The relationship between Physical Activity Level (PAL) and Body Mass Index (BMI) among adolescents (Ages 15-18)

Mohammed Nezzar

University Of soukahras (Algeria), Laboratory of Biological and Psychological Responses to Physical and Sports Activity (University Of Oum El Bouaghi)
Email: m.nezzar@univ-soukahras.dz
https://orcid.org/0009-0009-4956-8020

Ababsa Houssam Eddine

University Of soukahras (Algeria), Laboratory of Biological and Psychological Responses to Physical and Sports Activity(University Of Oum El Bouaghi)
Email: h.ababsa @univ-soukahras.dz
https://orcid.org/0000-0002-4788-4320

Abstract---The study aims to investigate the relationship between the level of physical activity among adolescents (aged 15-18) and the Body Mass Index (BMI), which is a universally recognized measure for distinguishing between overweight, obesity, and normal weight in individuals. The study was conducted on a sample of 20 students (both males and females) whose ages ranged from 15 to 18. These students were enrolled in the Hafar Al-Sass Mohammed Al-Eid Secondary School in the Wadi El Zenati Province, Guelma. The researcher employed a descriptive methodology for the study, using a questionnaire that addressed the types of physical activities performed by individuals in their daily lives to assess their level of physical activity. The study also relied on the Body Mass Index (BMI) as determined by IOTF standards. The study results indicated a very weak inverse relationship between the level of physical activity and the Body Mass Index for the study sample, with R = -0.14, which was not statistically significant as the Sig value (0.954) was greater than 0.05. The study also found that individuals in the sample with low levels of physical activity represented 75% of the study sample (15 students). Students classified as overweight or obese, according to IOTF criteria, represented 20% (4 students). The study did not identify any students with underweight, nor were there any students with high levels of physical activity in the study sample.

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1. Problem Statement

The concept of physical and sports activities goes beyond being just games or exercises that some believe are an occasional duty performed by teenagers without regularity. Modern humans tend to watch sports programs more than engaging in physical activities, prefer car rides over walking, and engage in prolonged periods of relaxation and sleep. These lifestyle choices often require less energy than the active living conditions of the past (Ziyabat and Aljabour, 2012). A significant issue arises from the lack of physical activity and reduced activity among contemporary individuals, leading to a significant health problem. This problem manifests as an accumulation of excess body fat and an increase in the prevalence of obesity (Ismail, Abdelfattah, and Al-Ameen, 1990).

Obesity, in this context, refers to the quantity of fat that exceeds the natural average concerning age, height, and gender (Al-Majid and Al-Yasiri, 2005). As noted by Abdelfattah and Ahmed (1994), physical activity can play a vital role in altering the energy balance equation, allowing for the elimination of excess calories and their expenditure through activity and movement. Physical activity offers numerous health benefits beyond just weight loss. Low physical activity is considered the fourth leading risk factor for deaths worldwide, representing 6% of mortality rates.

It follows high blood pressure, accounting for 13% of deaths, tobacco use at 9%, and elevated blood sugar at 6%. The low physical activity levels have been on the rise worldwide and have caused significant health issues for individuals and public health (World Health Organization (WHO), 2009). In 2016, more than 1.9 billion adults aged 18 and older, or 39%, were affected by overweight, with more than 650 million people suffering from obesity, which represents 13%. The majority of deaths worldwide are caused by excessive weight and obesity. In the same year, 41 million children under the age of five were affected by overweight and obesity. More than 340 million children and adolescents aged 5 to 19 years are also affected by overweight and obesity (Sherifi, 2021).

In light of the above, the research problem can be articulated in the following question:

2. Research Question

Is there a relationship between the level of physical activity and the body mass index (BMI) among the adolescent population (15-18 years old)?

Hypothesis:
There is a relationship between the level of physical activity and the body mass index among the adolescent population (15-18 years old).

Study Objectives:
The study aims to assess the level of physical activity among adolescents and examine its relationship with the body mass index (BMI).

Research Terminology: (Physical Activity Body Mass Index (BMI) Overweight (Obesity).)

Physical Activity: Any mental, behavioral, or biological process dependent on the energy of a living organism, characterized more by spontaneity than by response (Boudy, A., 1977).

Physical Activity: Physical activity is a broader concept than physical exercise. It refers to any bodily movement that involves the use of large muscles, including various sports, work-related activities, and some daily life activities. Physical exercise, on the other hand, involves structured and repetitive movements performed to improve physical fitness or its components (such as endurance, strength, or flexibility). Sometimes, the terms "physical activity" and "exercise" are used interchangeably, and the specific meaning depends on the context (Abdul, H., 2023).

These objectives can be summarized as follows:
- Maintaining the current level of physical function.
- Enhancing functional physical capacities.
- Restoring some lost functional physical capacities.
- Developing new physical capacities to compensate for those that have been lost (Ratib, 2008).

The procedural definition is: Physical activity is an activity performed by an individual that involves physical effort with the aim of maintaining or improving their physical fitness. This can involve individual or group activities or even participating in some daily life activities.

Body Mass Index (BMI): It is a globally recognized measure for distinguishing between underweight, normal weight, overweight, and obesity. BMI expresses the relationship between a person's weight and height, and it is endorsed by the National Institute of Health and the World Health Organization as the best standard for measuring obesity. BMI is calculated by dividing a person's weight in kilograms by the square of their height in meters:
BMI = Weight (kg) / (Height (m))^2

The procedural definition is the result of dividing a person's weight by the square of their height, and it is used to classify an individual as overweight, obese, underweight, or within a healthy weight range based on standard tables. However, it may not be relied upon in the case of bodybuilders and pregnant women.

Weight gain or obesity:
Obesity is defined as an increase in an individual's weight or excessive weight gain, which poses a serious health risk. Obesity is associated with numerous chronic diseases, and its prevalence is not limited to a specific segment of society;

it affects people of all age groups, including children, adolescents, and the elderly, as well as both genders (Sante, 2009).

Bahaa El-Din Ibrahim Salama views weight gain, obesity, and overweight as synonymous terms with the same meaning, although there may be technical differences. Weight gain signifies an increase beyond an individual's natural weight, determined by the relationship between height and weight. It's normal for an individual to have a certain amount of body fat as part of their total weight, but an excessive percentage of body fat is undesirable. The percentage of body fat differs between men and women, with studies indicating that a man is considered obese at 25% body weight, while for a woman, 35% is considered obese (Ibrahim, 2002). Herve Benony and others define childhood and adolescent obesity as a medical condition characterized by excess weight due to increased fat tissues distributed in specific regions of the body where fat accumulates (Benony, 2008). Kamal Jamal Al-Rabdi pointed out that excess weight means there's a predisposition to develop obesity if a person does not pay attention to their dietary habits (Al-Rabdi, 2008).

(Al-Zamil, 2011) stated that defining obesity would be easier if we knew the threshold that separates it from disease and death, and this remains unclear despite the increasing number of deaths among individuals with a weight exceeding 30% of their ideal weight. Simultaneously, metabolic and physiological disorders increase even in individuals with ideal and normal weights. While weight is a straightforward indicator of obesity, it is not the best method to measure the quantity of body fat. Therefore, it is necessary to establish a link between weight and the overall body size concerning height, age, and gender."
Please note that while I've provided a translation of the text, the understanding of medical terms and concepts may require consultation with a healthcare professional or further research.

Procedural Definition: It is the increase in body weight above the natural limit due to the accumulation of fat.

3. The methodological procedures for the study:

The methodology: The researcher adopted a descriptive approach.
This research method is concerned with providing a detailed description of the phenomenon or event under study, as indicated by the term "description" in the research focus (Jadari and Abu Helu, 2009).

Study Population and Sample: The study was conducted on students of Mohamed El-Aid Hafar Secondary School in the Wadi El Zenati District of Guelma Province. The researcher employed a purposive sampling method, selecting students from the second-year foreign languages class. The sample consisted of 20 students, comprising 12 females and 8 males.

Fields of Study:
A) Temporal Scope: From 15th January 2022.
B) Spatial Scope: Mohamed El-Aid Hafar Secondary School.
 C) Human Scope: Adolescents (Aged 15-18 years).

The tools for data collection that the researcher relied on included:

1. **Physical Activity Level Assessment Tool:** (Al-Azwati, 2019)
The level of physical activity for adolescents (aged 15-18) was determined by the amount of time they spend on various daily activities within a 24-hour period. This assessment is based on a specific form for calculating NAP (Non-Active Period) created by Martin (2000) for different types of physical activities and their coefficients. This process involves using a form that lists the various physical activity categories performed by children and teenagers in their daily lives. These categories classify physical activities for individuals between the ages of 10 and 18 into the seven categories described in the tool.

The time spent by the student in each category within a 24-hour day is recorded. Each category is associated with a specific level of physical activity, and the time spent in each category is multiplied by the corresponding activity level. These individual levels for the seven categories are then added together to obtain the Total Physical Activity Level (NAP).

After determining NAP and the student's age, a reference table is used to assess the activity pattern based on NAP and age. This process is conducted through an interview format, where the researcher asks the student about specific activities, and the student responds with the number of minutes or hours spent on each activity. For example, when asked, "How much time do you spend sleeping?" the student might respond with a specific number of hours, like 8 hours. If the student does not take midday naps, this is recorded as 0 hours. Similarly, if the student does not spend extended periods of time lying down at home, this is also recorded as 0 hours. These responses are then categorized under Section A, and the total is multiplied by the NAP for Category 1 (e.g., 01). Finally, this total is divided by 24 hours to calculate the activity level within that category, and the same procedure is applied to the remaining six categories.

Body Mass Index (BMI): The Body Mass Index is a measurement tool that allows for the assessment of the relationship between body weight and height. It also involves comparing the results with reference values to determine an individual's body pattern. It is calculated using the following formula: BMI = Weight (kg) / Height (m)².

In this study, the Body Mass Index (BMI) is used to determine the students' body patterns, whether they are overweight, have a normal weight, underweight, or obese, in comparison to the reference values in the BMI table. This assessment is done based on the individual's age category (Cole, Bellizzi, & Flegal, 2000)

Table Number (01): Reference Table for BMI for Males

Age Category	Underweight	Normal weight	Overweight	Obesity
[15-16 years]	]17.26-14.60]	]23.29-17.26]	]28.60-23.29]	28.60 =< from
[16-17 years]	]17.80-15.12]	]27.90-17.80]	]29.14-23.90]	from29.14 =<
[17-18 years]	]18.28-15.60]	]24.46-18.28]	]29.70-24.46]	from29.70 =<
18 years	]18.50-16.00]	]25.00-18.50]	]30.00-25.00]	30.00=<

Table Number (02): Reference Table for BMI for Females

Age Category	Underweight	Normal weight	Overweight	Obesity
[15-16 years]	]17.69-15.01]	]23.94-17.69]	]29.29-23.94]	29.29=<
[16-17 years]	]18.09-15.46]	]24.37-18.09]	]29.59-24.37]	29.56=<
[17-18 years]	]18.38-15.78]	]24.70-18.38]	]29.84-24.70]	29.84=<
18 years	]18.50-16.00]	]25.00-18.50]	]30.00-25.00]	30.00=<

4. Presentation, Analysis, and Discussion of Results

Table Number (03): Represents the classification of individuals in the sample according to their level of physical activity (**NAP**)

NAP	Low	Moderate	Adequate	Total
Sample : 20 students	15	02	03	20
Percentage	%75	%10	%15	%100

Based on the results in Table Number (03) shown above, it becomes evident that the number of students with a low level of physical activity is 15, representing 75% of the study sample. Those with a moderate level of physical activity are represented by two students, accounting for 10%. As for individuals with an adequate level of physical activity in the study sample, they are represented by 3 students, making up 15%.
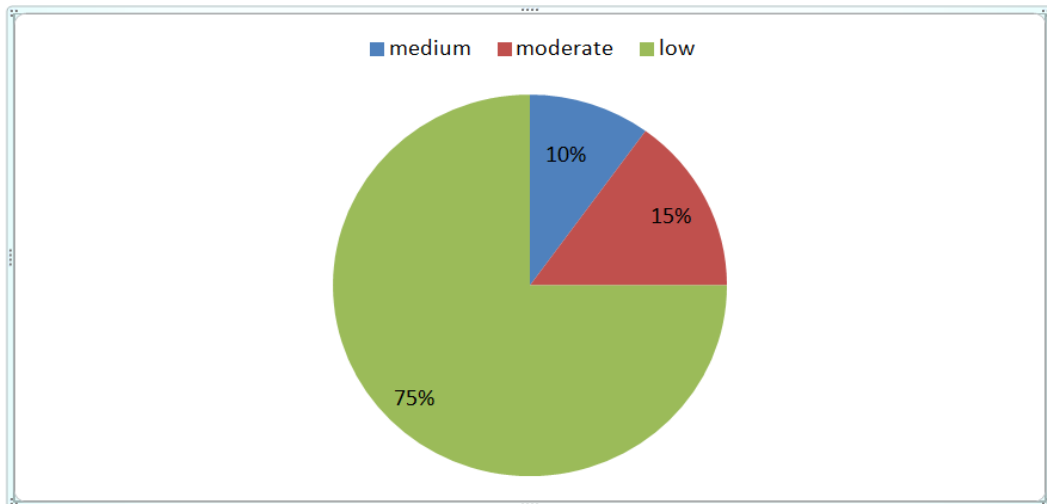
Figure Number (01): A pie chart illustrating the proportions of individuals in the study sample classified according to NAP

This table provides a classification of individuals in the sample based on their Body Mass Index (BMI). It shows the number of individuals falling into various BMI categories, including underweight, normal weight, overweight, and different classes of obesity.

Sample / category	Normal weight	overweight	obesity	total
Sample of 20 students	16	03	01	20
Percentag	%80	%15	%05	%100

Based on the results from Table 03, it can be observed that the sample of students is categorized as follows according to their body mass index (BMI) based on IOTF criteria: Normal Weight: There are 16 students (80% of the sample) classified as having a normal weight. Overweight: Three students (15% of the sample) fall into the overweight category. Obesity: One student (5% of the sample) is classified as obese. This classification provides an overview of the distribution of students in the sample based on their BMI categories according to IOTF standards.
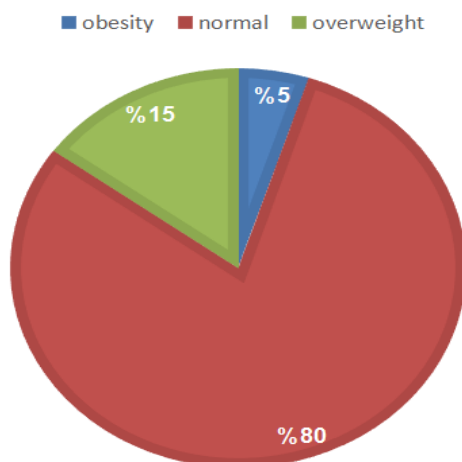
Figure No. 02: A pie chart showing the proportions of individuals in the study sample classified according to BMI (Body Mass Index).

Table No. 04: Illustrates the relationship between the level of physical activity (NAP) and the Body Mass Index (BMI)

NAP / category	Normal weight	overweight	obesity	Total	Percentage
Low level	12	02	01	15	%75
Medium level	01	01	00	02	%10
Moderate level	03	00	00	03	%15
Total	16	03	01	20	%100
Percentage	%80	%15	%05		

Based on the results in the table, it appears that: The number of individuals whose Body Mass Index (BMI) falls within the "normal weight" category, as defined by the IOTF criteria, and who have a low level of physical activity is represented by 12 students. There is one student within the "normal weight" category who has a moderate level of physical activity, and three students with a moderate level of physical activity. Two students, who are classified as "overweight" based on their BMI, have low levels of physical activity. There is one student with "overweight" based on their BMI and low levels of physical activity. No individual in the sample falls within the "normal weight" category and has a moderate or high level of physical activity. These results provide insights into the distribution of weight categories and physical activity levels within the study sample.

Table No. 05: Shows the results of the relationship between the level of physical activity (NAP) and the body mass index (IMC)

	Correlation Coefficient	Significance Level	Sig	Decision
IMC and NAP	-0.14	0.05	0.954	Not statistically significant

Based on the results of the table above, the statistical inference showed a very weak inverse relationship between the level of physical activity (NAP) and the body mass index (IMC) because R = -0.14 is not statistically significant, with a Sig value of 0.954, which is greater than the alpha value of 0.05.

From the results of the previous tables, it is evident that students with low levels of physical activity make up 75% of the study sample. The students classified as overweight and obese represent 20% of the sample, based on the body mass index criteria (IOTF), with 3 students having low physical activity and one student having moderate physical activity. This suggests that the occurrence of overweight and obesity in these individuals may be attributed to low to moderate levels of physical activity, along with other factors.

The results also indicate that 12 students have a normal weight but low levels of physical activity. This could pose a risk of changes in body mass index in the direction of an increase. The study sample did not include any students with underweight, and there were no individuals with high levels of physical activity. The article by Dr. Haider Abdullah Al-Doumi emphasizes that following healthy and balanced dietary programs, along with regular and sufficient physical activity, is one of the most important preventive measures against weight gain, obesity, and related diseases.

Furthermore, Al-Raqqad, Al-Awalma, Aldmour, and Athamneh (2007) noted in their book "Sports Culture" that obesity is rare among individuals who engage in regular physical activity or whose work requires continuous activity. This clearly highlights the impact of exercise on obesity, weight gain, and weight management. Physical activity is considered one of the most successful methods for controlling weight gain and plays a significant role in burning carbohydrates and fats in a positive and effective manner. Increasing physical activity along with a suitable diet is the best way to combat obesity in the long term (Al-Jabour and Qublan, 2012).

Furthermore, the study conducted by Lagridi Khiereddine in 2015 on the relationship between physical activity and obesity among school-going adolescents in Algeria found a weak inverse relationship between the level of physical activity and body mass index (BMI) and obesity. This is consistent with the results of your study and suggests that obesity is influenced by various factors beyond physical activity, such as genetics and nutrition. Zaoui (2018) also found that the proposed structured program has a positive effect on body fat percentage. To reduce body fat in adolescents, regular training sessions are recommended, aligning with the findings of Abdel-Fattah and Ahmed (1994). Many studies have demonstrated that, primarily, low levels of physical activity lead to obesity despite low food intake. Lamamra Hiyat's study in 2006 also emphasized the positive influence of physical activity on reducing obesity. In France, Chantal Simone and others in 2011 stressed the importance of promoting physical activity and combating physical inactivity to prevent weight gain among adolescents.

The study by Benhaha (2018) found that the average physical activity level was 1.65 for males and 1.39 for females. In the sample, 21% of adolescents were

found to have a sedentary lifestyle, while only 5% were described as very active. The most common activities among adolescents were sleeping, with 37% for males and 38.7% for females, and watching television, accounting for 24.10% for males and 28.3% for females. These sedentary activities reduced the time available for physical activities that have a positive impact on the health of adolescents.

The study by Benallal (2019) also found a relationship between the level of physical activity and the body mass index (IMC). It concluded that students who engage in physical activity, regardless of its intensity, tend to have a more appropriate body weight compared to those with low physical activity levels. The researcher also discovered an inverse relationship between the level of physical activity and obesity, which is consistent with the findings of your study. Additionally, the study demonstrated a link between sedentary behavior and obesity. These results align with your research findings, suggesting a consistent pattern in the relationship between physical activity, body mass index, and obesity among adolescents.

The study by Hashashi (2021) discovered a statistically significant inverse relationship between the level of physical activity and the body mass index (BMI) for female students at a significance level of $\alpha = 0.05$. This suggests that there is a correlation between the physical activity level of female students and their BMI. The study also found a statistically significant inverse relationship at a significance level of $\alpha = 0.01$ between physical activity level and BMI for all high school students. However, the relationship between the physical activity level and BMI for male students was inverse but not statistically significant, indicating no significant relationship between physical activity and BMI for male students in the study sample.

Additionally, the research conducted by Sharifi and Mukhtari (2021) demonstrated that unstable behaviors in children, such as spending most of their time watching television, using computers, or playing video games instead of engaging in physical activities, can lead to increased snacking outside regular meal times (snacking). This behavior contributes to weight gain. These findings further support the idea that physical activity plays a crucial role in the prevention of weight gain and obesity in adolescents, particularly when combined with a balanced diet and a reduction in sedentary behaviors like excessive screen time.

The study by Bkkar, Marzouki, and Hawish (2022) suggests that the proposed training program, which incorporates aerobic exercises, contributes to reducing obesity in women who exercise in the gym. They found statistically significant differences between pre- and post-measurements in various body measurements, including upper body dimensions and lower body measurements. The post-measurements favored the aerobic exercise program, indicating positive changes in body measurements. These results align with the findings of your study, which also indicated an inverse relationship between physical activity and obesity or weight gain.

5. Conclusion and Recommendations

Based on the results obtained from our study and their analysis, the researchers have identified a very weak inverse relationship between the level of physical activity and Body Mass Index (BMI). Additionally, the study has revealed that 75% of the total sample population has low levels of physical activity. Furthermore, 20% of the students suffer from obesity and overweight according to BMI indicators defined by IOTF criteria. Physical activity levels are considered one of the most significant factors in maintaining an individual's health and public health. Engaging in regular physical activities effectively raises an individual's level of physical activity by modifying their lifestyle and contributes to achieving public health and preserving individual well-being.

The study's recommendations include:

- Working on increasing an individual's level of physical activity by avoiding means that have a negative impact and reduce an individual's activity.
- Promoting and encouraging engagement in sports and recreational activities during leisure time and maintaining regular participation in them.

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