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ORIGINAL ARTICLE

# STUDY OF THE DIETARY AND ANTHROPOMETRIC PROFILE AND IDENTIFICATION OF DETERMINING FACTORS IN ADOLESCENTS AT SCHOOL IN THE KHEMISSET REGION OF MOROCCO

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## ABSTRACT

**Background.** The nutritional status and dietary diversity of adolescents play a crucial role in their growth, development, and overall health.

**Objective.** The aim of this study is to assess the nutritional status and determine the dietary diversity score in urban and rural school settings among Moroccan adolescents.

**Material and Methods.** We conducted a descriptive cross-sectional study in public schools in Khemisset in the municipality of Sidi Allal El Bahraoui, Morocco. We used a questionnaire to collect sociodemographic data and a 24-hour dietary recall to calculate the dietary diversity score.

**Results.** This study included 215 students. The mean BMI was 21.06 ± 0.23 kg/m2, with 60.8% of students having a normal BMI, 24.5% being underweight, 11.8% overweight, and 2.8% obese. The mean dietary diversity score was 5.672±0.956, with 21% having a low dietary diversity score, 12% having a high score, and 67% having a moderate score. Factors associated with nutritional status were place of residence, type of delivery, and age, while the dietary diversity score was associated with school level and BMI of adolescents.

**Conclusion.** The data from the study show that the diet of adolescents in the Khemisset region of Morocco is moderately diversified. In addition, the prevalence of underweight and overweight was worrying, underlining the need for multiple strategic interventions to improve the health status of adolescents.

**Key words:** *adolescents, dietary survey, risk factors, nutritional status, dietary diversity, Morocco*

## INTRODUCTION

Chronic non-communicable diseases (NCDs), mainly cardiovascular diseases, cancer, diabetes and chronic respiratory diseases are the main causes of mortality, with 70% deaths worldwide. They share common risk factors such as smoking and alcohol overdose, lack of exercise, unbalanced diet. They cause public health problems in all populations [1].

In fact, a balanced diet combined with sufficient physical activity is considered essential for maintaining a healthy state of health and reducing the risk of chronic disease [2].

Food is a multidimensional concept that combines several dimensions. During a meal, many foods containing different nutrients are eaten at the same time. The rhythm and context of meals, food choices and food combinations are influenced by many factors, including genetic, cultural, social, environmental, economic, health and lifestyle factors [3]. Public health recommendations are increasingly stressing the need for people to pay attention to the food they eat [4].

Socio-demographics factors such as gender, age and family composition are correlated with behaviors related to nutrition. As a result, the major food families do not occupy the same place in the consumption patterns of men and women [5]. Analysing the social aspects of diet in terms of health recommendations, and more generally that of social and cultural practices, provides valuable insights into the processes by which certain chronic diseases, such as diabetes, hypertension or hypercholesterolemia (and obesity) develop. But let's not forget that deficiencies exist in certain situations and are also a public health concern [6].

Analysis of the nutritional situation of the Moroccan population involves analysis of its socio-demographic evolution, its epidemiological profile

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and the evolution of its food consumption, which is at the root of a dietary change that is itself at the root of a nutritional transition [7]. The dietary transition is caused by the transition from a traditional diet, based on cereals and vegetables, to a diet that includes more products of animal origin, and tends to become rich in energy needs. Adolescents are the first to adopt these dietary changes [8].

In Morocco, there is a lack of studies on eating habits, eating behaviors, nutritional status and associated factors among adolescents. With this in mind, we conducted this study to describe the nutritional status, dietary profile, lifestyle and eating habits of a sample of school-going adolescents in the Khemisset region, as well as to explore the impact of socio-demographic factors on their diet.

## MATERIAL AND METHODS

A survey was carried out from December to February 2020 in the Khemisset region on a sample of 215 children and adolescents aged 13 to 19. The study protocol was approved by the Provincial Directorate of National Education and Sport in Khemisset, which granted permission to carry out the study. Before their participation, the objectives and methodology of the study were explained to the students and their consent was obtained. The students participated in the study were randomly selected. The classes assessed third year college (3TC) and second year college (2SC)) were also chosen at random.

The survey was based on a standardized questionnaire following a specific protocol to ensure the same procedure in all classes. Participants were asked to answer all the questions and encouraged to report any questions about parameters they did not know or understand. The questionnaire was completed in private so as to guarantee the confidentiality of the information and to allow them to express themselves freely. The first part of the questionnaire included socio-demographic information such as age, sex, living environment, weight, height, level of education, daily physical activities, etc. To study the food intake patterns of adolescents, we used a 24-hour recall in which the subjects surveyed declare the different food groups or drinks consumed, or during the last 24 hours (the food survey takes place in two days between them a month).

## RESULTS

*Socio-demographic characteristics*

This study involved 215 pupils, 61.9% of whom were in third Year College (3TC) and 38.1% in second Year College (2SC). The gender breakdown of our sample shows that 61.9% (n=133) are female and 38.1% (n=82) are male. The sex ratio was not balanced (F/M= 1.62; $p<0.001$). Age distribution showed that the average age of the students was 14.75±1.38 years, with a minimum of 13 years, a maximum of 19 years and a median of 15 years. The sample was composed of 82 boys (mean age = 15.10±1.28 years; range: 13-18 years) and 133 girls (mean age = 14.54 ± 1.39 years; range: 13-19 years).

The breakdown by place of residence shows that 73% (n=157) were from urban areas (girls=95 and boys=62) compared with 27% (n=58) from rural areas (girls=38 and boys=20).

As regards the parents' occupation, 70.7% (n=152) of fathers were in employment (with an occupation) and 88.8% (n=191) of mothers had no occupation. The breakdown of pupils by type of birth shows that 71.6% (n=154) were born naturally through the vagina (vaginal birth) and 28.4% (n=61) were extracted from the mother's uterus through an incision in the Abdomen (caesarean section). 13.02% (n=28) of these students reported having had a previous birth, half of whom were born by caesarean section (n=14).

*Anthropometric characteristics*

Body mass index (BMI) is calculated by dividing weight in kilograms by the square of height in meters (BMI = weight (kg) / height $(m)^2$). The distribution of pupils surveyed according to BMI shows that the average is 21.06±0.23 $kg/m^2$, with a minimum BMI of 14.28 $kg/m^2$ and a maximum BMI of 31.63 $kg/m^2$ and a median of 20.51. The distributions of BMI categories are 60.8% of pupils have a normal BMI, 24.5% are underweight, 11.8% are overweight and 2.8% are obese. The results of the $Chi^2$ test between BMI and certain socio- demographic variables are shown in Table 1.

In terms of place of residence, among pupils from rural areas, 12.28% were underweight and 14.3% were overweight or obese. Among urban pupils, 29.03% were underweight and 14.84% were overweight or obese.

There was a significant relationship between type of delivery and BMI ($p<0.05$). In fact, among the students extracted from a caesarean delivery, 21.67% were underweight and 4 students were overweight or obese. Among students who had undergone a vaginal delivery, 20.39% were underweight and 17.76% were overweight or obese.

Age is a factor significantly linked to BMI ($p<0.006$). In addition, 30.70% of pupils under 15 were underweight compared with 8.47% of pupils over 15, while 8.47% of pupils over 15 were underweight and 20.34% were overweight or obese.

Table 1. *Chi*$^2$ test between BMI and certain socio-demographic variables

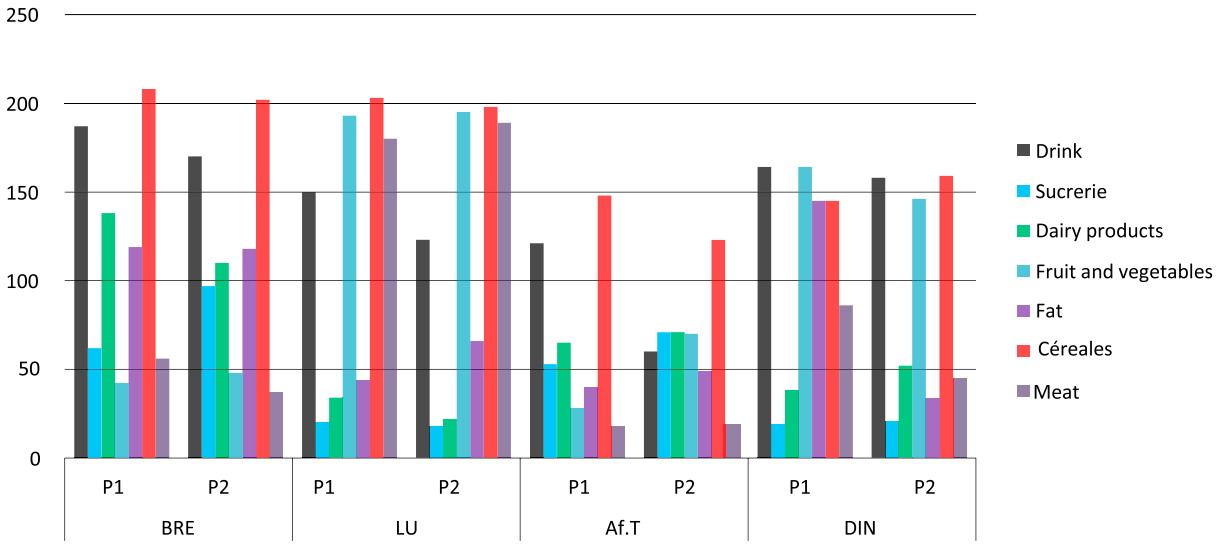
| Variable | Modality | BMI | | | | Total | *Chi*$^2$ (p value) |
|---|---|---|---|---|---|---|---|
| | | under weight | normal | overweight | obese | | |
| Sex | Male | 21 | 51 | 6 | 3 | 81 | 2.69 (p<0.44) |
| | Female | 31 | 78 | 19 | 3 | 131 | |
| Total | | 52 | 129 | 25 | 6 | 212 | |
| School level | 2TC | 26 | 52 | 3 | 0 | 81 | 14.29 (p<0.003) ** |
| | 3SC | 26 | 77 | 22 | 6 | 131 | |
| Total | | 52 | 129 | 25 | 6 | 212 | |
| Living environment | Rural | 7 | 42 | 5 | 3 | 57 | 9.11 (p<0.028) * |
| | Urban | 45 | 87 | 20 | 3 | 155 | |
| Total | | 52 | 129 | 25 | 6 | 212 | |
| childbirth | Normal | 31 | 94 | 22 | 5 | 152 | 7.5 (p<0.05) * |
| | Caesarean section | 21 | 35 | 3 | 1 | 60 | |
| Total | | 52 | 129 | 25 | 6 | 212 | |
| Age | <15 years | 47 | 87 | 16 | 3 | 153 | 12,.2 (p<0.006) ** |
| | > 15 years | 5 | 42 | 9 | 3 | 59 | |
| Total | | 52 | 129 | 25 | 6 | 212 | |

BMI: body mass index. *: significant difference; **: highly significant difference; 2SC: second year college; 3TC: third year college

*Study of dietary diversity in the survey population*

Dietary diversity is a qualitative measure of food consumption that reflects the variety of foods to which individuals or households have access. Before calculating dietary diversity score (DDS), the food groups to be included are defined in a way that is compatible with the eating habits and practices of the population under study. The most commonly used classification is that of the Food and Agriculture Organization (FAO). The DDS is then calculated by a simple count of the food groups that a household or individual has consumed in the period preceding the interview. The number of food groups consumed reflects the degree of diversity in the diet.

Figure 1 gives the comparative results for consumption by the different food groups over the four meals and between the two sampling periods. The graph shows the following information:




P: levy, BRE: breakfast, LU: lunch, Af.T: afternoon tea, DIN: dinner

Figure 1. Distribution of participants according to food group consumption frequency

1. The most consumed products in all meals are, in ascending order, cereals (96.7% of respondents), followed by drinks (tea, water, etc.) (87% answered "yes"), then dairy products and fats (64.2% and 55.3% respectively).
2. The same trend was observed during the second survey period, but with a decrease in frequency.
3. The respondents' answers confirm that the food group consumed most frequently is cereals, with a frequency of 68.8%.

The mean dietary diversity score was 5.672±0.956, with a minimum of 3, a maximum of 8 and a median of 6. In order to identify the categories, given the lack of a threshold defining the different classes of dietary balance, we proposed translating the scores into reduced centered variables (Z score). While adopting the following classification:

Class 1 - Z less than -1: low dietary diversity

Class 2 - Z between -1 and + 1: average dietary diversity

Class 3 - Z greater than + 1: high dietary diversity

The distribution of children surveyed according to DDS class and Z score is shows that 21% have a low DDS, 12% have a high DDS and 67% have an average DDS.

Table 2 presents the results of the $Chi^2$ test of independence between the DDS category and certain socio-demographic variables. The table shows that only school level showed a significant association with DDS ($Chi^2$=7.17; p<0.028). Among pupils in the 2nd year of secondary school, 12.19% showed low DDS and 8.54% showed high DDS. In the third year of secondary school, 12.03% had a low DDS and 22.56% a high DDS.

Figure 2 shows the results of the distribution of respondents according to DDS and BMI. The $Chi^2$ test of independence shows a strong relationship between these two factors (DDS and BMI) ($Chi^2$=42.42; p<0.000). Indeed, of the pupils with a normal BMI, 14.04% had a low DDS compared with 12.36% with a high DDS. Furthermore, of the overweight or obese pupils, 2 % of respondent had a low DDS and 40% had a high DDS.

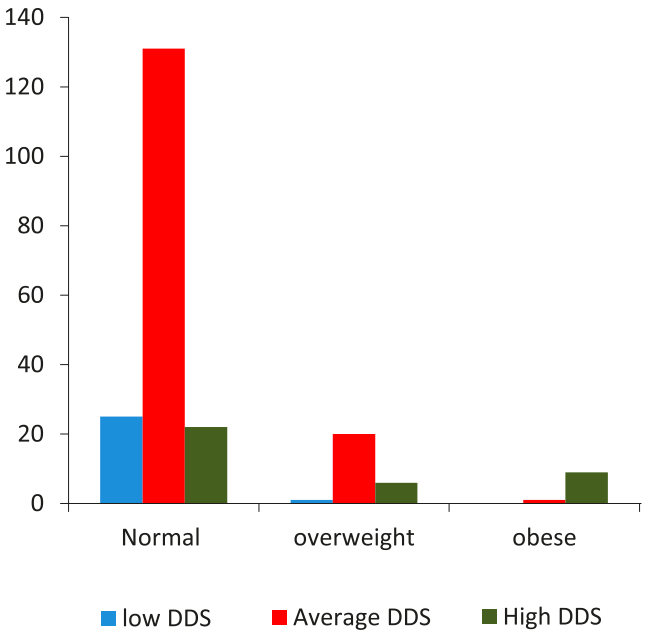



Figure 2. Distribution of respondents according to DDS and BMI

Table 2. $Chi^2$ test of independence between DDS and certain socio-demographic variables

| Variable | Modality | DDS | | | Total | $Chi^2$ (p value) |
|---|---|---|---|---|---|---|
| | | low | average | high | | |
| Gender | Male | 12 | 58 | 12 | 82 | 1.22 (p<0.54) |
| | Female | 14 | 94 | 25 | 133 | |
| Total | | 26 | 152 | 37 | 215 | |
| Level of education | 2SC | 10 | 65 | 7 | 82 | 7.17* (p<0.028) |
| | 3TC | 16 | 87 | 30 | 133 | |
| Total | | 26 | 152 | 37 | 215 | |
| Living environment | Rural | 8 | 42 | 8 | 58 | 0.76 (p<0.68) |
| | Urban | 18 | 110 | 29 | 157 | |
| Total | | 26 | 152 | 37 | 215 | |
| Childbirth | Normal | 19 | 108 | 27 | 154 | 0.76 (p<0.96) |
| | caesarian | 7 | 44 | 10 | 61 | |
| Total | | 26 | 152 | 37 | 215 | |
| Age | <15 years | 19 | 112 | 25 | 156 | 0.56 (p<0.75) |
| | >15 years | 7 | 40 | 12 | 59 | |
| Total | | 26 | 152 | 37 | 215 | |

*: Significant difference, 2SC: second year college, 3TC: third year college ; DDS : dietary diversity score

## DISCUSSION

The purpose of our study is to assess the nutritional status of adolescents attending schools in urban and rural areas of the Sidi Allal El Bhraoui Khemisset region in Morocco.

The chosen parameter is body mass index (BMI). However, the average BMI is 21.06±0.23 kg/m $^2$, with 60.8% of students having a normal body weight, 24.5% being underweight, 11.8% being overweight, and 2.8% being obese. This result is consistent with surveys conducted in other Moroccan cities. A cross-sectional survey conducted in 2014 on a sample of 2271 students in the eastern region of Morocco found a prevalence of overweight and obesity of 12.2% and 3.0% respectively (14.2% in girls versus 10.4% in boys) **[9].** Another study in the commune of Bitit Ait Oualal in the El Hajeb province of Morocco, conducted by *Nour El Yakine* et al. [10], showed that stunting, overweight, and obesity affected 25.9%, 7.7%, and 2.6% of the overall sample, respectively, with no significant difference between girls and boys.

Our mean BMI of 21.06±0.23 kg/m$^2$ is comparable to that reported by *Fedala* et al. [11] in Algeria in a school setting (BMI 19.03±3.77). However, in the Taza region of Morocco, the mean BMI among students was higher (28.26±3.04 kg/m$^2$) [12]. Additionally, our results are similar to those reported in a study in Congo, which found a prevalence of overweight and obesity among adolescents of 8% and 1% respectively, with a mean BMI of 18.82±3.15 kg/m$^2$ [13]. *Khader* et al. [14] reported that in Jordan, the overall prevalence rates of overweight and obesity among adolescents were 13.7% and 10.0% respectively.

The prevalence of overweight and obesity in our study is lower than in some developed countries such as the United States [15], Canada [16], and Italy [17], where the prevalence of overweight ranges from 22% to 36% and obesity from 4.15% to 9.45%. In France, a survey of 1,507 adolescents aged 11 to 17 years showed that 17.6% of students were overweight (including obesity) [18]. *Prado* et al. [19] found that in Spain, overweight was present in 29% of adolescents aged 13 to 16 years. There have been numerous studies conducted to assess the nutritional status of adolescents, aiming to understand nutritional intake and factors influencing their nutritional status. According to our survey, some selected variables were found to be associated with BMI, except for gender. Contradictory results regarding the distribution of overweight and obesity by gender have been observed in different countries, including Canada [16] and Italy [17], where the prevalence was higher in boys than in girls. In a population of Algerian adolescents aged 10 to 19 years in a school setting, boys were found to have higher rates of overweight and obesity (6.6% and 2.42%) compared to girls (2.16% and 0.54%) [11]. However, among students with overweight, 74.19% are from urban areas, while 25.80% of overweight or obese students are from rural areas. This shows that urban residence is a risk factor associated with overweight and obesity, which is consistent with several studies in the literature [20]. This can be explained by changes in dietary habits and lifestyle due to urbanization, which contributes to weight gain. The same relationship was found in a cross-sectional survey conducted by *Nouayti* et al. [9] among a sample of 2,271 students in the eastern region of Morocco. Additionally, a higher income of the father (including obesity) was associated with overweight.

In our study we note a significant relationship between the type of delivery and BMI. Indeed, among students born by caesarean section, 21.67% are underweight. Whereas among students born by vaginal delivery, 20.39% are underweight and 17.76% are overweight or obese. Age is also significantly associated with BMI. Furthermore, among students under 15 years old, 30.70% are underweight compared to 8.47% among students over 15 years old. Among students over 15 years old, 8.47% are underweight.

In a study by *El Kabbaoui* et al [10], found that overweight in adolescents is influenced by various social factors, including family income. The prevalence of overweight and obesity increases with family income. In developing countries, excess weight is primarily found in children and adolescents from higher socioeconomic families. Consequently, their children have access to highly energy-dense foods. Thus, motorized transportation to school, using the computer for more than 4 hours a day, and frequent consumption of sodas and carbonated beverages are reported as risk factors that contribute to overweight and obesity

This study also aimed to evaluate dietary habits in order to determine the Dietary Diversity Score (DDS) and its relationship with certain sociodemographic factors. The calculation of the DDS, as well as the list of food groups used, was established according to FAO recommendations. The most consumed food groups in our sample for the four meals were cereals, beverages, fruits, and vegetables. The average DDS was 5.672 ± 0.956 out of a total of 9. It skewed towards higher values, with a minimum of 3 and a maximum of 8. However, 21% had a low DDS, 12% had a high DDS, and 67% had a moderate DDS. This class needs to be closely monitored as children in this class can easily shift to a low or high DDS class. Educational level showed a significant association with DDS, with higher DDS observed among 3TC students. Another association was found between DDS and BMI. Among students with normal BMI, 14.04% had a low DDS, compared to 12.36% with a high DDS. Furthermore,

among overweight or obese students, the majority had a high DDS.

Our results are consistent with a study conducted on a sample of 463 children aged 9 to 17 years from the city of El Jadida, Morocco. This study found that 2.4% of children had a low DDS, 55.7% had a moderate DDS, and 41.9% had a high DDS. The mean DDS was 5.67±1.03 among children. Additionally, data analyses showed that children of parents with low education had higher mean DDS. Furthermore, children of parents with high economic status had lower mean DDS and Dietary Variety Score compared to those with low economic status. Moreover, high dietary diversity was less suitable among underweight and overweight children compared to those with normal weight [21].

In parallel, a national nutrition survey conducted in 2019 by the Moroccan Ministry of Health among children aged 6 to 12 years revealed that 39.1% of them had a very low dietary diversity, consuming less than 4 food groups per individual. Additionally, 49.9% of children had moderate dietary diversity, while 11% had a highly diverse diet (≥6 groups). The statistical analysis showed a significant difference between urban and rural areas, with more diversified consumption among children in urban areas [22]. In Algerian adolescents, the situation is not better. The results of the study conducted by *Karoune* et al. [23] among 327 adolescents aged 11 to 19 years in Eastern Algeria showed that the Dietary Diversity Score (DDS) had an average of 3.19±1.10. It ranged from 0 to 7. Adolescents with low DDS accounted for 19.6% of the total, while only 9.2% had a high DDS. Illiteracy was more common among parents of adolescents with low DDS. According to this study, parents' level of education was a more determinant factor of DDS than occupation. It had a negative relationship with dietary diversity among adolescents. Among Iranian adolescents aged 10 to 18 years, *Mirmiran* et al. [24] recorded a DDS of 6.25±1.08 out of a maximum of 10. This score reflects a diversified diet. *Yi Zhou* et al. [25] in a cross-sectional survey in central China between 2015 and 2020, found that 78.3% had insufficient dietary diversity, while nearly 1% reported sufficient dietary diversity. *Yi Zhou* also confirmed that high fat/sugar/salt dietary practices can lead to low dietary diversity, while high dietary diversity can have effects on BMI. This study highlighted the importance of increasing dietary diversity in a balanced and healthy manner.

The results of our study should be interpreted in light of certain limitations. Firstly, it was a cross-sectional study, and the results did not imply a cause-and-effect relationship but rather valid interpretations that could be used for further research. Additionally, the data were self-reported, which may introduce data bias.

## CONCLUSION

In our study, we found that the diets of the adolescents surveyed were moderately diversified. However, we also found a worrying prevalence of malnutrition. These indicators enable us to identify population groups at risk of poor nutrition. It is therefore crucial to take into account certain socio-economic, cultural and environmental factors, such as place of residence, type of childbirth, age, level of education and BMI, when devising strategies aimed at improving the dietary diversity and nutritional status of adolescents.

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**Conflict of interest**

*The authors declare that they have no conflicts of interest.*

## REFERENCES

1. WHO. Monitoring progress in the fight against non-communicable diseases. 2017. http://apps.who.int/iris.
2. *Estaquio C, Kesse-Guyot E, Deschamps V,* et al. Adherence to the French Programme National Nutrition Santé Guideline Score Is Associated with Better Nutrient Intake and Nutritional Status. J Am Diet Assoc 2009;109:1031-41.
3. *Krondl M, Coleman P.* Social and biocultural determinants of food selection. Prog Food Nutr Sci 1986;10:179-203.
4. *Pène, P., Lévi, Y., Bazex, M. M. J., Dreux, C., Gentilini, M., Jaffiol, C., & Oliver, J. L.*: Human consumption water and public health in metropolitan France. Bulletin de l'Académie nationale de médecine, 2011;195(2):403-429.
5. SAINT-POL T., 2014 - Determinants sociaux et culturels de l'alimentation. In INSERM. Social inequalities in health in relation to diet and physical activity. Collection Expertise Collective, Inserm, Paris: 217 - 235.
6. HEPA Europe, 2010 - European Network for the Promotion of Physical Activity for Health. Copenhagen, WHO Regional Office for Europe.
7. Report by the Ministry of Health. La Stratégie Nationale de la Nutrition 2011-2019. page 10.

8. *Rouget S.*: Changer le comportement alimentaire des adolescents: comment les motiver? Percentile, 2013;18(1):26-28.
9. *Nouayti H, Bouanani NH, Hammoudi J, Mekhfi H, Legssyer A, Bnouham M, Ziyyat A.*: Overweight and obesity in Eastern Morocco: Prevalence and associated risk factors among high school students. Rev Epidemiol Sante Publique. 2020 Sep;68(5):295-301.
10. *Lakhdar N. E. Y., Lamri D., Ouaddou A., & Ouahidi M.L.* Evaluation de l'état nutritionnel des élevés scolarises âgés de 12 à 18 ans dans la commune rurale de Bitit Ait Oualal dans la province de El Hajeb (Maroc). Antropo, 2022;(48):15-22.
11. *Fedala N, Mekimene L, Haddam AEM, Fedala NS.* Association entre l'indice de masse corporelle, l'activité physique et la sédentarité chez les adolescents algériens. Int J Innovat Appl Stud. 2015;10(2):489–497.
12. *El Haouari M., Ech-Chahbi H., Gouridech S., Fallouky K.* Impact du surpoids sur l'intégration dans les cours d'education physique et sportive chez des adolescents scolarises a taza (Maroc). Am J Innov Res Appl Sci 2018;220-225.
13. *Musung JM, Muyumba EK, Nkulu DN, Kakoma PK, Mukuku O, Kamalo BKM, Mukeng CK, Kakisingi CN, Malonga FK, Chenge FM, Luboya ON.* Prévalence du surpoids et de l'obésité chez l'adolescent en milieu scolaire à Lubumbashi, République Démocratique du Congo [Prevalence of overweight and obesity among adolescents in school in Lubumbashi, Democratic Republic of Congo]. Pan Afr Med J. 2019 Jan 28;32:49. French. doi: 10.11604/pamj.2019.32.49.15969.
14. *Khader YS, Batieha A, Jaddou H, et al.* Metabolic abnormalities associated with obesity in children and adolescents in Jordan. Int J Pediatr Obes. 2011;6:215-22
15. *Flegal KM, Ogden CL, Wei R, Kuczmarski RL, Johnson CL.* Prevalence of overweight in US children. Comparison of US growth charts from the Centers for Disease Control and Prevention with other reference values for body mass index. Am J Clin Nutr. 2001;73(6):1086–1093.
16. *Tremblay MS, Katzmarzyk PT, Williams JD.* Temporal trends in overweight and obesity in Canada, 1981–96. Int J Obes. 2002; 26(4):538–543.
17. *Vignolo M, Pistorio A, Torrisi C, Parodi A, Grassi S, Aicardi G.* Overweight and obesity in a group of Italian children and adolescents: prevalence estimates using different reference standards. Ital J Pediatr. 2004;30(1):53–57.
18. *Souames M, Brun P, Losfeld P.* Surpoids et régime alimentaire chez l'adolescent: étude dans les collèges du département des Hauts-de-Seine. Archives de Pédiatrie. 2005;12(10):1540–3.
19. *Prado C, Fernández-Olmo R, Rovillé-Sausse F.* Évaluation comparée de l'Indice KidMed et suivi hebdomadaire de l'estimation de l'apport nutritionnel des enfants et des adolescents. Antropo. 2009;18(1):1–7.
20. *Ghosh A.* Comparaison rurale-urbaine de la prévalence du surpoids et de l'obésité chez les enfants et les
21. adolescents d'origine indienne d'Asie. Asia Pac J Public Health. 2011;23(6):928-35.
22. *Sahel K, Elfane H, El-Jamal S, El Ayachi M, Belahsen R.* Food quality and nutritional status of school-going adolescents in the province of El Jadida in Morocco. Rocz Panstw Zakl Hig. 2022;73(4):423-433 doi: 10.32394/rpzh.2022.0237.
23. Le Ministère de la Santé, Direction de la Population, Programme National de Nutrition. Enquête nationale sur la nutrition (ENN 2019-2020) [Rapport]. Maroc, 2020.
24. *Karoune R., Dahel-Mekhancha C.* C. Score de diversité alimentaire chez l'adolescent: effet du niveau de vie (Algérie, 2014). Nutr Clin Métabol. 2014;31(1):80.
25. *Mirmiran P., Azadbaht L., Esmailzadeh A. and Azizi F.* Dietary diversity score in adolescents-a good indicator of the nutritional adequacy of diets: Tehran lipid and glucose study. Asia Pacific J Clin Nutri 2004;13(1):56-60.
26. *Zhou Y, Wang J, Duan Y, Luo X, Wan Z, Luo Y, Li Y, Wang Y, Xie J.*: Dietary diversity and determinants of young adults in central China: A cross-sectional study from 2015 to 2020. Front Nutr, 30 Sept 2022, doi: 10.3389/fnut.2022.931107

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