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Study of the relationship between a recreational sports program and an educational nutritional program accompanied by changes in body fat percentage among schooled adolescents (15-18 Years)

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Abstract

Aim. The study aims to examine the effectiveness of a recreational sports program coupled with nutritional education on the body fat percentage (BFP) among adolescent students.

Material and method. The research was conducted on a sample of 16 male adolescents, aged between 15 and 18 years, enrolled at Hadi Mahmoud High School in Tamalouka District, Guelma Province. The researcher utilized an experimental method with a single-group design, employing a questionnaire developed by MARTIN in 2000 to assess the level of physical activity. A proposed recreational sports program was implemented over a duration of 10 weeks, with three sessions per week, accompanied by an educational program consisting of eight theoretical lessons.

Results. The post-intervention results revealed a significant improvement in the level of physical activity, evidenced by the absence of any individuals with physical inactivity. The findings showed that 10 individuals, representing 62.5% of the sample, had a low level of physical activity, while six individuals, representing 37.5% of the sample, exhibited a moderate level of physical activity. No individuals were recorded with a high level of physical activity. Regarding the measurement of body fat percentage, a noticeable improvement was observed compared to the baseline results, with five individuals, representing 31.25% of the sample, having a high body fat percentage and 11 individuals, representing 68.75%, having a very high body fat percentage. The mean body fat percentage among the sample was recorded at 25.77%, with the lowest value noted at 20.3% and the highest at 30%. The post-intervention results also indicated that the Sig values were less than the significance level of 0.05, suggesting a statistically significant relationship between the level of physical activity and body fat percentage (BFP).

Key words*: body fat percentage (BFP), recreational sports, weight gain, obesity*

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Introduction

Health metrics are crucially designed to align with specific health objectives and interventions. The accurate measurement of body fat percentage offers essential data concerning the presence of fat mass, which significantly influences overall body weight. Variations in body fat percentage are impacted by individual differences in morphological structure and body composition.

Excessive body weight, extending beyond normal parameters, constitutes a severe health hazard, potentially subjecting communities to a spectrum of both communicable and non-communicable diseases such as cardiovascular diseases, hypertension, type 2 diabetes, and joint disorders.

Identifying individuals whose body weight surpasses normal or ideal benchmarks is a critical step in defining and tracking vital health indicators. Precise knowledge of body fat percentage facilitates the detection of changes in body composition, whether these are increases or decreases. This knowledge is particularly valuable when monitoring the effectiveness of specific sports or dietary regimens designed to reduce overall weight, aiming to decrease fat mass while preserving as much muscle mass as possible.

Standards for body composition set by the World Health Organization (WHO) and the National Institutes of Health (NIH) are foundational for assessing health status across populations. Hazaa (2010) underscores these standards, which stipulate optimal body fat ranges of 10-20% for men and 20-30% for women. It is critical to recognize that traditional measures of body weight, or even metrics like the Body Mass Index (BMI), do not adequately capture fluctuations in body composition.

Moreover, both the quantification of fat percentage and the understanding of muscle mass are essential for evaluating physical performance. This is corroborated by Hazaa (2010) and further supported by Al-Ghouli and Ibrahim (2001), who advocate for the numerous benefits that regular participation in various recreational activities, particularly sports, confers on an individual's physiological development. Engaging regularly in such activities not only enhances physical capacity but also contributes significantly to overall health and wellness.

The transformative effects of sports training are well-documented, encapsulating potential increases in muscle mass and decreases in fat levels, contingent upon the individual's body type (Ghandir, 2012; Kamach, 2011). Additionally, Al-Robdi (2008) accentuates the significance of integrating sports activities with a tailored dietary regimen. Effective strategies include scheduling meal times, thorough mastication of food, utilizing smaller portion sizes (such as small plates), and steering clear of artificial juices and high-calorie foods.

Conversely, prevailing societal norms often overlook the importance of such habits, which either positively or negatively influence health outcomes, entrenched within the broader socio-cultural framework of the community, family, or educational institutions.

The prevalent consumption patterns, characterized by an ignorance of food's nutritional content and caloric density, significantly contribute to obesity and excessive weight gain. This issue is compounded by a pervasive sedentary lifestyle, which detrimentally impacts body mass over time. The interplay between dietary behaviors and physical inactivity forms a critical axis in the health-disease spectrum across various demographic groups.

Particularly during the transitional phase from childhood to young adulthood, individuals aged 15-18 undergo significant physiological changes. This sensitive developmental stage is profoundly influenced by the prevailing lifestyle choices within one's immediate social environments—be it community, family, or school settings. Often, detrimental dietary habits are unknowingly adopted, accompanied by inadequate levels of physical activity, which collectively predispose these individuals to undesirable shifts in body mass.

In response to these challenges, researchers advocate for the development of a recreational sports program, amalgamated with an educational dietary initiative, aimed at reshaping behaviors and eradicating unhealthy dietary practices. The primary goal is to reduce visible fat mass among adolescents grappling with obesity. By monitoring changes in body fat percentage, we can gauge the effectiveness of physical training and dietary interventions in altering body composition (Al-Haramla and Jabari, 2017).

From the preceding discussion, the research problem can be articulated in the following question:

- Is there a correlational relationship between increasing physical activity accompanied by educational nutritional guidance and body fat percentage (BFP) among adolescents aged 15-18 years?

Aim

The researchers aim to:

- Develop and implement a recreational sports program tailored for adolescents aged 15-18 years, which integrates educational and dietary guidance to both prevent and address weight gain and obesity, and facilitate the reduction of excess body weight to within ideal parameters.
- Evaluate the effects of a recreational sports program on body fat percentage among adolescents who are overweight or obese, thus providing empirical data on the effectiveness of such interventions in altering body composition.

Materials and method

Study participants

The study focused on a specific demographic: overweight and obese adolescents undergoing secondary education, aged between 15 and 18 years.

A purposive sampling technique was employed, selecting 16 adolescents from this demographic based in Tamlouka, Guelma province, who met the criteria of being overweight or obese.

Study design

The assessment of physical activity levels among the students aged 15-18 was conducted using the PAL determination form developed by MARTIN (2000). This form allows for the categorization of various daily activities into seven distinct types based on the physical exertion involved.

Each activity type is assigned a duration (measured in minutes or hours over a 24-hour period) which is then multiplied by an activity coefficient specific to each category. The cumulative scores from all categories are then aggregated to derive the total activity level (NAP). This detailed methodology ensures a nuanced understanding of the students' physical activity patterns, facilitating targeted interventions based on the calculated activity levels and the specific ages of the students.

The process takes the form of an interview where the researcher asks the student about a specific activity, and the student responds with the number of minutes or hours, for example:

How long do you sleep? The student responds with a specific number of hours, e.g., 08 hours.

Do you sleep after noon? The answer is no, which translates in the tool to 00 hours.

Do you lie down at home for a long time? The answer is no, which translates to 00 hours, and then they are added under category A and the total is multiplied by the NAP specific to the category (01), and then divided by 24 hours to give the activity level for that category.

This tool was modified by Lazzouti in 2019 to become an interview with the student about the different activities during 24 hours to extract the number of hours and minutes more accurately step by step as follows:

Wake-up time: ……

Bedtime: ……

Toileting: ……

Breakfast: ……

Home-to-school journey: on foot……bus……

Arrival at school: ……

Classes: 08:00-12:00

Break: 10:00-10:10

School dismissal: 12:00, journey home: on foot ……. Bus ……

...and so on until the completion of the 24 hours to account for all activities undertaken.

Table 1. Classifies the results of the physical activity level according to MARTIN2000.

Activity Level (PAL)	Classification
0 – 1.60	Physically inactive
1.60 – 1.82	Low activity
1.82 – 2.04	Moderate activity
Greater than 2.04	High activity

Measurement of Fat and Muscle Ratios

The researcher used the technical card of the in-body device (OMROM / HBF-214) to determine the category of fat percentage and muscle percentage for the study sample.

Translation of Fat Percentage Results

Table 2. The classification of fat percentage in males.

Gender	Low Percentage	Normal Percentage	High Percentage	Very High Percentage
Males	5 to 9.9%	10.0 to 19.9%	20.0 to 24.9%	25.0 to 50%

Recreational Sports Program

- The researcher implemented the program over 10 weeks, with 3 sessions per week, totaling 30 sessions.
- The duration of each session ranged from 60 to 90 minutes, with the researcher gradually adjusting the intensity according to the capabilities of the sample being studied.
- The variety in group and individual activities, competitive games, and semi-sports activities included in the program construction aligned with the activity and capacity of the sample individuals and the intended study goals.
- Competitive recreational games were also included in the program.

Educational Guidance Program

The primary goal of the program is to enhance the cognitive understanding of food and nutrition among the study sample members, steering them away from undesirable dietary behaviours that can directly contribute to weight gain.

Results

General Characteristics of the Study Sample

Table 3. The characteristics of the study sample according to the weight variable.

Sample	Average Weight	Minimum Value	Maximum Value
16 individuals	88.41 kg	70.9 kg	104 kg

From Table 3 above, data demonstrates a range in body weight from a minimum of 70.9 kg to a maximum of 104 kg, with an average weight across the sample of 88.41 kg. This spread highlights the variability within the group, which is significant for assessing the impact of physical activity interventions tailored to varying weight categories.

Table 4. The initial classification of the sample individuals according to the PAL activity level.

	Physically Inactive	Low Activity	Moderate Activity	High Activity	Total
16 individuals	12	4	0	0	16
Percentage	75%	25%	0%	0%	100%

From the results of Table 4, which outlines the baseline activity levels of the study sample, it was found that 12 individuals had a physically inactive level; representing 75% of the sample, and 4 individuals were categorized under low activity, making up 25%. No cases were recorded under moderate and high physical activity levels.

Table 5. The post classification of the sample individuals according to the PAL activity level.

	Physically Inactive	Low Activity	Moderate Activity	High Activity	Total
16 individuals	0	10	6	0	16
Percentage	0%	62.5%	37.5%	0%	100%

According to the results of Table 5, which details the follow-up activity levels, no cases were categorized as physically inactive. Ten individuals were recorded with low physical activity levels, representing 62.5%, and six individuals had moderate physical activity levels, accounting for 37.5%. No cases were registered under the high physical activity level.

Results for the Pre and Post Measurements of Body Fat Percentage (BFP)

Table 6. Pre body fat percentage (BFP) Results for the study sample.

Sample	Normal	High	Very High	Average BFP%	Min Value	Max Value
16 individuals	0	3	13	28.36%	23.2%	34.2%
Percentage	0%	18.75%	81.25%			

Based on the results from Table 6, it is evident that no individual from the study sample has a normal body fat percentage. The results also indicate that 3 individuals, representing 18.75% of the sample, have a high body fat percentage, while 13 individuals, accounting for 81.25% of the sample, have a very high body fat percentage.

Additionally, the average body fat percentage among the sample members was found to be 28.36%, with the lowest recorded value being 23.2% and the highest at 34.4%.

Table 7. Post Body Fat Percentage (BFP) Results for the Study Sample

Sample	Normal	High	Very High	BFP%	Min Value	Max Value
16 individuals	0	5	11	25.77%	20.3%	30%
Percentage	0%	31.25%	68.75%			

The data presented in Table 7 shows that none of the participants within the study cohort maintained a normal body fat percentage. A detailed analysis reveals a pronounced accumulation of body fat in 5 participants, constituting 31.25% of the sample. Moreover, a significantly elevated body fat percentage was observed in 11 participants, accounting for 68.75% of the population studied. The mean body fat percentage across the cohort was registered at 25.77%, with the lowest and highest recorded values being 20.3% and 30%, respectively.

Analysis of Pre-Test Results Between NAP and BFP

Table 8. PAL and BFP Pre-Results for the Study Sample

Physical Activity Level	Normal		High		Very High		Total	
Physically Inactive	00	00%	02	12.5%	10	62.5%	12	75%
Low Activity	00	00%	01	6.25%	03	18.75%	04	25%
Moderate Activity	00	00%	00	00%	00	00%	00	00%
High Activity	00	00%	00	00%	00	00%	00	00%

According to the results from Table 8, no individual in the sample has a normal body fat percentage. Instead, among those with a high body fat percentage, two individuals suffering from physical inactivity were recorded, representing 12.5% of the sample, and one individual with low physical activity was recorded, representing 6.25%. No individuals were noted with moderate or high physical activity levels.

For individuals with a very high body fat percentage, ten individuals suffering from physical inactivity were recorded, accounting for 62.5% of the sample. Additionally, three individuals with low physical activity were noted, representing 18.75%. Again, no individuals with moderate or high physical activity levels were recorded.

Analysis of Post-Test Results between APL and BFP

Table 9. Post APL and BFP Results for the Study Sample

Physical Activity Level	Normal		High		Very High		Total	
Physically Inactive	00	00%	00	00%	00	00%	00	00%
Low Activity	00	00%	04	25%	06	37.5%	10	62.5%
Moderate Activity	00	00%	01	6.25%	05	31.25%	06	37.5. %
High Activity	00	00%	00	00%	00	00%	00	00%

According to the findings detailed in Table 9, no individual within the study sample has a normal body fat percentage. For those with a high body fat percentage, four individuals exhibiting low physical activity were identified, constituting 25% of this group, and one individual with moderate physical activity was noted, making up 6.25% of this category. Notably, no individuals were recorded as either physically inactive or having high physical activity.

Furthermore, among those categorized with a very high body fat percentage, six individuals were found with low physical activity, representing 37.5% of this group. Additionally, five individuals were observed with moderate physical activity, accounting for 31.25% of this subset. Again, no cases of physical inactivity or high physical activity levels were documented in this segment of the sample.

Results of relationship between APL and BFP in pre-measurements

Table 10. Correlation Results Between NPAL and BFP in the pre-measurements

		PAL 1	Percentage _L1
PAL 1	Pearson Correlation	1	-.279-
	Significance (Bilateral)		.295
	N	16	16

Table 10 delineates the statistical inference concerning the relationship between physical activity level measurements and body fat percentage (BFP). where the correlation coefficients indicated an inverse relationship

between NAP and BFP (R = -0.279). The significance (Sig.) values, exceeding 0.05, denote that the correlation does not reach statistical significance, thereby suggesting an absence of a substantial relationship between physical activity levels and body fat percentage.

Relationship Between PAL and Body Fat Percentage (BFP) in Post- measurements

Table 11. Correlation Results Between PAL and BFP in the post-measurements

		2PAL	Percentage
2PAL	**Pearson Correlation**	1	73-3-.
	Significance (Bilateral)		000.
	N	16	16

Table 11 presents the statistical inferences regarding the relationship between physical activity level measurements and body fat percentage (BFP) following intervention tests. The correlation results exhibit an inverse relationship between NAP and BFP, recorded as R=−0.373. Notably, the significance values, all below the 0.05 threshold, indicate a statistically significant relationship between physical activity level and body fat percentage, underscoring the efficacy of the interventions in influencing body composition.

Discussions

The statistical analysis conducted as part of this research meticulously examined the relationship between the physical activity level assessment questionnaire results and body fat percentage (BFP) in post-intervention assessments. The derived correlation coefficients reveal an inverse relationship between the Normalized Activity Profile (NAP) and BFP, quantified at R=−0.373R = -0.373R=−0.373. Significantly, the Sig. values, all registering below the threshold of 0.05, substantiate a statistically significant correlation between physical activity levels and body fat percentages.

The interpretation provided by the researcher suggests that the observed relationship stems from the enhanced physical activity levels of the study participants, who transitioned from a baseline of physical inactivity to engaging in regular sport activities, conducted three times a week, supplemented by their routine daily activities. This shift likely facilitated the metabolic consumption of stored energy in the form of fatty tissue, thereby improving the BFP measurements.

The effectiveness of the implemented programs, encompassing both the structured recreational activities and the educational dietary guidance, played a pivotal role in positively modifying the body fat percentages. This enhancement is attributed to the increased utilization of energy reserves stored as body fat coupled with the expenditure associated with the recreational sports program, which consistently elevated the activity levels among the participants.

Moreover, the dietary behavior modifications, influenced by the educational intervention throughout the experimental period, resulted in a tangible decrease in caloric intake. This reduction likely prompted the body to utilize stored fat as an energy source, consequently altering the body composition by reducing fat percentages and modifying muscle tissue dynamics.

This observation corroborates the theoretical framework posited by Kamach (2011), who elucidates that the shaping of body contours through fat accumulation involves multifaceted physiological processes unrelated to the foundational mechanisms of energy production and aerobic metabolism. Changes in muscle tissue, characterized by increased volume from training or atrophy from inactivity, are further discussed.

Salama B. (2011) underscores that educational dietary guidance effectively translates nutritional health facts into practical behavioral changes, targeting the eradication of entrenched unhealthy habits and rectifying prevalent misconceptions concerning diet and nutrition.

Additionally, Al-Kiki, Hammad, and Mahmoud (2016) emphasize the significance of guiding individuals towards forming balanced meals and introducing dietary alternatives, which are fundamental in reshaping established yet improper dietary behaviors. Their work highlights the role of enhanced nutritional awareness and the dissemination of a sound nutritional culture in effecting dietary changes known for their resistance to modification.

The outcomes of this investigation are consistent with the findings from numerous studies that examine the effects of physical activity on obesity and body fat percentages. Notably, Al Kalani (2009) observed a beneficial impact of physical activity on obesity, which aligns with our conclusions. Furthermore, Zeraoula (2018) identified significant statistical differences in fat percentage reductions between pre- and post-intervention measurements, further substantiating our results.

In a comprehensive study conducted by Oulamara (2005), an increment in the prevalence of obesity and overweight was recorded, escalating from 9.92% to 10.12% among children and adolescents over the period from 1996 to 2005. It was highlighted that overweight children exhibited notably lower levels of physical activity, particularly during rest periods. This trend was further explored in a 2013 study by Blounis Rachid, which presented a gender-specific analysis of abdominal obesity distribution, noting an increase of 31.5% in males compared to 12.5% in females.

Further evidence comes from Abdelkawi (2013), whose research demonstrated that a specifically designed sports program effectively reduced fat percentages by 1.63% in males and 1.14% in females. Similarly, Saleh (2009) reported that the prevalence of overweight and obesity in their study sample was 43.5% and 6.5%, respectively, across both genders.

This study also noted a relative increase in the consumption of food and essential nutrients overall. Additionally, it revealed that 67% of the participants regularly consumed breakfast, 51% indulged in fast food (an additional meal between main meals), and 62% drank soft drinks daily. The daily consumption rates of milk, dairy products, vegetables, and fruits—considered nutritive substances—were 47%, 67%, and 78%, respectively. Remarkably, about 63% of the youth engaged in daily sports activities, highlighting the critical role of regular physical exercise in managing body weight and composition.

The 2021 study by Malik illuminated the effectiveness of aerobic exercises and Zumba in modifying body circumferences (chest, hip, thigh) through pre- and post-intervention measurements. Complementarily, research conducted by Jarourou, Benzidan, and Ben Omar (2021) underscored the influence of a similar exercise program in reducing fat percentages among participants.

Moreover, Ziani (2021) delineated a significant link between dietary habits and body mass index, observing notable distinctions in obesity rates and lifestyles between participants engaged and not engaged in dietary training programs, with those in structured programs generally maintaining a normal weight.

Further reinforcing this narrative, the 2022 study by Cherit demonstrated that a cardio-based training program significantly reduced body fat percentages in obese women aged 20-30 years. This is aligned with findings from Fadlawi and Masoud (2020), who reported a reduction in body fat from an initial 15.190% to 11.97%, attributed to the efficacy of a structured football training regimen.

Corroboratively, Cherifi and Massawi (2023) reported that their proposed training program beneficially impacted weight, obesity, and body fat percentages among participants. These studies collectively affirm the pivotal role that consistent physical activity and managed dietary behaviors play in mitigating obesity and reducing excessive body fat.

Conclusion

This research underlines the crucial influence of physical activity levels and dietary behaviors on health, asserting that these factors can exert both positive and negative effects. The degree of physical engagement and adherence to sound nutritional guidelines fundamentally determine the overall health outcomes for individuals. In pursuit of maintaining and enhancing individual health, it is imperative to elevate physical activity levels through a variety of recreational sports activities. Simultaneously, adopting correct dietary behaviors is essential, focusing meticulously on both the quantity and quality of dietary intake, given its significant impact on body fat percentage in humans.

A comprehensive analysis of the pre-intervention data revealed that a substantial portion of the sample, precisely 75%, was categorized under a physically inactive status with 12 individuals. The remaining 25% comprised 4 individuals who fell into the low activity category. Notably, there were no recorded instances within the moderate or high physical activity categories.

In stark contrast, the post-intervention results demonstrated a remarkable improvement: complete eradication of physical inactivity was noted, with 10 individuals now classified under the low physical activity level, representing 62.5%, and 6 individuals advancing to a moderate physical activity level, accounting for 37.5% of the sample. The high physical activity levels remained unrecorded.

Moreover, a significant transformation was observed in the body fat percentages. Initially, none of the participants in the study exhibited a normal fat percentage. High fat percentages were observed in 3 individuals, constituting 18.75% of the sample, and very high percentages were seen in 13 individuals, representing 81.25%. The average Body Fat Percentage (BFP) among the sample at this stage was 28.36%, with the lowest recorded value being 23.2% and the highest at 34.4%.

Following the interventions, although no participants achieved a normal fat percentage, the distribution improved notably: high percentages of fat were recorded in 5 individuals, representing 31.25%, and very high

percentages in 11 individuals, accounting for 68.75%. The average BFP among the sample post-intervention was significantly reduced to 25.77%, with individual values ranging from a low of 20.3% to a high of 30%.

Additionally, the Sig. values post-intervention were less than the significance level of 0.05, underscoring a statistically significant relationship between the enhanced level of physical activity and the observed reductions in body fat percentage (BFP).

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