughout their lives [15]. For our indicators, the calculated means of overweight prevalence in boys and girls from our systematic review are 7.92% and 8.24%, respectively, and for obesity, 4.57% for boys and 3.93% for girls. According to the latest national population and family health survey in 2018, overweight and obesity also affect Moroccan children, with 13.9% overweight and 3% obese. Overweight is

more prevalent among girls (17.8%) than boys (10.7%), consistent with our systematic review results. This can be explained by boys' activity levels compared to girls, who are more sedentary.

Similarly, K. Kaoutar showed that the prevalence of overweight among students was 4.5%, more observed in girls than boys, a statistically significant difference. These results contrast with a study in China, which found that boys were more likely to be overweight and obese than girls in both urban and rural areas. The etiology of overweight and obesity in boys and girls may differ due to biology, as they have different body compositions, weight gain patterns, hormone biology, and susceptibility to social, genetic, and environmental factors. The study recommends gender-responsive interventions to prevent weight gain in Chinese primary school children, particularly addressing gender-specific eating behaviors and weight perceptions through population-based strategies [30].

Television use frequency was statistically associated with the corpulence of Moroccan students, but no correlation was found between hours spent on computers. Television time is a marker of sedentary behavior, especially in lower socio-economic classes where TV represents the only leisure means for Moroccan children [14]. Abdelmoujoud El Haboussi's work showed that the overweight rate exceeds 9%, more marked in girls (11.5%) compared to boys (7.5%), and the proportion of excess weight is twice as high in urban areas (14%) compared to rural areas (7%). Physical activity for children from very low socio-economic backgrounds was mostly limited to football matches, with television as their primary means of entertainment, as noted in Cherkaoui Dekali's study [9]. Generally, children from more affluent social categories are more exposed to being overweight and having riskier lifestyles [10]. Overweight and obesity are more prevalent among students who eat fast food, such as hamburgers, pizzas, fries, and cakes, four or more times a week. A statistically significant relationship exists between the frequency of breakfast consumption by students and their corpulence. The prevalence of overweight and obesity in children and adolescents in Marrakech Wilaya is 7.2%, consistent with Cherkaoui Dekkaki's findings in Rabat [11]. Meriem Sbai's work showed that many preschool children consume pasta, cakes, biscuits, and sweets but not dried fruits, legumes, or juice, explaining the high rate of overweight and obesity [12]. There is a significant

relationship between family income and adolescent weight, with prevalence increasing with family income and parental education levels [15].

RECOMMENDATIONS

This systematic review showed us, in the first place, a need to conduct and place other studies on childhood obesity in the different regions of our kingdom, which will include a large sampling of the child population of different age groups and in various quotes. Our work has also revealed the frightening situation that Moroccan children are experiencing in terms of Moroccan childhood obesity, and, as nutritionists, we will have to sound the alarm before the situation worsens.

To address this, we must start creating clinical nutrition units in Moroccan university hospitals. This unit will be set up at the hospital level. It will be provided by a doctor in clinical nutrition PhD who will be responsible for advising, educating, and caring for the nutritional point of view of overweight and/or obese children and children in malnutrition, as well as other nutritional disorders. Systematic screening for nutritional disorders is recommended for overweight and obese children.

THE BIASES OF OUR SYSTEMATIC REVIEW

During the initial planning of our systematic review, we faced significant time constraints that prevented us from proceeding with registration in the PROSPERO database. At that time, our priority was to quickly collect and analyze the available data to provide relevant insights on childhood obesity in Morocco, a topic of increasing importance for public health.

Our study aimed to fill an immediate gap in the existing literature regarding the trends and factors of childhood obesity in Morocco. Given that the first official survey on child nutrition in Morocco was published in 2019-2020, it was imperative for us to publish our results promptly to inform timely interventions and public policies.

We acknowledge that registration in PROSPERO could have enhanced the transparency and methodological rigor of our study. We are committed to registering all our future systematic reviews in PROSPERO to ensure greater transparency and align our work with best research practices.

Our systematic review has its limits because the population studied does not encompass the entire

Moroccan child population. It predominantly includes children from a specific economic class, which limits the generalizability of our findings. We were unable to demonstrate a wide range of results, including those from both rural and urban areas. This is partly due to the diverse nature of the Moroccan child population and partly due to field constraints, such as limited access to private educational establishments, excluding children educated in the private sector.

Moreover, our systematic review relied solely on BMI (Body Mass Index). While BMI is widely used and has significant utility, it has limitations regarding nutritional diagnosis, particularly in assessing adiposity. Accurate evaluation of adiposity ideally requires additional nutritional indices and parameters, such as skinfold thickness and waist circumference measurements.

In summary, although our study provides valuable insights into childhood obesity in Morocco, it is important to consider these limitations when interpreting our findings. Future research should strive to include a more representative sample of the Moroccan child population and employ a broader range of nutritional assessment tools to ensure a more comprehensive understanding of childhood obesity in this context.

CONCLUSION

Preventing childhood obesity in Morocco should be a public health priority because the country's health sector resource strategy will be strained by the high cost of treating obesity-related chronic diseases.

The Moroccan child population is more and more obese; this is explained by the change in lifestyle, which is completely changed, and which leads us to affirm that the obese Moroccan child would give us an obese Moroccan adult if no strategy was in place.

Our systematic review mentioned gaps in national data on this topic and the paucity of surveys on this. The interest in monitoring nutritional status at the individual and collective levels and the need to implement preventive, diagnostic, and early management strategies, in particular, the great need to train high-caliber doctoral nutritionists, for which there is a real need. Obesity is a Moroccan public health problem, and a heavy economic burden must stop it before it gets out of control.

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DECLARATION OF INTERESTS

The authors declare that they have no conflicts of interest.

REFERENCES

- [1] World Health Organization. Prioritizing areas for action in the field of population-based prevention of childhood obesity: a set of tools for Member States to determine and identify priority areas for action [Internet]. 2012 [cited February 6, 2023]. 84 p. Available from: <https://apps.who.int/iris/handle/10665/85400>
- [2] Ministry of Health of Morocco. National Nutrition Program. Morocco: Ministry of Health of Morocco 2019; p. 75.
- [3] Rohde K, Keller M, la Cour Poulsen L, Blüher M, Kovacs P, Böttcher Y. Genetics and epigenetics in obesity. *Metabolism* 2019; 92: 37-50. <https://doi.org/10.1016/j.metabol.2018.10.007>
- [4] Vidailhet M. [Obesity and complementary feeding time: a period at risk]. *Arch Pediatr Organe Off Soc Francaise Pediatr* 2010; 17(Suppl 5): S204-207.
- [5] Zotero | Your personal research assistant [Internet]. [cited February 6, 2023]. Available from: <https://www.zotero.org/>
- [6] SPSS Software - France | IBM [Internet]. [cited February 6, 2023]. Available from: <https://www.ibm.com/fr-fr/spss>
- [7] El Mossaoui M, Hasnae Benkirane, Aguenou H, Barkat A. Breastfeeding, What About in Morocco?: A Systematic Review and Meta-Analysis. November 24, 2022 [cited January 25, 2023]; 06(18). Available from: <https://zenodo.org/record/7353315>
- [8] El Mossaoui M, Barkat A. Complementary Feeding Practices and Weaning Practices in Morocco: A Systematic Review and Meta-Analysis. *International Journal of Child Health and Nutrition* 2024; 13(2): 64-76. <https://doi.org/10.6000/1929-4247.2024.13.02.2>
- [9] Cherkaoui Dekkaki I, Mouane N, Ettair S, Meskini T, Bouklouze A, Barkat A. Prevalence of Obesity and Overweight in Children: A Study in Government Primary Schools in Rabat, Morocco. *Arch Med Res* 2011; 42(8): 703-8. <https://doi.org/10.1016/j.arcmed.2011.12.004>
- [10] Sebbani M, Elbouchti I, Adarmouch L, Amine M. Prevalence of Obesity and Overweight among Primary School Students in Marrakech, Morocco. *Rev D'Épidémiologie Santé Publique*. 2013; 61(6): 545-9. <https://doi.org/10.1016/j.respe.2013.08.002>
- [11] Kaoutar K, Hilali MK, Loukid M. Dietary Behavior and Body Mass Index of Adolescents in the Wilaya de Marrakech (Morocco). Available from: www.didac.ehu.es/antropo
- [12] Sbai M, Aboussaleh Y. Nutritional Status and Overweight in Preschool Children in the City of Kenitra (Northwest Morocco).
- [13] Sellam EB, Bour A. Nutritional Status of Children Aged 6 to 60 Months in Morocco "Prefecture of Oujda-Angad". *BMSAP* 2015; 27(1-2): 56-63. <https://doi.org/10.1007/s13219-015-0122-9>
- [14] Kaoutar K, Hilali MK, Loukid M. Thinness and Overweight among Schoolchildren in Rural Areas of the Wilaya de Marrakech, Morocco.
- [15] El Haboussi A, Hilali MK, Loukid M. Assessment of Physical Activity and its Association with Overweight (Including Obesity) in School-going Adolescents in the City of Marrakech and the Province of Al-Haouz in Morocco.
- [16] El Kabbaoui M, Chda A, Bousfiha A, Bencheikh R, Aarab L, Tazi A. Prevalence of and Risk Factors for Overweight and Obesity among Adolescents in Morocco. *East Mediterr Health J* 2018; 24(6): 512-21. <https://doi.org/10.26719/2018.24.6.512>
- [17] Azekour K, Idir I, Lahrach N, El Bouhali B. Prevalence of Obesity and Overweight in Schools, Tafilalet Oasis, Southeast Morocco. *Pan Afr Med J* [Internet]. 2020 [cited January 26, 2023]; 35. Available from: <http://www.panafrican-med-journal.com/content/article/35/40/full/> <https://doi.org/10.11604/pamj.2020.35.40.17650>
- [18] Ministry of Health of Morocco. National Survey on Population and Family Health (ENPSF) 2018. Ministry of Health 2018.
- [19] Ministry of Health. National Nutrition Program [Internet]. 2019 [cited February 12, 2020]. Available from: <https://www.sante.gov.ma/Documents/2019/06/Programme%20National%20de%20Nutrition.pdf>
- [20] Ali AT, Al-Ani F, Al-Ani O. Childhood obesity: causes, consequences, and prevention. *Ceska Slov Farm* 2023; 72(1): 21-36. <https://doi.org/10.5817/CSF2023-1-21>
- [21] Morales Camacho WJ, Molina Díaz JM, Plata Ortiz S, Plata Ortiz JE, Morales Camacho MA, Calderón BP. Childhood obesity: Aetiology, comorbidities, and treatment. *Diabetes Metab Res Rev* Nov 2019; 35(8): e3203. <https://doi.org/10.1002/dmrr.3203>
- [22] Flenon JA, Mitchikpe CES, Hounhouigan DJ. Socio-economic and Lifestyle Factors Associated with Obesity in School-age Children Attending Private Primary Schools in Cotonou. *Int J Biol Chem Sci* 2018; 12(1): 217. <https://doi.org/10.4314/ijbcs.v12i1.17>
- [23] Boswell N. Complementary Feeding Methods-A Review of the Benefits and Risks. *Int J Environ Res Public Health* 2021; 18(13): 7165. <https://doi.org/10.3390/ijerph18137165>
- [24] Cohen RJ, Brown KH, Canahuati J, Rivera LL, Dewey KG. Determinants of Growth from Birth to 12 Months among Breastfed Honduran Infants in Relation to Age of Introduction of Complementary Foods. *Pediatrics* 1995; 96(3 Pt 1): 504-10. <https://doi.org/10.1542/peds.96.3.504>
- [25] Kalanda BF, Verhoeff FH, Brabin BJ. Breast and Complementary Feeding Practices in Relation to Morbidity and Growth in Malawian Infants. *Eur J Clin Nutr* 2006; 60(3): 401-7. <https://doi.org/10.1038/sj.ejcn.1602330>
- [26] Bar-Or O, Foreyt J, Bouchard C, Brownell KD, Dietz WH, Ravussin E, et al. Physical Activity, Genetic, and Nutritional Considerations in Childhood Weight Management. *Med Sci Sports Exerc* 1998; 30(1): 2-10. <https://doi.org/10.1097/00005768-199801000-00002>
- [27] Schmit G, Hammami S. Childhood Obesity and Early Dietary Experiences. *Arch Pédiatrie* 2006; 13(5): 501-4. <https://doi.org/10.1016/j.arcped.2006.02.006>
- [28] Ministry of Health of Morocco. National Nutrition Strategy. Ministry of Health of Morocco 2011-2019; p. 73.
- [29] Ministry of Health. Health Strategic Plan. Morocco, Rabat 2025; p. 11.
- [30] Zhang J, Zhai Y, Feng XQ, Li WR, Lyu YB, Astell-Burt T, et al. Gender Differences in the Prevalence of Overweight and Obesity, Associated Behaviors, and Weight-related Perceptions in a National Survey of Primary School Children in China. *Biomed Environ Sci BES* 2018; 31(1): 1-11.

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