JOURNAL OF PUBLIC HEALTH | Vol. 45, No. 4, pp. 1042–1055 | https://doi.org/10.1093/pubmed/fdad106 | Advance Access Publication July 5, 2023

Prevalence of health risk behaviours related to non-communicable diseases amongst South African university students: a systematic review

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ABSTRACT

Background Engagement in risk behaviours adopted during university continues after graduation, increasing the risk of non-communicable diseases (NCDs). This systematic review aimed to investigate the prevalence of NCD risk behaviours amongst South African university students.

Methods PubMed and Scopus databases were searched (January 1990–April 2022) for studies investigating alcohol consumption, cigarette smoking, inadequate consumption of fruits and vegetables and physical inactivity. Study qualities were assessed with the Joanna Briggs Institute critical appraisal and levels of evidence checklists. An overall prevalence percentage was obtained for each risk behaviour.

Results A total of 50 studies ($n = 26\,624$ students) were included. A range of 44.8–75.0% of students consumed inadequate servings of fruits and vegetables. Just over 54% consumed alcohol (95% confidence intervals [95%CI]:54.0–55.5%). A significantly higher percentage of males (44.2%) than females (25.8%) drank heavily ($P < 0.001$). Approximately one-third (34.8%, 95%CI:33.4–36.3%) were sedentary and 39.0% (95%CI:37.5–40.4%) were insufficiently active. Almost one-fifth (17.9%, 95%CI:17.3–18.5%) smoked cigarettes, being significantly more prevalent amongst males (21.8%) than females (13.5%) ($P < 0.001$). A total of 10% smoked 1–10 cigarettes/day and 1.2% smoked >10 cigarettes/day.

Conclusion High percentages of South African students eat inadequate servings of fruits and vegetables, consume alcohol are physically inactive and smoke cigarettes. South African universities should implement screening measures and health campaigns.

Keywords behaviour, public health, young people

Introduction

The transition from school to university brings social, physical and emotional changes for young adults. Moreover, this period is characterized by experimentation with behaviours.[1] This may be due to independence and new social connections.[2] Students may experiment with alcohol consumption, cigarette smoking, poor nutritional choices and lower physical activity levels.[2] The continued practise of these four behaviours shape the progression of physiological changes that increase the risk of developing non-communicable diseases (NCDs) and premature mortality.[3] Specifically, alcohol consumption, cigarette smoking, poor dietary practices and physical inactivity account for 3.3 million, 7.2 million, 4.1 million and 1.6 million annual deaths, respectively.[4]

Engagement in multiple NCD risk behaviours appears to be common amongst South African youth for alcohol consumption and both physical inactivity[5] and smoking.[6,7] Notably, behaviours adopted during university have been shown to continue following graduation, specifically for physical inactivity,[8–10] cigarette smoking[11,12] and alcohol consumption.[13]

Due to reports of South African youth engaging in multiple NCD risk behaviours,[5,7,14–16] a comprehensive analysis

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of the NCD risk behaviours practised by South African university students is warranted. Therefore, this systematic review aimed to investigate the prevalence of South African university student engagement in: (i) alcohol consumption, (ii) cigarette smoking, (iii) inadequate fruit and vegetable consumption and (iv) physical inactivity.

Materials and methods

Protocol and registration

A protocol was developed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement[17] and registered with the international prospective register of systematic reviews (CRD42021276041).

Study selection and eligibility criteria

Eligibility criteria were established and agreed upon by all authors. Studies that met these criteria were considered eligible for inclusion:

(i) Male and female participants, 18 years and older, registered as students at a South African university,
(ii) Reported the percentage of students engaging in:
  (a) Alcohol consumption
  (b) Cigarette smoking
  (c) Inadequate consumption of fruits and vegetables
  (d) Physical inactivity,
(iii) Full-text prospective and retrospective studies published in English between 1 January 1990 and 30 April 2022.

The following exclusion criteria were set:

(i) Studies available as abstract only, discussion paper, commentary, editorial or review,
(ii) Multi-country studies in which the data pertaining to South African students could not be obtained.

Search strategy

PubMed and Scopus databases were searched from 1 January 1990 to 30 April 2022 for articles investigating university student engagement in NCD risk behaviours. Filters were applied to limit the database searches to South Africa and to include full-text English articles with adults aged 18–44 years. The full search string can be found in Supplementary File 1. The authors conducted a secondary search on Google Scholar and manual searches from the reference lists of included studies.

Study screening mode

Article screening and selection were performed using the online platform, CADIMA.[18] Titles and abstracts were independently screened by two authors (GEF and JGE). The full texts of the remaining articles were independently screened by the same two authors. Disagreements were discussed and resolved. The final list of articles was examined to ensure that the same participants were not included in more than one article based on data from the same study.

Data extraction

The following data were extracted by one author (GEF): participants (number, sex, faculty, year of study), South African province, method of collecting behaviour data and the percentage of students (i) consuming alcohol, (ii) smoking cigarettes, (iii) consuming inadequate servings of fruits and vegetables and (iv) performing insufficient physical activity. The following criteria were used to classify each behaviour:

Alcohol consumption

Alcohol consumption was described as the percentage of students who reported consuming alcohol. 'Heavy alcohol consumption' was classified as consuming more than five and more than four drinks on one occasion by male and female students, respectively,[19] or when stated by the study authors.

Cigarette smoking

Cigarette smoking was identified for students smoking one or more cigarettes per day. Based on the classification of 'low-rate smokers' by Owen *et al*.,[20] this systematic review also categorized smokers as 'daily smokers' (1–10 cigarettes per day) or 'heavy daily smokers' (>10 cigarettes per day).

Inadequate fruit and vegetable consumption

Inadequate fruit and vegetable consumption was defined as (i) less than five servings of fruits and vegetables per day or (ii) less than two servings of fruits and less than three servings of vegetables per day.[21]

Physical inactivity

Physical inactivity was identified when (i) stated by the study's authors or (ii) physical activity guidelines were not met.[22,23]

Quality assessment and risk of bias

The studies in this systematic review are prospective descriptive cross-sectional studies. The Joanna Briggs Institute (JBI) critical appraisal checklist for studies reporting prevalence data was used to assess the quality.[24] This tool scores nine

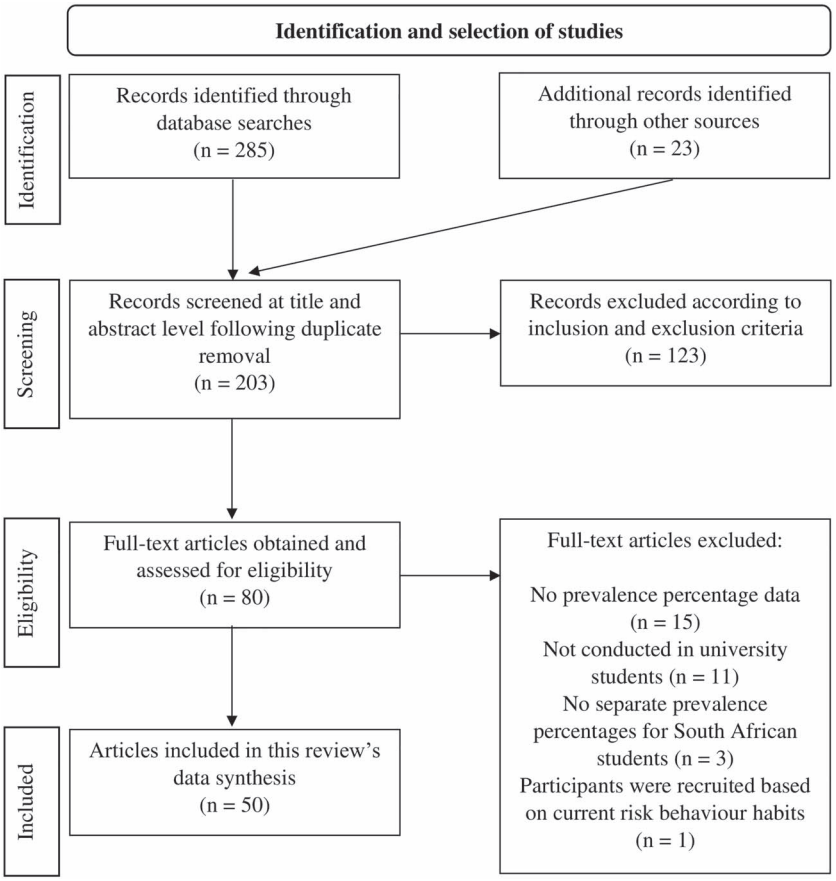

Fig. 1 Flow diagram for the selection of studies.

items as 'yes' (1 point), 'no' (0 points), 'unclear' (0 points) or 'not applicable' (0 points). Studies scoring 4 points or less were regarded as low quality, 5–7 points as medium quality and 8 or more points as high quality.[25,26] Two authors (GEF and JGE) independently performed the quality assessments. The same two authors independently determined the level of evidence using the JBI Levels of Evidence and Grades of Recommendation.[27] Consensus was obtained for all quality assessments.

Data analysis

Data were captured as the percentage of students engaging in an NCD risk behaviour. The percentages were pooled to obtain an overall percentage for each behaviour using Microsoft Excel (2016). Calculations were performed to obtain 95% confidence intervals (95%CI) using the methods outlined by Knowles *et al*.[28] Differences between sex were analysed using the two-sample test of proportions on StataMP17 (StataCorp LP, College Station, Texas, United States), with statistical significance set at $P < 0.05$. Heterogeneity was assessed by inspecting for studies with prevalence percentages significantly outside of the 95%CI range.

Results

Three hundred and eight studies were identified in the primary searches. Following duplicate removal, 203 studies underwent title and abstract screening, after which the full texts of 80 articles were assessed. In total, 30 articles were excluded, leaving 50 articles included in this systematic review (Fig. 1).

Quality assessment and level of evidence

The detailed evaluations of the quality assessments are presented in Supplementary File 2. Eleven studies were rated as high quality/low risk of bias. In total, 29 studies were rated as medium quality/moderate risk of bias and ten studies were rated as poor quality/high risk of bias. A total of 49 studies were cross-sectional descriptive studies and rated as 4b level of evidence, whilst one study was a randomized-controlled trial and rated as 1c level of evidence.[29] Some heterogeneity was observed, likely due to the variability in sample sizes.

However, the tight CIs suggest that the overall point estimate is reliable and a fair reflection of the prevalence of students engaging in the risk behaviours.

Study characteristics

The characteristics of the included studies are presented in Table 1. The 50 studies had a total of 26 624 students registered within various faculties and years of study. In total, 26 studies used convenience sampling, 18 used random sampling, four recruited all students and two used criterion-based sampling. The studies were conducted in Limpopo (n = 11), Gauteng (n = 11), Eastern Cape (n = 9), Free State (n = 6), Western Cape (n = 5), Kwazulu-Natal (n = 5), Northern Province (n = 1) and North–West Province (n = 1). One study was conducted in Gauteng and Limpopo. All data were obtained via self-reported questionnaires and 32 studies reported using validated questionnaires.

Student risk behaviours

The percentage of students engaging in NCD risk behaviours for each study is presented in Tables 2 and 3. The pooled results are presented below.

Alcohol consumption

Alcohol consumption was assessed most widely and reported in 40 studies. From 16 460 students (6612 male, 9146 female, 702 sex not reported), 54.8% (95%CI: 54.0–55.5%) consumed alcohol. In addition, 31.3% (95%CI: 30.6–32.0%, n = 5595) drank heavily. Male students were significantly more likely to consume alcohol and drink heavily than female students (39.0% versus 27.4%, and 44.2% versus 25.8%, respectively) ($P < 0.001$).

Cigarette smoking

A total of 29 studies assessed smoking behaviours. Amongst 15,054 students (6111 male, 7912 female, 1031 sex not reported), 17.9% (95%CI: 17.3–18.5%) smoked cigarettes. The percentage of male smokers was significantly higher than female smokers (21.8% versus 13.5%, respectively, $P < 0.001$). Across studies reporting the number of cigarettes smoked per day, 10.2% of students (95%CI: 9.2–11.1%) smoked 1–10 cigarettes/day and 1.2% (95%CI: 0.7–1.7%) smoked >10 cigarettes per day.

Inadequate fruit and vegetable consumption

Fruit and vegetable consumption was assessed the least and reported in five studies. The consumption of less than five daily servings of fruits and vegetables was observed amongst 44.8% (95%CI: 42.2–47.4%) of 1430 students. Amongst 1067 students, 61.7% (95%CI: 58.8–64.6%) consumed less than two daily servings of fruits and 75.0% (95%CI: 72.4–77.6%) consumed less than three daily servings of vegetables. No analyses per sex were done due to paucity of data.

Physical inactivity

A total of 15 studies reported on physical inactivity. Almost 35% (34.8%, 95%CI: 33.4–36.3%) of 4162 students performed no physical activity. Furthermore, 39.0% (95%CI: 37.5–40.4%) of 4094 students performed inadequate levels of physical activity. No analyses per sex were done due to paucity of data.

Discussion

Main findings of this study

A high percentage of students consumed less than the recommended daily servings of fruits and vegetables (range of 44.8–75.0%) and consumed alcohol (54.8%), with almost one-third of students classified as heavy alcohol consumers. Additionally, 34.8% and 39.0% of the students participated in no and insufficient physical activity, respectively, and ∼18% smoked cigarettes. The prevalence of alcohol consumption and cigarette smoking was significantly higher amongst the male compared with female students.

What is already known on this topic

Inadequate fruit and vegetable consumption

The percentage of South African university students consuming inadequate daily servings of fruits and vegetables is of concern considering that consuming less than five servings of fruits and vegetables per day is associated with an increased risk of developing an NCD.[30]

A review by Rodrigues *et al*.[31] reported that South African students had the highest prevalence for inadequate daily vegetable consumption when compared with 29 countries. Yet, in comparison to students from other African countries, Pengpid and Peltzer[32] reported that South African students from Limpopo had the second-lowest rate of inadequate fruit and vegetable consumption after Ivory Coast (64.8% versus 64.2%, respectively) and a considerably smaller percentage compared with the mean (80.5%) incorporating data from 23 countries. However, it should be noted that two-thirds of students from Limpopo did not meet the fruit and vegetable guidelines.[32] These findings from the multi-country study[32] suggest that university students on a global scale struggle to meet fruit and vegetable recommendations.

Viljoen *et al*.[1] reported that budgetary and time constraints affected South African students' dietary habits. It also appears

Table 1 Characteristics of included studies

Study & province	*Method of data collection*	*Participants*	*Age mean ± SD (range)*	*University faculty/department*	*Conducted year*
Limpopo					
Cherian, 2014[48]	Questionnaire developed by WHO	*n* = 120 (M = 61; F = 59)	18.3 ± 1.6 (16–20) 18.8 ± 1.4 (16–20)	2nd year education students	NR
Dantzer, 2006[47]	Non-specified questionnaire	*n* = 701 (M = 332; F = 369)	(17–30)	Non-health science students	1999–2000
Kyei, 2013[77]	Non-specified questionnaire	*n* = 209 (M = 99; F = 110)	NR	NR	NR
Peltzer, 2000[49]	Non-specified questionnaire	*n* = 793 (M = 370; F = 423)	21.1 ± 3.5 (18–25)	Non-health-science students	2000
Peltzer, 2002[78]	WHO Model Core Questionnaire	*n* = 799 (M = 441; F = 358)	20.1 ± 3.2 (16–49)	1st year students	NR
Peltzer, 2003[79]	Non-specified questionnaire	*n* = 793 (M = 370; F = 423)	21.0 ± 3.5 (18–25)	Non-health science students	NR
Peltzer, 2016[80]	IPAQ-SF and other non-specified questionnaires	*n* = 740	(16–30)	Undergraduate	2013
Pengpid, 2013b[81]	AUDIT and other non-specified questionnaires	*n* = 722 (M = 416; F = 306)	21.7 ± 8.8 (18–41)	Undergraduate health science students	NR
Pengpid, 2015[14]	IPAQ-SF	*n* = 888	(16–30)	Undergraduate	2013
Pengpid, 2021[32]	IPAQ-SF and other non-specified questionnaires	*n* = 830	Median: 20 IQR: 3	Undergraduate	2013–2015
Steptoe, 2002[66]	Adapted: Office of Population Censuses and Surveys in United Kingdom	*n* = 786 (M = 367; F = 419)	(17–30)	Non-health science students	NR
Gauteng					
Cronin, 2014[82]	Adapted: Behavioural Risk Factor Surveillance System Questionnaire 2012	*n* = 50 (M = 28; F = 22)	21.4 ± 2.0 (18–25)	Student-athletes in first team	NR
Janse van Rensburg, 2013[2]	Adapted: Student Health and Lifestyle questionnaire	*n* = 380 (M = 111; F = 269)	(18–47)	2nd year, 3rd year and postgraduate students	NR
Mogotsi, 2014[83]	SAQ	*n* = 217 (M = 89; F = 128)	(18–26)	1st year students	NR
Mthabela, 2021[84]	AUDIT	*n* = 377 (M = 136; F = 241)	(19–25)	1st–3rd year undergraduate Medicine, Dental and Nursing students	NR
Nkambule, 2018[85]	Non-specified questionnaire	*n* = 269 (M = 70; F = 199)	22.0 ± 3.3 (17–42)	Undergraduate dental and oral hygiene students	2015
Nyandu, 2019[58]	Non-specified questionnaire	*n* = 145 (M = 25; F = 120)	(17–36)	Undergraduate social work sciences students	NR
Pengpid, 2013a[29]	AUDIT	*n* = 722	21.9 ± 3.5	Undergraduate and postgraduate	2011–2012

(*Continued*)

Table 1 Continued

Study & province	*Method of data collection*	*Participants*	*Age mean ± SD (range)*	*University faculty/department*	*Conducted year*
Porter, 2009[72]	National College Health Risk Behaviour Survey	*n* = 600 (M = 350; F = 250)	NR	Undergraduate	2007
Reid, 2008[86]	Non-specified questionnaire	*n* = 986 (M = 463; F = 523)	21.0 ± 3.0	2nd year students	NR
Steyn, 2016[87]	Adapted from White *et al*.[88]	*n* = 815 (M = 185; F = 630)	20.4 ± 2.2	Undergraduate	NR
Viljoen, 2018[1]	Non-specified questionnaire	*n* = 484 (M = 268; F = 216)	NR	NR	NR
Eastern Cape					
Gresse, 2015[89]	Youth Risk Behaviour Surveillance System	*n* = 126 (M = 31; F = 95)	24.2 ± 4.2	Health sciences students	2013
Mandeya, 2019[54]	AUDIT	*n* = 213 (M = 105; F = 108)	22.0 ± 0.3	Undergraduate statistics service course students	NR
Maphisa, 2018[90]	AUDIT	*n* = 501	NR	Undergraduate and postgraduate	2014
Osuafor, 2017[52]	Non-specified questionnaire	*n* = 346 (M = 111; F = 235)	20.9 ± 0.12 (18–30)	1st year students	2016
Shumba, 2011[56]	Non-specified questionnaire	*n* = 40 (M = 20; F = 20)	(20–30)	Undergraduate and postgraduate	NR
Van den Berg, 2012[33]	Non-specified questionnaire	*n* = 161 (M = 51; F = 110)	24.9 (18–42)	Undergraduate department of nursing sciences students	NR
Walter, 2011[91]	GPAQ	*n* = 69 (F = 69)	20.1 (18–21)	Teaching, nursing, social work, public management students	NR
Young, 2009[55]	AUDIT	*n* = 2049 (M = 851; F = 1198)	21.3	Undergraduate and postgraduate	2007
Young, 2010[59]	AUDIT	*n* = 318 (M = 135; F = 183)	19.5 ± 1.3 (17–24)	Undergraduate	2009
Free State					
Bloemhoff, 2010[92]	IPAQ	*n* = 405 (M = 178; F = 227)	NR	3rd year students	2009
Smit, 2009[50]	Based on United States Department of Health and Human Services guidelines for identifying at-risk drinking behaviour	*n* = 371 (M = 181; F = 190)	NR	1st year, 4th year, 5th year medical students	2006
Van den Berg, 2013[93]	Previous Day Physical Activity Recall and other non-specified questionnaires	*n* = 161 (M = 39; F = 122)	21.5	Undergraduate healthcare sciences students	2007
Van Zyl, 2015[51]	AUDIT	*n* = 339 (M = 162; F = 174)	NR	Undergraduate and postgraduate	2012

(*Continued*)

Table 1 Continued

Study & province	*Method of data collection*	*Participants*	*Age mean ± SD (range)*	*University faculty/department*	*Conducted year*
Vorster, 2019a[16]	Amalgamation of validated questionnaires	*n* = 69 (M = 2; F = 67)	NR	2nd year nursing sciences students	2016
Vorster, 2019b[57]	Amalgamation of validated questionnaires	*n* = 113 (M = 43; F = 70) *n* = 58 (M = 29; F = 29)	(19–26) (19–25)	2nd year medical students 3rd year medical students	NR
Western Cape					
Cilliers, 2006[94]	16-item Baecke Questionnaire of Habitual Physical Activity	*n* = 360 (F = 360)	18.6 ± 0.4	1st year students	NR
Kruger, 2016[95]	Amalgamation of validated questionnaires	*n* = 4578 (M = 2069; F = 2509)	NR	All registered students	2013
Smith, 2009[96]	Non-specified questionnaire	*n* = 266 (M = 88; F = 178)	21.1 ± 1.0	Department of physiological sciences, third year students	NR
Steyl, 2011[97]	NCHRBS and ACHA-NCHA	*n* = 201	22.2 ± 4.7 (18–24)	Second year health sciences students	2006
Visser, 2019[98]	Non-specified questionnaire	*n* = 242 (M = 121; F = 121)	20.4 ± 1.7 20.4 ± 2.8	Undergraduate (not final year)	2016
Kwazulu-Natal					
Inaç, 2021[99]	AUDIT	*n* = 249 (M = 78; F = 171)	Median M: 23 Median F: 22	All registered students	2018
Hoque, 2011[100]	Non-specified questionnaire	*n* = 391 (F = 391)	21.4 ± 3.2 (17–45)	Undergraduate	2009
Kamanzi, 2005[73]	Non-specified questionnaire	*n* = 171 (M = 74; F = 97)	NR	Undergraduate and postgraduate	2001
Kazi, 2010[76]	ACSM modified health and physical activity questionnaire	*n* = 116 (M = 53; F = 63) *n* = 143 (M = 57; F = 86)	NR	Sport science students General education students	NR
Morar, 1998[101]	Non-specified questionnaire	*n* = 154 (M = 87; F = 67)	21.0 ± 1.6	Medical school students	NR
North-West Province					
Osuafor, 2016[53]	Non-specified questionnaire	*n* = 416 (M = 171; F = 245)	NR	Undergraduate and postgraduate	2014
Northern Province					
Steyn, 2000[102]	Non-specified questionnaire	*n* = 231 (F = 231)	NR	First year students	1994
Gauteng/Limpopo					
Senkubuge, 2012[15]	Global Health Professionals Students Survey	*n* = 722 (M = 340; F = 382)	23.0 ± 4.0	2nd and 6th year medical students	2008

WHO, World Health Organization; M, male; F, female; NR, not reported; IPAQ-SF, International Physical Activity Questionnaire—Short Form; AUDIT, Alcohol Use Disorder Identification Test; IQR, interquartile range; SAQ, Student Alcohol Questionnaire; GPAQ, Global Physical Activity Questionnaire; NCHRBS, National College Health Risk Behaviour Survey; ACHA-NCHA, American College Health Association—National College Health Assessment; ACSM, American College of Sports Medicine.

Table 2 Prevalence percentages of students consuming alcohol and smoking cigarettes

Study	*Alcohol consumer (%)**			*Heavy alcohol consumer (%)*, [a]*			*Cigarette smoker (%)**			*Daily cigarette smoker (%)[b]*			*Heavy daily cigarette smoker (%)[c]*		
	T	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*
Porter, 2009[72]		6.0	1.7		47.0	28.6		30.0	22.9		20.4	12.6			
Morar, 1998[101]		48.9	10.7					15.0	4.4		2.3	0.0			
Peltzer, 2002[78]		28.3	15.1		27.9	11.2		19.6	4.2						
Inaç, 2021[99]		66.2	67.8		28.2	16.7		33.3	15.6						
Peltzer, 2000[49]		8.8	1.9								11.1	0.5		2.5	0.5
Dantzer, 2006[47]		29.0	6.0		27.0	3.0									
Mthabela, 2021[84]		29.4	70.5		70.6	29.5									
Mandeya, 2019[54]		69.5	47.2		53.4	27.5									
Visser, 2019[98]		68.6	52.9		14.2	8.3									
Kyei, 2013[77]		71.7	54.5	49.0											
Nyandu, 2019[58]		92.0	87.5	39.9											
Nkambule, 2018[85]		46.0	39.0					19.0	8.0						
Cherian, 2014[48]		82.0	63.0					67.0	10.0						
Peltzer, 2003[79]		27.0	5.0					15.0	1.0						
Cronin, 2014[82]		85.0	73.0					29.0	18.0						
Smit, 2009[50]		65.8	45.3												
Hoque, 2011[100]			57.5												
Reid, 2008[86]	73.0			67.0			9.0			8.0			1.0		
Osuafor, 2016[53]	67.5				3.6		21.4			8.2					
Kruger, 2016[95]	75.0			22.8				22.0	14.8						
Gresse, 2015[89]	83.0			20.1											
Van den Berg, 2013[93]	65.2						63.0			10.6					
Osuafor, 2017[52]	60.1			32.2			31.5								
Steyl, 2011[97]	54.8			33.3			27.5								
Vorster, 2019b[57]	79.9						32.7								
Kazi, 2010[76]	12.6			43.5			23.7								
Steyn, 2016[87]	79.0						26.2								
Young, 2010[59]	32.4			57.9											
Maphisa, 2018[90]	68.5						35.1								
Vorster, 2019a[16]	81.2						40.6								
Mogotsi, 2014[83]	87.0														
Shumba, 2011[56]	65.0														
Van den Berg, 2012[33]	1.2														
Pengpid, 2013b[81]					32.0	8.3		21.9	3.7						
Young, 2009[55]					63.5	42.5									
Van Zyl, 2015[51]					32.8	25.8									
Peltzer, 2016[80]					31.5	12.6									
Pengpid, 2021[32]				16.6			11.9								
Pengpid, 2013a[29]				21.1											
Senkubuge, 2012[15]				18.3			17.3								
Janse van Rensburg, 2013[2]								29.5	70.4						
Smith, 2009[96]								19.0	10.0						

(*Continued*)

Table 2 Continued

Study	Alcohol consumer (%)*			Heavy alcohol consumer (%)*,[a]			Cigarette smoker (%)*			Daily cigarette smoker (%)[b]			Heavy daily cigarette smoker (%)[c]		
	T	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*
Steptoe, 2002[66]								15.0	4.0						
Steyn, 2000[102]									1.0						
Kamanzi, 2005[73]										24.6			0.9		
Cilliers, 2006[94]												13.1			
Mean (%)	**54.8**	**39.0**	**27.4**	**31.3**	**44.2**	**25.8**	**17.9**	**21.8**	**13.5**	**10.2**			**1.2**		

Total, total; M, male; F, female.

*Significant sex difference ($P < 0.001$).

[a]>4 and > 5 drinks on one occasion by female and male students, respectively, or when explicitly stated by study's authors.

[b]Smoking 1–10 cigarettes per day.

[c]Smoking >10 cigarettes per day. *Sex-specific analyses were not conducted for daily heavy cigarette smokers.

Table 3 Percentage of students consuming less than the recommended daily servings of fruits and vegetables and not participating in sufficient regular physical activity

Study	Insufficient physical activity (%)[a]			Physically inactive (%)			<2 Daily servings fruit (%)			<3 Daily servings vegetables (%)			<5 Daily servings fruit & vegetables (%)		
	T	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*	*T*	*M*	*F*
Gresse, 2015[89]	78.8			48.8			66.7			65.0					
Bloemhoff, 2010[92]		24.2	40.5												
Pengpid, 2015[14]		21.4	22.0												
Janse van Rensburg, 2013[2]		14.6	31.5												
Porter, 2009[72]		52.0	63.3											18.8	15.1
Smith, 2009[96]		54.0													
Walter, 2011[91]			52.0			43.0									
Van den Berg, 2013[93]	1.9			0.0			58.4			98.1					
Viljoen, 2018[1]	31.05			6.42											
Kamanzi, 2005[73]	30.0														
Pengpid, 2021[32]	16.9												64.8		
Peltzer, 2000[49]					41.8	61.0									
Visser, 2019[98]					9.9	16.5									
Cilliers, 2006[94]						27.2									
Kazi, 2010[76]				37.4											
Van den Berg, 2012[33]							42.2			97.5					
Mean (%)	**39.0**			**34.8**			**61.7**			**75.0**			**44.8**		

Total, total; M, male; F, female.

[a]Explicitly stated by the study's authors or when the ACSM[22] and WHO[23] physical activity guidelines were not met.

that inadequate nutrition knowledge,[33,34] undesirable tastes and inconvenience[35] affect fruit and vegetable consumption amongst South African students. Furthermore, students living in private accommodation appear to have a lower rate of fruit and vegetable consumption compared with students living at home.[36–39] This may be due to independence with shopping choices[31] and increased availability of fruits and vegetables at university residences.[40] The food environment of South

African universities should also be assessed.[41] Specifically, students have claimed that fruits and vegetables are not easily available on campus.[41,42] Based on past successful interventions amongst South African youth,[43] campaigns should be implemented across universities.

Alcohol consumption

The percentage of South African students consuming alcohol is alarming, especially considering that South Africa has the highest alcohol consumption rate in Africa.[44] Students are also more likely to be involved in an accident after consuming alcohol.[45] These findings suggest that better management is required by universities. In particular, alcohol interventions have been shown to reduce alcohol consumption amongst South African students.[29]

A 24-country study revealed that South African students from Limpopo had a higher prevalence of heavy alcohol consumption (16.6%) compared with the study average (10.5%).[32] In comparison to other African countries (Ivory Coast, Madagascar, Mauritius, Namibia and Nigeria), South Africa had the second highest percentage of alcohol consumers after Namibia.[32] Similar findings of a high prevalence of alcohol consumption amongst South African students have been reported in other multi-country studies.[46] A study by Dantzer *et al*.[47] reported that South Africa had the lowest prevalence of alcohol consumers, but a similar prevalence of heavy alcohol consumers between South African and non-South African students. It is important to note that differences in alcohol consumption habits may depend on the faculty from which students are recruited, suggested by the varying faculties and prevalence percentages of this review's studies, and should be considered in future research.

A significantly higher percentage of alcohol consumption amongst male than female students is widely reported.[46,48–54] This may be due to female students holding stricter boundaries for alcohol consumption.[52] Young and de Klerk[55] observed an association between alcohol consumption and academic failures. Specifically, the pass rate for male students was lower than that observed for females, coincident with a higher prevalence of heavy drinking amongst males.[55] This may be due to missed lectures or feeling ill or determined by another variable.[55] However, there are also reports in which students negate poor academic performance as a consequence of alcohol consumption.[56–58] Notably, similar consequences amongst sexes for alcohol consumption were reported by Young and Mayson,[59] despite male students reporting higher levels of alcohol consumption. This suggests that females are more vulnerable to the effects of alcohol consumption, even when consuming less than males,[60] although further investigation is warranted.

Physical inactivity

It is evident that a high percentage of South African students are insufficiently active, despite physical activity recommendations equating to only 30 min per day.[22,23] It is noteworthy that patterns of physical inactivity during university are likely to continue throughout adult life.[9] Sparling *et al*.[10] observed that 81.3% of inactive students were still inactive 6 years after graduating, whilst a contrast was observed for active students. This is concerning considering that physical inactivity is the fourth leading risk factor for global mortality,[61] accounting for 14% of premature mortality in South Africa.[62]

Notably, the prevalence of insufficient physical activity observed in this systematic review is similar to students from other African countries, including Ivory Coast (41.5%), Madagascar (26.9%), Mauritius (23.0%), Namibia (22.0%) and Nigeria (36.1%).[32] Although the prevalence of inactivity amongst South African students in the former study[32] was half than that observed in this systematic review (16.9% versus 34.8–39.0%, respectively), the former study only included students from Limpopo, whereas this systematic review included data from multiple South African provinces.

Physical inactivity appears to be a global problem reported amongst four in every 10 students,[14] and may be due to the prolonged periods of time spent seated at a desk.[63] Other reported barriers include lack of motivation and time and unaffordability.[64] Further to this, university students are prone to academic, financial and emotional pressures, which may cause students to neglect exercise.[14,65] Universities should encourage exercise modalities that appeal to students' limited time and budget.

Cigarette smoking

Almost one-fifth of South African students included in this review smoked cigarettes. In comparison to other African countries, Pengpid and Peltzer[32] reported a lower prevalence of smokers from the Ivory Coast (5.3%), Madagascar (9.7%), Mauritius (11.7%), Namibia (8.7%) and Nigeria (4.0%) than what was observed in this systematic review. Interestingly, Steptoe *et al*.[66] observed a trend towards a lower prevalence of smokers in developing countries (including South Africa) compared with developed countries, although further investigation is warranted.

In line with international studies,[67–70] a significantly higher prevalence of cigarette smoking amongst male than female students was observed. Notably, 18 years appears to be the median age at smoking onset in South Africa[71]—the age at which most students begin at a university. This finding is supported by Vorster *et al*.[16] in which 15.9% of the second-year students who smoked began smoking within the past year. Additionally, Porter *et al*.[72] reported that the percentage

of smokers in university was more than double that of a South African high school. It also appears that being friends with a smoker plays a pivotal role in smoking initiation.[73]

Tobacco cessation interventions do not appear to be successful amongst South African students,[29,74] although Kamanzi *et al*.[73] observed that majority of the students had intentions to quit. Implementing outdoor 'smoke-free zones' within the vicinity of campuses may reduce smoking habits.[75] Students will need to move further away, limiting time for smoke-breaks between classes. However, this requires further investigation. Importantly, students do not appear to be aware of the health consequences attributable to smoking.[66,76] As such, education and cessation campaigns should be implemented concurrently.

What this study adds

The current findings shed light on NCD risk behaviours practised by South African university students. South African universities should aim to improve risk awareness amongst students through education campaigns alongside the implementation of targeted interventions.

Limitations of this study

This systematic review included a large number of students in the pooled percentages and reports novel research within South Africa. However, the studies used self-report questionnaires, which may increase the risk for recall bias and social desirability bias and eighteen studies did not report using validated questionnaires. Given the variability in university faculties and provinces, the findings may be influenced by sparse data bias and the generalizability of the findings is limited.

Conclusion

A large proportion of South African university students consume inadequate servings of fruits and vegetables, drink alcohol are insufficiently active and smoke cigarettes. Moreover, male students are significantly more likely than female students to drink alcohol and smoke cigarettes. Universities should support the implementation of screening measures and campaigns to reduce engagement in these NCD risk behaviours.

Supplementary data

Supplementary data are available at the *Journal of Public Health* online.

Acknowledgements

The authors would like to thank Stellenbosch University for their support on this review and Mr. Diribsa T. Bedada for his assistance as a biostatistician.

Financial support

This review received no grant from any funding agency, commercial or not-for-profit sectors.

Conflict of interest

None.

Authorship

All authors contributed to the study's conception and design. GEF, JMP and JGE conducted the literature searches and screening. GEF and JGE extracted the data and performed all data interpretations. All authors wrote and approved the final manuscript.

Ethical standards disclosure

The preparation of this review did not involve the recruitment of participants.

Data availability

All data used in the manuscript are presented in the tables and are available upon request from the corresponding author.

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