Association between body mass index and presence of skin disorders in schoolchildren

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Abstract

Obesity is a chronic, multifactorial and complex metabolic disorder, in which organic damage can be evident in the short or long term, especially dermatological disorders. With the objective of verifying the association between the body mass index and the presence of dermatological conditions, students at a public school in the backcountry of Bahia were studied. This was a cross-sectional study in which 169 schoolchildren were evaluated. The outcome was skin conditions, and the independent variables were BMI, age, and sex. Data were analyzed with the chi-squared test and an α≤0.05. About 41 students (24.3%) were underweight, 92 (54.4%) were eutrophic, and 36 (21.3%) were obese. Among the dermatological conditions, stretch marks stood out with a prevalence of 58%, followed by cellulite with 26%, and acne with 24.3%. The age group (14-20 years) was significantly associated with BMI values (p=0.05). Similarly, acanthosis (p=0.05), striae, hidradenitis, and cellulite also showed a significant relationship with BMI (p=0.01). There was statistical significance (p=0.01) when the presence of up to six dermatoses was compared with the low weight, eutrophic, and obese groups. Certain skin conditions were significantly associated with BMI. It is necessary to carry out educational awareness and prevention actions aimed at these young people that lead to a reduction in obesity cases, considering that in this group the dermatological changes were more evident.

Keywords: Overweight. Obesity. Skin diseases. Students. Prevalence.

INTRODUCTION

Obesity is a nutritional and metabolic disorder of a multifactorial chronic nature. It has a strong genetic and environmental basis and triggers multiple health complications[1-2-3]. It is characterized by the exacerbated accumulation of lipids in adipocytes, with an increase in the volume of these cells by a mechanism of hyperplasia or hypertrophy[2,3].

The classification of obesity is based on the body mass index (BMI). By convention, BMI normality values are between 18.5-24.9. People with a BMI between 25 and 29.9 kg/m² are considered overweight and values greater than or equal to 30 kg/m² are obese. This index is the most used calculation for the assessment of body adiposity, since it is simple, practical, and free of cost[4]. The short and long-term damage to health resulting from obesity whose onset has occurred in adolescence is notorious in the short and

long terms. Orthopedic disorders, respiratory disorders, diabetes mellitus, dyslipidemias, systemic arterial hypertension, psychosocial disorders, and dermatological alterations stand out[3,5,6].

Among the main dermatological alterations, striae, acanthosis nigricans, and bacterial and fungal infections stand out[7,8]. These diseases are associated with mood disorders and can trigger an situation of isolation that becomes more intense, depending on the appearance, location and circumstances of these lesions. This can lead to a drop in quality of life and difficulty in adhering to physical exercise. The higher the degree of obesity, the more exacerbated these dermatological manifestations will be. In addition, as the skin area increases, there will be more friction, stretching, and crease formation[6].

Despite the high prevalence of obesity, both in the general population and in young students, and knowing that there is an increase in both cases and intensity, dermatological manifestations have been little studied in young schoolchildren[8]. Some dermatological lesions can lead from years to decades to develop, so evaluating skin lesions in a young overweight population can help to understand their genesis. Thus, the present study aimed to evaluate the association between BMI and skin conditions in students from a public school in the backcountry of Bahia.

METHODOLOGY

Study type and ethical aspects

This was a cross-sectional study that was developed with 169 high school students during the year 2020. All of them came from a state school in the city of Paulo Afonso, BA. Prior to data collection, the Informed Consent Form (ICF) was signed by all participants over 18 years of age and by the legal guardians of participating minors. Moreover, the Informed Assent Form (IAF) was also signed by the underaged participants, attesting to their acceptance to participate in the study. Students whose enrollment was blocked for any reason were excluded from this study.

The study was approved by the Research Ethics Committee of the Federal University of Vale do São Francisco (CAAE: 24281019.5.0000.5196).

Procedures and instruments for data collection

The researchers, previously trained, applied questionnaires consisting of personal identification, age group, and health history, followed by anthropometric analysis and clinical and dermatological assessment of the participants.

Weight and height assessment

During the physical examination, the anthropometric measurements of the students were taken twice using a portable electronic anthropometric scale (Modelo Línea, Krasts Cas, São Paulo, Brazil) and a stadiometer (Model microtoise setu, CMS Weighing Equipment Lid, London, United Kingdom). BMI was calculated by dividing body mass (in kg) by the square of height (in meters). Through the BMI value, the groups studied were categorized into underweight (≤ 18.5 kg/m²), eutrophic (18.6-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (≥ 30 kg/m²).

Dermatological evaluation

All students participating in the study were invited to answer a questionnaire, followed by a dermatological evaluation, to investigate possible afflictions.

Data analysis procedures

All data obtained were initially tabulated in the Excel® program (2020 version) and analyzed using the R® Software. The measurements obtained were submitted to a statistical treatment using Pearson's chi--squared tests (χ^2) to assess whether there was an association between the analyzed variables. In addition, the non-parametric Kruskal-Wallis and Mann-Whitney tests were used in order to compare three or two groups, respectively. The level of significance for rejection of the null hypothesis was $\alpha \leq 0.05$.

RESULTS

Descriptive analysis

The students ranged in age from 14 to 20 years old and had an average of 15.94 ± 1.33 years. 62.1% were female and 37.9% male. Among females, 46.2% were between 14 and 15 years old, 38.5% between 16 and 17 years old, and 15.4% between 18 and 20 years old. Of the male sex, 37.5% were ≤ 15 years old, 53.1% were between 16 and 17 years old, and 9.4% were ≥ 18 years old. The overall weight presented an average of 60.15 ± 14.22 kg. Height was 1.64 ± 0.083 m and BMI was 22.11 ± 4.50 kg/m2. As for the distribution of students in relation to BMI, 24.3% were classified as underweight, 54.4% eutrophic, and 21.3% obese.

Prevalence of skin disorders associated with gender

After dermatological evaluation, the overall prevalence of skin disorders was 73.4%. Among these, striae stood out with a prevalence of 58%, followed by cellulite 26%, acne 24.3%, keratosis and folliculitis, both with 10.7%, and finally, hidradenitis and acanthosis with 8.9%. and 7.1%, respectively. In addition, there was a higher prevalence of acanthosis (p=0.015), striae (p=0.001), and cellulite (p=0.001) in women participating in the study. On the other hand, acne was more common in men (p=0.043), as shown in Table 1.

Association between gender, BMI, and age group

Among the 41 underweight students, 58.5% were ≤ 15 years old, 39% between 16 and 17 and 2.4% ≥ 18 years old. As for normal weight, 41.3% were ≤ 15 years old, 41.3% between 16 and 17, and 17.4% ≥ 18 years old. Among obese students, 44.4% were ≤ 15 years old, 30.6% were 16 and 17 years old, and 25% ≥ 18 years old. There was no association between gender and BMI (p=0.819), table 2. However, there was a significant association between age group and gender (p=0.007) and between age group and BMI (p=0.050), as the table 3.

Of the students, 7.1% were diagnosed with acanthosis. Among these, 58.3% were obese (p=0.005). Stretch marks were diagnosed in 58%, of which 53% were eutrophic and 30.6% were obese (p=0.001). Hidradenitis occurred in 8.9% of schoolchildren, of which 53.3% were eutrophic and 46.6% obese (p < 0.011). Cellulite occurred in 26%, of which 40.9% were eutrophic and 47.7% obese (p < 0.001). When comparing the types of skin conditions with the three age groups, cellulite was the most prevalent in obese students (p=0.025), table 4.

BMI was associated with the number of dermatoses (p=0.01). Underweight students (median=57.35) both had a lower number of dermatoses when compared to eutrophic students (71.30; p=0.04) and obese students (85.47; p=0.01). In addition, the eutrophic and obese groups were compared, and the latter presented a greater number of dermatoses (p=0.01).

There was also an association between the presence of dermatoses and age group (p=0.023), with a higher average of dermatoses in individuals aged 18 years or older (106.50).

Table 1 - Association between skin conditions and gender. Paulo Afonso – BA, 2019.

Dermatological disorders	Gender		χ²	p
	Female	Male		
Acanthosis	11 (91.6%)	1 (8.3%)	5.85	**0.01***
Keratosis	9 (50%)	9 (50%)	1.26	0.262
Hirsutism	5 (100%)	0 (0%)	4.85	0.028
Acne	20 (48.7%)	21 (51.2%)	4.10	**0.043***
Alopecia	6 (85.7%)	1 (14.2%)	1.98	0.159
Stretch marks	77 (78.5%)	21 (21.4%)	26.80	**<0.001***
Hyperkeratosis	5 (83.3%)	1 (16.6%)	1.33	0.248
Fungal infections	2 (33.3%)	4 (66.6%)	2.11	0.146
Bacterial infections	1 (100%)	0 (0%)	0.95	0.328
Hydradenite	9 (60%)	6 (40%)	0.03	0.859
Psoriasis	0 (0%)	1 (100%)	1.95	0.162
Cellulite	40 (90.9%)	4 (9.09%)	20.94	**<0.001***

*Significant associations p<0.05

Table 2 - Association between gender and BMI. Paulo Afonso – BA, 2019.

Gender	BMI			χ²	p	Phi
	Under weight	Eutrophic	Obese			
Female	25 (23.8%)	56 (53.3%)	24 (22.9%)	0.40	0.81	0.04
Male	16 (25%)	36 (56.3%)	12 (18.8%)			

Table 3 - Association between age group, gender, and BMI. Paulo Afonso – BA, 2019.

	Age Group			χ²	p	Phi
	>15 years	16-17 years	18 years			
Gender						
Female	54 (51.4%)	31 (29.5%)	20 (19.0%)	**9,84**	0.007	0.24
Male	24 (37.5%)	34 (53.1%)	6 (9.4%)			
BMI						
Low weight	24 (58.5%)	16 (39%)	1 (2.4%)	9.50	0.05	0.23
Eutrophic	38 (41.3%)	38 (41.3%)	16 (17.4%)			
Obese	16 (44.4%)	11 (30.6%)	9 (25%)			

*Significant associations p<0.05

Table 4 - Association between skin conditions, BMI, and age group. Paulo Afonso – BA, 2019.

Dermatological disorders	BMI					Age Group				
	Under weight	Eutrophic	Obese	χ^2	p	>15 years	16-17 years	18 years	χ^2	p
Acanthosis	1 (8.3%)	4 (33.3%)	7 (58.3%)	10,723	**0.005***	6 (7.7%)	2 (3.1%)	4 (15.4%)	4,114	0.128
Keratosis	3 (16.6%)	9 (50%)	6 (33.3%)	1,921	0.383	9 (11.5%)	5 (7.7%)	4 (15.4%)	1.275	0.529
Hirsutism	0 (0%)	3 (60%)	2 (40%)	25.12	0.346	4 (5.1%)	1 (1.5%)	0 (%)	3,167	0.205
Acne	12 (29.3%)	18 (43.9%)	11 (26.8%)	2,440	0.295	17 (21.8%)	16 (24.6%)	8 (30.8%)	0.862	0.650
Alopecia	1 (14.3%)	5 (71.4%)	1 (14.3%)	0.855	0.652	5 (6.4%)	1 (1.5%)	1 (3.8%)	2,326	0.313
Stretch marks	16 (16.3%)	52 (53%)	30 (30.6%)	15,626	**<0.001***	41 (52.6%)	38 (58.5%)	19 (73.1%)	3,378	0.185
Hyperkeratosis	1 (16.6%)	3 (50%)	2 (33.3%)	0.593	0.743	5 (6.4%)	1 (1.5%)	0 (0%)	4,364	0.113
Fungal infections	2 (33.3%)	3 (50%)	1 (16.6%)	0.296	0.862	3 (3.8%)	2 (3.1%)	1 (3.8%)	0.070	0.965
Bacterial infections	0 (0%)	1 (100%)	0 (0%)	0.842	0.656	1 (1.3%)	0 (0%)	0 (0%)	1,553	0.460
Hydradenite	0 (0%)	8 (53.3%)	7 (46.7%)	8,969	**<0.011***	5 (6.4%)	5 (7.7%)	5 (19.2%)	4,146	0.126
Psoriasis	0 (0%)	1 (100%)	0 (0%)	0.842	0.652	1 (1.3%)	0 (0%)	0 (0%)	1,553	0.460
Cellulite	5 (11.3%)	18 (41%)	21 (47.7%)	25,580	**<0.001***	20 (25.6%)	12 (18.5%)	12 (46.2%)	7,407	**0.025***

*Significant associations p<0.05

DISCUSSION

Overweight in adolescence is seen as the main condition for obesity to develop and remain in adulthood. This is because early obesity, in addition to having immediate consequences, is highly likely to persist into adulthood, if prevention and management actions are not taken[9]. Interventions performed in adolescents are extremely important, because the more intense and earlier the onset of obesity is, the more severe the associated comorbidities will tend to be[3].

In the present study, the prevalence of obesity was higher in the age group from 14 to 15 years old, in line with the findings by Borges[5], in which the highest BMI values were concentrated between 13 and 14 years of age. This can be explained as a result of the pubertal development phase, in which the excess weight will be repaired by growth[10].

It is estimated that 10.8% to 33.8% of adolescents in different regions of Brazil are overweight and obese. However, few studies have explored overweight and obesity in children and adolescents in the Northeast and Southeast regions. In one of these rare surveys, a prevalence of obesity of 16.7% was observed in children in the Northeast[11]. In addition, some studies, when comparing overweight students from public and private schools, a higher frequency of overweight/obesity in students from private schools was observed[1,12,13]. However, Miranda et al.[14] demonstrated a higher prevalence (14.8%) of overweight/obesity in public school students. In the present study, a prevalence of overweight/obesity of 21.3% was found in public school students.

Research carried out in the state of Pernambuco considered a higher risk of overweight/obesity in male students (11.5%),

when compared to 2.4% in female students[15]. However, another study showed a higher prevalence in female students[5], which reinforces the results of the present study, by indicating a higher occurrence of overweight/obesity in women compared to men. This can be explained by the fact that boys participate in more vigorous physical activities, while women tend to spend more time with household chores or taking care of other people, facts culturally linked to gender issues; sex hormones and their influence on body composition in children and young people, as well as higher levels of leptin found in females, may also influence this process[16-17].

It is believed that there is a relationship between obesity and the increase in androgens in women and estrogen in men. Insulin and growth factors are responsible for the exacerbated activation of the sebaceous glands, interfering with the physiology of the skin. In addition, the effects of obesity on skin tissue are related to increased transepidermal fluid loss, changes in lymphatic drainage and microcirculation, hair, collagen structure and function, wound healing, and subcutaneous fat[5,18]. Obese people also have difficulty in cleaning some body regions, due to the increase in the volume of skinfolds, which favors the emergence and greater intensity of dermatoses[7].

Several dermatological diseases can affect obese individuals. Acanthosis nigricans, acrochordons, keratosis pilaris, hirsutism, acne, androgenic alopecia, stretch marks, lymphedema, chronic venous insufficiency, plantar hyperkeratosis, fungal and bacterial infections, in addition to hidradenitis suppurativa[8] are highlighted. Stretch marks are bands of wrinkling and atrophy seen in places where there has been stretching of the skin and rupture of elastic fibers due to increased tension. It occurs in areas such as the breasts, hips, and abdomen. Factors such as obesity, pregnancy, Cushing's syndrome, and the use of corticosteroids are associated with its onset[8].

Gómez[19] found a prevalence of 28.4% of stretch marks. In the same analysis, hirsutism was diagnosed in 5.6% of the patients and the most common manifestation was acanthosis, 97%[19]. It can be seen that the values found by Gómez[19] were quite discrepant and this fact can be explained by the difference in age group of the research participants. Moreover, there were differences in ethnic and sociodemographic characteristics, since Gómez's study was carried out in Mexico.

Endocrinopathies are the main causes of acanthosis nigricans and acrochordons, and obesity is the disorder that is most frequently associated with hyperinsulinism, diabetes mellitus, and insulin resistance. Significant insulin resistance is believed to produce compensatory hyperinsulinemia. Increased serum insulin interacts with insulin-like growth factor (IGF-1) receptors, triggering proliferation of keratinocytes and fibroblasts[20]. In the present study, the presence of acrochordons was not demonstrated; in addition, there was a low prevalence of acanthosis, justified by the young age of the participants, the size of the sample, and a probable insulin resistance.

A fact that drew attention in this study was the high prevalence of hidradenitis, when compared to other studies, in which it varied from 0.05 to 4.10%[21]. Also known as acne inversa, it has a tendency among females, as shown by Martorell[22]. Although hidradenitis has obesity as one of its risk factors, this association was not found, probably due to the young age of the participants and the size of the sample[23].

CONCLUSION

It was shown that most students aged 15 years or older were eutrophic. The high percentage of underweight and obese individuals is highlighted. Furthermore, gender was a differentiating factor for the occurrence of some skin conditions.

Certain skin conditions, especially stretch marks, hidradenitis, and cellulite, were significantly associated with BMI. Therefore, in students from a public school in the backcountry of Bahia where the present study was carried out, educational actions to raise awareness and prevention will be necessary that lead to a reduction in obesity cases, since in this group the changes were more evident.

Author statement CRediT

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