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Physical fitness and academic performance among undergraduate students of a Public University in Malaysia

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ABSTRACT

Physical Fitness and Academic Performance among Undergraduate Students of a Public University in Malaysia

This study investigated the relationship between health-related components of physical fitness consisting of morphological fitness (body fat % or BF %; Body Mass Index or BMI; and waist circumference or WC), metabolic fitness (blood glucose, lipid profiles and haemoglobin) and aerobic capacity (VO_{2max}) with academic performance. This cross-sectional study involved 324 volunteer undergraduates in their first year of study recruited by systematic random sampling from a public university in the city Shah Alam, Malaysia. Physical fitness was measured by anthropometric measurements using standard protocols and field fitness tests. Students' registration numbers linked the university database to import the Cumulative Grade Point Average. A weak, negative significant relationship was found between WC and academic performance ($r = -0.120$, $p = 0.034$). There was a weak negative significant relationship between VO_{2max} and academic performance ($r = -0.128$, $p = 0.029$). There was a negative, medium significant relationship between LDL-cholesterol and academic performance ($r = -0.505$, $p = 0.017$). Running of Linear regression analysis (stepwise) showed that household income ($B = 0.125$, $R^2 = 2.9\%$) and waist circumference ($B = -0.005$, $R^2 = 1.7\%$) contributed significantly towards academic performance ($F = 7.29$, $p<0.05$). Although waist circumference contributed significantly towards academic performance, it cannot be concluded that health component of physical fitness enhance academic performance since the association is so weak.

Keywords: academic performance; anthropometric; physical fitness; university students; blood profile

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INTRODUCTION

Academic performance (AP) is the result of education. To put it at simplest, it is the extent to which an institution, a teacher or student has achieved their educational objectives. It is commonly measured by exams. Nonetheless, there is no general agreement on how it is best tested and which aspects are the most significant [1].

When career competition grows more, the importance of AP at university has attracted parents, policy makers and ministry of education as well. Much effort is made to identify, evaluate and encourage the progress of students at university, since AP is one of the key factors to success in the working world [2].

Nutritional status and fitness measures were associated with higher AP (math and reading score) for sixth graders in a Midwest City School in the US [3]. In a review by Castelli and his colleagues [4], several studies have documented a positive relationship between physical fitness (PF) and AP or other cognitive performance measures, whereas other studies have observed small or negative relationships. Nevertheless, it cannot be inferred that physical fitness causes AP to improve. Therefore, numerous factors are associated with AP.

As regards of physical fitness and AP, the literature suggests several gaps. Most studies of the factors associated with students' educational accomplishment were mainly concerned with educational and/or personal attributes and do not concurrently investigate the students' health and fitness-related parameters. Furthermore, the associations between health status and AP were mostly examined in elementary, middle or high school children with limited studies among university students particularly in Malaysian context. Yet the nutritional status among Malaysian university students has not been studied with AP simultaneously.

Therefore, it cannot be inferred from the literature that PF enhances AP at university level in Malaysia. Indeed, most studies that assessed the associations between health and AP were undertaken in the US and Europe [3, 4].

This study assessed the contribution of personal attributes, and health-related components of PF towards AP. It was hypothesised that indicators of morphologic fitness (Body fat % (BF%), BMI and Waist Circumference (WC)) and metabolic fitness (blood glucose, blood lipids, hemoglobin) would be associated with AP. This research seeks to contribute to the evidence base on the importance of morphologic fitness and metabolic fitness for AP and therewith for academic institutions.

MATERIALS AND METHODS

This cross-sectional study was undertaken among first year undergraduate students at University Technology MARA (UiTM), Shah Alam during the academic session of the years 2010 to 2012. Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine and Health Science, University Putra Malaysia (UPM). According to the formula n = 50+8m [5], the sample size derived was 324 respondents, where "m" is equal to the number of independent variables. A total of 390 students were needed for this research after adding a non-response rate of 20%. A list of first year students was obtained from the assistant registrar of the faculty, which showed that there were almost 900 students on the list. A 'systematic random sampling' approach was adopted whereby every alternate student on the list was selected. Later, these students were contacted via telephone or email, and briefed about the study. Those who had current acute illness such as fever and influenza or any chronic disease, had participated in other research projects, or who were more than 25 years old were excluded from the study. A total of 324 respondents met the inclusion criteria and responded to the data collection. Data protection and confidentiality were observed at all times. A respondent's information sheet was attached to each questionnaire, and respondents were asked to read the information sheet and keep it for future reference. Respondents were also asked to sign a consent form once they agreed to participate in the study.

The information on the respondents' personal attributes, such as gender, age, entry level (matriculation, A-level and O-level), place of living (campus or off-campus), allowance sufficiency with a four-point response scale (1 = "always insufficient", 4 = "always sufficient"), scholarship, parents educational level (diploma or lower, graduate and post graduate), parents marital status (married, divorced or others, widowed) and household income were recorded using the self-administered questionnaire.

AP was measured by students' current Cumulative Grade Point Average (CGPA) [6]. The student's registration number was used to link the questionnaires to the university database and import the student's grades. A letter of request was sent to the Faculty of Sports Sciences and Recreation of UiTM to obtain the students' CGPA.

The respondents' height was measured using a non-stretchable stadiometer (SECA 201, Germany). Weight was measured by an Omron HBF-514C full body composition sensing monitor and scale (OMRON, Japan). The WC was measured using a non-stretchable measuring tape; and BF% was measured using a bioelectrical impedance analysis (BIA) technique using the Omron HBF-514C (OMRON, Japan). The BMI (kg/m2) was calculated using the individual's height and weight according to WHO [7]. A blood sample was drawn from a subsample of 162 respondents (79 males and 83 females) by proportionate stratified sampling, whereby, every other respondent was chosen from the total population list (n=324).

A finger prick sample of blood was drawn by a trained laboratory technician to measure haemoglobin, blood glucose and blood lipids. The blood sample was drawn from the pad of the middle finger according to the manufacturer's procedure. The first drop of finger-prick blood was discarded and the second one was dropped onto a special strip for reading blood glucose, blood lipids (serum total cholesterol, HDL-cholesterol, LDL-cholesterol, and triglycerides) and haemoglobin by the Reflotron® Plus instrument (ROCHE, Switzerland). To measure Maximum Aerobic Capacity (VO_{2max}) level respondents had to perform the Queens College Step test [8]. Respondents were required to do light warming-up activities prior to actual measurements.

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. 95% CI and $P < 0.05$ are set as levels of significance. Normal Q-Q Plot verified graphically that students' CGPA and other continuous variables were normally distributed since the data points were close to the diagonal line. The data showed no violation of linearity or homoscedasticity as well.

Independent sample t-test and one-way Analysis of Variance (ANOVA) were used to compare the mean current CGPA as the outcome variable between categories of independent variables. Pearson's correlation was used to find the association between continuous variables and current CGPA. Multivariate linear regression analysis was used in order to determine the significant effect of independent variables (personal attribute and health-related components of PF) on dependent variable (AP). The predictors which were significantly correlated with AP were entered into the multivariate regression (stepwise method) analysis.

RESULTS AND DISCUSSION

The triad of associations such as socio-demographic, PF, and AP were examined in this study. Table 1 shows the distribution of students according to socio-demographic characteristics. The mean (SD) of participants' age was 21.7 ± 1.1 years old with almost half of them (50.1%) at the age of 22 years old. The mean (SD) of CGPA was (3.02 ± 0.34).

Independent sample t-test and one-way ANOVA were run to compare the mean between categorical variables and CGPA. There were no significant differences in the mean CGPA and gender, scholarship, mothers' education level, mothers' and fathers' marital status. However, running of one-way ANOVA showed a significant difference in the mean CGPA between different entry levels ($F (3, 316) = 33.56$, $p = 0.001$). Further analysis by Tukey post-hoc test showed that the mean CGPA for matriculation and others was significantly higher than A-level ($p = 0.030$). The mean difference for O-level was significantly higher than A-level ($p = 0.001$). Independent sample t-test demonstrated that the mean CGPA of those who were living on-campus was significantly higher than those who were living off-campus ($t (316) = 2.000$, $p = 0.046$).

As it is shown in Table 2, there was no significant relationship between BF% and AP ($r = -0.041$, $p = 0.481$). In another study, a weak negative significant association was found between BF% and math score among school children [9]. In addition, Pearson's correlation showed a negative significant relationship between the undergraduate physics students' CGPA and their BF% in Nigeria ($r = - 0.920$) [10]. As a result, it cannot be concluded that lower BF% result a better AP. The difference between the result of this research and literature may be due to the subjects' differences.

A negative association was found between BMI and AP although it was not statistically significant ($r = -0.092$, $p = 0.103$). This finding was somehow consistent with other studies. For example, in the study of white males and non-white females, little evidence of significant relationship between BMI and AP was found [11]. In another study of 450 students in Ohio, a statistically significant negative association was found between BMI and academic achievement in mathematics grade and most considerably, a direct relation was obtained between students at risk for obesity and lower test performance [12]. Furthermore, associations were illustrated in 259 students in fifth, seventh and ninth grades in the US in overall academic achievement, mathematics achievement, and reading achievement, thus suggesting that aspects of physical fitness maybe worldwide associated with academic performance among students [4].

A weak, negative significant relationship was found between WC and AP ($r = -0.120$, $p = 0.034$). It seems that obesity may play an important role in AP. However, there was a weak negative significant relationship between VO_{2max} and AP ($r = -0.128$, $p = 0.029$). Since the data was collected at the Faculty of Sports Sciences and Recreations at UiTM, it can be justified. It seems that in this faculty people are more active. Everybody takes part in different physical activity program or they have different fitness course and so on. As a result, they might be fitter even though they are not good at their theoretical course.

Table 1. Distribution of socio-demographic characteristics of the participants (n = 324)

	Total (%)
Age (year)	
19	8 (2.4)
20	20 (6.1)
21	86 (26.5)
22	162 (50.1)
23	24 (7.4)
24	15 (5.1)
25	8 (2.4)
Gender	
Male	157 (48.6)
Female	167 (51.4)
Entry level	
Matriculation	7 (2.5)
A-level	93 (28.6)
O-level	76 (23.4)
Others	148 (45.5)
Living	
Campus	204 (63.0)
Off-campus	120 (37.0)
Scholarship	
Yes	256 (79.3)
No	68 (20.7)
Allowance	
Always insufficient	68 (21.0)
Mostly insufficient	111 (34.2)
Mostly sufficient	66 (20.4)
Always sufficient	79 (24.5)
Mothers education	
Diploma or lower	297(92.2)
Graduate	26(7.5)
Post graduate	1(0.3)
Fathers education	
Diploma or lower	271 (84.0)
Graduate	41 (12.2)
Post graduate	12 (3.8)
Mothers marital status	
Married	283 (87.8)
Divorced or others	15 (4.7)
Widow	25 (7.5)
Fathers marital status	
Married	288 (89.0)
Divorced or others	24 (7.2)
Widower	12 (3.8)
Household income (Malaysian Ringgit)	
0-1000	102 (31.3)
1001-2000	87 (27.0)
2001-3000	54 (16.6)
3001<	81 (25.1)

Note. Data are expressed as n (%) unless otherwise indicated.

Table 2. Relationship between physical fitness and academic performance (n = 324)

	Mean ± S.D	r-value	p-value
Body fat %	21.23 ± 5.74	-0.041	0.481
BMI (kg/m^2)	22.51 ± 4.18	-0.092	0.103
Waist circumference (cm)	71.5 ± 0.39	-.120	.034*
VO_{2max} (ml/kg/min)	44.99 ± 3.93	-.128	.029*
Blood glucose (mmol/l)	5.65±0.95	-0.097	0.289
Serum total cholesterol (mmol/l)	4.29 ± 0.79	-0.024	0.789
HDL-cholesterol (mmol/l)	0.75 ± 0.18	-0.087	0.702
LDL-cholesterol (mmol/l)	2.98 ± 0.59	-0.505	0.017*
Triglyceride (mmol/l)	1.10 ± 0.62	-0.054	0.548
Hemoglobin (g/l)	135.15 ± 14.31	-0.014	0.876

**Significant at p<0.05; [a] Pearson's correlation coefficient*

Searching through literature showed that there has been almost no study trying to find out the association between metabolic fitness and AP. As a result, studying the relationship between metabolic fitness and AP is the first of its kind. This research found that there was no statistically significant relationship between blood glucose, serum total cholesterol, HDL-cholesterol, triglyceride, hemoglobin and AP. Nevertheless, as it is shown in table 2, there was a negative, medium significant relationship between LDL-cholesterol and AP (r = -0.505, p = 0.017).

Overall, those who have higher WC and perhaps higher LDL-cholesterol have lower AP. However, it is not yet crystal clear that PF itself has affected AP. As a result, more specific research needs to be conducted regarding the triad of physical fitness and academic performance.

Linear regression analysis showed that household income and WC contributed significantly towards AP ($F = 7.29$, $p<0.05$). As it is demonstrated in table 3, household income and WC explained 4.6% of the variation in AP. Household income contributed 2.9% of the variation in AP. WC contributed 1.7% of the variation in AP. Based on this model the regression equation is as following:

Academic performance = 3.314 + 0.125 (household income) - 0.005 (WC)

Table 3. Association between socio-demographic and physical fitness with academic performance (Multiple linear regression (stepwise))

	Unstandardized Coefficients	Standardized Coefficients		R^2	ΔR^2
	Beta	**Beta**	**t**		
(Constant)	3.314		21.762		
Household income	0.125	0.178	3.150	0.029	0.029
Waist circumference	-0.005	-0.132	-2.327	0.046	0.017

Note: $^{*}p<0.05$; $F = 7.29$, $p<0.05$

Findings of another study support that having a high family income have a statistically significant association with students' achievement [13].

CONCLUSION

The current study provides important insight into the health-related components of PF and AP in the university-aged population. It was revealed that health component of physical fitness cannot enhance AP despite a significant association between WC, VO_{2max} and LDL-cholesterol with AP. Increasing PA and obesity prevention has been identified as the top priorities in the national health agenda, which may require additional focus among university students. Establishing healthy lifestyle from the time they are in university, at least, would ensure that they are in better health when they enter the workforce, where stress levels and time demands will be even greater. Additionally, it is also important that varsity-aged students are educated concerning how important is the simple height and weight measurement to calculate the BMI and understand that this measure is a basic health-screening tool. On the other hand, the university should also incorporate a health promotion program propounding PF and nutrition into the university's general education requirements.

The results maintain a focus on comprehensive health programmes at universities that take into account the multiple factors affecting students' AP. Comprehensive health promotion programmes may have the potential to discover relevant predictors of AP of university students and therewith, not only add to population health, but contribute to the core business of higher education institutions as well. In this study, personal attributes, health-related components of PF and AP were assessed at a particular point in time; therefore, this study is unable to demonstrate cause and effect relationship between these variables. In addition, alteration in health-related components of PF and AP were not determined over a period of time. Furthermore, this study was conducted among Bumiputera students of the Faculty of Sports Sciences and Recreations at UiTM. Further research ought to include more subjects from various universities and faculties in Malaysia to enhance the strengths of this study. On the other hand, since BIA is calculating body water, it is sensitive to fluid levels in the body and cannot be used for a period of time after eating, drinking, bathing or exercising [14]. So, it will reduce the validity of this measurement.

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