Prevalence and Co-Occurrence of Preventable Risk Factors for Noncommunicable Diseases in University Students

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Abstract

Background: Non-communicable diseases (NCDs) are the major cause of mortality globally. This study aimed to examine the prevalence and co-occurence of lifestyle risk factors in university students.

Methods: The research is as an analytical-cross-sectional study and it started in January 2022, lasted a total of 3 months until April 2022. A total of 485 students were included in the study. The structured data collection form was created by the researchers in the light of the literature review and face-to-face applied to students. This study's lifestyle risk variables for NCDs included physical inactivity, low fruit and vegetable consumption, alcohol use, tobacco use, being overweight/obesity and SSB consumption. The data was analyzed in the SPSS 2021 package program.

Results: The most frequent risk factor was insufficient physical activity (89.2%), followed by low fruits consumption (58.9%), low vegetable consumption (70.5%), alcohol consumption (44.5%), SSBs consumption (41.1%), tobacco use (25.2%), and being overweight or obesity (14.9%). Overall, 51.2% (46.5; 56.0) of students have a four or more risk factors. Co-occurrence of four or more lifestyle risk factors was significantly higher in students in private university (aOR:2.01 95% CI: 1.2; 3.35), living in student house (aOR:3.5795% CI: 1.96; 6.5), and fast food preference when eating outside (a0R:2.53 95% CI:1.62; 3.96).

Conclusions: Our findings point to potential interventions for NCD risk factors. More research is required to determine the impact of actions on risk factor reduction clustering and intervention-focused.

Background

Non-communicable diseases (NCDs) are the major cause of mortality globally. The prevalence of non-communicable diseases such as cancer, cardiovascular disease, respiratory diseases and diabetes continues to rise in all age groups across the world (1). To significantly reduce NCD deaths, policies that significantly reduce tobacco and alcohol use and hypertension, and increasing awareness of healthy nutrition and effective preventive steps are necessary (2).

It is important to raise public awareness of improving dietary practices and interventions aimed at reducing the disease burden caused by inadequate dietary intake, especially in developing countries and among men. Since non-communicable diseases have direct costs to health systems, it is also critique for policy makers to evaluate the prevalence of noncommunicable diseases risk factors and determine the global and national burden of diseases (3). On the other hand, indirect costs typically account for the majority of the overall economic burden of NCDs. These include the value of lost productive capacities resulting from people being unable to attend work or working less effectively due to NCD-related illness and eventual death. At the same time, transportation expenses for access to healthcare and various costs to employers in case of illness and death are among the indirect costs of NCDs. Non-communicable diseases constitute 45% of healthcare system expenditures in America and 51% of healthcare system expenditures in Germany (3).

The key should be maintaining especially lifestyle risk factors for noncommunicable diseases in adults as well as their concurrent occurrence in populations. Interaction of risk factors with each other can accelerate the emergence of the disease, and combining risk factors can increase the disease burden. Additionally, the presence of several lifestyle risk factors has been linked to an elevated risk of all-cause and cardiovascular disease mortality. Such evidence is critical for public health to address comprehensive interventions and decrease the disease burden due to the close-knit relationship between risk factors (4).

Major risk factors contributing to NCDs include unhealthy diets, tobacco use, alcohol use and physical inactivity. Therefore, these diseases are mostly preventable (5). As lifestyle changes especially nutrition transition have become the primary cause of the increasing prevalence of NCDs in recent years (6), it appears that nutritional therapy plays one of the most important factors in the multidisciplinary healthcare system. According to new findings of studies, nutritional assistances assure both clinical and cost benefits in the prevention and treatment of multiple noncommunicable diseases (7). There is also growing concern from a public health perspective that poor nutrition increases the potential risk of chronic diseases and nutritional problems (8).

NCDs have significant and increasing health and financial costs to individuals, families, the health system and the economy. Without prevention of common risk factors and early diagnosis of non-communicable diseases, there will be increased economic and social costs for society. Research is needed for appropriate intervention studies.

This study aimed to examine the prevalence and co-occurence of lifestyle risk factors (poor nutrition, physical inactivity, tobacco use, alcohol use, SSB consuming and being overweight/obesity) for non-communicable diseases among students enrolled in the Department of Nutrition and Dietetics of the Faculty of Health Sciences in one public and the other private of two universities.

Methods

The research is as an analytical-cross-sectional study and it started in January 2022, lasted a total of 3 months until April 2022. The study was carried out at the Faculty of Health Sciences of two universities which are one public and the other private. Students were contacted in their classrooms before class. Written informed consent form was obtained from all students included in the study.

The structured data collection form was created by the researchers in the light of the literature review and face-to-face applied to students. This study's lifestyle risk variables for NCDs included physical inactivity, low fruit and vegetable consumption, alcohol use, tobacco use, being overweight/obesity and SSB consumption. Anthropometric measures and self-reported information on health, household characteristics, and living circumstances were gathered by the researchers.

Population

The research sample was selected as all Nutrition and Dietetics students of the Faculty of Health Sciences. According to the G power analysis conducted considering 80% power, 0.05 margin of error, medium effect size and 10% losses, it was aimed to reach the entire population without falling below at least 320 people and the study was completed by including 265 people from the state university and 220 people from the private university. During the data collection process, students who did not attend the course, filled out the data collection form incompletely, and participated in the pilot application were excluded from the study and the study was completed with a total of 485 students.

Questionnaire

Height (cm) and weight (kg) were questioned objectively, and BMI was calculated with the formula weight/height2 to determine whether they were normal weight (≤ 24.9 kg/m2), overweight (25.0-29.9 kg/m2) or obese (≤ 30 kg/m2). Being overweight and obese has been considered a risk factor. Physical activity level (frequency of moderate or high intensity physical activity lasting at least 30 minutes without interruption) was questioned as almost every day, 5–6 days a week, 2–4 days a week and 1 day or less a week, and activity levels were evaluated. A physical activity level of less than 150 minutes per week is considered insufficient physical activity level as a risk factor. Smoking was classified as active smoker, previously smoked but later quit, or non-smoker. Active smoking has been accepted as a risk factor. Alcohol consumption was assessed by asking, “Have you drank alcohol at least once in the last month?” was used to examine current alcohol consumption. A positive answer to this question was considered to be using alcohol. Frequency of alcohol use was questioned by asking "frequency of consuming alcoholic beverages in the amount of one glass/glass of wine" and classifying it as almost every day, 4–6 days a week, 1–3 days a week, a few days a month, less or not at all. Alcohol use has been accepted as a risk factor.

Food consumption was recorded and consumption of four or fewer vegetables per week was classified as low vegetable consumption, and consumption of four or fewer fruits per week was classified as low fruit consumption. Sugar sweetened beverages (SSBs) drink consumption was questioned, those who never drank or drank occasionally (a few days a month) were combined, and consuming SSBs at least 1 day a week was considered a risk factor. As a result, the risk factors in this study were classified as insufficient physical activity level, smoking, alcohol use, low consumption of vegetables and fruits, overweight or obesity, and consumption of SSBs.

Statistics

The data was analyzed in the SPSS 2021 package program (9). Prevalences and 95% confidence intervals (95% CI) were calculated to identify risk factors for noncommunicable diseases according to sociodemographic characteristics. Difference analyzes between measurement type variables were examined with t test. Count type variables were compared according to sociodemographic characteristics using the chi-square test.

One hundred and twenty-eight potential combinations of the seven risk factors were analyzed (all combinations of seven variables = 2^7). Some combination groups were excluded because no one was included, a total of 77 combinations were included. Having risk

factors at the same period was considered co-occurrence. Having four or more risk factors was considered the threshold for identifying a co-occurrence, and after this threshold, the rates fell suddenly.

A multivariable logistic regression model was built to examine the odds ratios (ORs) and its 95% confidence intervals (CI) for the association between determined variables (sex, age, education level) and four or more risk factors. Statistical significance was accepted as $p < 0.05$ in all analyzes.

Results

The total number of students included in the study was 265 (54.6%) from the state university and 220 (45.4%) from the private university a total of 485 (86.6% women) with a mean age of 21.21 ± 3.10 years. Overall, 23.5% were in the first year of university, 30.5% were in the second, 24.3% were in the third, and 21.8% were in the fourth year of the university. 34.4% of the students lived in the student house during their university education, and 29.5% lived with family.

Table 1 shows the prevalence and 95% confidence intervals of determined risk factors for the students. Overall, the most frequent risk factor was insufficient physical activity (89.2%), followed by low fruits consumption (58.9%), low vegetable consumption (70.5%), alcohol consumption (44.5%), SSBs consumption (41.1%), tobacco use (25.2%), and being overweight or obesity (14.9%). Students living in students house have higher prevalence tobacco (34.5%) and alcohol consumption (58.2%). On the other hand, low vegetable (76.0%) and fruit prevalence (67.3%) was higher in students living in dorm. SSBs consumption was more prevalent Grade 1 students.

Table 1
Prevalence and 95% confidence intervals of risk factors for non-communicable diseases

	Insufficient physical activity	Tobacco use	Alcohol consumption	Low vegetable consumption	Low fruit consumption	Overweight or obesity	SSBs consumption
Gender							
Female	91.9 (88.8; 94.3)	24.8 (20.7; 29.2)	43.3 (38.5; 48.2)	70.0 (65.3; 74.4)	58.7 (53.8; 63.5)	12.2 (9.2; 15.7)	39.0 (34.1; 44.0)
Male	73.0 (60.3; 83.4)	28.1 (17.6; 40.8)	53.1 (40.2; 65.7)	74.2 (61.5; 84.5)	59.7 (46.4; 71.9)	32.8 (21.6; 45.7)	55.7 (42.4; 68.5)
Age							
18–20 years	90.2 (85.5; 93.7)	22.6 (17.3; 28.6)	43.8 (37.2; 50.5)	76.6 (70.4; 82.0)	61.3 (54.5; 67.7)	13.8 (9.6; 19.1)	50.0 (43.0; 57.0)
≥ 21 years	88.4 (83.8; 92.0)	27.4 (22.1; 33.3)	45.2 (39.0; 51.5)	65.2 (59.0; 71.1)	56.7 (50.4; 62.9)	15.9 (11.7; 20.9)	33.6 (27.7; 39.9)
Grade							
Grade 1	90.4 (83.4; 95.1)	21.1 (14.0; 29.7)	43.0 (33.7; 52.6)	69.6 (60.2; 78.0)	60.7 (51.0; 69.8)	14.2 (8.3; 22.0)	51.8 (42.1; 61.3)
Grade 2	89.7 (83.5; 94.1)	25.0 (18.3; 32.8)	40.5 (32.6; 48.9)	76.6 (68.8; 83.2)	57.6 (49.1; 65.8)	17.1 (11.4; 24.2)	41.7 (33.0; 50.8)
Grade 3	84.7 (77.0; 90.7)	24.6 (17.1; 33.4)	46.6 (37.4; 56.0)	76.9 (68.2; 84.2)	63.2 (53.8; 72.0)	13.6 (8.0; 21.1)	41.5 (32.5; 51.0)
Grade 4	92.4 (85.5; 96.7)	30.5 (21.9; 40.2)	49.5 (39.6; 59.5)	55.4 (45.2; 65.3)	53.5 (43.3; 63.5)	14.3 (8.2; 22.5)	28.0 (19.5; 37.9)
University							
Public	87.5 (83.0; 91.3)	22.3 (17.4; 27.8)	42.3 (36.2; 48.5)	69.9 (63.9; 75.5)	62.7 (56.5; 68.7)	16.7 (12.4; 21.7)	37.3 (31.4; 43.4)
Private	91.2 (86.7; 94.6)	28.6 (22.8; 35.1)	47.3 (40.5; 54.1)	71.2 (64.7; 77.1)	54.3 (47.5; 61.1)	12.8 (8.7; 18.0)	46.4 (39.2; 53.7)
Mother's education level							
Primary or secondary school	89.7 (84.3; 93.7)	22.3 (16.5; 29.0)	34.8 (27.9; 42.1)	70.2 (62.9; 76.8)	60.1 (52.5; 67.4)	14.7 (9.9; 20.6)	36.7 (29.6; 44.3)
High school or university	89.2 (85.0; 92.5)	27.2 (22.2; 32.6)	50.7 (44.8; 56.5)	71.1 (65.5; 76.2)	58.4; 52.5; 64.1)	15.3 (11.3; 19.9)	44.0 (38.1; 50.1)
Father's education level							
Primary or secondary school	90.8 (84.9; 95.0)	23.6 (16.9; 31.4)	38.9 (30.9; 47.4)	66.4 (58.0; 74.2)	58.6 (49.9; 66.8)	16.0 (10.4; 23.0)	37.5 (29.4; 46.2)

	Insufficient physical activity	Tobacco use	Alcohol consumption	Low vegetable consumption	Low fruit consumption	Overweight or obesity	SSBs consumption
Gender							
High school or university	88.1 (84.1; 91.4)	26.0 (21.3; 31.1)	46.8 (41.3; 52.4)	73.4 (68.2; 78.1)	59.3 (53.7; 64.7)	14.5 (10.9; 18.8)	43.0 (37.4; 48.8)
Residence during education							
Living with family	89.4 (83.1; 93.9)	18.2 (12.2; 25.5)	34.3 (26.5; 42.7)	64.5 (56.0; 72.4)	45.4 (37.0; 54.0)	14.8 (9.4; 21.7)	32.8 (24.9; 41.6)
Student house	87.9 (81.9; 92.4)	34.5 (27.3; 42.3)	58.2 (50.3; 65.8)	69.8 (62.1; 76.7)	61.5 (53.5; 69.0)	18.2 (12.6; 24.9)	39.9 (32.2; 48.0)
Dorm	90.3 (84.9; 94.2)	21.6 (15.8; 28.4)	40.3 (33.0; 48.0)	76.0 (68.9; 82.2)	67.3 (59.7; 74.2)	12.1 (7.6; 17.9)	48.5 (40.7; 56.3)

Table 2 shows the prevalence of the co-occurrence of all combinations of the seven risk factors. Among the combinations, four risk factors (28.9%) had the highest prevalence, followed by three risk factors (22.6%) and two risk factors (18.3%). The highest prevalence (9.9%) observed in combinations of risk factors was the co-occurrence of insufficient physical activity level, low vegetable and fruit consumption, and SSB consumption. The observed prevalence of individuals with no risk factors is 0.9%, while that of individuals with all risk factors is 0.5%. When risk factors were examined alone, the highest prevalence was insufficient physical activity (89.2%, *95% CI: 86.1; 91.9*), followed by low vegetable consumption (70.5%, *95%CI: 66.3, 74.7*), low fruit consumption (58.9%, *95% CI:54.2; 63.7*), alcohol consumption (44.5%, *95% CI:40.6; 49.1*), SSB consumption (41.1%, *95% CI:36.8; 45.5*), tobacco use (25.2%, *95% CI:21.6; 29.3*) and being obesity/overweight (14.9%, *95% CI: 11.8; 18.3*).

Table 2
Co-occurrence of risk factors for non-communicable diseases

	Insufficient physical activity	Tobacco use	Alcohol consumption	Low vegetable consumption	Low fruit consumption	Overweight or obesity	SSB consumption	Observed prevalence (%)
7 (0.5%)	+	+	+	+	+	+	+	0.5
6 (5.6%)	+	+	+	+	+	+	-	0.2
	+	+	+	+	+	-	+	3.9
	+	+	+	-	+	+	+	0.2
	+	+	-	+	+	+	+	0.5
	+	-	+	+	+	+	+	0.9
5 (16.3%)	+	+	+	+	+	-	-	5.1
	+	-	-	+	+	+	+	0.5
	+	+	+	-	-	+	+	0.2
	-	+	+	+	+	+	-	0.2
	+	-	+	+	+	+	-	1.2
	+	-	+	-	+	+	+	0.2
	+	+	-	+	-	+	+	0.7
	+	+	+	-	+	-	+	0.2
	-	+	+	+	+	-	+	0.9
	+	-	+	+	+	-	+	4.8
	+	+	-	+	+	-	+	0.9
4 (28.9%)	+	+	+	+	-	-	-	1.8
	+	+	+	-	+	-	-	0.7
	+	+	+	-	-	-	+	0.9
	+	+	-	+	+	-	-	0.7
	+	+	-	+	-	+	-	0.5
	+	+	-	-	+	+	-	0.2
	+	+	-	-	+	-	+	0.5
	+	-	+	+	+	-	-	6.2
	+	-	+	+	-	+	-	0.9
	+	-	+	+	-	-	+	2.5
	+	-	+	-	+	+	-	0.5
	+	-	+	-	+	-	+	0.7
	+	-	+	-	-	+	+	0.5
	+	-	-	+	+	+	-	0.9
	+	-	-	+	+	-	+	9.9

The presence of risk factors is shaded grey.

	Insufficient physical activity	Tobacco use	Alcohol consumption	Low vegetable consumption	Low fruit consumption	Overweight or obesity	SSB consumption	Observed prevalence (%)
	+	-	-	+	-	+	+	0.2
	+	-	-	-	+	+	+	0.2
	-	+	+	+	-	+	-	0.2
	-	+	+	-	+	+	-	0.2
	-	+	+	-	-	+	+	0.5
	-	+	-	+	+	+	-	0.2
	-	-	-	+	+	+	+	0.2
	-	-	+	+	+	-	+	0.2
3 (22.6%)	-	-	-	+	+	-	+	0.2
	-	-	+	-	+	+	-	0.2
	-	-	+	+	-	-	+	0.2
	-	+	+	-	-	-	+	0.2
	-	+	+	-	-	+	-	0.2
	-	+	+	+	-	-	-	0.2
	+	-	-	-	-	+	+	0.7
	+	-	-	-	+	-	+	0.7
	+	-	-	+	-	-	+	2.3
	+	-	-	+	-	+	-	0.9
	+	-	-	+	+	-	-	9.7
	+	-	+	-	-	-	+	0.9
	+	-	+	-	+	-	-	1.6
	+	-	+	+	-	-	-	2.8
	+	+	-	-	-	-	+	0.2
	+	+	+	-	-	-	-	0.7
	+	+	-	-	+	-	-	0.7
	+	+	-	+	-	-	-	0.2
2 (18.3%)	-	-	-	-	-	+	+	0.5
	+	+	-	-	-	-	-	0.7
	-	+	+	-	-	-	-	0.2
	-	-	+	+	-	-	-	0.5
	-	-	-	+	+	-	-	1.2
	-	-	-	-	+	+	-	0.2
	+	-	-	-	-	-	+	2.5

The presence of risk factors is shaded grey.

	Insufficient physical activity	Tobacco use	Alcohol consumption	Low vegetable consumption	Low fruit consumption	Overweight or obesity	SSB consumption	Observed prevalence (%)
	-	+	-	-	-	-	+	0.2
	+	-	+	-	-	-	-	1.4
	-	+	-	+	-	-	-	0.2
	+	-	-	+	-	-	-	5.5
	+	-	-	-	+	-	-	3.5
	+	-	-	-	-	+	-	1.4
	-	-	+	-	-	+	-	0.2
	-	+	-	-	+	-	-	0.2
1 (7.0%)	-	-	-	+	-	-	-	0.9
	-	-	+	-	-	-	-	0.2
	+	-	-	-	-	-	-	6.2
0 (0.9%)	-	-	-	-	-	-	-	0.9

The presence of risk factors is shaded grey.

Overall, 51.2% (46.5; 56.0) of students have a four or more risk factors. Students who have four or more risk factors were more likely to live in student houses (39.1%) and prefer fast food when eating out (59.5%). Moreover, among students with four or more risk factors, the prevalence of students with five or more hours of daily screen time is higher (60.1%) than those with fewer risk factors. The average daily water intake is higher with 26.22 ± 11.14 in students with three or more risk factors (Table 3).

Table 3
Comparing four or more risk factors for sociodemografic variables

		Three or less risk factors	Four or more risk factors	*p*
Overall		48.8% (44.0; 53.5)	51.2% (46.5; 56.0)	
Age (n = 443)	*18–20 years*	90 (41.7%)	114 (50.2%)	*0.071*
	≥ 21 years	126 (58.3%)	113 (49.8%)	
Gender (n = 443)	*Female*	192 (88.9%)	193 (85.0%)	*0.228*
	Male	24 (11.1%)	34 (15.0%)	
University (n = 443)	*Public*	131 (60.6%)	122 (53.7%)	*0.142*
	Private	85 (39.4%)	105 (46.3%)	
Grade (n = 443)	*Grade 1*	50 (23.1%)	59 (26.0%)	*0.424*
	Grade 2	57 (26.4%)	64 (28.2%)	
	Grade 3	55 (25.5%)	62 (27.3%)	
	Grade 4	54 (25.0%)	42 (18.5%)	
Residence (n = 432)	*Living with family*	74 (34.9%)	52 (23.6%)	*0.026*
	Student house	64 (30.2%)	86 (39.1%)	
	Dorm	74 (34.9%)	82 (37.3%)	
Frequency of eating outside (n = 433)	*Less than once a week*	83 (39.2%)	45 (20.4%)	*< 0.001*
	1–3 times per week	87 (41%)	102 (46.2%)	
	Four or more times a week	42 (19.8%)	74 (33.5%)	
Preference of eating outside (n = 431)	*In dining hall or one-pot meals*	103 (61.7%)	64 (38.3%)	*< 0.001*
	Fast food	107 (40.5%)	157 (59.5%)	
Daily screen time (n = 434)	*Less than 5 hours*	107 (50.7%)	89 (39.9%)	*0.020*
	5–9 hours	97 (46.0%)	116 (52.0%)	
	10 hours or more	7 (3.3%)	18 (8.0%)	
		Mean ± SD	**Mean ± SD**	
		4.77 ± 2.17	5.36 ± 2.38	*0.007*
Daily water intake (ml/kg) (n = 420)		26.22 ± 11.14	23.96 ± 11.08	*0.038*
SD: Standart deviation				

Multivariable logistic regression analysis for the co-occurrence of four or more risk factors for NCDs is shown in Table 4. Co-occurrence of four or more lifestyle risk factors was significantly higher in students in private university (aOR:2.01 95% CI: 1.2; 3.35), living in student house (aOR:3.57 95%CI: 1.96; 6.5), and fast food preference when eating outside (a0R:2.53 95% CI:1.62; 3.96). Conversely, there was a reverse association between daily water intake (a0R:0.98 95% CI:0.96; 0.998) with four or more risk factors.

Table 4
Multivariable logistic regression analysis for selected sociodemographic characteristics and co-occurrence of four or more risk factors for non-communicable diseases *(n = 407; R^2 = 0.164)*

	aOR (95% CI)	*p*
University *Public*		
Private	2.01 (1.2; 3.35)	*0.008*
Grade *Grade 1*		*0.505*
Grade 2	0.98 (0.53; 1.79)	*0.941*
Grade 3	1.00 (0.53; 1.89)	*1.00*
Grade 4	0.62 (0.28; 1.35)	*0.226*
Age *18–20 years*		
> 21 years	0.98 (0.59; 1.65)	*0.946*
Gender *Female*		
Male	1.67 (0.88; 3.19)	*0.117*
Mother's education level *high school or university*		
Primary or secondary school	0.73 (0.47; 1.14)	*0.169*
Residence *Living with family*		*< 0.001*
Student house	3.57 (1.96; 6.5)	*< 0.001*
Dorm	2.47 (1.34; 4.56)	*0.004*
Daily screen time *Less than 5 hours*		*0.459*
5–9 hours	1.25 (0.80; 1.95)	*0.329*
10 hours or more	1.67 (0.61; 4.62)	*0.322*
Daily water intake (ml/kg)	0.98 (0.96; 0.998)	*0.031*
Preferences of eating outside *In dining hall or one–pot meals*		
Fast food	2.53 (1.62; 3.96)	*< 0.001*
OR: odds ratio, 95% CI: confidence interval 95%. References are shown as superscripts.		

Discussion

We evaluated the prevalence and co-occurrence of determined risk factors for NCDs and examined the co-occurrence of lifestyle risk factors considering socio-demographic characteristics in university students in this study, we evaluated the prevalence and co-occurrence of determined risk factors for NCDs and examined the co-occurrence of risk factors according to sociodemographic characteristics.

We found a significant prevalence of risk factor co-occurrence in more than half of the research population (51.2%; 95% CI: 46.5–56.0) having four or more risk factors. Moreover, there was a reverse association between daily water intake with four or more risk factors. Previous studies show that risky behaviours commonly co-occur, with 52% in the USA (10), 55% in the Netherlands (11), 59% in Brazil (12) and 68% in England (13). Correspondingly, four lifestyle risk variables (inadequate fruit and vegetable intake, smoking, alcohol drinking, and poor physical activity) were studied in research targeted at the co-occurrence and clustering profiles of

cardiovascular lifestyle risk factors among adults in West Africa. The prevalence of two or more cardiovascular lifestyle risk factors co-occurring was nearly half (46.4%; 95% CI: 43.1–49.7) (14).

Among the seven risk variables presented, several combinations might occur, we found the most common combinations of risk factors were the co-occurrence of insufficient physical activity level, low vegetable and fruit consumption, and SSB consumption, which indicate in particular increased risk group for NCDs. Similarly, a systematic review found that especially high prevalence of insufficent physical activity and low fruit and vegetable intake (15). These findings coherent with data from other countries including United States (16), where low fruit and vegetable intake and physical inactivity were the most common co-occurring behaviours. Most studies in the literature put on adult populations at the center; with fewer studies considering younger or older adults and students. It should be noted that the primary limitations of studies with co-occurrence were fluctuated cut-offs of risk attitudes. These limitations make it harder to compare research and are likely to contribute to the observed variability in most data.

We found no association between having four or more risk factors and students' mothers' education level. Similarly, another study which is aimed to determine co-occurence risk behaviours among Bangladeshi students found no relationship with co-occurence of five or more risk factors (17). Another study conducted with Brazilian adolescents found that except for frequent ultra-processed food intake, stundets whose moms were better educated had a lower frequency of all risk factors (irregular eating of fruits and vegetables, insufficient physical activity and smoking) (18). In the aforementioned study, "irregular consumption of fruits and vegetables" was defined ≥ 5 times in a week, as in our study. The fact that the study was conducted on adolescents and the age range was quite wide may be the reason for the different results from our study. Additionally, in the aforementioned study, the sale of tobacco and alcohol to adolescents is prohibited in Turkey, as in Brazil. This can be explained by the age group difference in the higher tobacco use and alcohol consumption in our study.

This study findings show that an inverse relationship between daily water intake and having four or more risk factors. Although there is no clustered study on co-occurrence risk factors for NCDs and daily water consumption, one prospective study found that higher water intake is related with lower risk of mortality (19). Similarly, a systematic review of prospective cohort studies demonstrated that higher total water consumption is linked to a decreased risk of CVD mortality (20). Since proper hydration and water consumption are required for important physiological and metabolic functions, comprehending the relationship between water consumption and NCD risk factors is critical for policymakers.

The research on this topic is exceptionally heterogeneous, with different approaches for defining and assessing risk factors and no consensus on which risk factors typically occur together (18). Thus, there is a need for studies that cluster and comprehend different risk factors for NCDs and include different age groups, especially university students.

We have some limitations in the study. It should be underlined that this study relied on self-reported habits, which might have resulted in information bias, potentially underestimating the prevalence of risky behaviours. In our study, due to the female population being in the majority, selecting two universities, one private and the other public, may have created a bias in the results.

Conclusions

Our findings point to potential interventions for NCD risk factors. More research is required to determine the impact of actions on risk factor reduction clustering and intervention-focused. Although NCDs are mostly an issue for adults and the elderly, however they are progressively appearing at a far younger age. Future research is needed with different clustering of risk factors and comprehensive data with NCDs.

Declarations

Ethics approval and consent to participate

The research was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Aydin Adnan Menderes University Faculty of Medicine Clinical Research Ethics Committee (protocol no. 2021/047, dated 30 November 2021). Written informed consent form was obtained from all students included in the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interest.

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Authors' contributions

S.G.E., and I.C contributed to the design and implementation of the research, to the analysis of the results. I.C. contributed to the writing of the manuscript. S.G.E. encouraged I.C. to investigate and supervised this work.

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