Original Article

Comparison of physical activity and sedentary behavior levels in secondary and university students

Atividade física e comportamento sedentário: comparação entre alunos de ensino médio e universitários

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ABSTRACT

Objective: to compare physical activity and sedentary behavior in university students and secondary students. **Methods:** the cross-sectional study involved 202 selected secondary students and 171 university students. The Global Physical Activity Questionnaire was administered to the respondents. Percentages, chi-square test, Mann Whitney U test and linear regression were used for data analysis. **Results:** about 63% and 32% of secondary and university students, respectively, reported high levels of physical activity, while 84.7% and 71.9% of secondary and undergraduate students, respectively, met guidelines for sedentary behavior. The secondary students had significantly higher scores than the university students in vigorous (p=0.004), moderate (p<0.001), and total physical activity (p<0.001). The observed difference was more prominent among females. **Conclusion:** secondary students had higher scores of physical activity and spent less time in sedentary behavior. **Descritores:** Exercício Físico; Comportamento Sedentário; Estudantes; Adulto Jovem; África do Sul.

RESUMO

Objetivo: comparar níveis de atividade física e comportamento sedentário entre estudantes de ensino médio e universitários. **Métodos:** estudo transversal com 202 estudantes do ensino médio e 171 universitários. O Questionário Global de Atividade Física foi aplicado aos participantes. Porcentagens, os testes Qui-quadrado e Mann-Whitney, e regressão linear foram utilizados para a análise dos dados. **Resultados:** cerca de 63% e 32% dos estudantes de ensino médio e universitários, respectivamente, relataram níveis altos de atividade física, enquanto 84,7% e 71,9% deles, respectivamente, atenderam às diretrizes para comportamento sedentário. A pontuação dos estudantes de ensino médio foi significativamente maior que a dos alunos universitários em atividade física vigorosa (p=0,004), moderada (p<0,001), e total (p<0,001). As diferenças encontradas foram maiores entre mulheres. **Conclusão:** os alunos do ensino médio apresentaram maiores escores de atividade física e despenderam menos tempo em comportamentos sedentários. **Descriptors:** Exercise; Sedentary Behavior; Students; Young Adult; South Africa.

Introduction

The World Health Organization (WHO) suggests that 3.2 million deaths annually are attributed to lack of sufficient physical activity, which is a risk factor for diseases such as diabetes, cardiovascular diseases, strokes, cancer of the colon and breast, mental health issues, obesity, and falls. Individuals from 5 to 17 years of age are recommended to engage in 60 minutes of moderate-vigorous physical activity per day, while adults are recommended to perform 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous-intensity physical activity per week. Unfortunately, more than 80% of the global adolescent population, as well as 25% of the adult population, do not perform adequate physical activity[1].

The Sedentary Behavior Research Network classifies sitting time as sedentary behavior, and a positive association have been observed between more time spent in sedentary behavior and increased mortality risks[2-3]. A cut-off point of 7 hours per day has been recommended and sitting time above this level is considered risky and correlated to an increased risk of all-cause mortality. Sedentary behavior includes watching TV, screen time, sitting, computer usage, and playing videogames[3].

A reduction of physical activity is seen when a learner makes transition from secondary school into university[4]. This is consistent with other studies globally, as reported by systematic reviews and meta--analysis[4-5]. They report that a decline in physical activity exists in the transition from adolescents into young adults[4]. A similar pattern was seen with regards to certain sedentary behavior, which increased with this transition[5].

South African studies comparing the prevalence of physical activity and sedentary behavior between learners studying at secondary and tertiary levels appear to be scarce. In addition, high levels of sedentary behavior have been reported among South African young adults[6]. Education specific to the population can influence positive changes in health behavior[7]. A

study examining the baseline physical activity and sedentary behavior data in the population of university and secondary school students may be useful for health promotion strategies, thus preventing morbidity and associated health care costs within this population in South Africa. Therefore, the aim of this study was to compare physical activity and sedentary behavior in university students and secondary students.

Methods

A cross-sectional design was used for the study. The study sample comprised 202 secondary school students and 171 university students in Durban, KwaZulu-Natal. Durban is a growing industrialized city and, with an estimated population of 3,176,254, it is the largest city in the KwaZulu-Natal province.

The inclusion criteria were male and female grade 11 and 12 students, and university students that were fully registered for the 2020 academic year. The random sampling technique of lottery was used to choose the secondary schools. The university health science disciplines were selected based on consent for participation. The sample size was determined using the option for comparison of two independent proportions in GPower version 3.1.

Pre-study estimates of the two proportions were taken from SA literature indicating that 67% of university students and 50% of children and youth respectively met international guidelines for physical activity[8]. Consequently, a minimum sample size of 261 was calculated for both groups, adopting a 5% sampling error at a 95% confidence level. With additional 10% for non-response, the minimum sample size was increased to 287 (144 per group).

A biographical questionnaire was used to elicit information regarding participants' sociodemographic characteristics, while the Global Physical Activity Questionnaire was used to measure participants' levels of physical activity and sedentary behavior. The questionnaire comprises 16 questions and has 4 sections: activity at work/school/university, travel

to and from places, recreational activities, and sedentary behavior. Metabolic Equivalent of Task's (MET's) were used to describe the intensity of physical activity. Evaluation of physical activity levels was completed by assessing the responses in which participants were questioned about the total number of days and the duration of vigorous, moderate, walking activities. A combined physical activity score was calculated using the following formulae: walking/travel MET= 4.0 x activity duration (min) x activity days; moderate MET= 4.0 x activity duration (min) x activity days; and vigorous MET=8.0 x activity duration (min) x activity days. From this, total physical activity scores for each individual were calculated using the following equation: Total physical activity MET= sum of walking/travelling+ moderate+ vigorous MET-minutes/week. The total physical activity was categorized as low, moderate, and high levels, according with the guidelines of the physical activity (PA) Research Committee (low: total PA<600 MET's mins/week; moderate: 600 MET's mins/week ≤ total PA < 1500 MET's mins/week; high: total PA ≥ 1500 MET's min/week).

The levels of sedentary behavior were evaluated as time spent in sedentary behavior such as sitting and watching television. Participants were categorized as meeting or not the recommendation for sedentary behavior using the cut-off point (maximum of 7 hours per day) reported for subjective measurement studies[3]. The questionnaire has been found as having good to very good short and long term test–retest reliability[9].

Data collection took place between September and December 2019. Principals of secondary schools and heads of departments at the university were contacted via email or telephone, and meetings to explain study details were scheduled with them. Appropriate dates, times and venues were arranged to meet the students, inform them about the study and hand out the relevant information letters and consent forms. In order not to encroach on teaching and learning, data collection took place during free periods or during the Physical Education period (for secondary students).

Questionnaires were given to the students who consented to fill at the time and venues agreed and were returned when completed.

Data were analysed using the SPSS software, 27.0 version. The Kolmogorov-Smirnov test indicated that data was not normally distributed, hence the use of non-parametric tests for analysis. A frequency table and percentages were used to summarise categorical sociodemographic variables, while median and quartiles were used to summarise continuous sociodemographic variables. Pearson's chi-square test was used to compare categorical sociodemographic variables while Mann-Whitney's U test was used for the comparison of continuous variables. Using the enter method, sociodemographic variables that were significantly different between the university and secondary students were fed into two separate multiple linear regression models to identify the predictors of participants' total physical activity score and sitting time (models 1 and 2 respectively). Based on the regression analysis, data were stratified by sex in SPSS for further analysis. The study group was the independent variable while physical activity scores/levels and ST were the dependent variables. The level of significance was set at $p<0.05$.

The study was approved by the University of KwaZulu-Natal's Humanities and Social Sciences Research Ethics Committee (HSS/0310/019M). Relevant gatekeepers' permissions were granted by the office of the Registrar of the University and the provincial Department of Education of KwaZulu-Natal. The written informed consents of school principals and heads of departments at the university were also obtained.

Results

Three hundred and seventy-three participants (171 university students and 202 secondary students) took part in the study. As expected, the secondary school group had a significantly higher proportion of participants aged 16 and 17, while the undergraduate group had a significantly higher proportion of participants who were ≥18 ($p<0.001$). The undergraduate

group had a significantly higher proportion of female respondents while the proportion of males in the secondary group was significantly higher than that of the undergraduate group (p<0.001). The secondary group had a significantly higher proportion of colored participants than the undergraduate group (p=0.009). Furthermore, the undergraduate group significantly weighed more (p=0.017) and had a higher Body Mass Index (BMI) (p=0.011), while the two groups were comparable in their heights (p=0.873).

Two separate linear multiple regression models were computed to determine the predictors total physical activity and sitting time for each, which are presented in Table 1. The analysis of variance (ANO-

VA) for model 1 was significant and the model explained 11.5% of the variances of total physical activity (degrees of freedom (df) = 6, F=7.926, p<0.001, R^2=0.115). Results showed that study group (B=939.19, p=0.001) and sex (B= -1198.29, p<0.001) were the main significant predictors of total physical activity. Age, race, weight, and BMI were not significantly associated with total physical activity. The ANOVA for model 2 was also significant, and the model explained 9.5% of the variances of sedentary time (df=6, F=6.391, p<0.001, R^2=0.095); however, the study group (B= -102.88, p<0.001) was the only significant predictors of ST found. Age, sex, race, weight, and BMI were not significantly associated with total physical activity.

Table 1 – Associations of total physical activity and sedentary time with participants sociodemographic characteristics (n=373). South Africa, 2020

Variable	B	t	p-value	95% Confidence Interval for B	
				Lower Limit	Upper Limit
Total physical activity (df= 6, F = 7.926, p<0.001, R2 = 0.115)					
Constant	1417.562	1.116	0.265	-1081.331	3916.455
Study group	939.192	3.227	0.001*	366.881	1511.504
Age	110.728	.500	0.618	-325.151	546.607
Sex	-1198.287	-4.170	< 0.001*	-1763.378	-633.196
Race	25.568	.228	0.820	-194.921	246.056
Weight	-10.585	-.699	0.485	-40.385	19.214
Body Mass Index	69.073	1.692	0.092	-11.208	149.354
Sedentary time (df= 6, F = 6.391, p<0.001, R^2 = 0.095)					
Constant	447.251	4.412	< 0.001	247.905	646.597
Study group	-102.876	-4.431	< 0.001*	-148.531	-57.220
Age	-9.904	-.560	0.576	-44.675	24.868
Sex	25.271	1.102	0.271	-19.808	70.350
Race	8.619	.964	0.336	-8.970	26.208
Weight	-.690	-.571	0.569	-3.067	1.687
Body Mass Index	0.921	.283	0.777	-5.483	7.325

*Denotes significant difference at p<0.05; df: degrees of freedom

The comparison of physical activity and sitting time scores of secondary school students and university students is presented in Table 2. The results of Mann-Whitney's U showed that the secondary school group had significantly higher vigorous and moderate

physical activity scores than the university group. Furthermore, the secondary school group had a significantly higher total physical activity score than the university students.

The results further showed that the university group spent significantly more time in sedentary activities than the secondary student group. Following stratification of data by sex, findings revealed that male university students and secondary school students were not significantly different in their physical activity and sitting time scores. Results further showed that female secondary school students had significantly higher scores of vigorous, moderate, and total physical activity than their university counterparts.

Table 2 – Comparison of physical activity and sedentary behavior scores of university students and secondary school students (n=373). South Africa, 2020

Variable	University students Median (IQR)	Secondary School students Median (IQR)	z	p-value
All (n=373)				
Vigorous	0.00 (0.00, 480.00)	240.00 (0.00, 1600.00)	-5.108	0.004*
Moderate	520.00 (76.00, 1080.00)	720.00(195.00,1620.00)	-2.876	< 0.001*
Walking	0.00 (0.00, 600.00)	100.00 (0.00, 500.00)	-1.536	0.125
Total	1080.00 (420.00, 2000.00)	1990 (705.00, 4080.00)	-4.873	< 0.001*
Sedentary time	300.00 (240.00, 480.00)	180.00 (120.00, 360.00)	-5.694	< 0.001*
Male (n=119)				
Vigorous	0.00 (0.00, 1440.00)	440.00 (0.00, 2280.00)	-1.831	0.067
Moderate	900.00 (240.00, 1440.00)	700.00(180.00,1598.00)	-0.146	0.884
Walking	0.00 (0.00, 600.00)	240.00 (0.00, 560.00)	0.461	0.645
Total	1440.00(600.00,3840.00)	2270.00(1206.00,4815.00)	-1.320	0.187
Sedentary time	240.00 (180.00, 300.00)	240.00 (120.00, 360.00)	-0.648	0.517
Female (n=254)				
Vigorous	0.00 (0.00, 0.00)	0.00 (0.00, 1440.00)	-3.980	< 0.001*
Moderate	430.00 (19.00, 900.00)	720.00 (200.00, 1685.00)	-2.812	0.005*
Walking	0.00 (0.00, 530.00)	0.00 (0.00, 420.00)	-0.791	0.429
Total	900.00 (360.00, 1840.00)	1750.00 (438.00, 3570.00)	-3.535	< 0.001*
Sedentary time	360.00 (240.00, 480.00)	180.00 (120.00, 360.00)	-5.631	< 0.001*

*Denotes significant difference at p<0.05; IQR: Interquartile range
Note: Physical Activity scores were measured in METs/week while sedentary time was measured in seconds

The comparison of the levels of physical activity and sedentary behavior among secondary school students and university students is depicted in Table 3. Overall, a significantly higher proportion of the university students participated in moderate physical activity than the secondary school group did, while a significantly higher percentage of the secondary school students participated in high physical activity than their university counterparts (p<0.01). A significantly higher proportion of secondary school students met the recommendations for sedentary behavior, with 84.7% compared to 71.9% of the university students (p<0.003).

Following data stratification by sex, a significantly higher proportion of male university students participated in moderate physical activity, 38.6% compared to 14.9% of male secondary school students (p=0.027). Conversely, a significantly higher proportion of male secondary school participants participated in high level of physical activity, 69.3% compared to 48.4% of male university students (p=0.027). The proportion of university and secondary school students who met or did not meet guidelines for SB was not significantly different (p=0.325). The same pattern was observed among the females, as a significantly higher percentage of university students participated in moderate physical activity, while a significantly higher percentage of secondary school students participated in high level physical activities when compared to their university counterparts.

Table 3 – Levels of physical activity and sedentary behavior of university students and secondary students (n=373). South Africa, 2020

Variable	University Students (n= 171) n (% within group)	Secondary Students (n =202) n (% within group)	Chi-square	p-value
Physical activity				
Level			39.498	< 0.001*
Low	51[a] (29.8)	47[a] (23.3)		
Moderate	65[a] (38.0)	29[b] (14.4)		
High	55[a] (32.4)	126[b] (62.7)		
Status of sedentary behavior			8.981	0.003*
Met guideline	123[a] (71.9)	171[b] (84.7)		
Did not meet guideline	48[a] (28.1)	31[b] (15.3)		
Male (n=119)[†]				
Physical activity level			7.425	0.027*
Low	5[a] (16.1)	15[a] (17.0)		
Moderate	11[a] (35.5)	12[b] (13.6)		
High	15[a] (48.4)	61[b] (69.3)		
Status of sedentary behavior			0.969	0.325
Met guideline	3[a] (9.7)	15[a] (17.0)		
Did not meet guideline	28[a] (90.3)	73[a] (83.0)		
Female (n=254)[‡]				
Physical activity level			25.351	<0.001*
Low	46[a] (32.9)	32[a] (28.1)		
Moderate	54[a] (38.6)	17[b] (14.9)		
High	40[a] (28.6)	65[b] (57.0)		
Status of sedentary behavior			11.290	0.001*
Met guideline	45[a] (32.1)	16[b] (14.0)		
Did not meet guideline	95[a] (67.9)	98[b] (86.0)		

*Denotes significant difference at p<0.05; [†]University students (n= 31)/Secondary students (n= 88); [‡]University students (n= 140)/Secondary students (n= 114); a,b: Proportions with different subscripts are significantly different at p<0.05

Discussion

The authors predicted the possibility of recall bias and the tendency of the young population involved to over-perform in physical activity. To avoid such a bias, the authors reminded participants about the confidentiality of the information provided and the need to provide honest reports. It was also ensured that participants did not fill the questionnaires in the company of their schoolmates and friends, as they were surveyed individually. In addition, researchers and assistants randomly picked some respondents and verbally asked them the same questions in the questionnaire to ensure consistency. Sampling of few schools and universities is another limitation that could have threatened the external validity of the study results. In view of the demographic diversity of SA, this study only included students from one South African province, indicating the need for further studies with a wider geographical scope.

Despite these limitations, the results have some clinical implications for health professionals, government agencies and educational institutions. Despite recommendations from WHO[1] and other bodies, lack of physical activity is still a huge concern globally. Tailoring physical education and physical activity promotion to specific age groups may have an impact in provoking the desired behavioral changes towards greater participation in physical activities, and special attention should be given to the female students. This study sheds light on the current levels of physical activity among students of secondary schools and

tertiary institutions. It also corroborates the earlier reported trend of decrease in physical activity levels when students transition from secondary to tertiary institutions.

A larger proportion of secondary school students participated in high levels of physical activity compared to the university students. This could be because secondary school students have a statutory break period daily, which is usually used for sporting activities. Most university students reportedly participated in moderate levels of physical activity, a finding that contradicted those from another South African study, where majority performed low levels of physical activity[10]. The reason for the difference could be due to the sample size being smaller than that of the current study. Furthermore, the higher proportion of low levels of physical activity in that study could be because the proportion of female students in their study was higher than the current study, in addition to our observations that females are less involved in vigorous physical activity when compared to their male counterparts[10-11].

A high proportion of the university students met the recommendations for moderate levels of physical activity as set by the WHO[3]. This is consistent with a US study where most of the students met/surpassed the recommendation of at least 150 minutes of moderate intensity physical activity per week[12]. The current study findings are also consistent with that of a study in Nigeria where about eighty-five percent of health profession students met the said recommendations[13].

In the current study, just below one-third of university students did not meet the recommendations to avoid behavior of less than 7 hours sitting per day. The findings of the current study are better than the prevalence of 34-90% of sitting time reported in a recent systematic review[14]. This inconsistency could be attributed to variations in definitions for sedentary behavior. In that systematic review, sedentary behavior was described as time involved in media, e.g. television, computer usage, and virtual gaming[14-15]; fifte-

en percent of secondary school students did not meet the recommendations to avoid sedentary behavior in the current study, which corroborates reports from a similar study where sitting time and sedentary behavior were a major concern among adolescents[8].

Secondary students had higher vigorous, moderate, and total physical activity scores and less sitting time in comparison to the university group. This pattern was also demonstrated by a systematic review which reported a decline in physical activity from adolescence into entering adulthood[5]. Additionally, a study reported a decrease in physical activity as well as an increase in time spent in sedentary behavior such as the use of the internet and studying from secondary school to tertiary education[4]. Another study reported that most students were involved in vigorous physical activity when they were in high school but only about half of them same students met the guidelines when they were in college. A probable reason for higher physical activity scores among secondary school students is the participation in Physical Education lessons which are offered as part of the education curriculum, as this was reported by a study to be an influential reminder to physical activity participation among secondary students[16]. The current study showed that a student that performs more physical activity spends less time in sedentary behavior, which is consistent with findings from a recent study[17].

Analysis by sex stratification show that male university students and male secondary school students were statistically comparable in terms of their physical activity and sitting time scores. On the other hand, the secondary school female students demonstrated significantly higher vigorous, moderate, and total physical activity scores, but lower sitting time scores than the female university students. In terms of physical activity and sedentary behavior levels, a higher proportion of secondary school students was found with high levels of physical activity participation when compared to the university students, among both male and female subgroups. A significantly higher proportion of female secondary students

was involved in sedentary behavior when compared to the university students, but the difference in level of sedentary behavior was not significant among the males. This could be a result of higher participation of male students at all levels in club sporting activities during break times and free periods. They are also more likely to cycle to school, as demonstrated by an earlier study[9].

The results above seem contrary to results of a systematic review[5] which reported that there was a slightly larger decline in physical activity among males than females. However, this difference may be attributed to the high proportion of females participating in this study, and the fact that levels of physical activity were not categorized in the systematic review[5].

This study summarily reports a decline in physical activity when students transit from secondary schools to university in the area studied. This decline in physical activity coincided with an increase in sedentary behavior. Reduced physical activity and increased sedentary behavior adversely affect cardio-respiratory fitness, being risk factors for non-communicable diseases, the leading cause of death globally. Considering that many habits are formed during the adolescent/teenage/young adult stage, it may prove beneficial, in both short and long terms, to enhance efforts to strengthen community and individual based physical activity participation, with health promotion programs from governmental and non-governmental agencies.

Conclusion

Most university students presented moderate levels of physical activity, while most secondary school students presented high levels of physical activity. A high proportion of female students, in both groups, did not meet the recommendations for sedentary behavior. Secondary students have higher scores of physical activity and spend less time in sedentary behavior. The current findings may inform policy changes regarding health promotion strategies for adolescents and young adults in South Africa.

Authors' Contribution

Conception and data collection of the article: Naidoo N, Olagbegi OM, Nadasan T.
Statistical analysis and interpretation of data: Afolabi JO.
Writing of the article and relevant critical review of the intellectual content and approved the final version to be published: Naidoo N, Olagbegi OM, Nadasan T, Afolabi JO.

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