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## Academic performance and physical activity among rural high school learners in South Africa

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### Abstract

This study ascertained that there is a relationship between Physical Activity (PA) and Academic Performance (AP) among rural high school learners in South Africa. A cross-sectional design was used in the study to determine the relationships between PA and AP among high school learners. AP data were collected from 275 Grade 12 learners using standardised tests for English and Mathematics, while PA data were collected using the Youth Physical Activity Questionnaire (YPAQ) and were analysed using descriptive and inferential statistics. Results show that for English, boys who were in the physically less active category performed better than girls in the very active category, while in Mathematics boys and girls performed poorly. PA results in Metabolic Equivalents (METs)/hours/week show that 62.9% of the learners were very active (>45.5), 14.9% were moderately active (> 45.5), and 22.2% were less active. A Spearman correlation between PA and AP shows weak correlations for English ( $r = 0.19$ ) and Mathematics ( $r = 0.15$ ). Chi-square results show a positive relationship between PA and PA for both subjects. These results show that PA is positively related to AP, which may have far-reaching implications in high schools because any bodily movement accounts for PA's potential impact on AP. Hence, walking to school and back might have improved learners' PA, at least in this study.

*Keywords: Physical Activity; Academic Performance; Physical Education; METs*

### Introduction

Physical Activity (PA) is any body movement that makes muscles contract and increases energy requirements in the body (Thivel et al., 2018). PA can be moving from one place to another or doing various chores at home. This type of PA can affect the Academic Performance (AP) of learners (Setiakarnawijaya et al., 2021). Daily participation in moderate-intensity PA has been shown to improve mental and physical health (Chu et al., 2014) and overall quality of life (RodríguezFernández & Ramos-Díaz, 2017). Elmagd et al. (2016) conducted a study that supports the idea that PA and exercise have several positive effects, including lowering stress and anxiety, boosting self-esteem, improving memory, and strengthening bones and muscles. In addition, research has shown that regular PA improves health (Anderson & Durstine, 2019; Safi et al., 2021). Currently, adolescents are affected by a few chronic diseases that may retard their AP in schools.

PA in adolescents improves body metabolism, reduces hypertension, and increases AP (Poitras et al., 2017). A daily 60 minutes of moderate PA is recommended (World Health Organization, 2020), but many adolescents do not meet this standard (Guthold et al., 2020). Few consider walking to school as an effective PA (Larouche 2 et al., 2014; Lubans et al., 2011). For example, in Australia, the proportion of children aged 10–14 years old who walked to school decreased from 44.2% in 1971 to 21.1% between 1999 and 2003 (van der Ploeg et al., 2008). In Canada (Toronto), the proportion of children aged 11–13 years old who walked to school decreased from 55.7% in 1986 to 48.1% in 2006 (Buliung et al., 2009). In addition, in the US, the proportion of children aged 5–11 years old who rode a bicycle or walked to school decreased from 49.3% in 1969 to 13.1% in 2009 (McDonald et al., 2011).

A recent study shows that light activities like walking to and from school may contribute to 48% of the daily PA (Campos-Garzón et al., 2023). According to Romanova et al. (2023), high PA among high school learners results in good AP. Despite the many benefits of PA, over 60% of the world's population does not achieve the recommended duration, which is an accumulated 150 minutes of moderate to vigorous PA (MVPA) every week, as suggested by WHO (2020) (Guthold et al., 2020). Based on a comprehensive evaluation of the total PA (Acebes-Sánchez et al., 2019), Pengpid & Peltzer's (2023) prior study on undergraduate students in 23 nations revealed that 41.4% did not reach the required PA levels. Worse still, PA decreases with an increase in age among students and the populace in general (Caestine et al., 2017). Global Observatory for Physical Activity (GoPA) 2015 and 2020 surveys show that PA surveillance and research scores varied greatly among countries, with the highest recorded in Europe and the least exhibited in Africa. It can be argued that many students do not engage in enough PA in Africa because they record formal activities and do not include informal activities like walking to school and back. Studies on the relationship between AP and PA among high school learners are limited and contradictory. For example, Themane et al. (2006) contend that there is a relationship between PA and AP among rural primary school learners from Ellisras in South Africa. Three views are evident in the literature: PA improves AP (James et al., 2023); PA may or may not improve AP (Peiris et al., 2022); and PA does not improve AP (Esteban-Cornejo, 2014; Aadland, 2017). In South Africa, no study has considered walking to school as PA and related it to AP in Mathematics and English, and this is a knowledge gap. Therefore, this study aimed at investigating the relationship between PA and AP in English and Mathematics. The study sought to answer this question: Does PA affect the AP in English and Mathematics amongst rural high school learners in South Africa? This study contributes to the understanding of the relationship between PA and AP in the South African context.

### Method

A cross-sectional design was used because the researchers wanted to determine the relationships between PA and AP who were similar in socio-economic status and age group, attending the same grade, and travelling four to five kilometres to and from school. The study was from the Xihoko circuit in Limpopo Province, which borders Zimbabwe, Mozambique, and Swaziland. This province is rural and economically poor.

### Participants

The study population comprised 12 high schools from the Xihoko circuit. Three schools were selected using purposive sampling. The purpose of being selected was based on learners travelling four to five kilometres to school and back home. A total of 275 (111 boys and 164 girls) Grade 12 learners aged 17-19 years (Mean  $18 \pm 1$  SD) were the sample of this study. These learners travelled similar distances and studied English as a First Additional Language and Mathematics subjects.

### Measures

A self-reported Youth Physical Activity Questionnaire (YPAQ) instrument was used to collect data for PA. The YPAQ was modified to suit the educational objectives and the South African context. Two lecturers in education checked the validity, and a 90% agreement was achieved; the YPAQ was modified before it was administered to the learners. Thus, 13 questions in the modified questionnaire were grouped into five categories: bio-demographic, attendance in PE lessons, and PA like soccer, tennis, and rugby. Sedentary activities like watching TV, using a computer, and playing TV games were not considered PA. For reliability, the instrument was piloted on 20 learners from one school, which was not part of the study. The Cronbach Alpha was 94.6%, suggesting that the instrument was suitable for the study.

PA were assigned Metabolic Equivalents (METs) values applying the Compendium of Physical Activities Tracking Guide (CPATG) per hour and week (Ainsworth, 2011). CPATG provides a coding structure for use in different contexts and is linked to METs intensity levels. Since we used a self-reported questionnaire to quantify the energy costs of learners' activities, we contend that the CPATG classification was suitable (Ainsworth, 2011). The CPATG provides different energy costs: low, moderate, and vigorous. These energy costs are METs at an inactive metabolic rate of 1.0 unit (4.184 kJ/kg/hr) (Schutz et al., 2001).

One MET is regarded as the energy cost of an inactive person. METs in minutes were multiplied with the MET score by the number of minutes (hours) of exercise (walking in our case) for a week. Thus, PA was categorised as follows: less active (PA: <32.5 METs/hours/week), moderately active (PA: 32.5-45.5 METs/hours/week), and very active (PA: >45.5 METs/hours/week). Using the METs per hour per week makes it possible to compare our data with other studies that use self-reported energy cost questionnaires (Ainsworth, 2011).

The examinations were administered and marked by different teachers, who were not the regular teachers of the participants, to avoid any bias. In mathematics, skills like algebraic equations, sequencing and patterns,

finance, growing and decaying and calculus were assessed, while in the English language, context, literature and writing skills were assessed. Data in both English and Mathematics were scored as follows: <40 not succeeded; 40%-49% adequate performance; > 49-75% Above Adequate performance; and >75% was a pass with Distinction according to the Department of Education rubric.

**Procedures**

The first author administered the questionnaire in each of the 3 schools and invited questions to be clarified. Each respondent used thirty minutes to complete the questionnaire, which was collected afterwards. Data were collected from three schools after getting permission from the University Ethics Committee. Permission to carry out the study was sought from the Circuit Manager of Education, the principals of schools, and the parents of the learners involved.

**Analysis**

Statistical Package for Social Sciences (SPSS) Software version VS 22 was deployed to calculate descriptive statistics (means and standard deviations) and inferential statistics (Spearman’s rank correlations) since data were not uniformly distributed to test the associations between PA and AP. Kruskal Wallis checked for the differences between the three levels of METs, which also related to AP in class. In addition, a Chi-square was used to test the null hypothesis that PA does not positively affect AP in both English and Mathematics. Similarly, these last two tests were used since the data were not uniformly distributed.

**Findings**

Results show that in English, physically less active boys performed better than girls in the very active category, while in mathematics, boys and girls equally performed poorly (Table 1). A Spearman correlation between PA and AP for English and Mathematics exhibited weak positive correlations (Tables 2 & 3). Finally, a Chi-square test shows that PA and AP for English and Mathematics were positive, suggesting a significant relationship between AP and PA (Table 4).

In Mathematics, the performance was generally low for boys and girls across all the PA categories. For the less active category, boys and girls attained AP (mean 26 ± SD 13.5), while for the moderate category, AP was (mean boys 25 ± SD 20.2 and girls 26 ± SD 13.0). Boys attained (mean 26 ± SD 15.4) in the very active category, and girls attained (mean: 24 ± SD 15.3). Thus, Mathematics performance was generally low, though it was within the range of DoE elementary achievement (20%-30%)the range of DoE elementary achievement (20%-30%).

Table 1: Descriptive results for AP (English and Mathematics) per PA category.

Table 1 shows that very active learners for both English and Mathematics were at 62.9%, while less active was 22.2%. There were three categories of PA from self-reported for 275 participants: very active (173; 62.9%), moderately active (41;14.9%), and less active (61; 22.2%). Table 1. Also, table 1 shows descriptive results for AP (English and Mathematics) in each category of PA. It is evident from Table 1 that in English, the boys in the physically less active category performed better than girls in the very active category (boys mean 43 ± SD 11.2, girls mean 38 ± SD 7.9). Generally, performance was low because the highest value achieved was 43%. According to the Department of Education (DoE) achievement scale, the mean of 43% falls within adequate achievement, which is between (40%-49%). However, there was a narrow margin between the performance of moderately

Subject	PA category	Boys (n=111)			Girls(n=164)		%	METs	
		N	Mean	SD	Mean	SD			
English	Less active	31	43	11.2	30	38	7.9	22.2	22.05
	Moderate active	17	42	9.9	24	41	11.3	15.0	38.94
	Very active	63	42	12.2	110	41	4.4	62.9	92.98
Mathematics	Less active	31	26	13.5	30	26	13.5	22.2	22.05
	Moderate active	17	25	20.2	24	26	13	14.9	38.94
	Very active	63	26	15.4	110	24	15.3	62.9	92.98

active and very active boys (mean 42 ± SD 9.9) and girls in the same categories (mean 41 ± SD 11.3), respectively. The performance of boys in English in very active category did not match with high METs, like the girls and in English there was no clear pattern.

*Spearman's rank Correlation*

Table 2 English performance versus METs hours (Spearman R)

			<b>Correlations</b>	
			<b>English</b>	<b>METs</b>
Spearman's rho	English	Correlation Coefficient	1,000	.079
		Sig. (2-tailed)	.	.189
		N	275	275
	METs	Correlation Coefficient	.079	1,000
		Sig. (2-tailed)	.189	.
		N	275	275

Table 2 Spearman correlation for English shows a weak relationship between PA and AP where  $r_s([273]) = [.189]$ ,  $p = [<.05]$ .

Table 3 Mathematics performance versus METs hours (Spearman R)

			<b>Correlations</b>	
			<b>English</b>	<b>METs</b>
Spearman's rho	Mathematics	Correlation Coefficient	1,000	-,086
		Sig. (2-tailed)	.	,154
		N	275	275
	Mets	Correlation Coefficient	-,086	1,000
		Sig. (2-tailed)	,154	.
		N	275	275

Table 3 Spearman correlation for Mathematics shows a weak relationship between PA and AP, where  $r_s([273]) = [.154]$ ,  $p = [<.05]$ . Thus, Spearman correlation between PA and AP for English and Mathematics in Tables 2 and 3 exhibited weak positive correlations.

*Chi-Square Test*

To test English and Mathematics groups of learners with different physical activities was done using Chi-Square Test (Table 4).

**Table 4: Chi-square test results for three categories of activities.**

Subject	Group	Category	Obs	Exp	O-E	(O-E) <sup>2</sup>	(O-E) <sup>2</sup> /E
English	Boys	Less active	43	41.65	1.35	1.83	0.04
		Moderate	42	42.00	0.00	0.00	0.00
		Very Active	42	42.00	0.00	0.00	0.00
	Girls	Less active	38	18.46	19.54	381.75	20.68
		Moderate	41	59.28	-18.28	334.05	5.64
		Very Active	41	13.78	27.22	741.07	53.79
		<b>Total</b>					<b>80.10</b>
Subject	Group	Category	Obs	Exp	O-E	(O-E) <sup>2</sup>	(O-E) <sup>2</sup> /E
Mathematics	Boys	Less active	26	13.08	12.92	166.80	12.75
		Moderate	25	25.67	-0.67	0.44	0.02
		Very Active	26	25.16	0.84	0.07	0.03
	Girls	Less active	26	25.83	0.17	0.03	0.00
		Moderate	26	25.33	0.67	0.44	0.02
		Very Active	24	24.84	-0.84	0.70	0.03
		<b>Total</b>					<b>12.84</b>

Key: Obs represents Observed, exp represents Expected.

Table 4 shows that a Chi-square for English was  $\chi^2(2, N = 275) = 80.10, p = 0.05$ , while Mathematics was  $\chi^2(2, N = 275) = 12.84, p < 0.05$ . Hence, learners studying English who participated very actively were more likely to perform better than those studying Mathematics. Since Chi-square values for English and Mathematics are greater than 5.99 from the statistical tables, the null hypothesis, which states that PA does not positively affect AP in English and Mathematics, is rejected.

### Discussion – Conclusions

The study investigated the relationships between Physical Activity (PA) and Academic Performance (AP) in English and Mathematics in five secondary schools where learners walked four to five kilometres daily to school and back. The results show that very active learners had a high AP in English and Mathematics compared to those in the less active category (Table 1). These results agree with Cipriano et al. (2024) and Owen et al. (2022), who contend that there is a connection between PA and AP. This can be true because the muscles and brain work hand in hand to improve learning. Moreover, learners aged 4 to 18 are in a developmental stage where the mind and body need exercise to keep healthy. In addition, the time boys and girls spend studying English subject can contribute to the performance. Also, very active learners tend to increase their heartbeat, allowing more blood to circulate to the brain and enhance alertness in class, which concurs with the Nashiro et al. (2024) study. However, there are few studies on the effect of PA intensity on AP, and this needs further study.

The moderate PA category shows that girls outperformed boys. It could mean that gender differences and other factors could contribute to those differences (Table 1). Other factors could be internal and external variables (Hossinger et al., 2020; Flack et al., 2020). It can be attributed to gender differences and other factors (Table 1). Internal variables could include intrinsic motivation (Ryan & Deci, 2020), while external involves factors outside the control of the student. These can include socioeconomic status, family environment, peer relationships, teaching pedagogy, curriculum, access to resources, and technology (Wentzel, 2022).

A Spearman correlation (Table 2) and Chi-square test (Table 3) show that PA and AP for English and Mathematics were positively correlated, suggesting a significant relationship between PA and AP. Hence, the former improves learners' health, leading to a clear mind to cognate well (Setiakarnawijaya et al., 2021; Teuber et al., 2024). Also, Etnier (2003) contends that there is a connection between PA and AP because these learners aged 4 to 18 are in a developmental stage. Furthermore, recently, learners' AP and PA have been shown to have a positive relationship (Herfet et al., 2024), but the extent of the PA is often unclear and needs further study.

Finally, the results were analysed according to the academic year when the study was conducted. Thus, we were able to observe how those learners performed in their terminal examinations. In future studies, longitudinal studies and stake examinations should be considered to ascertain trends in AP in relation to PA. Also, the intensity of walking to and from school should be controlled using an odometer to avoid biases.

The performance in the two subjects was similar across the categories (Table 2). Boys' AP in English did not match with very active category METS category unlike girls, while in Mathematics there was no clear pattern for boys and girls (Table 1). The lack of pattern suggests that there could be other factors that may need further study.

The overall low correlation could be related to the few students who exhibited high METs and yet had very low AP. The very active category differed from the low and moderate, suggesting that the very high METs corresponded to high AP. The PA and AP association, ranging from moderate to strong, suggest that learners with high PA are likely to have high AP, which agrees with James et al. (2023) and Romanova et al. (2023). Barbosa et al. (2020) show divergent relationships between PA and AP. Also, PA improves AP in students, suggesting that all academic individuals need PA to perform well academically (Romanova et al., 2023).

It can be concluded that those learners who walked to school and back home daily had exercise exceeding 60 minutes. The duration is important because any vigorous walking for over 45 minutes has been reported to improve AP. PA levels of 90 min per week were linked to enhanced AC, as was PA (James et al., 2023). However, the overall low correlation could be related to a few students who exhibited high METs and yet had very low academic performance. Thus, it can be concluded that exercise enhances academic performance. Less active boys seemed to favour them more than girls, whereas PA in Mathematics showed no differences for boys' and girls' scores (Table 3), and this was contrary to our expectations.

For English, PA in the less active category seemed to favour AP among boys rather than girls, whereas PA in Mathematics shows no differences in AP between boys and girls (Table 3). The different levels of PA between genders in English and Mathematics suggest that gender influences learners' AP. This suggestion concurs with the World Health Organisation (WHO, 2020), which contends that PA refers to all activities the human body experiences. Thus, bodily movements, playing, cooking, cleaning the house, walking to school and other recreational activities can constitute PA, which could determine AP among gender. This study focused on PA because of walking 10 km (from home to school and back home) and compared it with AP in Mathematics and English. Other body movement activities that are informal and unique to gender require further study

## Conclusions

The study ascertained that PA was positively related to AP in high school learners who experienced daily walks of four to five kilometres to and from school. Notwithstanding these positive associations, the findings have several limitations. First, a cross-sectional study, by its nature, cannot be used to determine cause and effect. Second, the data through self-reporting are prone to prejudice and overstating. The results may not be generalisable to all South African schools. Also, the use of an odometer is recommended to minimise bias.

The present study has far-reaching implications for policymakers and teachers. Policymakers should take cognizance of the benefits of walking to school and back home daily. Walking to school was an additional PA for Grade 12 learners. Hence, it implies that learners should take part in PA more sustainably, like the learners who walked to and from school for over an hour to gain AP benefits. Also, the results suggest a need, among others, for an eclectic approach to tackling underperformance by integrating sustained PA into the school curricula. Hence, to minimise these limitations, there is a need for further studies.

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