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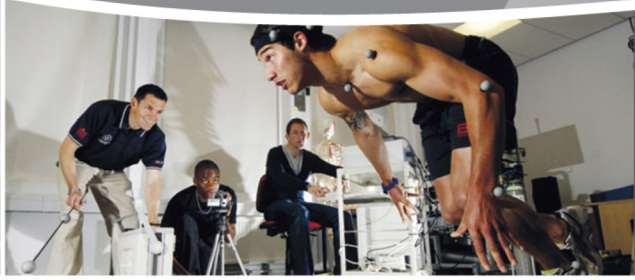

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The Swedish Journal of Scientific Research

Original Article

Anthropometric Attributes and Dietary Practices of School aged Adolescents in Different Governorates of Oman

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ABSTRACT

Background: Adolescence begins with the onset of physiologically normal puberty and this period of development corresponds to the adolescents nutritional status. As stated by the World health Organization, anthropometric assessment represents a crucial indicator of a population health**. Objective:** This study aimed to assess the obesity prevalence and habitual dietary habits of school aged adolescents in different governorates of Oman. **Subjects & Methods:** This cross-sectional survey consisted of a convenient sample of 4252 subjects recruited from the eleventh governorates in Oman, their age ranged between 15-17 years. Written informed consent was obtained, and a diet, anthropometric, and a medical history questionnaire was administered to all enrolled study subjects. **Results:** The study showed that almost half of the population had a normal body mass index (BMI). Obesity, overweight and underweight represented (15%,11%, 23% respectively). Female had higher percentage of overweight and obesity, while male had higher percentage of underweight. Only 50% of the population had breakfast more than three times a week. Fifty and forty percent of adolescents were having fruits and vegetables servings less than 4 times a week, respectively. Surprisingly, 20% reported junk food consumption 4-7 times a week. There was a significant correlation between BMI and the geographic distribution of the population; Al Dakhilia governorate showed the highest percent for underweight (27.9%), overweight and obesity was highly noticed in Dofar governorate (25.6%, 20.6% respectively). **Conclusion:** Adolescence is a second sensitive developmental period in which puberty and brain maturation lead to a new set of behaviors and capacities. Early intervention program has an important role in changing nutritional behavior of adolescents to assure raising healthier generation.

Keywords: Adolescents, body mass index, habitual dietary habits, oman

INTRODUCTION

Due to urbanization and the rapid economic growth, there were dramatic changes in dietary patterns. Association was approved between changes in dietary habits, physical activity and urbanization, as well as the Westernization which occurred in the Arab countries during the past three decades, and the high prevalence of overweight and obesity in the region. Changes in lifestyle to a more sedentary existence, importation of high caloric density processed foods, an urbanized environment with poor access to parks or areas for exercise contributing to lack of physical activity, and so on are found in many of the Arab countries, particularly those members of the Gulf Cooperation Council. Adolescents were affected the most, as they might be strongly influenced by mass media and peer pressure for conformity. Food choices and purchases are increasingly made by the adolescent. Snacking, skipping meals and intake of junk foods are common features of

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adolescents' diet in developed countries. Currently, adolescents have an increased intake of sweetened beverages, French fries, pizza, and fast food, and a consequent lack of recommended fruits, vegetables, dairy foods, whole grains, lean meats, and fish. This change in eating pattern results in consumption of excess fat, saturated fat, trans fats, and added sugars along with insufficient consumption of micronutrients such as calcium, iron, zinc, and potassium, as well as vitamins A, D, and C and folic acid.

Excessive food intake, has been shown to have detrimental effects on adolescents' health, such as increasing their susceptibility to diseases and precipitating diabetes, heart disease and hypertension. moreover, inadequate intake of carbohydrates, proteins, fat, vitamins and/or minerals has been shown to have severe consequences on growth during this stage. As an attempt to investigate associations between vitamin D status and dietary vitamin D intake among adolescents, a cross-sectional study was conducted with adolescents aged 14–18 years old (n=198). Vitamin D status was positively correlated with vitamin D intake. This result illustrates the importance of stimulating an adequate intake of vitamin D via natural food sources. Additionally, the adoption of a healthy lifestyle and a diversified healthy diet, should also be encouraged.

Poor dietary patterns can within a relatively short time lead to various types of morbidity. Good dietary habits and a diet that is safe and balanced can enhance the growth of children, improve immunological competence to overcome infections, sustain optimal cognitive function and contribute to a healthy reproductive system.

According to ministry of health in Oman, there is an increase in the nutritional deficiencies and metabolic disorders for the age group (15-19), this increase was rapidly among female subjects. Diet-related non-communicable diseases (NCD) such as obesity, cardiovascular disease, stroke, diabetes and some forms of cancer exist or are emerging as public health problems in many developing countries. Obesity and sedentary lifestyles have been involved in the etiology of many NCDs among adults. The World Health Organization (WHO) has recommended a diet low in fat, sugar and salt, and high in fruit and vegetables in order to protect against the development of obesity. WHO noted insufficient policy response and progress in curbing the burden of NCD; it has been and is calling countries to increase the action of NCD risk factors, including unhealthy diet, to reduce the preventable and avoidable burden of morbidity, mortality and disability due to NCD.

In 2015, the methodology of the Child Health and Nutrition Research Initiative (CHNRI) was used to establish global research priorities in adolescent health. It includes several areas such as: management of non-communicable diseases, mental health, nutrition and physical activity.

Adolescence is a sensitive developmental period in which puberty and brain maturation lead to a new set of behaviors and capacities. In addition to basic health and nutrition care, interventions such as prevention of drug and alcohol abuse, life skills, vocational training, health literacy and preparedness for parenthood can also impact on the Early Childhood Development (ECD) of the next generation.

The most effective public health interventions to improve nutrition in the long term are those that focus on changing food frequency, eating habits, and the size of daily portions. Increasing school children's food frequency through nutrition education programs would improve their quality of life in the long term and possibly throughout their lives.

Al-Sinani and others in their study, which aimed to assess the effectiveness of dietary and lifestyle advice. Counselling diabetic patients about the impact of food, nutrition and exercise on diabetes shifted the patients from "Poor" to "Good" control in terms of metabolic outcome.

Al-Lamki emphasized on the active role of university faculty and staff in educating the public regarding good nutrition and disease prevention and called to take positive and definitive steps to improve the health of the community in particular the young ones.

SUBJECTS AND METHODS

Study Design and Population

This cross-sectional study was conducted from February to November 2016, in different governorates of Oman, with a sample of 4252 Omani schools aged 15-17 years (2122 males and 2130 females) from all of the 11 sultanate governorates (Musandam, Al Batina North, Al Batina

South, and Al Dhahera governorates). All study subjects were recruited on voluntary basis, and they were all healthy, non-smokers, and free of endocrine disorders, eating disorders, gastrointestinal diseases, or any non-communicable diseases (cardiovascular diseases, diabetes, and hypertension). None of the study participants were consuming any multivitamins supplementation.

Socio-demographic Characteristics

These characteristics include; age, gender, residential status, medical family history, vitamins or nutritional supplements, monthly income, educational level, and physical activity. The data was collected during personal interviews with all study participants.

Anthropometric Assessment

Measurements of weight, height, and percentage body fat and waist circumference were taken by highly research assistants. The subject's height was measured with socks and shoes removed, standing upright with feet together in the center of the base plate. Height (m) was measured to the nearest 0.1 cm. Weight was measured to the nearest 100 g using a TANITA scale, with subject in light clothing without shoes. Body mass index (BMI) was calculated by the measured height and weight recorded during the interview. The interviewer measured the height and weight of each individual twice. The average of these two measurements was calculated to determine a height and weight to use in the calculation of BMI.

Nutritional Assessment

Dietary assessment was estimated for all study participants. The Participants reported retrospectively the frequency of consumption of each food group on the basis of 6 levels of frequencies by asking the participants to report the frequency of weekly consumption: from rarely or never to more than 7 times a week. Data was analyzed with IBM SPSS Statistical software, version 23. The used food frequency questionnaire (FFQ) was tested for its validity, reliability and reproducibility before conducting the study. The FFQ included 9 different food groups (breads/cereals, vegetables, fruits, meat/meat substitutes, milk/dairy products, deserts, beverages, sandwiches, and traditional Omani dishes).

STATISTICAL ANALYSIS

Depending on the distribution of the variable of interest, descriptive statistics of continuous data will be presented by using the mean and standard deviation, and the median and the interquartile range. Categorical data will be presented as frequencies and percentages. Unpaired student's *t*-test will be used to detect differences between groups for continuous variables, while chi-square will be used to investigate possible correlations between categorical variables. ANOVA test will be used to detect significant differences in BMI within the groups. Differences with p-values < 0.05 were considered significant. All statistical analyses were conducted using Statistical Package for Social Sciences (SPSS 21.0) and statistical significance was set at.05.

RESULTS AND DISCUSSION

There was a significant correlation between BMI categories and gender. Female had higher percentage of overweight and obesity, while male had higher percentage of underweight, Figure 1. Recent reports suggested that there was a direct relationship between adolescent fatness and increased risk of cardiovascular diseases. Moreover, there was a significant correlation between BMI categories and the geographic distribution of the sample. Al Dakhilia governorate showed the highest percent for underweight (27.9%), overweight and obesity was highly noticed in Dofar governorate (25.6%, 20.6% respectively). Dhofar and Al Wusta governorate had the lowest percent of normal weight (40.1%,42.1% respectively). Thirty-three percent of the sample were taking breakfast on a weekly basis, while (38.7%) were taking breakfast once, twice a week or not at all. There was a significant correlation ($P<.05$) between weekly breakfast serving and BMI categories. As illustrated in Figure 2, BMI increases as breakfast servings decreases. Obesity was at the highest level when there was no breakfast serving. According to

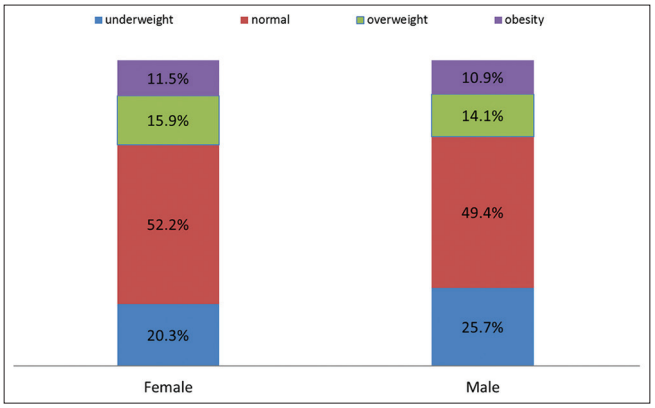

Figure 1: Correlation between body mass index categories and gender

Al Kailani (2013), skipping breakfast was dominant among the Omani adolescence. Half of the sample were taking sweetened drinks five to seven times a week. Thirty-nine percent of the obese adolescents were having five to seven sweetened drinks a week. Only (23%) of the sample were drinking power drinks. Thirty-seven percent of the participants were having fruits five times or more a week (37%) and (41%) were taking vegetables on the same base, which is lower than the adequate fruits and vegetables consumption level. There was a significant difference ($P<.005$) in male and female fruits and vegetables' consumption; where males' consumption was higher by (7%) than female, for both vegetables and fruits.

Based on a regional cross-country study there were a significant difference in male and female consumption of fruits and vegetables; where Omani male ate fruits and vegetable more than five times a day. Interventions should take into consideration the psychosocial, environmental and socio-environmental factors influencing fruits and vegetables intake within countries. Dietary recommendations for a healthful diet across Europe recommend consumption of at least five portions of fruit and vegetables a day reduced intakes of saturated fat and salt, and increased consumption of complex carbohydrates and fiber.

Descriptive statistics of the dietary practices variables among males and females are displayed in Table 1. There was a statistically significant negative association between being male and vegetable intake, percent of MUFA (mono-unsaturated fatty acids) and percent of PUFA (poly-unsaturated fatty acids). The males consumed almost one serving of vegetables less than females (p=0.0063). The males reported consuming significantly more energy (kcal) and percent of kcals from saturated fat than the females. The mean caloric intake among the males was 2780 kcal compared to only 2298 kcal reported in the females as a comparison group (p=0.033). The males consumed 3.8% more calories from saturated fat than the females (p<0.0001). Also of interest, the mean intake of goodies, including cakes, cookies, and pies, was 1.91 among males compared to 0.72 in females (p=0.0002).

At the individual level, the adjusted analyses suggest that the males consumed fewer servings of vegetables, and a lower percentage of energy from MUFA and PUFA. The males also consumed a greater amount of energy intake, whole grains, and a greater percentage of energy from saturated fat. Surprisingly, there were not as many significant differences between the males and females in the nutritional intake as was initially hypothesized. This may be because more traditional

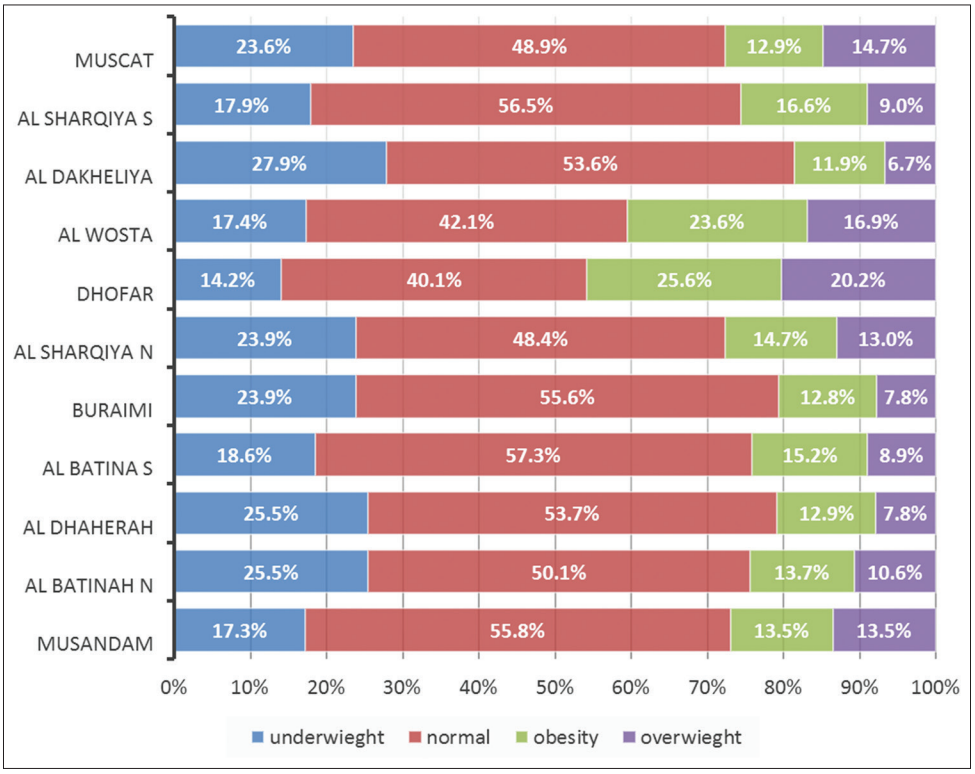

Figure 2: Correlation between body mass index categories and governorate

Table 1: Comparison of dietary practices between the males and females study participants

Variable	Males (N=2122)	Females (N=2130)	*p* of Significance
Energy (kcal/day)	2780 (871)	2298 (871)	0.0326*
Fruits (servings/day)	2.6 (2.8)	1.4 (3.4)	0.0964
Vegetables (servings/day)	1.2 (1.5)	1.9 (1.9)	0.0063*
Whole Grains (servings/day)	2.2 (2.4)	1.6 (1.9)	0.1524
Total Fiber (g/day)	23.6 (10.6)	19.3 (8.5)	0.3057
Soluble Fiber (g/day)	6.7 (2.9)	5.4 (2.4)	0.4129
Insoluble Fiber (g/day)	16.7 (8.4)	13.5 (6.6)	0.2626
% kcal from fat/day	38.0 (8.6)	36.8 (10.0)	0.7665
% kcal from Sat fat/day	16.7 (4.7)	12.6 (4.4)	0.0001*
% kcal from MUFA/day	12.6 (3.1)	14.1 (4.4)	0.0493*
% kcal from PUFA/day	5.5 (2.9)	7.1 (3.5)	0.0027*
Trans Fat (g/day)	5.9 (2.7)	5.9 (4.2)	0.1052
Omega 3 Fatty Acids (g/day)	1.8 (1.1)	1.5 (0.9)	0.9492
Red Meat (servings/day)	1.9 (3.0)	2.2 (2.8)	0.2303
Processed Meat (servings/day)	1.84 (2.09)	1.3 (1.8)	0.3106

Results are expressed as Mean (SD), MUFA (mono-unsaturated fatty acids), PUFA (poly-unsaturated fatty acids), *Significantly different, P<0.05

high-fat and high-calorie diet, utilizing foods were consumed. To our knowledge, there is no current population-based research in the literature describing dietary practices in the school aged Omani adolescents and there is very limited population-based research examining the nutritional status and/or diet.

This research was more exploratory in nature, with the goal being to better describe the nutritional intake and dietary practices of the school aged adolescents community to generate potential hypotheses to explain the high prevalence rates of obesity and overweight. The results from this research will also increase the understanding of the culture, nutritional intake, and dietary behaviors in the adolescents population as a high risk group for non-communicable diseases, which fills a large gap in the literature. These results may also aid in the future direction for health related research and dietary interventions in the Omani adolescents as these data could be used to develop a food frequency questionnaire (FFQ) culturally relevant for this population and to be used in future epidemiological studies. In conclusion, these results may provide more direction for future chronic-disease research conducted within this high risk group of the Omani adult's population.

CONCLUSION

The association between diet and lifestyle habits and adolescents is well documented in literature and has been well studied in other populations. However, such studies in the Omani population are scarce. Our study results have provided baseline diet and lifestyle characteristics for adolescence is a second sensitive developmental period in which puberty and brain maturation lead to a new set of behaviors and capacities. However, as nutritional deficiencies and metabolic disorders are noticeably increasing over the last five years and normal body mass index are only around fifty percent. Preventive actions are highly recommended to insure a healthy generation. Evidence was found for the effectiveness of especially multicomponent interventions promoting a healthy diet in school-aged children. It is an important time to intervene with their nutritional intake to meet nutrient needs and develop dietary patterns that may persist into adulthood. An early intervention program will contribute in creating a fundamental foundation for correcting the current dietary pattern and raising a well-equipped community.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Authors' Contributions

Majed S. Al-Busafi and Kashef Zayed conducted the field work, data collection, and data analysis. Other authors conceptualized the study and supervised the whole research activity. All authors have made equal

contribution in developing, revising and editing the manuscript.

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The Swedish Journal of Scientific Research

Original Article

The most Common Injuries in Team and Individual Sports, and Related Training Mistakes

Case Study: Sultanate of Oman

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ABSTRACT

Objective: This study aims to investigate the common injuries in team and individual sports, and the common related training mistakes that lead to the injuries. **Method**: This is a cross sectional study, covering 262 athletes through an online survey. The survey aims to investigate the main injury factors, injury first aiders, and injured athletes' satisfaction with the support provided by the first aiders. **Result:** Fifty-nine percent of the participants classified their injury as moderate. Thirty-four of the participants noted that failure to warm-up before performing is one of the main injury factors. Almost half of the participant did not receive rehabilitation after an injury that needed surgical intervention.

Keywords: Athletes, Injury, Sport, Training, Oman.

INTRODUCTION

Medical illnesses and sports-related injuries have an effect on both an athlete's health and their performance. The combination of high sport-specific participation and high injury rates leads to the highest burden of injury. These injuries can have serious consequences for the injured athlete in terms not only of treatment costs and time lost from sport, but also a greatly increased risk of early osteoarthritis, decreased sport participation associated with all-cause morbidity, overweight, and obesity[1],[2]. Thus, reducing the public health burden associated with sport injuries is critical.

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It is important to focus on the implementation context and real-world effectiveness in evaluating prevention strategies in sport[3]. Studies from Scandinavia have documented that sports injuries constitute 10–19% of all acute injuries treated in the emergency room, and the most common injury types are knee and ankle injuries [4]. As people become more involved in sport and exercise, sports medicine becomes increasingly important.

Serious knee injuries, such as those to the anterior cruciate ligament (ACL), are a growing cause for concern [5]. The highest incidence is seen in adolescents playing pivoting sports, such as football, basketball, and team handball [6].

Injuries are more common in football compared to most other types of sport [7]. Ellen et al. (2011) [8] followed ten softball and eight baseball teams in high schools during the 2009 softball and baseball seasons. They found that both softball and baseball players

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experienced a low incidence of injury and that most injuries were minor and affected the upper extremity. Injury rates were highest during the first month of the season, suggesting that athletes may benefit from a more gradual increase in activity and a structured off-season injury prevention program.

Arin et al. (2004)[9], applied their study on 306 male football player participants. During the 4-month competition season, 170 of the 306 players (56%) incurred 244 injuries: 206 (84%) were acute injuries, and 38 (16%) were overuse injuries. No significant difference was found in the incidence of injury between the elite and the first division or between the first and second half of matches or training sessions. Two hundred and one (82%) injuries were located on the lower extremities. The thigh was the most frequent injury location (24%), followed by the knee (16%), groin (13%), lower leg (13%), and ankle (9%). The most frequent injury type was muscle strains, with the majority occurring during matches (73%). They identified four specific injury types as being the most frequent: hamstring strains, groin strains, knee sprains, and ankle sprains. Bayne et al. [10] (2017), in their 10-month cohort study involving two football teams over the duration of Soccer League in South Africa, where the medical staff recorded daily football exposure, illness, and injuries, reported in their study that the knee was more frequently affected than the ankle or thigh, joint injuries were more common than muscle injuries, and there was a larger proportion of severe injuries.

Beynnon [2001] reported that women who played soccer had a higher incidence of ankle injury than those who played field hockey or lacrosse. Among men, there was no relationship between type of sport and incidence of injury [11].

Until recently, the hip joint was not thought to be a significant cause of problems in the athletic population. However, the Australian Football league (AFL) reported that hip and groin pain is the third most common injury, accounting for between 5 and 15% of all football-related injuries; it is also prevalent in many other sports, including tennis, football of all codes, and hockey[12].

The likelihood of a sportsperson sustaining an injury to the hip joint can be increased by the demands of the sport, in particular, sports that require repetitive hip flexion, adduction, and rotation[13]

The incidence of volleyball injuries in the Netherlands is estimated to be 170,000 per year [14]. Kilic et al.'s (2017) results showed that ankle, knee, and shoulder injuries are the most common injuries sustained while playing volleyball[15].

Youth have very high sport participation rates. However, sport is also the leading cause of injury in adolescents, accounting for >30% of injuries in this population across many countries. The estimated injury incidence proportion in youth sport is 35 injuries requiring medical attention/100 youth annually (ages 11–18)[16].

Sport science (including strength and conditioning) and sports medicine (including doctors and physiotherapists) practitioners share a common goal of keeping players injury free [17]. Studies have shown that Sports Medicine Professionals (SMPs, i.e., athletic trainers, physiotherapists), who are in regular contact with athletes during treatment, are in an ideal position to inform, educate, and assist with both the psychosocial and physical processes of injury[18]. Indeed, it appears that SMPs are the first to attend to the injured athletes' needs[6] and are often present immediately after an injury has taken place—a time when the levels of pain and confusion experienced by the athlete are at their worst. However, many SMPs feel inadequately trained to address the psychosocial aspects of injuries and to implement psychosocial strategies[19,20].

A precise description of the inciting event is a key component to understanding the causes of any particular injury type in a given sport [21]. Orchard [22] proposed hypothetical relationships between training (both under-training and over-training), injury, fitness, and performance. Both inadequate and excessive training loads can result in increased injuries, reduced fitness, and poor team performance. Excessive and rapid increases in training loads are likely to be responsible for a large proportion of non-contact, soft-tissue injuries. However, physically hard (and appropriate) training develops physical qualities, which, in turn, protects against injuries. Orchard emphasized the importance of monitoring training loads, including the load that athletes are prepared for, as a best practice approach to the long-term reduction of training-related injuries.

In a study of rugby league players, it was found that the majority of training injuries (37.5%) were sustained in traditional conditioning activities that involved no

skill component (i.e., running without the ball), while the incidence of injuries in game-based training was low (10.7%)[23]; these results suggest that game-based training offers a relatively safe method of conditioning for team sport athletes [24].

For players with a history of previous injury, a balanced training program appears to reduce the risk of re-injury to the same level as healthy ankles in football and volleyball players [25].

Gorostiaga et al. (2006) stated that 'understanding the effects of periodized training and competition time spent volumes and intensities may provide insights for enhancing performance and prevent injury in elite handball team sport' [26].

According to the Sports Medicine Center, there were 14,970 injuries treated by the center in 2016. Football injuries accounted for most of the injuries, corresponding to 89% of the total injuries. This percentage was an increase of 15 % over the previous year (2015). Seventy percent of the injuries were knee injuries, and 17% were muscles and tendon injuries.

RESULTS

The study showed that 28% of the participants had tendon strain, 23% had a torsion, and 18% had muscle strain. Figure (1) illustrates the main injuries among participants. Participants reported that knees and feet are the main affected parts during play (40%, 31% respectively), as illustrated in Table (1).

Fifty-nine percent of the participants classified their injury as moderate, while 24% classified it as serious. Figure (2), shows that 26% of the serious injuries occurred during official matches. Thirty-four of the participants noted that ignoring warming before practicing is one of the main injury factor, 28% highlighted the fitness level of the player, and the appropriateness of the infrastructure was reported by 12%. Orchard[27] proposed hypothetical relationships between training (both under-training and over-training), injury, fitness, and performance. Both inadequate and excessive training loads could result in increased injuries, reduced fitness, and poor team performance.

Moreover, thirty-nine (27%) of the participants stated that the injury was due to a sudden movement or a mistaken movement. Ellen et al. (2011) [8] suggested that athletes may benefit from a more gradual increase in activity and a structured off-season injury prevention program. For players with a history of previous injury, a balanced training program appears to reduce the risk of re-injury to the same level.

Table 1:

part	frequincy	valid percent
knee	104	39.7
foot	82	31.3
leg	36	13.7
arm	9	3.4
shoulder	9	3.4
arm joint	8	3.1
spaine	5	1.9
others	9	3.5
total	262	100

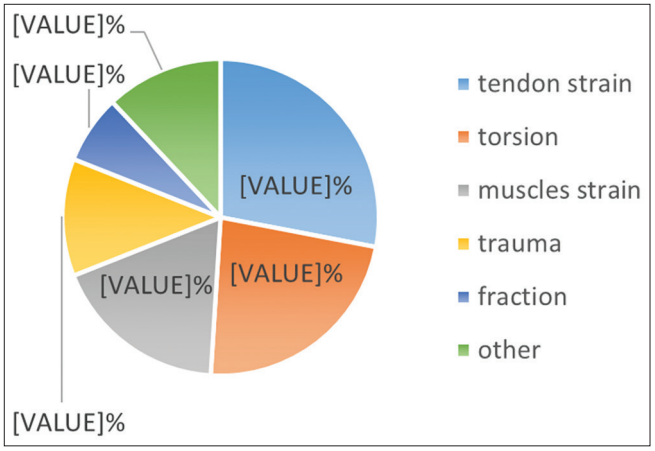

Figure 1: Injury type

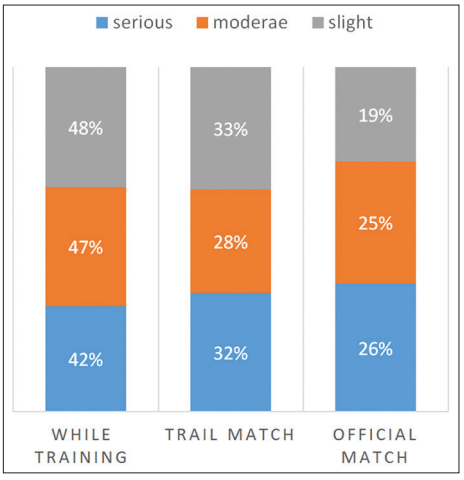

Figure 2: injury level and the stage of injury

Coaches and physiotherapists were the first aiders for (28%, 26%) of the participants. For 15%, their colleagues provided them with the first aid and 5% treated themselves, while 19% did not receive any first aid. However, more than half of the participants were not satisfied with the first aid provided. The majority of the satisfied participants were treated by physiotherapists and coaches (34%, 25% respectively). Figure (3) shows the satisfaction level with support from first aiders. In addition, almost half of the participants did not receive any rehabilitation after an injury that needed surgical intervention.

Studies have shown that SMPs, i.e., athletic trainers, physiotherapists, who are in regular contact with athletes during treatment, are in an ideal position to inform, educate, and assist with both the psychosocial and physical processes of injury[28]. Indeed, it appears that SMPs are the first to attend to the injured athletes' needs[6] and are often present immediately after an injury has taken place—a time when the levels of pain and confusion experienced by the athlete are at their worst. However, many SMPs feel inadequately trained to address the psychosocial aspects of injuries and to implement psychosocial strategies[29],[30].

CONCLUSION

Understanding the effects of periodized training and competition time spent volumes and intensities may provide insights into how to enhance performance and prevent injury. Moreover, SMPs must be adequately trained to address the psychosocial aspects of injuries and to implement psychosocial strategies.

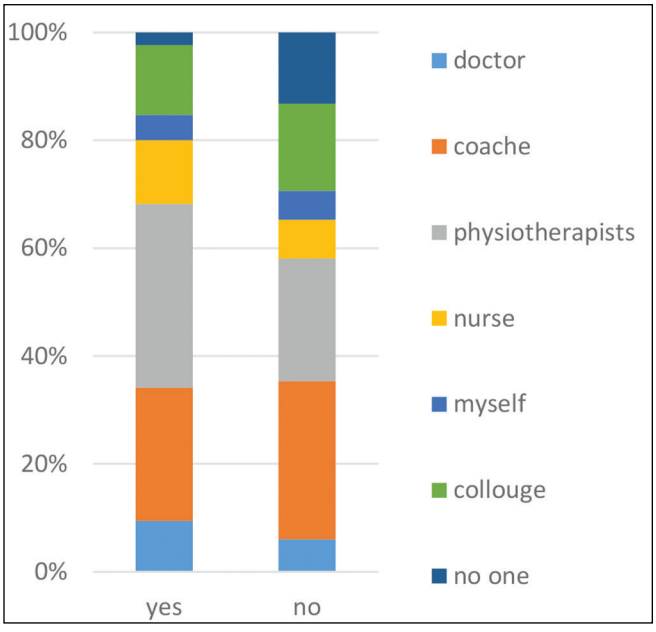

Figure 3: Satisfaction level from the provided first aid

The results of this study show that there is a difference in the causes of the occurrence of sports injuries between all sports, and between individual and team sports. In addition, the results show that there is a correlation between the types of sports injuries and the type of sport practiced, whether team or individual sport. Also, there is a significant correlation between the types of sports injuries and the type of specialization, where the types of sports injuries vary according to the different sports specialization.

One of the main causes of sports injuries is that coaches and athletes do not give enough attention to warming up, as well as paying little or no attention to safety factors. Therefore, there is a need to educate coaches and athletes through theoretical and practical lectures about warming up and safety factors, which should be considered to reduce the number of injuries among athletes. There is a need also to educate sports coaches to work according to the rules of sports training in the development of training plans, taking into account that the training plans fit with the physiological and physical abilities of athletes.

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Original Article

Contribution of some anthropometric, physical and physiological measurements in the level of digital achievement in a running for 400 meters for students in the field of physical education

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SUMMARY

The aim of this study was to identify the contribution of some anthropometric, physical and physiological measurements in the level of numerical achievement in a running of 400- meter among students in the field of physical education. To achieve this, the study was conducted on a sample of (100) students from the Department of Physical Education at the Technical University of Palestine "Khadoori" (PTUK), between the ages of (18-23) years. The two researchers used the descriptive method of its relevance to the nature of the study. Besides, Anthropometric measurements were made in terms of stature length, body mass, arm length, leg length, length of the instep, circumference of the shoulders, circumference of the chest, circumference of the abdomen, circumference of the thigh, circumference of the leg), and physical measurements in terms of (10 seconds, divide 5 steps (right-and-left), 200-meter sprint, Gri Cooper (12) minutes. To be added, physiological measurements In terms of heart rate, resting time and postoperative stress, systolic and diastolic pressure at the time of rest and after exertion (Cooper), and maximum oxygen consumption (Vo2max). The two researches used the SPSS program in data analysis. The results of the study showed that the abdominal circumference and the instep length were the most anthropometric measurements contributing to the level of digital achievement of track event (400 m), which contributed to the interpretation of (13.8%) of running time. Based on these results, the researchers recommend that trainers should take appropriate anthropometric, physical and physiological measurements for each of the athletics activities.

Keywords: Anthropometric, physical and physiological measurements, running for 400 meters, undergraduate.

INTRODUCTION TO THE STUDY

Physical characteristics and anthropometric measurements are one of the most important means and the cornerstone of success and reach the highest levels of any sport game.(Zar, et al. 2008, p21- 22) and (Mande, 2016, p. 15) indicate that understanding the anthropometric and physical determinants of each Sports activity is an important and influential factor in athletic achievement. Each sport activity has its own anthropometric and physical requirements that pave the way for the player who has these requirements to achieve achievement. (Gursavek & Mishra 2012) added that it is as important as the athlete's technique in any game. This requires the care of trainers and teachers when selecting players. (Zar, et al., 2008, p21- 22) thinks that excellence and success in sporting activities depends on the player's physical abilities such as strength, speed, endurance, agility and other

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physical abilities. In addition, (Parseh & Hassan 2015, p382), citing (Zapartdis et al., 2009), noted that the medals awarded to Eastern European players in 1972 and 1976 were due to attention to the anthropometric and physical requirements in selecting gifted athletes according to the requirements of each game. to be added, Physiological measurements are also considered to be the most important basic components of athletic achievement, as the trainers are trained in guiding and building training loads in terms of intensity, size and density, the most important of which are the maximum consumption of oxygen, heart rate and blood pressure. Furthermore, Abdel Fatah (p.172, 1997) indicated that "(Vo2max) is one of the most important physiological parameters of success in endurance sports, in which the player's physical level can be predicted. Physiologists such as (Fox, et al., 1989) (1984) (Lamb, 1985) (Astrand & Rodahl, 1986) found that Vo2max is the most accurate measurement of the fitness of the circulatory system, which represents the efficiency of the heart, lungs and blood in the transport of oxygen to the working muscles. Besides, (Wilmore & Costill 2004) noted that VO2max is strongly related to medium and long-term events, most notably the running. The idea of studying this variable stems from the fact that the 400-meter running is one of the short distances. The two researchers also believe that the player who does not have the anthropometric and physical measurements appropriate to the type of activity he practices, will be subjected to biomechanical problems leads to exert more effort and time than his colleague, who has the anthropometric and physical measurements that qualify him to the required achievement at the same time. Technical and training will not be able to prepare a hero from anybody, and hence the problem of the study, which can be summarized by answering the following question:

What are the most anthropometric, physical and physiological measurements, which contribute to the level of digital achievement of the 400 meter running of the students of physical education at the Technical University of Palestine "Khadouri"?

The two researchers also believe that the importance of the study is highlighted through the results that may help the training workers to raise the level of athletes and lead them to the highest levels, and save time, effort and money.

METHOD AND PROCEDURES

Study Approach

The researcher used the descriptive approach in his study of correlation due to its suitability for study purposes.

Society and Sample of the Study

The study was conducted on a sample of (100) students from the Department of Physical Education at the Technical University of Palestine "Khadoori". They were randomly selected from the study population of 170 students. The study sample represented 58.82% Table 1 shows the characteristics of individuals in the study sample according to age, height, and body weight.

Tools and Devices Used

In order to collect data, the following tools were used:

- Data collection form that included the following information:

(age, height, body mass, anthropometric measurements in terms of lengths and circumferences, physiological measurements, physical altars), an American-made mechanical balance of "Deteco" type, Measuring tape for lengths, and circumferences, siren, electronic stopwatch, exercise bench, start cubes, polar clock for pulse and postoperative systolic pressure measurement, medical stethoscope, sources and references.

Study Procedures

The researcher performed the anthropometric, physical and physiological measurements and measured the level of digital achievement of the 400-meter track event in the real time period between 2/10/2016 and 5/4/2017.

Reliability and Consistency of Tests

To verify the accuracy of the physical measurements and the level of digital achievement of the 400- meter running, the discriminatory reliability was used on a sample of 30 students from the Department of Physical Education at the Technical University of Palestine, who were excluded from the original study sample and were divided into two equal groups distinctive and Non-distinctive. Then apply (T) test for the independent samples to indicate the differences between them, and the results of Table 2 show that.

It is clear from the results of Table 2 that there are statistically significant differences at the level of α (0.05) in all the physical tests and the time of accomplishing the 400- meter running between the two distinctive and non-distinctive groups and for the benefit of the distinct group. In addition, the result of the discriminatory reliability indicates measurement of the tests in what they were designed for.

To ensure that the tests were stable, the (Test-Retest) method was used on the same survey sample. The time interval between the first and second application was (8) days, Pearson correlation and self-honesty were used, and the results of Table 3 show that.

It is clear from the results of Table 3 that there is a statistically significant relationship at the level of significance ($\alpha \leq 0.05$) in all physical measurements and the level of numerical achievement of the run 400 m between the first and second applications. (0.87 – 0.90) Self-correctness values ranged from 0.932 to 0.948. The Pearson correlation coefficient for the measurements of the digital achievement level of the track event 400 meters (0.85) and Self-correctness reached (0.921). This is evidenced by the physical measurements and the digital achievement of the track event 400 meters with a good degree of stability that meets the purposes of the study.

As for anthropometric measurements, they are not necessarily reliable and consistent, because they have a high degree of reliability and consistency. They are adopted in most previous studies and are one of the most accurate measuring instruments because they are relatively measurable and have little error (Kirkendall et al., 1987).

As for the physiological measurements, the devices used to measure the physiological variables are true and consistent, they are highly accurate, and the possibility of error is very few, where the researcher to verify the safety before using them, and also make sure of the accuracy of the results before entering them to the computer for statistically processing which is adopted in most previous studies such as Sarma & Anantarup (2017), (Prioreschi, et al., 2017), Dhara & Chatterjee (2015).

Table 1: Distribution of the sample of the study according to the variables of age, height and mass of the body (n = 100)

Changes	Measuring unit	Average	Deviation	Torsion coefficient
Age	Year	19.0	1.20	0.53
Height	Meter	1.75	0.06	–0.32
Body mass	Kilogram	70.33	8.07	0.05

Table 2: Test results for independent samples to indicate the differences between the two distinct and non-distinct groups in physical measurements and the level of digital achievement of 400- meters track event under study (n = 100).

Group Physical and skill measurements	Measuring unit	Distinct group (N=15)		Non-distinct group (N=15)		Value (T)	Level of significance *
		Average	Deviation	Average	Deviation		
Wide jump of stability Test	Centimeter	234.60	9.54	206.33	10.10	7.876	0.000*
Sitting out of recession 10 sec. Test	Number of times	12.93	0.88	8.33	1.34	11.069	0.000*
200 metre run Test	SEC	28.27	0.93	31.59	1.17	–8.590	0.000*
5-Step hop (Right) Test	Meter	12.07	1.19	10.01	0.837	5.492	0.000*
5-step hop (left) Test	Meter	11.87	0.85	10.13	0.78	5.884	0.000*
400 metre run Test	Minute	1.17	0.05	1.59	0.27	–5.816	0.000*

Table 3: Results of Pearson correlation coefficient for the relationship between the first and second applications of physical measurements and the level of numerical achievement of the track event of 400 meters under study (n = 100)

Physical and skill measurements	Measuring unit	First application		Second application		Value (R)	Self-honesty
		Arithmetic average	Standard deviation	Arithmetic average	Standard deviation		
Wide jump of stability Test	cm	220.46	17.31	223.26	15.56	0.90**	0.948
Sitting out of recession 10 sec. Test	once	10.63	2.59	11.40	2.14	0.87**	0.932
200 metre run Test	second	29.94	1.98	29.80	1.89	0.87**	0.932
5-Step hop (Right) Test	metre	11.04	1.45	11.23	1.26	0.88**	0.938
5-step hop (left) Test	metre	10.99	1.19	11.10	1.15	0.87**	0.932
400 metre run Test	minute	1.38	0.29	1.34	0.32	0.85**	0.921

*D statistically at ($\alpha \leq 0.05$), **statistically significant at ($\alpha \leq 0.01$)

Statistical Treatments

In order to answer the questions of the study, the Statistical Package for Social Sciences (SPSS) was used by making the following statistical treatments:

- Standard averages and standard deviations.
- Coefficient Pearson Correlation.
- Simple Linear Regression (T) and (Beta) to determine the regression line equation.

DISPLAYING AND DISCUSSING THE RESULTS OF THE STUDY

First: Results Related to the First Question

What are the most anthropometric measurements that contribute to the level of digital achievement of 400 meter track event when students in the field of physical education?

To answer this question, Pearson Correlation Coefficient was used to determine the relationship between anthropometric measurements and the level of digital achievement of the 400 meter run as a first step. The linear stepwise regression was then applied to determine the contribution of statistically linked anthropometric measurements (Independent variable) at the digital level of 400 meter track event (continued variable) as a second step. The following is a presentation of the results of this question:

The results of Table 4 show a statistically significant relationship between the digital level of (400 m) track event and the anthropometric measurements (length of the instep and belly circumference), where Pearson correlation coefficient values were respectively (-0.28, 0.24) Where there is a statistically significant relationship between the digital level of the event of 400 m and other anthropometric measurements. The following is a presentation of the results of the multi-step linear regression of the contribution of anthropometric measurements to the digital achievement level of the 400 meter run under study:

The results of Table 5 show that the most anthropometric measurements that are able to contribute to the digital level of the 400 m event were the length of the instep and the belly circumference, where R^2 reached (0.138) The T-test, the beta factor, and the results of Table 6 were used.

The results of Table 6 show that the value of T was statistically significant at α (0.05). The anthropometric measurements (Belly circumference and length of sitting) were interpreted in 13.8% of run time (400 m) consequently the proposed equation would read as follows:

The digital level of track event (400 m) min. = 1.306 - () Length of instep (cm) × 0.014 (+) Belly circumference (cm) × 0.003).

As for the event of (400) meters, the results of the analysis of mono-variance in Table 5 showed that the belly and foot circumferences were the most anthropometric measurements capable of contributing to the digital level of this event. They contributed to the interpretation of 13.8% This result is consistent with the study of Abdul Haq (2007), where the results showed that the belly circumference contributed to the interpretation of (62.5%) of the skill of jump on the horse is open, as Othman, 2009 0.039), and the

Table 4: Pearson correlation coefficient results to determine the relationship between anthropometric measurements and the track event for 400 meter among students of physical education (N = 100)

Anthropometric measurements	Measuring unit	Minimum value	Maximum value	Arithmetic average	Standard deviation	Value (R)
Age	Year	18	23	19.70	1.20	−0.06
Body mass	Kg	49	90	70.33	8.07	−0.01
Lengths	Metre	1.62	1.86	1.75	−0.11	−0.11
Tallness	Cm	68	80	74.37	−0.05	−0.05
Arm	Cm	82	104	92.43	−0.02	−0.02
Leg	Cm	23	34	26.55	−0.28**	−0.28**
Instep						
Circumference	Cm	77	99	86.64	0.01	0.01
Chest normal	Cm	21	33	26.25	0.15	0.15
Humerus	Cm	21	29	25.64	−0.09	−0.09
Higher forearm	Cm	58	93	76.21	0.24*	0.24*
Belly	Cm	41	63	52.52	−0.07	−0.07
Thigh	Cm	28	45	34.67	−0.03	−0.03
Leg calf						

*D statistically at ($\alpha \leq 0.05$) , **statistically significant at ($\alpha \leq 0.01$)

Table 5: Results of the analysis of the mono-variance to identify the regression coefficient of the proposed predictive equation for track event of (400 m) among students in the field of physical education

Anthropometric measurements	Source of Contrast	Total boxes of Regression	Freedom degrees	Average boxes	Value (F)	*Significance level	R^2
Length of the instep	Regression	0.057	1	0.057	8.722	0.004*	
	Error	0.640	98	0.007			0.082
	Total	0.697	99				
Length of the instep + belly circumference	Regression	0.096	2	0.048	7.777	0.001*	
	Error	0.601	97	0.006			0.138
	Total	0.697	99				

* Significance level ($\alpha \leq 0.05$)

Table 6: The results of the T test and the beta coefficient of the regression line equation for the contribution of anthropometric measurements at the digital level of (400 m) track event among students in the field of physical education

Component of equation of anthropometric measurements	Value	Standard error	Beta coefficient	Value (t)	* Significance level	Cumulative Contribution Ratio%
Consistent	1.551	0.129		12.012	0.000*	8.2
Length of instep	-0.014	0.005	-0.286	-2.953	0.004*	
Consistent	1.306	0.159		8.218	0.000*	
Length of instep +	-0.014	0.005	-0.282	-2.988	0.004*	13.8
Belly circumference	0.003	0.001	0.238	2.251	0.013*	

* Significance level ($\alpha \leq 0.05$)

researchers attributed the cause of the contribution of the circumference of the belly in the completion of run 400 meters to the importance of belly circumference is free of grease. In this increase in belly circumference is an indication of increased body mass and therefore increased resistance to the feet. This is confirmed by Al Hindi (2012) and Al-Lala (2000, p. 140), who say that weight gain is an impediment to muscle Of the speed and strength of activities requiring rapid movements, and the studies of Maldonado et al. (2002) and Arrese & Ostariz (2006) Anthropometric measurements such as height, weight, and body mass free of grease, while

researchers attribute the cause of the contribution of the foot in the digital achievement of the event of 400 meters run to increase the base of the pivot, which gives greater momentum and balance better during the run, specifically the run on the direction of the impact of strength repelling and central strength, and believes that the length of the step and speed of frequency in the run of 400 meters depends on two factors which are the muscle strength of the two legs in addition to the length of the instep, the longer the length of the Length of the instep the less resistance and the greater the strength produced and thus the length of the step and speed of frequency increase.

Second: Results on the Second Question

What is the most physical measurements contribution to the digital level of the track event of 400 meters among the students of the specialization of physical education?

To answer this question, Pearson Correlation Coefficient was used to determine the relationship between physical and digital measurements of the 400 m track event as a first step, and then the Linear Stepwise Regression analysis was applied to determine the contribution of statistically linked physical measurements Independent variable) at the digital level of track event 400 meters (dependent variable) as a second step, the following is a presentation of the results of this question:

The results of Table 7 show a statistically significant relationship at α (0.05) between the digital level of 400 meters and all physical measurements. The following is a presentation of the results of the multi-step linear regression of the contribution of physical measurements at the digital level to the track event of 400 meters:

The results of Table 8 show that the most physical measurements capable of contributing to the digital level of (400 m) track event were (200 m and 5 left) and R2 to (0.275) The T-test, the beta coefficient, and the results of Table 9 were used.

The results of Table 9 show that the value of (T) was statistically significance at the ($\alpha \leq 0.05$)level. The physical measurements (200m run and 5 left step) in interpretation (27.5%) of the running time (400m) Thus, the proposed equation becomes as follows:

Table 7: Results of correlation coefficient Pearson to determine the relationship between physical measurements and the track event of 400 meter under study by students in the field of Physical Education (N = 100)

Physical measurements	Measuring unit	Minimum value	Maximum value	Arithmetic average	Standard deviation	Value (R)
Wide jump from stability test	cm	140	293	218.50	29.58	–0.31**
Sitting from recession 10 sec. test	once	8	15	10.89	1.75	–0.30**
200 metre run test	second	26.60	37	29.99	2.19	0.45**
5-step hop (right) test	metre	6.70	15.20	11.19	2.07	–0.38**
5-step hop (left) test	metre	6.85	15.80	11.59	2.29	–0.39**

*D statistically at ($\alpha \leq 0.05$) , **statistically significant at ($\alpha \leq 0.01$)

Table 8: Results of the analysis of the mono-variance to identify the regression coefficient of the proposed predictive equation for (400 m) track event for students in the field of physical education.

Physical measurements	Source of Contrast	Total boxes of Regression	Freedom degrees	Average boxes	Value (F)	Significance level *	R^2
200 m run	Regression	0.142	1	0.142	25.155	0.000*	
	Error	0.555	98	0.006			0.204
	Total	0.697	99				
200 m run + 5 step left hop	Regression	0.192	2	0.096	18.414	0.000*	
	Error	0.505	97	0.005			0.275
	Total	0.697	99				

*Significance level ($\alpha \leq 0.05$)

Table 9: Results of T test and beta coefficient for regression equation for the contribution of physical measurements at the digital level of (400 m) track event among students in the field of physical education

Components of equation for the physical measurements	Value	Standard error	Beta coefficient	Value (t)	* Significance level	Cumulative Contribution Ratio%
Consistent	0.652	0.104	0.452	6.289	0.000*	20.4
200 metre run	0.017	0.003		5.016	0.000*	
Consistent	0.872	0.122		7.123	0.000*	
200 metre+ run	0.014	0.003	0.364	4.004	0.000*	27.5
5 step left hop	-0.010	0.003	-0.280	- 3.081	0.0.00*	

*Significance level ($\alpha \leq 0.05$)

The digital level of track event (400 m) min. = 0.872 + run 200 m (s) run × 0.014 (-) 5 steps left step (cm) × 0.010).

As for the 400 meters run, the results of the single-variance analysis in Table 9 showed that a test of 5 steps hop left and 200 meters run were the most physical measurements contributing to the digital level of the track event of 400 meters (400) which contributed to an explanation in the interpretation of (27.5%) of time of the (400) meters run. This result is consistent with the study of Al-Enezi (2012), which showed the test of three hops contributed to the interpretation (56.2%) in the long and triple jump as Abu Altaieb et al. (2010) showed that there is a positive correlative relationship between the strength characterized by speed, explosive strength, moving strength and the digital level of triangular jumping event, where their percentage of performance interpretation reached 82%and researchers attribute the reason why the contribution of the strength characterized by speed in the test of the "5 steps" in the level of digital achievement in the 400 meters run to the track event of 400 meters classified among the events that depend on the anaerobic system in the production of energy, as Ahmed (1999, p. 149) referred to the association of muscle strength with speed, saying, "There is no speed without muscle strength." Al-Khuzaie (2010) noted that strength characterized by speed plays an important role in the acceleration phase during the 400 meters run, and the stage of decreasing speed requires the player to compensate it by increasing the length of the step frequency calculation in addition to the arms and likely increase its speed and this requires the player to a high level of strength characterized by speed in the legs and arms.

Where the two researchers attribute the reason why the 200-meter run test at the digital achievement level in the 400-meter run has contributed to the importance of speed bearing in this event as a common denominator between 200-400 meters and depends on the lactic energy system, Akira Ito et al. (2008) (Albek et al. 2009, p. 83) states that the track event of (200-400 m) is the most important based on the anaerobic system which requires a high level of speed bearing, where the speed of the player begins to decrease gradually due to high intensity and great effort, and the emergence of fatigue that is lactic acid, and Ahmed (1997, p. 36) thinks that the player loses 0.5 seconds during the third and fourth 100 meters of the race, as Zaher (2009, 124- 124) states that the player feels tired after the end of 300 meters, and intensifies during the last 40-90 meters of the race, and the player must maintain his speed as much as possible to rush in the end with all his strength to finish the race, and here shows the importance of speed bearing the player will achieve a better result than others, as the study of Singh and Malik (Singh & Malik, 2015) and Ahmed (2010) that the characteristic of speed bearing was the most important physical characteristics of the 400 m runners.

Third: Results Related to the Third Question

What are the most physiological measurements that contribute to the digital level of track event of 400 meter among students in the field of physical education?

To answer this question, Pearson Correlation Coefficient was used to determine the relationship between physiological measurements and the digital level of track event of 400 m as a first step, and then the Linear Stepwise Regression analysis was applied to determine the contribution of statistically associated physiological measurements (independent variable) at the digital level of 400 m (dependent variable) as a second step. The following is a presentation of the results of this question:

It is clear from the results of Table 10 that there is a statistically significant inverse relation between at ($\alpha \leq 0.05$) between the numerical level of (400 m) track event and maximum oxygen consumption (VO2 max). The following is a presentation of the results of the multi-step linear regression of the contribution of physiological measurements at the digital level of the 400-meter track event:

The results of Table 11 show that the most physiological measurements able to contribute to the digital level of the (400 m) track event was (the maximum consumption of oxygen VO2 max), where the (R^2) value reached to (0.094). To identify the linear regression equation, the T- Test and the beta coefficient were used, and the results of Table 12 show that.

The results of Table 12 show that the T-value was statistically significant at the significance level ($\alpha \leq 0.05$), as the physiological measurement (the maximum oxygen consumption VO2 max) contributed to explain (9.4%) of the (400 m) running time, so the proposed equation becomes as follows:

The digital level of the (400 mpm) track event = 1.401 - (maximum oxygen consumption VO2 max (ml/kg/min) × 0.004).

As for the 400 meter track event, the results of the one-way analysis of variance in Table 9 showed that the maximum oxygen consumption (Vo2 max) was the most physiological measure, contributing to the digital level of the 400 meter track event, as it contributed to explain (9.4%) of running time. This result is consistent with Abbas' study (2008), which showed that the Vo2 max contributed to explain (82.85%) of the skilled performance level of ground tennis, and it is also consistent with (Sarma & Anantarup, 2017),

Table 10: Results of Pearson correlation coefficient to determine the relationship between physiological measurements and the track event of 400 meter under study by students in the field of Physical Education (N = 100).

Physiological measurements	Measuring unit	Minimum value	Maximum value	Arithmetic average	Standard deviation	Value (R)
Pulse during resting time	Pulse/minute	52	88	65.78	6.18	0.18
Pulse during effort	Pulse/minute	120	184	149.21	13.31	0.16
Systolic pressure resting time	Mm / hg	99	130	115.13	6.47	-0.10
Systolic pressure time effort	Mm / hg	120	189	150.50	12.74	-0.13
Diastolic pressure resting time	Mm / hg	43	80	65.48	8.04	-0.09
Diastolic pressure time effort	Mm / hg	48	110	73.78	8.86	-0.03
Maximum oxygen consumption (VO2 max).	Mm/ kg / minute	35.75	67.04	53.94	6.03	-0.30**

*D statistically at ($\alpha \leq 0.05$) , **statistically significant at ($\alpha \leq 0.01$)

Table 11: Results of the one-way analysis of variance to identify the regression coefficient of the proposed predictive equation for the (400 m) track event among physical education students

Physiological measurements	Source of contrast	The sum of squared deviations	Degrees of freedom	The average of squares	F Value	Significance level*	R^2
Maximum oxygen consumption VO2 max	Regression	0.065	1	0.063	10.158	0.002*	0.094
	Error	0.631	98	0.006			
	Total	0.697	99				

*Significance level ($\alpha \leq 0.05$).

Table 12: Results of T- test and beta coefficient of the linear regression equation for the contribution of physiological measurements in the digital level of the (400 m) track event among physical education students

Equation components for physiological measurements	Value	Standard error	Beta coefficient	T- value	Significance level *	Cumulative Contribution Ratio %
Constant	1.401	0.073		19.286	*0.000	9.4
Maximum oxygen consumption VO2 max	-0.004	0.001	-0.306	-3.187	*0.002	

*Significance level ($\alpha \leq 0.05$).

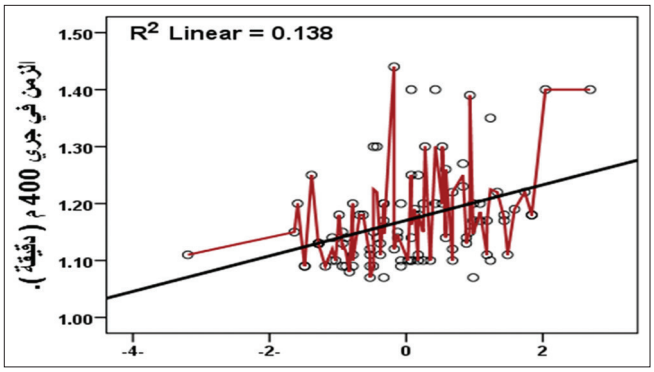

Figure 1: Regression line for the contribution of anthropometric measurements in the digital level of the track event of 400 meters (minute)

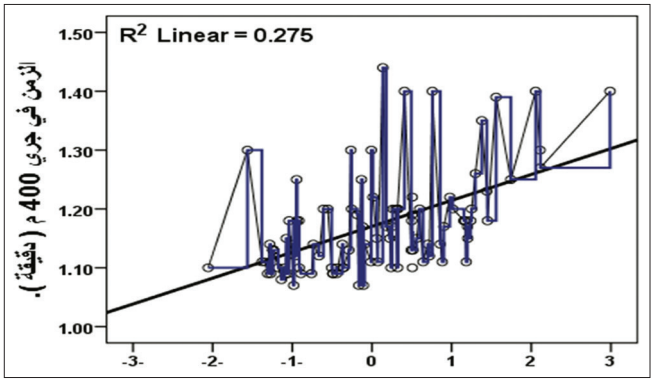

Figure 2: Regression line for the contribution of physical measurements at the digital level of the track event of 400 meters (minutes)

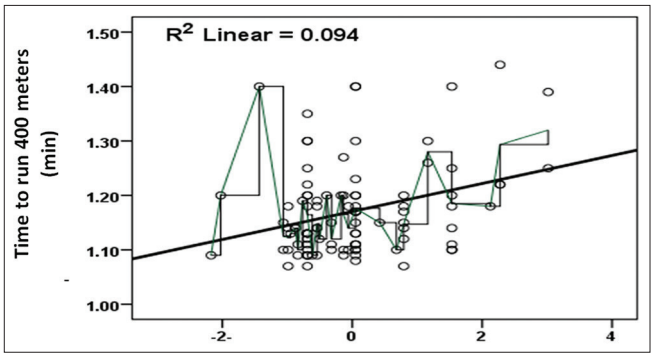

Figure 3: Regression line of Maximum oxygen consumption at the digital level of the (400 m) track event (min.).

(Prioreschi, et al, 2017) study, and (Dhara & Chatterjee, 2015) study, whose results showed a contribution rate and a great connection to sports achievement. The researcher attributed the reason of VO2 max contribution in the digital level of the 400 meter track event to the development of heart and lungs' of the study sample individuals on the understanding that they are student athletes, and therefore have advantage of the heart cavity size and this leads to the absorption of a larger amount of blood, so athletes receive more oxygen for the purpose of producing energy with fewer heartbeats.

In addition to increasing the heartbeat size caused by the heart size increasing as an adaptation of what the students learn from different programs and loads of training during the practical lectures. Furthermore, Sayed (2003, p. 211) stated that the lungs elasticity and their ability to stretch and shrink for the performance of strong and deep breathing movements increases, the breathing rate decreases,its depth increases, the athlete's efficiency increases in oxygen utilizing and consuming to produce energy, the strength and efficiency of breathing muscles improves, and the pulmonary sizes of the endurance athlete increases in general. As well, the researcher attributed this to the increased cardiac output during running due to the muscles need to consume oxygen, to increase the heart drive during the enemy resulting from the need for muscles to consume oxygen. Khalil (2008, p. 155) stated that the pulse amplitude increases during physical exertion, leading to an increase in cardiac output. This is confirmed by Abdel Fattah (2000) by saying that cardiac output can increase by increasing the heart rate or pulse size, so this increase in cardiac output is offset by an increase in the maximum rate of oxygen consumption (Vo2 max) among students.

CONCLUSIONS

By presenting and discussing the study results, the two researchers found that the best anthropometric measurements that have the ability to determine the level of digital achievement of 400 meters running were (the abdominal circumference and the length of the instep), while the tests (running 200 meters, and hopping 5 steps on the left foot) were the most physical measurements able to determine the level of digital achievement of the 400 meters track event, while (Vo2 max) was the most physiological measurements able to determine the level of digital achievement of the 400 meters track event.

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