JOURNAL OF THEORY AND PRACTICE IN SPORT
MUĞLA SITKI KOÇMAN UNIVERSITY
FACULTY OF SPORT SCIENCES

The Association of Physical Activity, Sports Participation and BMI with Academic Performance: A Quantitative Study on Post-Secondary Students in Malta

Alessio Magro[1]

Renzo Kerr-Cumbo[2]

Ayrton Zarb[3]

To cite this article: Magro, A., Kerr-Cumbo, R., & Zarb, A. (2002). The association of physical activity, sports participation and BMI with academic performance: A quantitative study on post-secondary students in Malta. *Journal of Theory and Practice in Sport, 1*(1), 47-65.

Received: 08.11.2022

Accepted: 25.11.2022

Published: 25.12.2022

[1] MCAST, Institute of Community Service, Paola, Malta, magroalessio9@gmail.com
[2] MCAST, Institute of Community Service, Paola, Malta, Renzo.kerr.cumbo@mcast.edu.mt
[3] MCAST, Institute of Business, Management and Commerce, Paola, Malta, Ayrton.zarb@mcast.edu.mt
***Corresponding Author Information**

The Association of Physical Activity, Sports Participation and BMI with Academic Performance: A Quantitative Study on Post-Secondary Students in Malta

Abstract

Several studies have argued that physical activity and sports participation or scoring high in the Body Mass Index (BMI), may impede students from achieving high marks throughout their scholastic year. The rationale behind this study was to test for these hypotheses to scientifically test if such variables have a causation effect on students' marks. Using a quantitative approach through self-reported online questionnaires, the produced results prove that there is no correlation between sports activity and the unweighted average mark obtained by University of Malta (UoM) students and those following courses within the Malta College of Arts, Science and Technology (MCAST). Furthermore, the study did not produce any statistically significant correlations between the amount of physical activity by the student and the average mark obtained by students at the end of their academic year. However, the produced regression models prove that the BMI score of a person has a negative causation effect on the academic mark obtained by the student, whereby for every additional BMI category that students reach, their average end-of-year score decreases by 1 mark, signaling that obesity is having a negative impact on students' academic performance. Also, despite regular physical activity having no direct effect on academic performance, still it was proven to influence the BMI score. This leads this study to suggest the promotion of more physical activity within educational institutions ultimately affects students' performance.

Keywords: Sports activity, Sports participation, BMI, Academic mark

Fiziksel Aktivite, Spora Katılım ve VKİ ile Akademik Performansın İlişkisi. Malta'daki Lise Sonrası Öğrenciler Üzerine Niceliksel Bir Çalışma

Özet

Çeşitli araştırmalar, fiziksel aktivite ve spora katılımın ya da Beden Kitle İndeksinde (VKİ) yüksek puan almanın, öğrencilerin eğitim yılları boyunca yüksek notlar almalarını engelleyebileceğini ileri sürmüştür. Bu çalışmanın arkasındaki mantık, bu tür değişkenlerin öğrencilerin notları üzerinde nedensel bir etkiye sahip olup olmadığını bilimsel olarak test etmek için bu hipotezleri test etmektir. Kendi kendine bildirilen çevrimiçi anketler yoluyla niceliksel bir yaklaşım kullanarak, elde edilen sonuçlar, spor aktivitesi ile Malta Üniversitesi (UoM) öğrencileri ve Malta Sanat, Bilim ve Sanat Koleji'ndeki dersleri takip edenlerin aldığı ağırlıksız ortalama not arasında bir ilişki olmadığını kanıtlıyor. Teknoloji (MCAST). Ayrıca çalışma, öğrencinin fiziksel aktivite miktarı ile akademik yılın sonunda öğrencilerin aldığı ortalama not arasında istatistiksel olarak anlamlı herhangi bir ilişki üretmedi. Ancak üretilen regresyon modelleri, bir kişinin BMI puanının öğrencinin akademik notu üzerinde olumsuz bir nedensellik etkisi olduğunu kanıtlamakta ve öğrencilerin ulaştığı her ek BMI kategorisi için yılsonu ortalama puanı 1 puan azalmaktadır. , obezitenin öğrencilerin akademik performansı üzerinde olumsuz bir etkiye sahip olduğuna işaret ediyor. Ayrıca, düzenli fiziksel aktivitenin akademik performans üzerinde doğrudan bir etkisi olmamasına rağmen, yine de BMI puanını etkilediği kanıtlanmıştır. Bu, bu çalışmayı, eğitim kurumlarında daha fazla fiziksel aktivitenin teşvik edilmesinin nihayetinde öğrencilerin performansını etkilediğini önermeye yönlendirir.

Anahtar Kelimeler: Spor etkinliği, Spora katılım, VKİ, Akademik not

Introduction

Malta has been ranking as one of the most obese countries in Europe and the world for more than a decade. To add insult to injury, according to the Country Health report published by the Organisation for Economic Co-operation and Development (OECD) and the European Observatory on Health Systems and Policies (2021 p.7), "rates of overweight and obesity in Malta have increased over the past decade and are the highest in the European Union (EU) for both adults and adolescents." It is alarming to notice that Maltese children are classified as having one of the highest obesity rates in Europe (WHO, 2022, Figure 1) and that 37% of men and 33% of women in Malta are predicted to have a Body Mass Index (BMI) above 30kg/m^2 by 2030, ranking Maltese men and women first and fourth respectively in the charts of European countries with the highest estimated prevalence of obesity (World Obesity Federation, 2022).

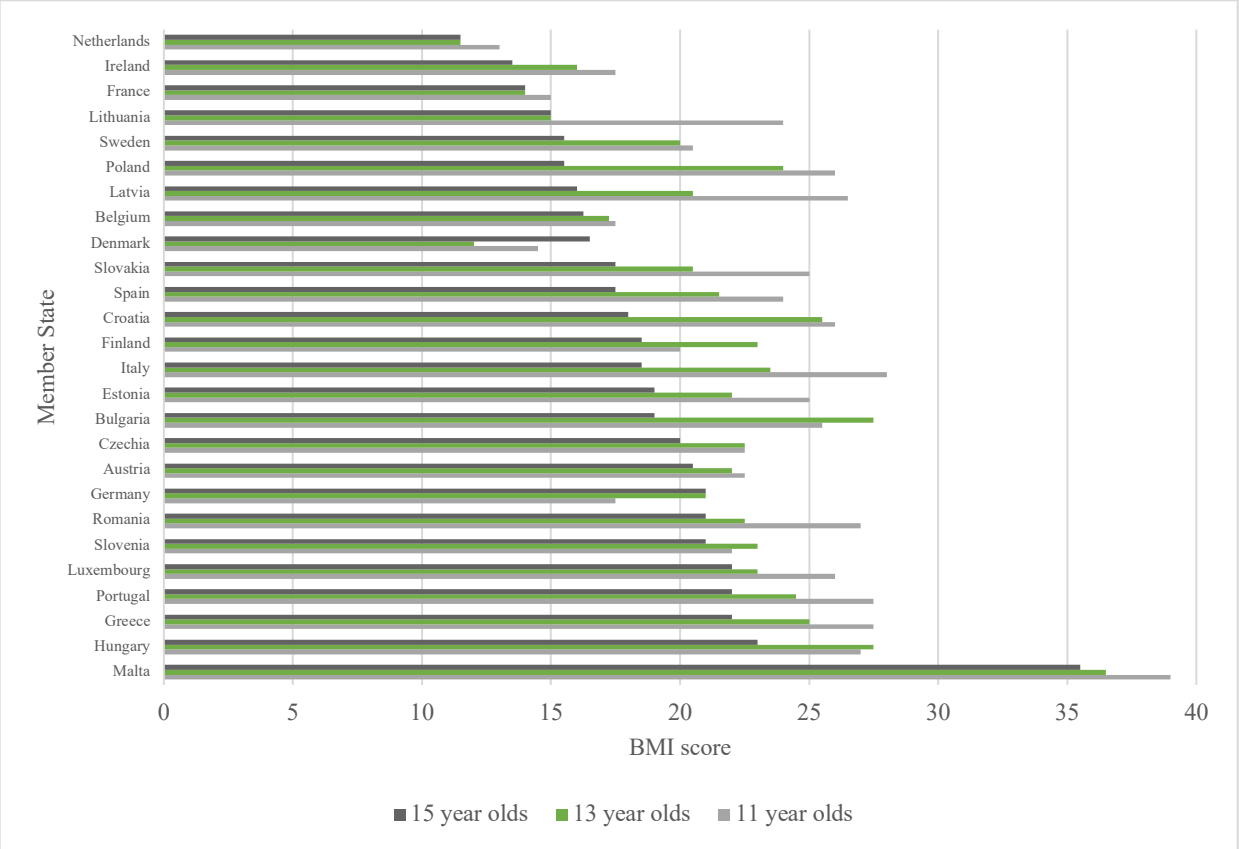

Figure 1. Obesity among children within the European Union (EU) (WHO, 2022)

These statistics justify the ongoing debate underlining the attention sports and physical activity should be given on the Maltese Islands. In fact, there is consensus in the international literature that regular participation in sports and physical activity can improve health (WHO, 2012), including positive causation of physical and mental wellbeing (Wilson *et al.*, 2022), and lowering the risk of developing various diseases (Elmagd, 2016). The gains from sports

participation were also acknowledged in Kenioua and Abd Elkader's (2016) paper, concluding that participation in sports and physical activity have positive benefits on the public, whereby students who are athletes enjoy better physical and mental wellbeing. Also, by being active as from a young age, according to Eime *et al*. (2013), it prevents the development of other health problems since students can refresh their minds from their school related work, as well as maintain a healthy body weight that prevents diseases, strengthens muscles and bones, and reduces the risk of harmful diseases (Elmagd, 2016).

Purpose of the Study

Despite the benefits that sports participation as from a young age have on individuals, students, especially those in higher education, may get discouraged from participating in sports or physical activity due to the time needed for practice (Rees & Sebia, 2010). There is agreement that less time for school work and for employment purposes may lead to sub-optimal academic results and lower income for students (Pfeifer & Corneliben, 2007). Recently, there has been an international widespread interest to examine for the possible association of physical activity and sport participation with academic performance (Dyer *et al*., 2017), as well as for the association of students' body weight with their academic performance (Santana *et al*., 2017).

Both the benefits indicated by research and the widespread interest found in international research were catalysts for this study. The rationale behind this study was to explore for the possible association between the practicing of sports, being physically active, as well as being healthy (as measured using the BMI score) on students' academic performance. It specifically focuses on post-secondary students in higher education in the small Mediterranean archipelago of Malta.

Literature

The WHO (2020 p.2) considers physical activity to be,

> "Any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work."

Still, although these can be considered as part of an individual's daily routine, one should reach the recommended requirements to have a healthy lifestyle (Matiba, 2015; WHO, 2014). Under such a definition of physical activity lie physical exercises which are known to maintain or

improve different components of physical fitness through repetitive, planned and structured body movements (Elmagd, 2016).

Although Sutula (2018) acknowledges that there are multiple definitions of sports, the definition adopted in this study is that of Oxford Learner's Dictionary (2022) which considers sports as an "activity that you do for pleasure and that needs physical effort or skill, usually done in a special area and according to fixed rules". Then, sports participation refers to "purposeful active participation in sports related physical activities performed during leisure-time" (Deelen, Ettema, & Kamphuis, 2018, p. 4).

There are a wide range of sports available, some require athletes to exert vigorous physical activity while others demand minimal effort (Ghildiyal, 2015). Moreover, individuals have the choice to decide to take part in a particular sport for personal enjoyment, recreation, or to win a reward (International Council of Sports Science and Physical Education [ICSPE], 1991; Coakley 1994).

Another focus of this study is on obesity which is universally measured using the Body Mass Index (BMI) (Centre for Disease Control and Prevention, 2022). The BMI is calculated by dividing weight (in kilograms) by the square of the person's height (in centimetres) (BMI calculator, n.d.). According to Coulman and Toran (2020), the BMI could be categorised as depicted in Table 1, whereby a person is considered as obese if the BMI score exceeds 30.

Table 1. BMI categories

BMI	BMI classification
Below 18.5	Underweight
18.5 – 24.9	Normal weight
25.0 – 29.9	Overweight
30.0 – 34.9	Obesity class 1
35.0 – 39.9	Obesity class 2
Above 40	Obesity class 3

Sports, physical activity, and academic performance

Academic achievement can be split into different learnings such as communicative (oral, writing, reading), mathematical, social science, and thinking skills, being all factors that may help students to succeed on both an academic and societal level (Moore, 2019). However, the appropriate measurement of students' academic achievement is still not agreed by all the stakeholders in the industry (educators, experts and policymakers) which allow researchers to use various ways of measuring academic performance, including Grade Point Average (GPA), teacher ratings, memory tests, grade retention, and dropout rates (Ampofo & Osei-owusu, 2015).

Determinants behind academic performance

According to Hamid (2019) and Navarro *et al*. (2020) there are two factors affecting students' academic performance, categorised as internal and external factors. Internal influences are formed with talents and biological traits, including students' competences and aptitude towards learning, self-motivation, hard work and having a good memory (Georgiou, 1999; Hamid, 2019). Conversely, external influences are determinants affecting students' academic performance for which the student has no control, including the socio-economic status of the students' family background and the demands by educators (Roman, 2013). According to Roslan *et al*. (2011) these two factors play an essential role in shaping students' academic achievements.

However, besides such factors, the literature identifies other factors which may affect the students' performance while at school, whereby Al-Muslimawi and Hamid (2019) proposes a balanced mix of academic and extra-curricular activities that could enable students to attain a positive experience during their years in college. On the other hand, according to the same authors, an imbalance towards one of the two areas can lead to stress and anxiety. This is also corroborated in Akey's (2006) finding which argues that engagement in non-academic activities motivates the student to learn more academic aspects. In return, according to Sivrikaya (2019) such motivated students have an increased chance of achieving good academic levels.

Sports participation, physical activity, and students' wellbeing

The WHO (2022) stated that participation in physical activity or sports can be beneficial for students because it helps them to keep their body fit and keep their brain fresh for everyday life. Moreover, according to Wichstrøm and Wichstrøm (2009), participation in sports has a lot of benefits when dealing with addictions as it may prevent individuals from consuming unhealthy

substances such as drugs, alcohol, tobacco, and gambling, amongst others. This is especially because participation in sports requires a lot of time and dedication that could otherwise be used for the previously mentioned adverse purposes.

In addition, sports organisations promote a healthy lifestyle and therefore it requires that players do not consume illicit substances out of respect for their audiences (Pate *et al*., 2000). This is also corroborated by Yu *et al*. (2006) who argue that students who engage in different activities that they enjoy, and are excellent at them, have a lower chance of resorting to unhealthy lifestyles or unlawful actions, while sedentary students may experience different repercussions associated with inactivity which may further develop into health conditions such as obesity.

Sports participation, physical activity, and academic scores

In a 12-month study aimed at investigating the association between sports participation, physical activity, and students' GPA, Fox *et al*. (2010) found that high school girls who participated in physical activity and sports had better GPA scores than those who do not, while for the boys, only those who practiced in a team experienced better GPA scores than their counterparts. This is also corroborated in Dyer *et al*.'s (2017) study when investigating the association between sports participation and grades in both English and Mathematics. Other studies that have drawn the same positive conclusions about the two variables, including Rees and Sabia (2010), and Morales *et al*., (2011), amongst others. Other positive conclusions were drawn by Teferi (2020) who found that participation in sports does not only positively affect students academically, but also in terms of behaviour, causing students to further engage in learning (Uzzaman, Uddin, & Banu, 2009).

However, Pfeifer and Corneliben (2007) found that students who typically achieve high grades might find it challenging to juggle between the two roles since both participation in sports and studying for the exams are exceptionally time-consuming. Still, the authors suggested that the culture of competitiveness, effort and persistence that athletes build as part of their routine could be applied in school to maximise academic performance.

Still, even though several authors proved a significant positive association between participation in either physical activity or sports, and academic performance, other researchers have found opposing results (Daley, 2000; Lumpkin & Favor, 2012). For instance, Shulman and Bowen (2001), and Poolton *et al*. (2006) discovered that students who participate in sports scored achieved lower scores when compared with non-athlete students. In fact, those students who lack academically and participate in extra curriculum activities such as drama, art, music,

and particularly physical activity, may have a higher chance of successfully improving in their chosen activity, leading to an imbalance between the two roles, as previously identified by Muslimawi and Hamid (2019).

Locally, such a relationship has been tested by a few authors, including Cremona (2015) who investigated the relationship between physical activity and sports participation on the academic performance of second and third-year students at the University of Malta (UoM), resulting in a statistically insignificant relationship among the two variables. Similarly, Saliba and Xuereb (2011) conclude that students who practice a sport do not improve their academic results, however, for male students there was a slight improvement in Mathematics, Maltese, and English.

Obesity and academic performance

Overweight and obesity are well known global epidemics, whereby 53% of Europeans are categorized as overweight (Eurostat, 2022). In particular, the problem with obesity in Malta has been rising and has been one of the highest in Europe for a number of years (Cuschieri *et al.*, 2016).

Costs of obesity

The condition of obesity is considered as one of the diseases that may cause substantial harmful effects on our bodies by allowing too many adipocytes and body fats (Wehigaldeniya *et al*., 2017). This condition can be developed when a person consumes surplus calories which are converted into body fat (Reinehr, 2018; Tobin, 2013; Valenzia, 2017). Moreover, according to Reinehr (2018), if obesity develops during the period of adolescence, it normally prolongs to adulthood, which may result in premature death. One contributor to such an increase in obesity, especially among teenagers, is the excessive use of technology, such as the internet and other electronic devices, leading individuals to spend their time static rather than participating in physical activity (Alotaibi *et al*., 2020).

To counteract for such problems, the WHO (2011) recommends that individuals take part in physical activity, especially those between 18 and 64 years who should perform at least 150 minutes of moderate-intensity aerobic exercise or 75 minutes of vigorous intensity per day. Other recommendations were proposed by Reinehr (2018) who believes that a well-planned food nutrition could be an important solution to help individuals eat healthy and hence lessen the chances of increasing the weight.

The impact of obesity on students' academic scores

In a rich dataset of 72,399 respondents among South Korean adolescents, Kim and So (2013) discovered that both boys and girls who were considered as overweight or obese attained poorer academic performance vis-à-vis others who were considered as underweight or normal. This conclusion was also made by Do and Finkelstein (2011) in a similar study within the same country. Other research that complements such a conclusion includes the study by Tobin (2013) who discovered that there is a negative association between fast-food consumption and test scores in Mathematics and reading, while the results from Anderson and Good's (2017) study demonstrates that the higher the BMI score of the student, the lower his/her academic performance. Such an impact of obesity among children was not only tested to examine its impact on students' academic performance, but also on students' memories, being an important factor during the exams. Moreover, the results produced by Wu *et al*. (2017) conclude that obese students are associated with poorer scores in memory tests than those who are considered as healthy.

However, in a systematic review, Santana *et al*. (2017) concluded that more than 55.9% of the papers that they reviewed have reported that the association between obesity and academic performance is still uncertain. In fact, the authors suggested that there is a need for more longitudinal and further studies to be performed to have a better idea in this area.

Literature gap

Following such a review of different research done globally and locally, it noticed that few local studies have been done on this subject. The only two studies that are published in relation to this topic were done by Xuereb and Saliba (2011) and Cremona (2015), whereby both studies focused solely on the relationship between sports participation and academic performance. However, the aim of this study is to merge the association between physical activity, sports participation, and BMI with academic performance. Hence, such a comprehensive study will be providing a richer view of these factors among post-secondary students.

Method

The study aimed to investigate the association between participation in physical activity, sports participation, and BMI on academic performance, by performing a quantitative study amongst post-secondary students in Malta. Therefore, the hypotheses that are being tested in this study are:

H_0: Students' participation in physical activity is not associated with students' average grade.

H_1: Students' participation in physical activity is associated with students' average grade.

H_0: Students' participation in sports is not associated with students' average grade.

H_2: Students' participation in sports is associated with students' average grade.

H_0: Students' BMI is not associated with students' average grade.

H_3: Students' BMI is associated with students' average grade.

Research Design

Following a review of the work produced by past authors on the subject, including Do and Finkelstein (2011), and Kim and So (2013), primary data was sought for the purposes of this study through the collection of quantitative data so as to scientifically answer the research hypotheses.

Participants of this study

Students who attended a course at the UoM and the Malta College of Arts, Sciences and Technology (MCAST) between 2019 and 2020 have been invited to participate in this study by filling-in an online self-completion questionnaire. Participants were rigorously chosen to ensure that adequate analyses could be performed. Specifically, the selection criteria set for this study required students to have been attending the same higher education institution for at least one year and they had to be over 18 years of age. Such a criteria ensures that there is comparability between the two institutions and all students would have already received the marks during the 2019/2020 academic year.

Sampling strategy

Convenience sampling was the most effective way to obtain valid and reliable data to acquire data from the two categories of students, whereby participants of this study were selected from the two selected clusters (MCAST and UoM), and hence ensure proportional representation of both clusters. These two clusters provide a statistical overview of higher educational institutions in Malta since a considerable number of students attend these institutions.

The questionnaire was sent to a total of 15,444 students following a course at MCAST and the UoM. While MCAST students received the questionnaire through their MCAST electronic mail, making it easier for the participants to access the link, UoM students received the link via an application called esims. Based on a 95% confidence interval and a 5% margin of error, the

sample required to be collected was of 375 responses. In total after receiving the answers, 300 responses were left valid since some respondents did not satisfy the previously set criteria. Although the above set rate was not met, the sample is closer than the 90% confidence interval and 10% margin of error criteria which requires 68 responses.

Data Collection

Data was collected through an online self-reported questionnaire, whereby every potential participant received the questionnaire via his/her institution's email address or eSims account. Moreover, the available social media groups for such two groups of students were used to further distribute the questionnaire which was created through Google Forms. The benefit of using such a program is that it can be sent to many participants at once and then it allows the researcher to analyse the data collected. Moreover, such a platform allows participants to feel as comfortable as possible to answer sensitive questions, in particular their weight.

In-line with the questionnaires designed by past researchers on the subject (Cremona, 2015; Kim & So, 2013), personal data was asked, specifically regarding the participants' age, sex, weight, height, physical activity levels, and sports participation. The quantification of the degree of physical activity and sports participation of the individual was possible by including several frequencies as options, allowing the participant to choose the one that most applies to his/her situation. This was followed by asking participants to provide their obtained marks for each subject based on how many academic units they had during the academic year 2019/2020. Moreover, for the purpose of better data management, rather than taking individual grades, the average grades were calculated to construct an unweighted GPA, as was done by Fox *et al*. (2010). The BMI score was computed following the collection of the weight and height of the student and based on the interpretation by Coulman and Toran (2020) in Table 1.

Data Analysis

To provide an answer to the three research hypotheses, regressions were designed and computed to capture the individual impact of each independent variable on the dependent variable. For the purposes of this study, two sets of regressions were set, intended to model the changes in students' academic score (measures using the unweighted GPA scores) and their BMI level. Each regression was performed using the Ordinary Least Squares (OLS) technique which minimises the errors. However, for OLS regressions to be efficient, a suitable sample size is required.

The regressions models adopted in this study are displayed below, together with an explanation of each variable in Table 2.

$$\begin{aligned}\text{MARKS}_i = \beta_0 + \beta_1\text{AGE} + \beta_2\text{GENDER} + \beta_3\text{LEVEL} + \beta_4\text{BMI} + \beta_6\text{UNITS} + \beta_7\text{ENROLMENT} + \beta_8\text{SPORT} \\ + \beta_9\text{BMI}_{\text{CATEGORIES}} + \beta_{10}\text{WEIGHT} + \beta_{11}\text{HRS}_{\text{PHYSICAL}} + \beta_{12}\text{PHYSICAL}_{\text{ACTIVITY}} + \beta_{13}\text{UNI}_{\text{SPORT}} \\ + \beta_{14}\text{UNI}_{\text{PHYSICAL}} + \varepsilon_i\end{aligned}$$

$$\text{BMI}_i = \beta_0 + \beta_1\text{AGE} + \beta_2\text{GENDER} + \beta_3\text{SPORT} + \beta_4\text{HRS}_{\text{PHYSICAL}} + \beta_5\text{PHYSICAL}_{\text{ACTIVITY}} + \varepsilon_i$$

Results

The Descriptive Statistics output in Table 3 is used to examine, compare, and contrast the dataset between UoM and MCAST participants. It can be noted that there are no significant differences among the two group of participants with regards to:

- The age of the two groups.
- The gender of the respondents.
- The level of studies at which the student is studying.
- The enrolment type of the respondents, whether full-time or part-time.
- The average marks obtained by the end of the year.

Such findings ensure that the two groups are comparable to each other. The Descriptive Statistics exercise also enables us to examine the socio-demographic characteristics of the participants, revealing that there were more female over male participants and that most students were following level 5 and 6 courses. Moreover, it can be noted that the median BMI score among all participants is 25, being considered as overweight, while on average, 8 hours per week are spent in training, although MCAST students tend to practice slightly more than UoM participants.

Preliminary analysis

Academic mark and hours of physical training

To examine the first research hypothesis, the Spearman correlation test was used to assess whether there is a statistically significant correlation among the two numerical variables. The results in Figure 3 prove that there is no statistically significant correlation between the hours of physical training (per week) and the marks obtained by the participants by the end of the year, leading the null hypothesis not to be rejected.

H_0: There is no linear relationship between the two variables

H_A: There is a linear relationship between the two variables

Table 2. Academic marks versus number of hours per week in training

			HRS_ TRAINING	MARK
Spearman's rho	HRS TRAINING	Correlation coefficient	1.000	.028
		Sig. (2-tailed)	.	.811
		N	80	78
	MARK	Correlation coefficient	.028	1.000
		Sig. (2-tailed)	.811	.
		N	78	289

Therefore, training or not training are not correlated with lower or higher marks. Similar conclusions were also produced by Poolton, Masters and Maxwell (2006) who concluded that students who engaged in more physical activity did not perform any better academically than other students who do not.

Academic mark and practicing sports

The second analysis aims at examining whether there is a statistically significant correlation between the academic mark obtained by the participants and whether they practice a sport or not, intended to test the second research hypothesis. The Mann Whitney U-test output displayed in Figure 2 tests whether there is a statistically significant correlation between e participants who practice sports (SPORT) and the average end-of-year mark obtained by the participant (MARK). Since the p-value of the Mann-Whitney test is greater than 0.05, then the null hypothesis is not rejected, meaning that there are no statistically significant differences in the marks obtained by the participants between those who practice a sport (Sport = 1) and those who do not (Sport = 0).

H_0: There is no significant difference between the two groups

H_A: There is a significant difference between the two groups

Table 3. Academic marks versus whether the participant practices sports

Ranks

	SPORT	N	Mean rank	Sum of Ranks
MARK	.0	211	147.36	31092.50
	1.0	78	138.62	10812.50
	Total	289		

Test Statistics[a]

	MARK
Mann-Whitney U	7731.500
Wilcoxon W	10812.500
Z	-.789
Assymp Sig. (2-tailed)	.430

a. Grouping Variable: SPORT

These findings corroborate with those by Cremona (2015) who also produced a statistically insignificant link between sports participation and academic performance among second and third year UoM students.

Regression analyses to determine students' marks

The aim of this study is to identify whether the participation in sports, the number of hours of training and the BMI of the student affects the GPA score obtained. Therefore, a series of regressions were tested (Table 4) to test for the possible relationship among the following variables, in line with the research hypotheses set earlier.

Following a multicollinearity test to examine for the degree of association between the independent variables it was revealed that there exists severe multicollinearity between 'BMI_CATEGORIES' and 'BMI', and 'PHYSICAL_ACTIVITY' and 'HRS_PHYSICAL'. Therefore, such variables will not be regressed together in the model. Moreover, White heteroskedastic consistent standard errors were used to overcome for the possible problem of heteroskedasticity which would have led to biased results.

Following the trial of several regression models, intended to be able to examine possible results and choose the best model out of those available, the optimal regression model is regression 8. This is concluded based on A.C. Harvey's criteria which guides researchers to choose the model which has the highest goodness of fit model, is theoretically consistent, and does not have insignificant variables so as not to incur irrelevant variable bias in the model.

The chosen model is explaining 4.1% of all the changes in the dependent variable, being common in regression analyses based on questionnaire data collection, especially since the dependent variable was constructed based on participants' recollection of memories (Steele *et al*., 2009). The resulting regression is:

$$\mathrm{MARK_i} = 72.82 + 0.15\mathrm{AGE_i} + 2.75\mathrm{GENDER_i} - 1.00\mathrm{BMI_{CATEGORIES}} + \varepsilon_i$$

The constant term of the chosen regression is 72.82, meaning that when all the independent variables are equal to zero, the individual would obtain 72 marks. Then, the coefficient for the variable 'AGE' is 0.15, meaning that for every year of the participant, his/her marks increase by 0.15. For instance, if the age of the participant increases by 20 years, the age increases by 3 marks over the constant terms.

The variable 'GENDER' has a positive coefficient, meaning that whenever the participant was a female, her mark increases by 2.75 marks over and above male participants. The term 'BMI_CATEGORIES' has a negative coefficient which means that as the individual moves from one BMI category to a higher one, the marks obtained by the participant decreases by 1 mark. The last term represents the error term which includes other factors that were not captured by the model to explain changes in the dependent variable.

Therefore, such results corroborate with the findings by Franz and Fereesu (2013) who concluded that students who eat unhealthy food and have a poor nutrition experience and experience lower academic results, compared to students who eat healthy food. Moreover, this result was also evident in Wehigaldeniya *et al*.'s (2017) study which pointed out that students with normal weight get better results than those who are classified as obese.

Regression analyses to determine students' BMI

The second regression model was constructed to identify the factors that determine the participants' BMI. Several regressions have been tested (Table 5) to explain changes in the BMI of the participant. Following the performance of several statistical models, the chosen regression is model 6 since it has the highest number of significant variables, as well as having a relatively high goodness of fit measure (R^2). Therefore, the chosen regression model is:

$$\mathrm{BMI_i} = 26.18 + 0.15\mathrm{AGE_i} - 1.58\mathrm{GENDER_i} + 1.85\mathrm{SPORT_i} - 1.01\mathrm{HRSPHYSICAL_i} + \varepsilon_i$$

This chosen regression model is explaining 12.57% of the changes in the BMI of the participants, whereby the rest are captured under the error term. The constant term is 26.18 meaning that when all the independent variables are equal to zero, the participant has such BMI value. For every additional age of the participant, his/her BMI value increases by 0.15 basis

points. Moreover, female participants have a BMI value which is less than males by 1.58 basis points. The results produced also explain how those participants who practice sports tend to have a higher BMI than those who do not by 1.85 basis points, due to higher muscle which contributes to higher weight. However, for every additional hour of physical training that the participants practiced, their BMI value decreases by roughly 1 basis points.

Discussion

Maltese sports and physical activity enthusiasts constantly advocate for more school time to be allocated on such activities as they directly help students improve their grades. However, the results from this study contend with the findings by Din (2005), Saliba and Xuereb (2011) and Cremona (2015), that those who practice sports or other physical activity do not experience improved academic achievements, as evident in Table 4. Still, the results in Table 5 prove that longer hours of physical activity per week help lower the person's BMI, and then the results in Table 4 prove that those participants who had lower BMI experience an increase in their academic marks. Therefore, although physical activity and training do not have a direct positive effect on students' academic marks, it indirectly contributes to an ultimate positive effect.

Conclusion

The purpose of the study was to look at the effect of students' participation in physical activity and sports, and their BMI has on the average grades obtained among higher educational students following a course at the UoM and MCAST. The produced results prove that the participation in sports or physical activity does not seem to contribute to improved academic scores but as students have higher BMI, measured by categorising the BMI using international established criteria, their grades decline. However, the second set of regressions has proven that the number of hours of training has a direct impact on the students' BMI which therefore leads this study to conclude that the participation in physical activity, although it does not have a direct impact on improving students' academic score, it has an indirect impact as it reduces students' BMI which in turn leads to improved academic grades.

Recommendations

Policy recommendations

Such findings corroborate with recommendations made by the International Survey of Children's Subjective Well-being which proposes child-friendly spaces for play and physical exercises to improve the quality of life of children. Research shows that an effective calendar

of initiatives creates a culture of physical activity within higher secondary institutions. Therefore, college administration should ensure that ongoing physical activity events are present throughout the academic year to create a culture of physical activity. Moreover, Cumbo *et al*. (2019) suggested that students' timetables should be fixed for students to be able to engage in some form of physical activity. Furthermore, college fitness centres, if available, must remain open after school hours to allow further use of such facilities provided by the institutions. In addition, investing in sports facilities, such as pools, athletic tracks and training classes could help encourage students to be more active, which could lead to such students to be motivated throughout their studies.

Limitations of the study

The collected sample, although substantial, did not meet the 95% confidence interval criteria. The reason for such a low response rate was due to the technique adopted to distribute the questionnaire, whereby students might not check their institution's emails and esims messages frequently, leading to a moderately low response rate. Moreover, the collected sample was slightly over-represented by MCAST students, not being a true representation of the population. Furthermore, the chosen technique required students to recollect past academic marks, referred to in the literature as recall bias. Therefore, this might contribute to biased results.

Author Contribution

Alessio Magro worked on developing the idea for such a study, worked on the write-up and data collection for such a study. Dr. Renzo Kerr-Cumbo conceptualized this study, helped further develop the idea and contributed towards the write up of this paper. Ayrton Zarb worked on the data analysis and the write up of the findings of this study.

Conflict of Interest

All authors declare that there are no conflict of interest present in this work.

Ethical Statement

This study has passed ethical clearance which was granted by the Research Ethics Committee (REC) within MCAST.

References

Alanís Navarro, J.A., Alanís Cantú, R. and Barón, A., 2020. Internal & external causes determining the academic performance of the university student. *RIDE. Revista Iberoamericana para la Investigación y el Desarrollo Educativo*, *11*(21).

Body mass index (BMI) calculator (no date) *DiabetesCanadaWebsite*. Available at: https://www.diabetes.ca/managing-my-diabetes/tools---resources/body-mass-index-(bmi)-calculator (Accessed: October 13, 2022).

Cefai, C. and Galea, N. (2020) *International Survey of Children's Subjective Wellbeing Malta 2020*. rep. Msida: University of Malta.

Defining adult overweight & obesity (2022) *Centers for Disease Control and Prevention*. Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/obesity/basics/adult-defining.html#:~:text=If%20your%20BMI%20is%2018.5,falls%20within%20the%20obesity%20range. (Accessed: October 13, 2022).

Eurostat (2022) *Over half of adults in the EU are overweight - Products Eurostat News - Eurostat*. Available at: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210721-2#:~:text=While%2045%25%20of%20adults%20living,body%20mass%20index%20(BMI). (Accessed: October 13, 2022).

Hamid, A.A., 2019. External and Internal Factors Affecting Students' Academic Performance. *Basic Education College Magazine For Educational and Humanities Sciences*, (43).

Kenioua, M. and Boumasjed, A., 2016. Sport and mental health level among unıversıty students. *Physical education of students*, 20(3), pp.39-42.

OECD/European Observatory on Health Systems and Policies (2021), Malta: Country Health Profile 2021, State of Health in the EU, OECD Publishing, Paris/European Observatory on Health Systems and Policies, Brussels.

Rees, D.I. and Sabia, J.J. (2010). Sports participation and academic performance: Evidence from the National Longitudinal Study of Adolescent Health. *Economics of Education Review*, *29*(5), pp. 751–759. Available at: https://doi.org/10.1016/j.econedurev.2010.04.008.

Steele, M., Smart, N., Hurst, C. and Chaseling, J. (2009). Evaluating the statistical power of goodness-of-fit tests for health and medicine survey data. In *The 18th World IMACS Congress and MODSIM09 International Congress on Modelling and Simulation* (pp. 192-196). Modelling and Simulation Society of Australia and New Zealand and International Association for Mathematics and Computers in Simulation, July 2009.

Weighing the costs of obesity (2017) *Weighing the Costs of Obesity in Malta*. Price Waterhouse Coopers. Available at: https://www.pwc.com/mt/en/publications/weighing-the-costs-of-obesity.html (Accessed: October 12, 2022).

WHO, 2022. *Health Behaviour in School-aged Children (HBSC) study*. [online] Available at: <https://www.who.int/europe/initiatives/health-behaviour-in-school-aged-children-(hbsc)-

study?fbclid=IwAR3rU10mnA9HRpLnklIJsLQFGttRrflNe6R3ZGWpaaQ6IpDqcuhbW_ogNsg> [Accessed 23 July 2022].

World Health Organisation (2022) *Sports and health*. Available at: https://www.who.int/initiatives/sports-and-health (Accessed: October 13, 2022).