

**Vinnikov D.<sup>1</sup>, Romanova Zh.<sup>2</sup>, Dushpanova A.<sup>3</sup>, Absatarova K.<sup>4</sup>,  
Utepbergenova Zh.<sup>5</sup>, Ualiyeva A.<sup>6</sup>, Dr. Kaushal K Tiwari<sup>7</sup>**

<sup>1</sup>MD, PhD, MPH, e-mail: denisvinnikov@mail.ru

<sup>2</sup>MD, PhD, e-mail: Zhanna.Romanova@kaznu.kz

<sup>3</sup>MD, PhD, Acting assistant Professor, e-mail: Anar.Dushpanova@kaznu.kz

<sup>4</sup>Master of Mathematics, e-mail: Karashash.Absatarova@kaznu.kz

<sup>5</sup>MPH, e-mail: Zhazira.Utepbergenova@kaznu.kz

<sup>6</sup>MPH, e-mail: Aliya.Ualiyeva@kaznu.kz

Al-Farabi Kazakh National University, Almaty, Kazakhstan

<sup>7</sup>MD, MS, IMCS, PhD, Associate Professor, Kathmandu University College of Medical Sciences,  
Teaching Hospital Bharatpur, Chitwan Nepal

**PREDICTORS OF PHYSICAL ACTIVITY  
IN KAZAKHSTAN UNIVERSITY STUDENTS**

Assessing physical activity in Kazakhstan university students and identifying its predictors may help plan, advocate and implement effective public health interventions. This cross-sectional survey of 889 students of all years of study at al-Farabi Kazakh National University was completed in May 2017. Selected variables were tested in adjusted logistic regression models to predict regular physical activity (RPA) or walking 6 km every day. Sixty-one percent of female and 54% of male students ( $p < 0.05$ ) walked 6 km a day. 54% of female and 72% of male students ( $p < 0.001$ ) exercised at least 3 times a week for 40 min. Being a male (adjusted odds ratio (OR) 2.04 (95% confidence interval (CI) 1.47;2.84) and sleeping for 8 hours predicted RPA (OR 1.47 (95% CI 1.07;2.01)). Alcohol use (OR 0.44 (95% CI 0.30;0.65)), waterpipe smoking (OR 0.53 (95% CI 0.37;0.75) and sleeping 8 hours (OR 1.67 (95% CI 1.20;2.33)) predicted walking 6 km a day or more. Identified health disparity between female and male students should guide public health interventions in the university students' community.

**Key words:** physical, training, university, health behavior, tobacco, students

**Винников Д.<sup>1</sup>, Романова Ж.<sup>2</sup>, Душпанова А.<sup>3</sup>, Абсатарова К.<sup>4</sup>,  
Утепбергенова Ж.<sup>5</sup>, Уалиева А.<sup>6</sup>, Dr. Kaushal K Tiwari<sup>7</sup>**

<sup>1</sup>PhD, MPH, e-mail: denisvinnikov@mail.ru

<sup>2</sup>М.Ф.К., e-mail: Zhanna.Romanova@kaznu.kz

<sup>3</sup>PhD, доцент м.а., e-mail: Anar.Dushpanova@kaznu.kz

<sup>4</sup>Математика магистрі, e-mail: Karashash.Absatarova@kaznu.kz

<sup>5</sup>MPH, e-mail: Zhazira.Utepbergenova@kaznu.kz

<sup>6</sup>MPH, e-mail: Aliya.Ualiyeva@kaznu.kz

әл-Фараби атындағы Қазақ ұлттық университеті, Қазақстан, Алматы қ.,

<sup>7</sup>MD, MS, IMCS, PhD, доцент, Катманду университетінің медицина ғылымдарының колледжі,  
Бхаратпур педагогикалық ауруханасы, Читван, Непал

**Қазақстандық жоо студенттерінің  
физикалық белсенділігінің предикторлары**

ЖОО студенттерінің физикалық белсенділігінің деңгейін арттыруға бағытталған қоғамдық денсаулық сақтаудың тиімді бағдарламаларын жоспарлау, қорғау және жүзеге асыру үшін өмір сүру салтының аталған компонентін бағдарлау қажет. Ұсынылып отырған зерттеуге ҚазҰУ барлық білім алу деңгейлерінің 889 студенті қатысты. Біз регрессиялық талдау арқылы тұрақты физикалық белсенділіктің (ТФБ) және күнделікті 6 километр жаяу жүрудің жеке предикторларының рөлін бағаладық. Күнделікті қыздардың 61% және жігіттердің 54% ( $p < 0,05$ ) 6 км-ден жаяу жүретіні анықталды. Қыздардың 54% және жігіттердің 72% ( $p < 0.001$ ) кем дегенде 40 минут бойы

аптасына кем дегенде 3 рет тұрақты физикалық белсенділікпен айналысады. Ерлер жынысы (түзетілген мүмкіндік коэффициенті (МҚ) 2,04 (95% сенім аралықтары (СА) 1,47;2,84) және күніне 8 сағат ұйқы (МҚ 1,47 (95% СА 1,07; 2,01) ТФБ-пен ассоциацияланған болып шықты. Алкоголь ішу (МҚ 0,44 (95% СА 0,30;0,65)), кальян шегу (МҚ 0,53 (95% СА 0,37;0,75) және тәулігіне 8 сағат ұйқы (МҚ 1,67 (95% СА 1,20;2,33)) күнделікті 6 км жаяу жүрумен байланысты екені анықталды. Анықталған физикалық белсенділік деңгейінің жынысқа байланысты айырмашылықтары университеттер студенттері арасында салауатты өмір салтын насихаттау бойынша іс-шараларды жоспарлауға көмектеседі.

**Түйін сөздер:** физикалық белсенділік, университет, салауатты өмір салты, темекі шегу, студенттер.

Винников Д.<sup>1</sup>, Романова Ж.<sup>2</sup>, Душпанова А.<sup>3</sup>, Абсатарова К.<sup>4</sup>,  
Утепбергенова Ж.<sup>5</sup>, Уалиева А.<sup>6</sup>, Dr. Kaushal K Tiwari<sup>7</sup>

<sup>1</sup>PhD, MPH, e-mail: denisvinnikov@mail.ru

<sup>2</sup>к.м.н, e-mail: Zhanna.Romanova@kaznu.kz

<sup>3</sup>MD, PhD, доцент, e-mail: Anar.Dushpanova@kaznu.kz

<sup>4</sup>магистр математики, e-mail: Karashash.Absatarova@kaznu.kz

<sup>5</sup>MPH, e-mail: Zhazira.Utepbergenova@kaznu.kz

<sup>6</sup>MPH, e-mail: Aliya.Ualiyeva@kaznu.kz

Казахский национальный университет им. аль-Фараби, Казахстан, г. Алматы  
<sup>7</sup>MD, MS, IMCS, PhD, доцент, колледж медицинских наук Университета Катманду,  
университетская клиника Бхаратпур, Читван, Непал

### Предикторы физической активности студентов казахстанского вуза

С целью планирования, адвокации и реализации эффективных программ общественного здравоохранения, направленных на повышение уровня физической активности студентов ВУЗов, необходим мониторинг этого компонента образа жизни. В настоящее поперечное исследование было включено 889 студентов КазНУ всех уровней обучения. Мы оценивали роль отдельных предикторов регулярной физической активности (РФА) и ежедневного прохождения 6 километров с помощью множественного регрессионного анализа. 61% девушек и 54% парней ( $p < 0,05$ ) ежедневно проходили 6 км. 54% девушек и 72% парней ( $p < 0,001$ ) занимались РФА, по меньшей мере, 3 раза в неделю в течение, по меньшей мере, 40 минут. Мужской пол (скорректированное отношение шансов (ОШ) 2,04 (95% доверительный интервал (ДИ) 1,47;2,84) и сон в течение 8 часов в день (ОШ 1,47 (95% ДИ 1,07;2,01) были значимо ассоциированы с РФА. Употребление алкоголя (ОШ 0,44 (95% ДИ 0,30;0,65)), курение кальяна (ОШ 0,53 (95% ДИ 0,37;0,75) и сон в течение 8 часов в день (ОШ 1,67 (95% ДИ 1,20;2,33)) были значимо ассоциированы с ежедневным прохождением 6 км. Выявленные половые различия в уровне физической активности помогут спланировать будущие мероприятия по продвижению здорового образа жизни среди студентов университетов.

**Ключевые слова:** физическая активность, университет, здоровый образ жизни, курение, студенты.

### Introduction

Physical activity is one of the most meaningful constituents of lifestyle and health behaviors, whereas moderate or vigorous activity are amongst the basic recommendations to reduce the burden of a number of medical conditions and complications (Milton 2014: 369–381). Moderate and vigorous physical activity levels range substantially between countries, with a trend towards lower activity in high-income countries. Abundant epidemiological evidence confirms a strong link between physical inactivity and all-cause mortality, cardiovascular disease, diabetes and even cancer, similarly relevant for low-income countries (Milton 2014: 369–381). Despite apparent association of healthier lifestyle

and more physical activity with improved health outcomes, relevant health policy to sustain these lifestyle attributes are largely lacking in many low-income countries worldwide (Lachat 2013: e1001465).

Various scales are proposed to monitor physical activity in both sexes, but they all yield consistent conclusions on low physical activity of both men and women in Central Asia and in Kazakhstan in particular. In Kazakhstan, economy in transition, the population is believed to have low physical activity scores, and such evidence was drawn from a series of epidemiological surveys (Atkinson 2016: 40–45). Despite increasing number of existing amateur health clubs and fitness centers in Kazakhstan (Moldasheva 2016: 53–57), the prevalence of

physical inactivity still remains unacceptably low, such as 13.6% in men and 11.9% in women (Guthold 2008: 486-494). Using alternative metrics, they report somewhat 25% men involved in vigorous and 42% in moderate activities, whereas these estimates equal 13% and 34% in women (Bosdriesz 2012: 110). Such low physical activity is most alarming given growing economic opportunities in Kazakhstan sometime in mid-2000s, especially when compared to greater physical activity levels in the neighboring Kyrgyzstan with poorer resources (Cockerham 2004: 1409–1421).

These epidemiological surveys report on the representative samples; however, no specific study was conducted or published in Kazakhstan university students to date. Moreover, we found no data in the literature on the multivariate analysis of predictors of selected levels of physical activity in Kazakhstan university students, which would help address public health policy gaps in engaging students in more active lifestyle, as recommended by the WHO (Organization WH 2012). In addition, given likely association of students' physical activity with tobacco use, the association of tobacco consumption with levels of physical activity in Kazakhstan university students would be of great interest, especially if to consider very high prevalence of waterpipe use in Kyrgyzstan students, shown recently (Mahalik 2007: 2201–2209). Therefore, the aim of this study was to assess physical activity in Kazakhstan university students and identify its predictors in order to plan, advocate and implement effective public health interventions.

## Methods

### *Study design*

This was a cross-sectional survey using a self-administered questionnaire. Students of all years of study from al-Farabi Kazakh National University (N total 889) were invited to participate and fill the questionnaire in either Russian or Kazakh. The university is the number one rated university in Republic of Kazakhstan and located in the center of Almaty, the largest city in the country. The university offers undergraduate and graduate education in a wide range of specialties, including, but not limited to physics, chemistry, biology, biotechnology, political science, social science, philosophy, language studies, history, IT, ecology and public health. We completed data collection in spring 2017. Questionnaire was offered to a selected sample of the university students off classes; all questionnaires were anonymous, and no personal

information was collected in this study. The study protocol was approved by the Committee on Bioethics of the School of Public Health.

### *Questionnaire*

We have created our own questionnaire with 45 questions mainly focused on lifestyle and health behavior. On inception, the questionnaire was compiled in Russian, but later translated to Kazakh and validated with back translation in focus groups. Demographic data part consisted of five questions on the date of birth, school, sex, year of study and the date, followed by three questions on socioeconomic status. The latter asked whom the responder lives with, preferred method of transportation to the study venue (walking, public transportation or driving), and the cumulative monthly income. The following seven questions were a detailed history of cigarette smoking status, including willingness to cease smoking. We then asked about waterpipe smoking and the use of electronic cigarettes or snus (chewed smokeless tobacco). This section also inquired about the attitudes, such as «How sure are you that smoking cigarettes is associated with a number of chronic conditions, including almost all cancer, chronic obstructive pulmonary disease and other?».

Alcohol consumption was verified with two questions, also with details on the choice of beverage. Three more questions asked about compliance with the recommendation to sleep 8 hours a day, the time of going the bed and any daytime sleepiness. Physical activity part was the broadest section in the questionnaire. We first asked whether the student walked the recommended 10,000 steps or roughly 6 km a day including weekends, and whether he/she was engaged in a moderate or strenuous physical activity off campus at least 3 times a week for 40 min or more in another question. For convenience in data interpretation, we named the latter outcome as regular physical activity (RPA). These two variables were then treated as the outcomes in this study. In the following set of questions, we offered a list of types of RPA, such as volleyball, soccer or basketball; gym or powerlifting; dancing; yoga and other. This section ended with a question whether the student used a sport gadget, what kind of sports supplements he/she used, and what the individual perceived reasons for engaging in RPA he/she was considering.

### *Statistical analysis*

There were two independent outcomes in the study treated as binary variables, including walking at least 10,000 steps or 6 km every day including weekends, and engagement in RPA. A set of demographic and lifestyle attributes, all transformed into binary variables were tested as predictors in two

separate models. Age, number of smoked cigarettes and smoking duration were the only continuous variables, which we tested for normality. Age was considerably left-skewed, therefore analyzed using non-parametric methods and reported as median with the corresponding interquartile range (IQR). Otherwise, data are presented as means with the standard deviation of the mean, whereas the probability of chance in univariate comparisons was tested using t-test. In univariate comparisons, binary data were tested for the probability of chance between groups using 2\*2, 2\*3 and so on contingency tables with  $\chi^2$  and the corresponding p-value.

Selected variables with p-value below 0.05 were then tested as predictors of two outcomes in separate models. We report both crude and adjusted odds ratios (OR) with their 95% confidence intervals (CI). Adjustment was done for confounders identified as significant predictors in crude models. In these adjusted models, all confounders were included, thus blocking their confounding in order to yield true exposure-outcome effects of significant predictors. We completed all calculations in NCSS 11 (Utah, USA).

## Results

The current sample of university students were predominantly young females (Table 1). Year of study distribution was left-skewed, with 70% of students from undergraduate years 1 and 2. Most of them lived in the university dormitories, which were located at or near the campus, therefore, 76% of students walked from the dormitories to classrooms. Most students were from low-income settings, and only 2% had 100,000 tenge or more a month (about 300 USD). On average, there were quite few smokers in this sample (10%), with substantial difference in cigarette smoking prevalence between males and females. Up to 50% of male students ever tried waterpipe smoking, and the overall waterpipe ever-smoking was identified in 30% students. 71% students never tried alcohol, however, alcohol consumption patterns dramatically differed between males and female students. Twenty-eight percent of students slept recommended 8 hours a day and 59% of students were engaged in voluntary physical activity or complied with 6 km daily walking.

**Table 1** – Demographic and lifestyle descriptors of the sample under study

Variables	All	Females	Males	p
N (%)	889 (100)	618 (70)	271 (30)	
Age, years (median (IQR))	19 (2)	19 (1)	20 (2)	0.001 <sup>#</sup>
Year of study				
Year 1, N (%)	349 (39)	263 (43)	86 (32)	0.001 (2*6)*
Year 2, N (%)	276 (31)	189 (31)	87 (32)	
Year 3, N (%)	157 (18)	10 (17)	49 (18)	
Year 4, N (%)	77 (9)	44 (7)	33 (12)	
Year 5, N (%)	17 (2)	10 (2)	7 (3)	
Year 6, N (%)	13 (1)	4 (0)	9 (3)	
Residence				
With parents, N (%)	101 (11)	61 (10)	40 (15)	0.001 (2*3)*
Dormitory, N (%)	646 (73)	483 (78)	163 (60)	
Renting apartment, N (%)	142 (16)	74 (12)	68 (25)	
Reaching university from home daily				
Walking	677 (76)	495 (80)	182 (67)	0.001 (2*3)*
Public transportation	149 (17)	96 (16)	53 (20)	
Driving	63 (1)	27 (4)	36 (13)	
Monthly income				
Less than 25,000 tenge, N (%)	399 (47)	302 (49)	97 (36)	0.001 (2*5)*
25-50,000 tenge, N (%)	295 (34)	200 (33)	94 (35)	
51-100,000 tenge, N (%)	144 (17)	89 (14)	55 (20)	
101-500,000 tenge, N (%)	40 (1)	19 (3)	21 (8)	
More than 500,000 tenge, N (%)	11 (1)	7 (1)	4 (1)	

Variables	All	Females	Males	p
Cigarette smoking				
Never cigarette smokers, N (%)	716 (81)	558 (90)	158 (58)	0.001*
Daily smokers, N (%)	88 (10)	23 (4)	67 (25)	0.001*
Cigarettes a day <sup>-1</sup>	10.5±15.2	10.6±9.8	10.4±6.2	0.90
Smoking duration, years	2.6±1.7	2.6±1.7	3.0±1.6	0.30
Waterpipe smoking				
Ever-smokers, N (%)	271 (30)	138 (22)	133 (49)	0.001*
Sessions per month <sup>-1</sup> (median (IQR))	1 (2)	1 (1)	2 (3)	0.001#
Electronic cigarette regular users, N (%)	56 (6)	20 (3)	36 (13)	0.001*
Smokeless tobacco daily-users, N (%)	39 (4)	16 (3)	23 (8)	0.001*
Alcohol consumption				
Never, N (%)	626 (71)	498 (81)	128 (47)	0.001 (2*4)*
Seldom, N (%)	191 (21)	101 (16)	90 (33)	
Moderate, N (%)	51 (6)	14 (2)	37 (14)	
At least once a week, N (%)	21 (2)	5 (1)	16 (6)	
Alcoholic beverage, N (%)				
Beer, N (%)	106 (40)	28 (23)	78 (55)	0.001 (2*4)*
Wine, N (%)	88 (33)	63 (54)	25 (18)	
Liqueur, martini, N (%)	48 (17)	26 (22)	22 (15)	
Cognac, vodka, N (%)	26 (10)	9 (1)	17 (12)	
Sleep				
8 hours or more, N (%)	245 (28)	171 (28)	74 (27)	0.76 (2*3)
6-8 hours, N (%)	491 (55)	345 (56)	146 (55)	
6 hours or less, N (%)	153 (17)	102 (16)	50 (18)	
Walking 6 km daily, N (%)	526 (59)	380 (61)	146 (54)	0.03*
Engaged in regular physical activity, N (%)	526 (59)	332 (54)	194 (72)	0.001*

Note: # – significant difference using Mann-Whitney U-test; \* – significant difference using 2\*2, 2\*3, 2\*4, 2\*5 or 2\*6 test

Almost all lifestyle attributes were distributed differently in men compared to women. Significantly more male students lived with their parents, used public transportation or drove as opposed to walking. All kinds of tobacco products use and alcohol were more prevalent in male students, however, physical activity pattern had almost opposite directions in men compared to women. Significantly more women walked the recommended 6 km daily, however, 72% male students were doing some sort of regular physical activity compared to 54% girls. These two metrics of physical activity (RPA and walking) were further analyzed separately with regard to their predictors (Table 2). In the univariate comparisons, sex, waterpipe ever-smoking, electronic cigarette use, alcohol and sleep duration predicted RPA. 6-km walking every daily had somewhat different set

of predictors in the similar univariate comparison (Table 2). In this analysis, almost all selected variables could predict compliance with walking 6 km a day, including cigarette smoking, alcohol and even residence at the dormitory. Additionally, the need to walk to classrooms from the dormitory also contributed to the cumulative 6 km a day.

We then selected significant variables to test their predicting role in two distinct metrics of physical activity using crude and adjusted models. For RPA, adjustment to all included variables in the model eventually blocked all tobacco products use prediction, and only male sex and sleeping 8 hours a day increased the odds of participation in the voluntary physical activity almost twice and by half correspondingly (Table 3). With regard to walking 6 km a day, no residence in the dormitory or monthly income were associated with the outcome in the

adjusted model. The need to walk to the university or residence in the dormitory were blocked in these models, yielding a set of three significant predictors for this outcome. Waterpipe ever-smoking and

alcohol use were inversely associated with walking mandatory 6 km a day, whereas sleeping 8 hours a day or more increase the odds of walking 6 km by 67%.

**Table 2** – Baseline lifestyle determinants in relation with two scales of students' physical activity

	Regular physical activity			Walking 6 km a day		
	Yes	No	p	Yes	No	p
N (%)	526	363	n/a	526	363	n/a
Age below 19, N (%)	132 (25)	93 (26)	0.86	144 (27)	81 (22)	0.06
Male sex, N (%)	194 (37)	77 (21)	0.001	146 (28)	125 (34)	0.03
Residence, with parents, N (%)	61 (12)	40 (11)	0.79	53 (10)	48 (13)	0.05
Residence, in the dormitory, N (%)	374 (71)	272 (75)	0.21	420 (80)	226 (62)	0.001
Residence, renting, N (%)	91 (17)	51 (14)	0.19	53 (10)	89 (25)	0.001
Walking to the university, N (%)	393 (75)	284 (78)	0.23	444 (84)	233 (64)	0.001
Using public transportation, N (%)	89 (17)	60 (17)	0.89	58 (11)	91 (25)	0.001
Driving, N (%)	44 (8)	19 (5)	0.07	24 (5)	39 (11)	0.001
Monthly income below 50,000 tenge, N (%)	400 (76)	294 (81)	0.08	440 (84)	254 (70)	0.001
Never cigarette smokers, N (%)	417 (79)	299 (82)	0.25	462 (88)	254 (70)	0.001
Daily cigarette smokers, N (%)	59 (11)	31 (9)	0.19	33 (6)	57 (16)	0.002
Waterpipe ever-smoking, N (%)	174 (33)	97 (27)	0.001	110 (21)	161 (44)	0.001
Electronic cigarette regular smoking, N (%)	42 (8)	14 (4)	0.01	31 (6)	25 (7)	0.55
Smokeless tobacco daily smoking, N (%)	29 (6)	10 (3)	0.05	22 (4)	17 (5)	0.72
Never-drinkers, N (%)	355 (67)	271 (75)	0.02	427 (81)	199 (55)	0.001
Seldom-drinkers, N (%)	133 (25)	58 (16)	0.001	73 (14)	118 (33)	0.001
Moderate-drinkers, N (%)	29 (6)	22 (6)	0.73	20 (4)	31 (9)	0.003
Once-a-week-drinkers, N (%)	9 (2)	12 (3)	0.12	6 (1)	15 (4)	0.004
Sleeping 6 hours of less, N (%)	85 (16)	68 (19)	0.03	75 (14)	78 (21)	0.005
Sleeping 6-8 hours, N (%)	279 (53)	212 (58)	0.05	285 (54)	206 (57)	0.45
Sleeping 8 hours or more, N (%)	162 (31)	83 (23)	0.01	166 (32)	79 (22)	0.001
Believe in 100% evidence smoking is related to morbidity, N (%)	402 (76)	294 (81)	0.05	439 (83)	257 (71)	0.001

**Table 3** – Logistic regression of selected predictors for RPA or walking 6 km a day

Predictors	Outcome: RPA		Outcome: walking 6 km a day	
	Crude	Adjusted	Crude	Adjusted
Sex (reference: female)	2.17 (1.60;2.95)	2.04 (1.47;2.84)	0.73 (0.55;0.98)	1.25 (0.89;1.77)
Age (reference: 19 and older)	Not included		Not included	
Residence in the dormitory (reference: all other)	Not included		2.40 (1.78;3.24)	0.95 (0.56;1.60)
Walking to the university (reference: all other)	Not included		3.02 (2.20;4.15)	1.76 (0.99;3.13)
Monthly income below 50,000 tenge a month	Not included		2.20 (1.59;3.03)	0.93 (0.61;1.43)
Daily cigarette smoking (reference: all other)	Not included		0.36 (0.23;0.56)	0.96 (0.56;1.67)
Waterpipe ever-smoking (reference: all other)	1.34 (1.00;1.79)	1.04 (0.73;1.47)	0.33 (0.24;0.44)	0.53 (0.37;0.75)

Predictors	Outcome: RPA		Outcome: walking 6 km a day	
	Crude	Adjusted	Crude	Adjusted
Electronic cigarette regular use (reference: all other)	2.16 (1.16;4.02)	1.40 (0.71;2.76)	Not included	
Smokeless tobacco daily use (reference: all other)	2.06 (1.00;4.28)	1.25 (0.56;2.79)	Not included	
Alcohol (reference: never-drinkers)	1.42 (1.05;1.91)	1.05 (0.72;1.51)	0.28 (0.21;0.38)	0.44 (0.30;0.65)
Sleeping 8 hours or more (reference: less than 8 hours)	1.50 (1.10;2.04)	1.47 (1.07;2.01)	1.66 (1.22;2.26)	1.67 (1.20;2.33)
Believe in 100% evidence smoking is related to morbidity	Not included		2.08 (1.51;2.87)	1.25 (0.86;1.81)

Note: data are presented as odds ratios (ORs) with 95% confidence intervals (CI); RPA – regular physical activity.

## Discussion

This is the first report of the patterns of regular physical activity and their predictors in Kazakhstan students. Using cross-sectional design with all years of study coverage, we identified significant differences in almost all lifestyle attributes in male and female students. Moreover, we found that regular physical activity and walking 6 km a day were different priorities for men and women, where the first was more prevalent in male students with the opposite trend in females. In adjusted for a set of predictors models, we found that only male sex and sleeping 8 hours a day predicted engagement in physical activity, whereas alcohol and waterpipe use coupled with adherence to sleeping minimum of at least 8 hours a day could predict compliance with walking 6 km a day. We also found that on average, almost 60% of interviewed students were engaged in RPA and the same number was walking enough to comply with a recommendation of reaching a 10,000 steps minimum.

This study yielded surprising results. First and foremost, the understanding of RPA and walking 6 km a day were different in both sexes. In general, male students prioritized doing sports, whereas women considered walking a priority. Greater involvement of men in RPA is consistently found in other studies in young people, where male sex is a predictor of greater activity even in adjusted models. In a Swedish study, student's sex was a significant predictor of greater physical activity (Schmidt 2012: 1). In a small sample of Turkish dental students using Health-Promoting Lifestyle Profile II questionnaire, they also found that male students had a significantly greater physical activity score compared to female counterparts (Peker 2011: 413–420). Mexican study confirmed that male sex was also a predictor for more intense physical activity (Ulla Díez 2009: 85-

93), along with marital status and mother's education. The interactions between ego, beliefs that effort produced success, and parental orientation may be quite complex in both sexes (Biddle 2003: 1–20), but male perceptions of masculinity may play critical role in greater commitment of men to RPA (Mahalik 2007: 2201–2209). In the latter study, they found that social norms of behavior, including exercising were more important to men than women, which explained the difference we found for two selected outcomes. For Kazakhstan university male students, exercising in the gym and group sports perform as social norm, whereas walking was equally important for male and female students.

The overall prevalence of engagement in physical activity of Kazakhstan university students is somewhat greater when compared to German students (40%) (Keller 2008: 189–195) or elsewhere (Von Ah 2004: 463–474), however lower physical activity of female students in our study is alarming. Coupled with worse socioeconomic status, this lower activity may predict apparent health disparity, already obvious at a time of university period in life. Greater vulnerability of women in oriental societies may put them at risk of poorer health outcomes as a result of limited access to service or insufficient exercise already in the university, as we show herein. These varying social norms may preclude women from achieving better health outcomes in future. In contrast, up to 66% of women in the Western world may meet the recommended physical activity goals (Quintiliani 2010: 134–137). Altogether, identification of these lifestyle disparities should promote active public health intervention targeted at women already in the university.

Despite quite low overall cigarette smoking prevalence in our study, somewhat 50% prevalence of waterpipe smoking in men should be addressed by the policy makers considering not only waterpipe

health effects, but its inverse association with compliance with walking 10,000 steps a day. Growing waterpipe prevalence has also become a matter of concern in the neighboring Kyrgyzstan, where similar trends were identified recently (Brimkulov 2017: 625). Poor knowledge on health effects of waterpipe smoking, coupled with poor regulation help waterpipe spread in Central Asia, where heavy burden of cancer and chronic obstructive pulmonary disease from waterpipe smoking are yet to come in future. The evidence from our study shows that waterpipe smoking ban should be advocated for a variety of reasons, including its inverse association with recommended physical activity.

Our study has a number of distinct limitations. First, its cross-sectional design apparently hampers verification causality and the direction of the associations. Thus, we are not sure we can properly identify the direction the association of good sleep with RPA in our adjusted model. Such cross-sectional design is the design of choice in the majority of reports on students' lifestyle and has a number of advantages, such as low cost and fast results. Secondly, we used our own questionnaire for lifestyle attributes, which may complicate direct comparison with other studies of the similar kind, constructing their surveys on standardized tools. We believed that, on the one hand, those conventional instruments may be too lengthy and would need validation in Kazakh language, whereas on the other, we aspired to take a deeper look at the attributes of physical activity with our additional set of questions. Finally, as in many other studies of this kind, some unmeasured confounding was also present, and collecting comprehensive data on those may be almost impossible in questionnaires like this. Of note, adjusted regression models in other studies, where standardized tools were applied, reported the  $R^2$  of around 0.10-0.20, whereas our adjusted

analysis of all eligible variables in regression yielded  $R^2$  of somewhat 0.40. With some level of certainty, this means we could identify almost half of predictors, explaining the final variability of the outcome, leaving about the other half unmeasured.

The sample size of almost 900 students should be considered a strength of our survey. This enables to obtain high statistical power in almost all our models. Moreover, a deeper analysis of physical activity is another potential strength allowing for deeper reviewer of comparisons between men and women and other subgroups with each other. Finally, our sample of university students, given the leading role of the university in Kazakhstan ranking, may serve a good representation of the youth structure within the country, because the university students were quite equally distributed as to their region of origin within the country.

### Conclusion

In conclusion, this first cross-sectional survey estimating the level of physical activity of Kazakhstan university students showed that up to 60% of students were physically active, either engaged in voluntary sports or walking at least 6 km a day. Female students, however, may experience future health vulnerability because of the associated lower engagement in regular physical activity compared to men when studying at the university. Combined public health interventions tailored at smoking cessation and better sleep may result in greater physical activity of the university students in order to help them reach better fitness plans.

#### *Conflict of interest*

The authors declare that they have no conflict of interest.

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