ARTICLE ORIGINAL

Anthropometric Characteristics of Tunisian Population in Comparison to the World

Caractéristiques anthropométriques de la population tunisienne par rapport au monde

Malek Tlili, Mounir Landolsi, Mohamed Salah Jarrar, Sihem Khelifi, Nader Naouar, Slah-Eddine Ghannouchi

Laboratory of Anatomy, Faculty of Medicine of Sousse, Sousse University, Tunisia,

RÉSUMÉ

Introduction : L'anthropométrie est la seule et unique méthode universellement applicable, bon marché et non invasive qui permet d'étudier les proportions du corps humain. Les mesures anthropométriques sont le reflet de l'état nutritionnel et de santé, mais peuvent aussi être utilisées pour prévoir les aptitudes, l'état de santé et la survie. C'est donc un outil fiable, mais actuellement sous-utilisé, pour orienter les politiques de santé publique.

But : Par conséquent, ce travail a étudié les caractères anthropométriques des Tunisiens et les a comparés aux autres pays.

Méthodes : 429 sujets ont participé à cette étude (322 hommes et 107 femmes), âgés de 20 à 85 ans. La masse corporelle, la taille du corps, la circonférence de la cuisse, la longueur des membres inférieurs et l'indice de masse corporelle étaient les paramètres anthropométriques pris en compte dans notre étude.

Résultats : Avec une taille moyenne de 171 cm chez les hommes et 157 cm chez les femmes, les Tunisiens étaient proches des pays voisins. Néanmoins, avec une masse corporelle de 77,23 kg et 72,66 kg et un IMC de 26,48 et 29,18 respectivement pour les hommes et les femmes, la Tunisie a la plus forte prévalence de l'obésité de la région, en particulier pour les femmes. Plusieurs corrélations anthropométriques ont également été observées telles que les relations entre la circonférence de la cuisse, l'IMC, la masse corporelle, la longueur des membres inférieurs et la taille du corps.

Conclusion : L'obésité s'avère être un problème de santé publique pour lequel des stratégies et des mesures efficaces sont nécessaires.

Mots-clés : Obésité, Anthropométrie, Afrique du Nord, Genre

SUMMARY

Background: Anthropometry is the one and only universally applicable, inexpensive and non-invasive method for studying the proportions of the human body. Anthropometric measurements reflect nutritional status and health, but can also be used to predict skills, health status and survival. It is therefore a reliable tool, but currently underused, to guide public health policies.

Aim: Therefore, this study investigated anthropometric characters of Tunisian people and compared it with those of other nationalities.

Methods: 429 subjects have participated in this study (322 men and 107 women), aged between 20 and 85. Anthropometric measurements used in this study were body mass, body size, thigh circumference, lower limbs length and body mass index.

Results: With an average body size of 171 cm for men and 157 cm for women, Tunisians were close to neighboring countries. Nevertheless, with a body mass of 77.23 kg and 72.66 kg and a BMI of 26.48 and 29.18 respectively for men and women, Tunisia has the highest prevalence of obesity in the region, especially for women. Several anthropometric correlations have also been noticed such as relationships between thigh circumference, BMI, body mass, lower limbs length, and body size.

Conclusion: Obesity is proving to be a public health problem for which effective strategies and measures are needed.

Key-words : Obesity, Anthropometry, North African, Sexual category

Correspondance
Malek Tlili
Laboratory of Anatomy / Faculty of Medicine of Sousse, Sousse University, Tunisia
Mail: tl.malek91@gmail.com

INTRODUCTION

Anthropometric measurements are not archaic methods for classing groups of human beings, they allow us to have not only a global analysis of society but also in some pathological cases its evolution (nutrition status and fertility, obesity and longevity) (1) .

Body mass and body size are the first measured anthropometric parameters that can give us an idea of human morphological characteristics. Measuring them requires simple materiel: a calibrated scale and a flexible measuring tape are generally sufficient (2) . For more details on the human morphological characteristics, other anthropometric parameters are required. In our case, we considered the length of the lower limbs and the circumference of the thigh.

The development of psychological aptitude has been the subject of numerous studies (3,4) but it was not the case for morphological characters despite their importance. Previous investigations were published in order to characterize morphological specificities of different populations (5,6). To our knowledge, only few works have been concerned with the anthropometric measurements of the Tunisian population in comparison with other nationalities (5,7-9).

Therefore, the aims of this study were to investigate anthropometric characters of Tunisian people and to compare their characteristics with those of other nationalities.

METHODS

Participants

429 subjects have participated in this study (322 men and 107 women), their ages between 20 and 85 years.

The survey was carried out in accordance with the ethical principles for medical research involving human subjects.

Anthropometry

In the context of medico legal and medico social expertise, the anthropometric measurements were taken following a standard socioeconomic questionnaire (age, marital status, job position, and social class belonging). They were carried out by a professionally qualified person over a period of 16 years (1998-2003). All the measurements were taken in the morning at an average temperature of 21°. Subjects with a chronic disease and leg length discrepancy were eliminated.

Body mass was measured using a calibrated scale (Detecto, USA) with an accuracy of 0.1 kg, body size was measured using a wall-mounted stadiometer (Person-check®, Kirchner & Wilhelm, Germany), and the circumference of the thigh and the length of the lower limbs was measured with a flexible tape.

After measuring body mass and body size, the experimenter measured the lower limbs' length from the anterior superior iliac spine (ASIS) to the medial malleolus (10). For thigh circumference, the measurement was taken at 10 cm proximal to the superior pole of the patella. We have used this landmark in order to avoid error caused by synovial effusion. Overall adiposity was assessed by Body Mass Index, using the following formula:

$$BMI\,(kg{\cdot}m^{-2}) = Body\ mass/\ (Body\ size)^2$$

Thinness was defined as BMI < 18.5 $kg{\cdot}m^{-2}$, overweight (including obesity) as BMI ≥ 25.0 and obesity as BMI ≥ 30. Thirty years old was taken as the beginning age of senescence (11).

Statistical Analysis

Microsoft Access 2007 was used for collecting anthropometric data and descriptive statistics were performed for all measurements using statistical software SPSS®, 16.0 (SPSS Inc., Chicago IL, USA). All data were expressed as means ± *SD*. Relationships between thigh circumference, BMI, body mass, lower limbs length, and body size were made using Pearson's correlation coefficient. The $p \leq 0.05$ criterion was used for establishing statistical significance.

RESULTS

General characteristics of participants

The anthropometric characteristics of our participants were showed in the Table 1 and 2.

The prevalence of normal corpulence for the whole population was 32.6%. The prevalence of underweight was 3%, the prevalence of obesity alone was 27.3%, and that of overweight alone was 37.1%. The prevalence of overweight including obesity was 64.4%.

In Tunisia, the prevalence of overweight in both sexes was 40.7% for men and 26.2% for women and that of obesity was respectively 21.7% and 43.9%. The prevalence of extreme obesity (BMI ≥ 40) was approximately 0.6% for men and 5.6% for women.

For women, the prevalence of thinness was 0.9% whereas for men, it was 3.7%.

Table 1. Descriptive data of measured variables for all Participants

	All population (n = 429)		
	Mean ± *SD*	Min	Max
Age (years)	42.41 ± 11.29	20	85
Body size (cm)	167.21 ± 8.64	141	188
Body mass (kg)	76.09 ± 14.79	46	128
Lower limbs Length (cm)	89.64 ± 5.44	73	106
Thigh circumference (cm)	46.93 ± 5.78	31	65
BMI (kg·m^{-2})	27.16 ± 5.06	16.72	43.82

Table 2. Anthropometric characteristic of participants by sexual category

	Men (n = 322)			Women (n = 107)		
	Mean ± *SD*	Min	Max	Mean ± *SD*	Min	Max
Age (years)	43.25 ± 11.48	20	85	39.86 ±10.36	20	69
Body size (cm)	171 ± 6.74	143	188	157 ± 6.29	141	175
Body mass (kg)	77.23 ± 14.48	46	128	72.66 ± 15.25	46	113
Lower limbs Length (cm)	91.13 ± 4.91	74	106	85.17 ± 4.43	73	96
Thigh circumference (cm)	46.13 ± 5.37	33	61	49.31 ± 6.31	31	65
BMI (kg·m^{-2})	26.48 ± 4.52	16,72	42.68	29.18 ± 5.99	18.29	43.82

Anthropometric characteristic of Tunisians by gender and age

In fact, the average height for subjects under 30 years of age was 173 cm for men and 158.6 cm for women and the average height for subjects over 30 years of age was 170 cm for men and 156.5 cm for women (Table 3).

Women aged over 30 years old gained 10.68 kg compared to women aged under 30 years old. But men only took 3.88 kg (Table 3).

Table 3. Anthropometric characteristic of participants by gender and age

	Men (n = 322)		Women (n = 107)	
	< 30 years (n = 50)	> 30 years (n = 272)	< 30 years (n = 26)	> 30 years (n = 81)
	Mean ± *SD*	Mean ± *SD*	Mean ± *SD*	Mean ± *SD*
Body size (cm)	173.56 ± 5.55	170.11 ± 6.81	158.6 ± 5.33	157.5 ± 6.58
Body mass (kg)	74.76 ± 14.09	77.69 ± 14.54	64.58 ± 17.25	75.26 ± 13.67
BMI (kg·m^{-2})	24.76 ± 4.21	90.68 ± 4.86	25,52 ± 6,15	30.36 ± 5.48
Lower limbs length (cm)	93.58 ± 4.52	26.80 ± 4.51	85.23 ± 4.10	85.15 ± 4.56

Relationships between different measured parameters

For both men and women, there was a strong correlation between BMI and thigh circumference (r = 0.84, p < 0.01; r = 0.72, p < 0.01, respectively, Figure 1). The same strong correlation was also observed in both between, body mass and thigh circumference (r = 0.81, p < 0.01; r = 0.74, p < 0.01, respectively, Figure 2) and body size and lower limbs length (r = 0.81, p < 0.01; r = 0.60, p < 0.01, respectively, Figure 3). Only a moderate negative correlation was revealed between age and body size (r = -0.26, p < 0.01; r = -0.22, p < 0.05, respectively).

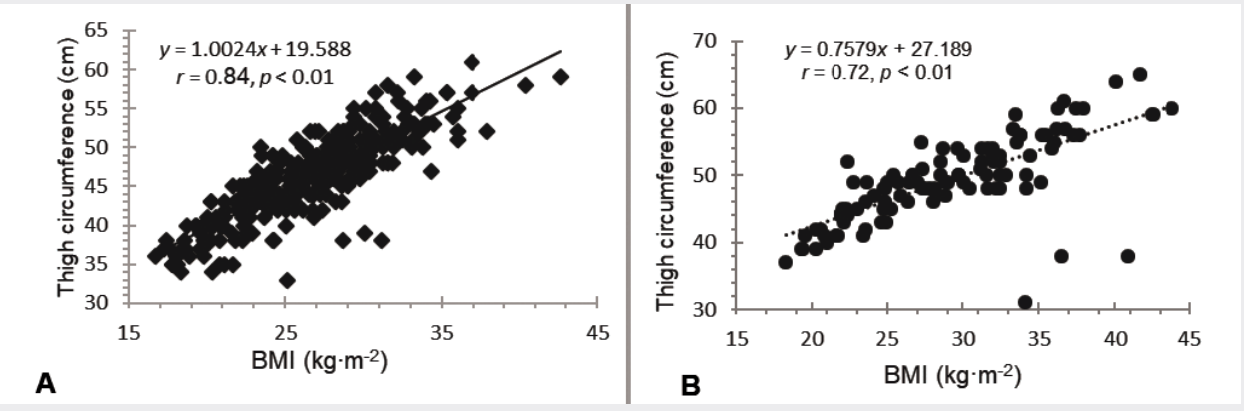

Figure 1. Correlation between BMI and thigh circumference in Tunisian men (A) and women (B)

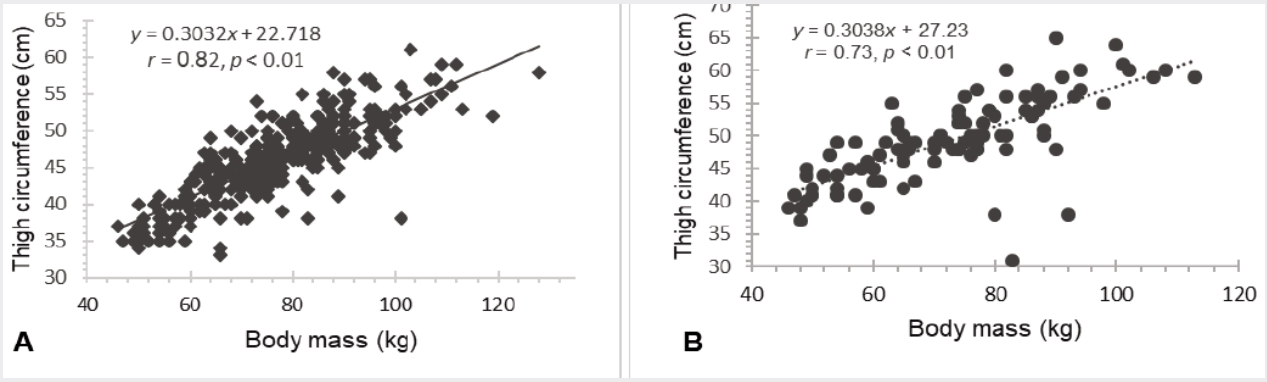

Figure 2. Correlation between body mass and thigh circumference in Tunisian men (A) and women (B)

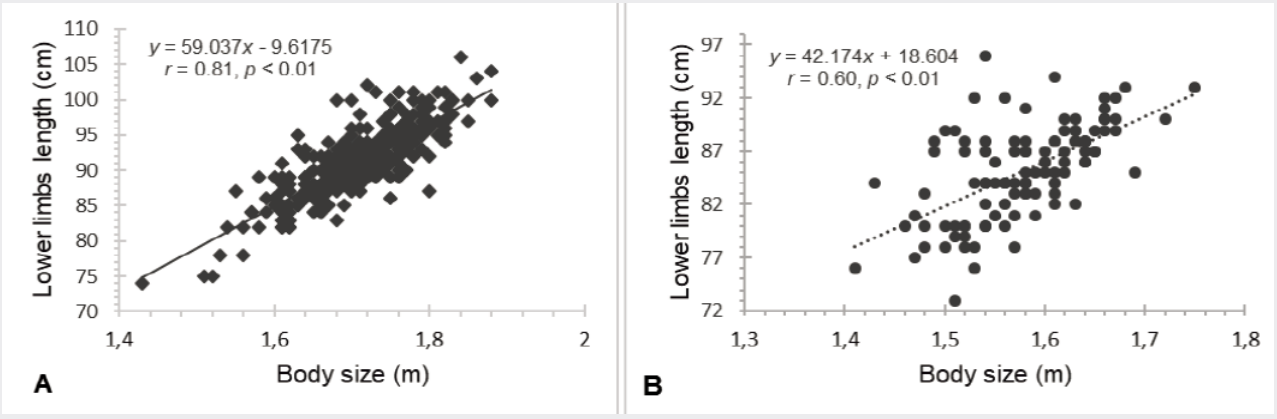

Figure 3. Correlation between body size and lower limbs length in Tunisian men (A) and women (B)

DISCUSSION

The main purpose of this study was to investigate and to compare anthropometric characters of Tunisian people with those of other nationalities.

Tunisian women's body size was in average 14 cm less that men's body sizes. This difference was not as great as that of the measured body mass which is at 4.57 kg. That is why Tunisian women were more corpulent than men with a BMI of 29.18 $kg \cdot m^{-2}$.

For both men and women, the prevalence of overweight (40.7% and 26.2%) and that of obesity (21.7% and 43.9%) were very high, all the more for women. The prevalence of extreme obesity (BMI ≥ 40) was around 0.6% for men but much higher for women: 5.6%. For women, the prevalence of thinness was very low (0.9%) whereas for men, it was not negligible (3.7%). The gender inequalities regarding corpulence were high. The prevalence of thinness was much lower and that of obesity much higher amongst women.

Comparison of anthropometric characters of Tunisian people with those of other nationalities.

With an average body size of 171 cm for men and 157 cm for women (Table 2), our results were very similar to those of Algeria, 170.9 cm for men and 158.1 cm for women (7). They were also close to those of Afro-American women, which ranged from 161.7 to 158.25 cm (9). While Tunisian men's body sizes were comparable to Sudanese and Guinean men (171 cm) (8). In comparison with European populations, the results that we accrued were rather close to those of the Portuguese population, in which the

male and female's body sizes were 170 cm and 159 cm. Portugal was the European country with the smallest body size for both sexes (5) However, in a relatively recent anthropometric study (12) authors have shown that the body sizes of Indian inhabitants in three different regions (Oraon, Dhimal, and Sarak) were far lower than those of Tunisian men (from 160.65 to 163.34 cm).

The smaller human bodies are not necessarily the least corpulent. With a BMI of 26.48 $kg \cdot m^{-2}$ (Table 2), Tunisian men have a higher BMI than Algerian men (24.1 $kg \cdot m^{-2}$) (7) . As for the Indian population, the BMI ranges from 18.48 to 20.07 $kg \cdot m^{-2}$ (12). Compared to Europeans, Tunisians' BMI was the same as those of the Greek people, who have the highest value in Europe (26 $kg \cdot m^{-2}$) (5,15). Tunisian women BMI was higher than female Algerian (27.4 $kg \cdot m^{-2}$) (7) and European BMI (15) . In fact, the largest female European BMI was recorded in the United Kingdom with a value of 26 $kg \cdot m^{-2}$.

In our study, the prevalence of normal corpulence throughout the population (for both men and women) was 32.6%. The prevalence of underweight was 3%, the prevalence of obesity was 27.3%, and that of overweight was 37.1. The prevalence of overweight including obesity was 64.4%. The similarities between countries of Maghreb ethnic origin, their socio-cultural context and their mid-term development would predict similarities in corpulence. However, even in what appears as a homogeneous area, there was a mixture concerning the distribution of the population in the corpulence classes (16). For example, in Morocco (17) , the prevalence of normal corpulence throughout the population (men and women) was 41.5%. The prevalence of underweight was 5.3%, the prevalence of obesity alone was 22%, and the prevalence of overweight alone was 31.3%. The prevalence of overweight including obesity was 53.3%. The population's distribution in the corpulence classes in Europe (15) was different, almost 3.5% underweight, 32% overweight, 10% obese and 54.5% normal corpulence.

As for African's countries the percentages of these parameters were different. Indeed, there are countries where the prevalence of overweight does not exceed 10% like Niger and others where it represents 60% like the Seychelles (18). Therefore, Tunisia was one of the countries with the highest rate of overweight in the African continent. Despite this high percentage it remains lower than that of United States (19), where the prevalence of obesity is 34.4%. To explain this phenomenon, several factors have contributed to the resurgence of obesity in Tunisia such as disruption of dietary patterns, increased consumption of animal fats, increased sedentariness and decreased physical activity (20,21,22).

The situation was relatively different for subjects from a poor socio-economic level, to which a large part of our study population belongs. In the literature, epidemiological studies have also shown a strong association of childhood obesity with unfavorable situations of parents (23,24,25) in developed countries with obesity prevalence 3-4 times higher than the in richest districts (24,25). This is due to the availability of food high in refined fats and sugars and lack of access to healthy food choices, especially vegetables and fruits (26).

Evolution of morphological characteristics with age and relationships between different measured parameters

In our study, there is a strong significant correlation between leg length and body size in both sexes ,Figure 3) This finding corroborates with the results of Parot's study (13). Indeed, the body size of Chinese men was 161.07 cm, their leg length was estimated at 83.77 cm (14) while that of Tunisians was 91.13 cm with an average body size of 171 cm.

Our statistical results also showed that the body sizes of elderly men and women were smaller than that of younger subjects (Table 3) ,which was also highlighted in Parot's study (13) that deals with the evolution of several anthropometric characters with age. Our results were the conclusion of a cross-sectional analysis since it has not been possible to follow the evolution of the body sizes of the different subjects of the population over the years. Previous studies have shown an increase in the body sizes of current generations (27,28,29). It is therefore important to try to dissociate what is attributable to the individual and to the generation to which he belongs. Several factors explain this decrease, such as disc settlement, sagging of the vertebral bodies and sagging of the arch of the foot.

Unlike body size, the corpulence increases remarkably with the age of the individual and this was more noticed in the female population; BMI increased from 24.76 to 26.80 $kg \cdot m^{-2}$ for men over 30 years and from 25.52 to 30.36 $kg \cdot m^{-2}$ for women over 30 years (Table 3). This increase in body mass and subsequently, BMI, was partly dependent

on the thighs for both sexes. There was a strong positive relationship between circumference of the thigh and body mass for both men and women respectively (r = 0.81, $p < 0.01$; r = 0.73, $p < 0.01$, Figure 2). Whereas, previous studies that have shown that android obesity is more common than gynoid obesity (30). The difference concerning the effect of age on corpulence between the two sexes was widening across the age groups. This is mainly due to hormonal factors; women after the age of menopause are more corpulent and that is possibly due to the number of kilograms gained by the woman after each pregnancy, which is estimated at 12.5 kg (31).

CONCLUSION

In this paper we studied the morphological characteristics of the Tunisian population and compared it to that of other populations of the world. Our statistical analysis showed that in both, the average body size of men and women was higher compared to populations in North Africa and Europe and obesity is predominantly female whereas overweight is rather a male situation. Therefore, effective preventive measurements adapted to their lifestyle are necessary, and the establishment of a Tunisian causal model of obesity would be required.

Acknowledgements: Special thanks to Mr. Radhouane Toumi for his assistance.

REFRENCES

1. Pagezy H. Mesurer quoi? Pourquoi mesurer? Place de l'anthropométrie en anthropologie de l'alimentation. Bulletin de l'Association Française des Anthropologues. 1982;9(1):38-44.
2. Mimouni S, Mimouni N, Pontier J, Massarelli R. Indices de poids et taille dans les études morphologiques. Biom Hum Anthropol. 2008;26(3-4):161-71.
3. Pages R. L'évolution récente de quelques modèles en psychologie sociale. L'année psychologique. 1957;57(1):121-32.
4. Bonnardel R. L'évolution de la psychologie individuelle en France et ses réalisations actuelles. L'année psychologique.1949;50 : 485-505.
5. De Saint Pol T. Corps et appartenance sociale: la corpulence en Europe. Données Sociales 2006.2006;649–56.
6. Marquer P, Chamla MC. L'évolution des caractères morphologiques en fonction de l'âge, chez 2089 Français de 20 à 91 ans. Bulletins et Mémoires de la Société d'Anthropologie de Paris. 1961;2(1):71-8.
7. Atek M, Traissac P, El Ati J, Laid Y, Aounallah-Skhiri H, Eymard-Duvernay S, et al. Obesity and association with area of residence, gender and socio-economic factors in Algerian and Tunisian adults. PloS One. 2013;8(10).
8. Heuse GA. Études anthropologiques sur les Noirs soudanais et guinéens (anthropométrie, morphologie descriptive, odontographie). Bulletins et. Mémoires de la. Société d'Anthropologie de Paris.1956;7:359-91.
9. Herskovits MJ. The anthropometry of the American Negro. Columbia University Press.1930;11.
10. Sabharwal S, Kumar A. Methods for assessing leg length discrepancy. Clin Orthop. 2008;466(12):2910-22.
11. Battié MC, Videman T, Parent E. Lumbar disc degeneration: epidemiology and genetic influences. Spine. 2004; 29(23):2679-90.
12. Banik SD. Health and nutritional status of three adult male populations of Eastern India: an anthropometric appraisal. Ital J Public Health.2012; 6.
13. Parot S. Recherches sur la biométrie du vieillissement humain. Bulletins et Mémoires de la Société d'Anthropologie de Paris. 1961;2(3):299-341.
14. Legendre AF. Étude anthropologique sur les Chinois du Setchouen. Anthropométrie. Bulletins et Mémoires de la Société d'Anthropologie de Paris. 1911;2(1):102-24.
15. De Saint Pol T. Surpoids, normes et jugements en matière de poids: comparaisons européennes. Populations et Sociétés. 2009;455.
16. Mokhtar N, Elati J, Chabir R, Bour A, Elkari K, Schlossman NP, et al. Diet Culture and Obesity in Northern Africa. J Nutr. 3 janv 2001;131(3):887-92.
17. Sawadogo C, Essaadouni L. Prévalence de l'obésité à Marrakech.2009.
18. Correia J, Pataky Z, Golay A. Comprendre l'obésité en Afrique. Rev Med Suisse. 2014;10:712-6.
19. Shields M, Carroll MD, Ogden CL. Prévalence de l'obésité chez les adultes au Canada et aux États-Unis . US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.2011.
20. Zedini C, Limam M, El Ghardallou M, et al. Prevalence of overweight in schools in the rural region of Hazoua (Tozeur). Tunis. Med. 2016;94: 398.
21. Hills AP, Mokhtar N, Brownie S, et al. Childhood obesity in Asia: the value of accurate body composition methodology. Asia Pac. J. Clin. Nutr.2014;23 : 339–343.
22. Lokrou A, Nioblé C. Prévalence du surpoids et de l'obésité en milieu scolaire en Côte-d'Ivoire. Médecine des Maladies

Métaboliques. 2008;2(3):303-4.

23. Tauber M, Ricour C, Bocquet A. L'obésité infantile: nécessité d'un consensus autour de la prévention. Archives de Pédiatrie. 2007;14(11):1279-81.
24. Charles MA. Epidémiologie de l'obésité de l'enfant. Journal de Pédiatrie et de Puériculture. 2004;17(6):345-6.
25. Frelut ML. Obésité de l'enfant et de l'adolescent. Encycl Med Chir. (Elsevier, Paris), Pédiatrie, 4-059 – D – 10, 2001, 10 p.
26. Koubaa A,Younes K, Gabsi Z, et al. Facteurs de risque de l'obésité chez l'enfant. Tunis. Med. 2012;90: 387-93.
27. Sutter J, Izac R, Toan TN. L'évolution de la taille des polytechniciens (1801-1954). Population.1958;373-406.
28. Wroczynski C. Le physique et la santé. S.D.N. Bull. Org. d'Hygiène.1937;6: 593-733.
29. Boudin JC. Études ethnologiques sur la taille et le poids de l'homme chez divers peuples et sur l'accroissement de la taille et de l'aptitude militaire en France. V. Rozier; 1863.
30. Hatri A. Prévalence de l'obésité androïde dans la population algéroise. Rev Médecine Interne. 2007;28:126-7.
31. Salle BJ. Adaptation métabolique et besoin en calcium pendant la grossesse. Rapport des Journées de Techniques Avancées En Gynécologie Obstétrique et Périnatalogie. 1995;647-53.