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Physical Activity Levels and Type 2 Diabetes Risk Scores of University Students

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ABSTRACT The present study is to reveal physical activity levels and type 2 diabetes risk scores of university students in accordance with gender differences and determine the relation between physical activities and type 2 diabetes scores. One thousand ninety three students studying at Erzincan University (540 female and 553 male) participated in the study. A short form of the International Physical Activity Questionnaire and Finnish Diabetes Risk Score Questionnaire were used to determine physical activity scores and type 2 diabetes risk scores of the students. For analysis of the data, an independent t-test, one-way analysis of variance test and Pearson correlation analysis were used. Diabetes risk scores of women were found to be higher than men ($p<0.01$). Diabetes risk scores of men have a negative relation with all physical activity sub-categories, but for women it was found only in terms of vigor and total activity levels ($p<0.01$). It can be concluded that the association between diabetes risk scores and physical activity levels of male students was stronger than that of female students. Thus, increasing physical activity may reduce the diabetes risk score in university students.

INTRODUCTION

According to the new diabetes atlas published recently, the prevalence of diabetes is increasing worldwide. The latest studies conducted by IDF (2013) considered, it is predicted that totally 382 million people of whom 8.3 percent are adults have diabetes in the world and this number will increase to 592 million by 2035. It is also stated that diabetes is certainly one of the challenging health problems in the 21st century (IDF 2013).

Diabetes development due to rapid cultural and social changes, malnutrition habits (WHO 1994), increase in old population, increasing urbanization, low level of physical activity, weight gain, obesity (WHO 1994; Ramachandran et al. 2002; Wild et al. 2004; Shaw 2007), rapid economic growth, socioeconomic changes besides life expectancy (Shaw 2007; WHO 2009, 2011), has become one of the crucial public health problems (Onat et al. 2006; IDF 2013).

For the past 20 years, diabetes has been prevailing and research shows that it has even reached to an alarming extent in Turkey (Kelestimur et al. 1999; Satman et al. 2002; Onat et al. 2006; Satman et al. 2013; Onat et al. 2014). In Turkish Diabetes Epidemiology Study (TURDEP-I study) conducted 1997-1998 in Turkey, diabetes prevalence in individuals over 20 years old was found to be 7.2 percent (Satman et al. 2002). On the other hand, in The Turkish Epidemiology Survey of Diabetes, Hypertension, Obesity and Endocrine Disease (TURDEP-II) study realized in 2010, these values increased to 13.7 percent (Satman et al. 2013). In accordance with the data by IDF in 2013, Turkey with a rate of 14.8 percent is the leading country in Europe in terms of diabetes prevalence (IDF 2013).

Although type 2 diabetes is generally seen in adults, the young generation is also reported to have been affected in recent years in developing countries (Dabelea et al. 1998; Kitagawa et al. 1998; Rosenbloom et al.1999; Mazza et al. 2005; Haines et al. 2007; Shaw 2007; Urakami et al. 2007; IDF 2013; Dabelea et al. 2014; Pronk and Remington 2015). In most countries, increasing levels of obesity and physical inactivity have made type 2 diabetes a globally potential public health problem (IDF 2013). Researchers state that such lifestyle changes as slight loss of weight and increase in physical activity levels may lead to a decrease in running risk of type 2 diabetes in people at high risk (Tuomilehto et al. 2001; Vahasarja et al. 2014; Vahasarja et al. 2015). However, only twenty-nine to forty-two percent of

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individuals with pre-diabetes have sufficient physical activity levels (Zhou and Mi Oh 2012; Zhou et al. 2012). In addition, it is widely known that most people are not much informed about the risk degree of diabetes. Therefore, this study is to reveal physical activity levels of university students and type 2 diabetes risk scores according to gender differences and to ascertain the relation between physical activities and type 2 diabetes.

Objectives

This study aims to reveal physical activity levels of university students and type 2 diabetes risk scores according to gender differences and to ascertain the relation between physical activity and type 2 diabetes.

METHODOLOGY

Subjects

One thousand three hundred fifty seven voluntary students studying in 2011-2012 school terms at Faculty of Education, Faculty of Arts and Science, Health College, Vocational School and Tourism Vocational School in Erzincan University took part in the study. First, the students previously informed about the content of the research confirmed their written consent about the study. When the students with musculoskeletal, cardiorespiratory, metabolic and other systemic problems beside those using drugs (including oral contraceptive pills) as well as the ones whose data was lacking were not included in the study, the research was completed with 1093 people (540 female whose average age was 20.6±1.9 years and 553 male whose average age was 21.4±2.1years).

Height (cm), Circumference (cm) and Weight (kg) Measurements

"Height was measured to the nearest 0.1 cm using a stadiometer. Weight was measured to the nearest 0.1 kg on an electronic scale" (Seca Corp, Birmingham, United Kingdom).

Waist circumference was measured with a soft measurement tape. The waist was measured directly on the body with light clothing with an accuracy of 0.5 cm. "The waist circumference was taken at the midpoint between the iliac crest and the lower border of the ribs after a normal expiration" (Han et al. 2006). The hip circumference was measured from the widest portion of the buttocks, with the tape parallel to the floor. Each measurement was repeated twice. "When the measurements were within 1 cm of one another, the average was calculated. The moment the difference between the two measurements exceeded 1 cm, the two measurements were repeated" (WHO 2008).

BMI (Body Mass Index) and WHR (Waist-Hip Ratio)

BMI was calculated as body mass in kilograms divided by height in meters squared (kg/m^2). WHR was calculated by dividing the waist circumference to hip circumference (WHO 2008).

Measurement of Physical Activity Level

Physical activity levels of students were assessed by using a short form of the International Physical Activity Questionnaire (IPAQ), which includes details about the "last seven days" of physical activity. Validity and reliability of the questionnaire were analyzed by Ozturk (2005) in Turkey. This short form consists of seven questions and contains information about the time spent in sitting, walking, moderate intense activities and vigorous intense activities. Measurement of total scores of the short form includes walking, moderate intense and vigorous activity, total time (minutes) and frequency (days) of vigorous activity. Sitting score (sedentary behaviors level) is separately calculated. For a complete measurement of all activities, each activity is supposed to be performed for at least 10 minutes at a time. The "MET-min/week" score is obtained by multiplication of minute, day and MET level (resting oxygen consumption values). For calculation of the walking score, the walking time (minute) is multiplied by 3.3 MET. For measurement of moderate intense activity level, 4 MET values were considered while for vigorous intense activity level, 8 MET values are taken into consideration. Physical activity levels are classified as inactive (<600 MET-min/week), minimally active (600-3000 MET- min/week) and sufficiently active (beneficial for health) (>3000 MET-min/week) (Craig et al. 2003).

Measurement of Diabetes Risk Score

The Finnish Diabetes Risk Score Questionnaire (FINDRISC) was used to measure the students' type 2 diabetes risk scores (Lindstrom and Tuomilehto 2003; IDF 2010). The validity of the questionnaire has been assessed by the National Public Health Institute of Finland in an independent population survey. This questionnaire has widespread use in academic research in Turkey and it can be assessed from the official page of International Diabetes Federation in Turkish and others different languages. FINDRISC consists of eight variables, namely, age, BMI, waist circumference, physical activity, diet, antihypertensive drug use, high blood glucose, and family history of diabetes (Lindstrom and Tuomilehto 2003; Saaristo et al. 2007). The maximum score of the questionnaire is 27.

Statistical Analyses

Statistical analysis was performed using the SPSS software for Windows (version 16.0). The data was summarized and the means, standard deviations and frequency distributions were evaluated. To explain the relation between the measurements, the Pearson correlation analysis was used according to test results of normality. Independent samples t-test was used to compare genders. Variance analysis was administered to determine the differences among the physical activity groups. Following the variance analysis, Tukey HSD, one of multiple comparison tests, was administered to find out among which groups these differences exist. The significance was 0.05.

RESULTS

The average age, height, weight and standard deviations of the participants in the research are given in Table 1. In this paper, the mean heights of female and male students were found to be 163.4±5.6 cm and 175.1±7.1 cm, respectively. The means of body weight were 55.7±7.7 kg and 70.3±9.9 kg, respectively (Table 1).

Table 1: Physical characteristics of the participants in the study

Variables	*Women (n=540)*	*Men (n=553)*
Age (years)	20.6± 1.9	21.4± 2.1
Height (cm)	163.4± 5.6	175.1± 7.1
Body Weight (kg)	55.7± 7.7	70.3± 9.9

As seen in Table 2, except for time spent in sitting and hip circumference, for the other parameters there were statistically significant differences between genders. Male students had significantly lower diabetic risk scores than girls ($p<0.01$). On the other hand, walking, moderate, vigorous, total MET (min/week), waist circumference ($p<0.01$) and WHR ($p<0.05$) of male students were statistically higher than girls.

It was found that only 28.1 percent of the participants had sufficient level of physical activity, 61.4 percent had a low level of activity while 10.5 percent were completely inactive. Diabetes risk scores of the students as low (72%), light (24.7%), moderate (2.8%) and high (0.5%) level were determined. More than half of the participants (75.2%) had no family history of diabetes reported. Results obtained from the questionnaire show that first-degree relatives (9.1%) and second-degree relatives (15.6%) of participants have a history of diabetes (Table 3).

Statistically significant differences were found between the genders in the physically inactive group in terms of all variables, hip circumference, waist circumference, WHR and BMI

Table 2: General characteristics of the participants in the study

Variables	*Women (n=540)*	*Men (n=553)*	*t values*	*P value*
BMI (kg/m^2)	20.9± 2.7	22.9± 4.9	-8.898	0.000**
Waist Circumference (cm)	80.1± 8.6	84.2± 9.2	-7.603	0.000**
Hip Circumference (cm)	95.4± 7.1	98.6± 39.4	-1.860	0.063
Waist-Hip Ratio (WHR)	0.8± 0.1	0.9± 0.4	-2.229	0.026*
Diabetes risk score	5.5± 3.1	3.8± 2.8	9.701	0.000**
10-year Diabetes risk score	2.8± 3.7	1.9± 3.0	4.503	0.000**
Walking MET (min/week)	1465.1± 1629.5	1788.5± 1536.6	-3.377	0.001**
Moderate MET (min/week)	239.1± 550.6	377.8± 703.7	-3.624	0.000**
Vigorous MET (min/week)	269.9± 794.7	996.8± 1499.3	-9.980	0.000**
Total MET (min/week)	1974.06± 2219.9	3163.2± 2615.8	-8.094	0.000**
Time spent in sitting (min)	329.3± 156.7	331.3± 142.0	-0.222	0.824

*$P<0.05$ **$P<0.01$

Table 3: Physical activity levels and diabetes risk score of participants

	Women		Men		Total	
	n	%	*n*	%	*n*	%
Physical Activity Levels						
Inactive (<600 MET min/week)	86	15.9	29	5.2	115	10.5
Low (600 - 3000 MET min/week)	360	66.7	311	56.2	671	61.4
Sufficient (> 3000 MET min/week)	94	17.4	213	38.5	307	28.1
Diabetes Risk Score/10-year Risk Score						
Low / 1%	329	60.9	458	82.8	787	72
Light / 4%	188	34.8	82	14.8	270	24.7
Moderate / 16%	20	3.7	11	2	31	2.8
High / 33%	3	0.6	2	0.4	5	0.5
Family History of Diabetes						
No	365	67.6	457	82.6	822	75.2
Yes- 1st-degree relatives	64	11.9	36	6.5	100	9.1
Yes 2nd -degree relatives	111	20.6	60	10.8	171	15.6

($p<0.01$). No significant difference was seen in the hip circumference of the group with low-level of activity and no important difference was found in the hip circumference and WHR values of the group with sufficient activity in terms of genders ($p>0.05$). The evaluation of diabetes risk score and 10 year diabetes risk scores suggest that risk scores of men were significantly lower than those of women in groups with low level of physical activity and sufficient physical activity ($p<0.01$). No statistically significant differences were observed in diabetes and 10-year diabetes risk scores of inactive male and female students. In Table 4, it is clearly seen that WHR values of female students in all physical activity groups are seen in moderate risk groups.

Evaluating diabetes risk scores and 10-year risk scores of male students according to physical activities, the risk scores of inactive group were found statistically higher than those of the group with low ($p<0.05$) and sufficient activities ($p<0.01$). No significant difference was seen in risk scores between the groups with low and sufficient level of activity ($p>0.05$). The results of variance analysis indicated no significant differences in diabetes risk scores of female students according to their physical activity cases.

As shown in Table 6, there was a statistically negative relation between diabetes risk score and vigorous and total activity of women ($p<0.01$). No statistical relation was found between diabetes risk score and time spent in sitting, walking and moderate intense activity of women ($p>0.05$). On the other hand, a statistically negative relation was observed between diabetes risk score and walking, moderate ($p<0.05$), vigorous, and total activity of men ($p<0.01$). The correlation between time spent in sitting and diabetes risk score of men was significantly positive ($p<0.01$).

DISCUSSION

In this cross-sectional study, physical activity level and type 2 diabetes risk score of university students were investigated. Higher level of walking, moderate, vigorous, total MET (min/week), waist circumference and WHR were estimated for men than women. Men had significantly lower diabetes risk scores than women. No significant difference appeared for the time spent in sitting between women and men. The present paper states that 10.5 percent of university students were inactive, 61.4 percent had a low level of activity and 28.1 percent had a sufficient level of activity. Women (15.9%) and men (5.2%) participating in the study were found to be inactive. Values of women and men with low level of physical activity were 66.7 percent and 56.2 percent respectively, while those of women and men with sufficient level of physical activity the values were 17.4 percent and 38.5 percent, respectively. The findings of the study imply that physical activity levels of men were higher than those of women ($p<0.01$) (Table 2). In the assessment of diabetes risk scores, risk degrees of men were lower than those of women ($p<0.01$) (Table 2). No history of diabetes in most families of both men (82.6%) and women (67.6%) was reported (Table 3).

In the study conducted by Savci et al. (2006), it was found that fifteen percent of the students were inactive, sixty-eight percent had a low level of activity and eighteen percent had sufficient activity levels. In another study, it is stat-

Table 4: General characteristics of participants in the study according to physical activity levels

Variables	Inactive			Low physical activity			Sufficient physical activity		
	Women (n=86)	*Men (n=29)*	*t value*	*Women (n=360)*	*Men (n=311)*	*t value*	*Women (n=94)*	*Men (n=213)*	*t value*
Height (cm)	162.8± 5.6	177.0± 5.8	-11.785**	163.4± 5.7	174.4± 7.8	-20.969**	163.9± 5.5	176.0± 6.0	-6.690**
Body Weight (kg)	55.9± 7.2	71.0±11.1	-8.420**	55.7± 8.0	70.0± 10.0	-20.599**	55.7± 7.4	70.5± 9.5	-3.366**
BMI (kg/m^2)	21.1± 2.6	22.6± 2.8	-2.622**	20.9± 2.8	23.2± 6.1	-6.590**	20.7± 2.5	22.7± 2.5	-6.526**
Waist Circumference (cm)	80.6± 8.1	85.6± 9.1	-2.780**	80.1± 8.9	84.4± 9.9	-5.899**	79.7± 7.8	83.8± 8.1	-4.077**
Hip Circumference (cm)	95.9± 7.2	97.9± 6.1	-1.380	95.5± 7.4	100.1± 52.1	-1.661	94.9± 5.5	96.6± 8.5	-1.798
WHR	0.8± 0.1	0.9± 0.1	-3.184**	0.8± 0.1	0.9± 0.1	-2.271*	0.8± 0.1	0.9± 0.6	-1.043
Diabetes Risk Score	6.0± 3.0	5.3± 3.5	1.018	5.5± 3.1	4.1± 2.8	6.268**	5.2± 3.4	3.2± 2.6	5.721**
10-year Diabetes Risk Score	3.5± 6.4	3.2± 4.4	0.279	2.7± 3.4	1.9± 3.0	3.181**	2.6± 4.3	1.5± 2.0	3.052**
Low / %1 (N) (%)	46 (% 53.5)	19 (% 65.5)		218 (% 60.6)	252 (% 81)		65 (% 69.1)	187 (% 87.8)	
Light / %4	36 (% 41.9)	8 (% 27.6)		127 (% 35.3)	51 (% 16.4)		25 (% 26.6)	23 (% 10.8)	
Moderate / %16	3 (% 3.5)	1 (% 3.4)		14 (% 3.9)	7 (% 2.3)		3 (% 3.2)	3 (% 1.4)	
High / %33	1 (% 1.2)	1 (% 3.4)		1 (% 0.3)	1 (% 0.3)		1 (% 1.1)	-	

*P< 0.05 **P<0.01

Table 5: Multiple comparison test of diabetes risk scores of male students' physical activity cases

Dependent variable	*(I) Physical activity levels*	*(J) Physical activity levels*	*Mean difference (I-J)*	*Std.error*	*P value*
Diabetes Risk Score	Inactive	Low	.22963*	.09045	0.031*
		Sufficient	.31213*	.09221	0.002*
	Low	Sufficient	.08250	.04143	0.115
10-Year Diabetes Risk Score	Inactive	Low	1.51580*	.57094	0.022*
		Sufficient	1.91306*	.58203	0.003*
	Low	Sufficient	.39726	.26153	0.283

*P<0.05 **P<0.01 Tukey HSD

ed that only ten percent of 594 students studying kinesiology in Canada had sufficient levels of physical activity (Burke et al. 2005). Hallal et al. (2003) allege in their study that thirty-eight percent of 20 to 29-year-old people were physically inactive. In addition, Haase et al. (2004) found in their study on physical activity of 19928 university students from 23 culturally and economically different countries that inactivity frequency was twenty-three percent in northwestern Europe and USA, "thirty percent in central and southern Europe, thirty-nine percent in Mediterranean countries, forty-two percent Asia-Pacific countries and lastly, forty-four percent in developing countries".

The results from this paper reveal that vigorous and moderate intense activities are unusually done by the students. In this paper the walking rates are higher than those in the mentioned researches. The studies in the literature examined, it is obvious that inconsistency in physical activity levels results from age (Hallal et al. 2003), race (Hallal et al. 2003; Haase et al. 2004), cultural differences and socioeconomic situation (Hallal et al. 2003; Haase et al. 2004; Burke et al. 2005) and different measurement methods used (Hallal et al. 2003).

In this paper, the physical activity levels of men were found to be higher than those of women. In most studies on university students, it was also found that male students were physically more active than female ones (Leslie et al. 1999; Haase et al. 2004; Savci et al. 2006). Therefore, the findings in this study show similarity with existing literature.

Diabetes risk scores of women were found to be higher than those of male students. In the diabetes research based on population in Turkey (TURDEP-I), diabetes is reported to be more common among the women (Satman et al. 2002). Similarly, in TURDEP-II study conducted 12 years after TURDEP-I, it was reported that women have higher prevalence of diabetes than men (Satman et al. 2013). The results obtained in this research on diabetes risk scores are similar with other studies on Turkish population. Since the average age of men and women in this paper was under 45 years, it can be concluded that the age factor is not effective on diabetes risk score. Diverse distribution of risk factors may account for different diabetes risk scores between men and women (King et al. 1998). Physical activities of women are limited to household activities and they do not have a habit to participate in sportive activities, either (Satman et al. 2002). This might be the reason why physical activity levels of women are lower than those of men. On the other hand, waist and hip circumference of women examined, women are classified into the moderate risk group. Waist to hip ratio is a central (android) indicator of obesity. Central obesity is known to be related with type 2 diabetes (Pan et al. 2014). Peterson et al. (2015) stated that android adiposity, great sedentary behavior, and low, moderate and vigorous physical activity were the strongest predictors of insulin resistance or diabetes among aging adults. The findings in this paper show that in the women, the rate of diabetes history in the family is higher than in men. So it is thought that the reason why women have higher diabetes risk scores than men is due to low level of physical activities, high waist to hip ratio and a possible history of diabetes in families.

When diabetes risk scores of men and women were compared according to physical activity levels, the risk scores of women in groups with low and sufficient level of activity were found to be significantly higher than those of men ($p<0.01$) (Table 4). No significant differences were seen between diabetes risk scores of inactive women and men. Diabetes risk scores of men in all activity groups were lower than

Table 6: The correlation between diabetes risk score and physical activity

		Women (n=540)					*Men (n=553)*				
		Time spent in sitting (min.)	*Walking MET*	*Moderate MET*	*Vigorous MET*	*Total MET*	*Time spent in sitting (min.)*	*Walking MET*	*Moderate MET*	*Vigorous MET*	*Total MET*
Diabetes Risk Score	R	0.066	-0.058	-0.071	-0.165**	-0.119**	0.105**	-0.093*	-0.093*	-0.192**	-0.190**
	P	0.126	0.178	0.097	0.000	0.006	0.014	0.028	0.029	0.000	0.000

R = Coelation coefficient P = Value

those of women. No significant change was observed in diabetes risk scores of female students according to their physical activities. Diabetes risk scores of inactive male students were found statistically higher than those with low level of activity and sufficient activity ($p<0.05$, $p<0.01$) (Table 5).

In one study it was reported that gender-related differences might result in risk differences of type 2 diabetes development and in differences in type 2 diabetes prevalence between men and women (Belue et al. 2009). Lifestyle differences between the genders may account for lower diabetes risk scores for men in all activity groups compared to women. Low level of vigorous and moderate intense activities of women may account for the lack of significant difference in diabetes risk scores of women in different physical activity groups.

The present study suggests that with the reduction in physical activity levels of men, the diabetes risk scores were significantly increased. In a study conducted by Rockette-Wagner et al. (2015), it was reported that the low levels of sedentary time caused a lower risk of developing diabetes. Most studies on the benefits of physical activity report that those who are physically active may not develop insulin resistance, impaired glucose tolerance or type 2 diabetes (Eriksson and Lindgarde 1991; Helmrich et al. 1991). Kriska et al. (2003) state that for those who frequently participate in physical activity, it is less possible to develop type 2 diabetes. The rate of diabetes development in most age and gender groups is lower in more physically active individuals than less active ones. This paper shows similarity with the literature that the more active the male students are, the lower the rate of diabetes risk scores is.

The findings in this paper suggest that a negative relation exists between male students' diabetes risk scores and walking, moderate intense activities ($p<0.05$), vigorous activities and total activity ($p<0.01$), while the relation is positive with the time spent in sitting ($p<0.01$). In female students, only vigorous activities and total activity ($p<0.01$) are inversely associated with diabetes risk scores (Table 6).

In most studies conducted, it is clearly stated that a physically active lifestyle and specifically moderate intense activities are closely related with a low level of type 2 diabetes risk (Helmrich et al. 1991; Manson et al. 1991; Manson et al. 1992; James et al. 1998; Baan et al. 1999; Defay et al. 2001; Van Dam et al. 2002; Combe et al. 2004; Dunstan et al. 2004; Laaksonen et al. 2005; Jeon et al. 2007). Evidence accumulated from the previous study shows that moderate to vigorous intensity physical activity, aerobic activity such as walking (Jeon et al. 2007) and running (Williams and Thompson 2013) or strength training (Kuwahara et al. 2015) can reduce the risk of type 2 diabetes. Walking at a brisk pace but not at an easy or casual pace is more effective in the prevention of type 2 diabetes (Hu et al. 1999; Hu et al. 2001; Laaksonen et al. 2005).

In this paper, diabetes risk scores of women do not have a significant relation with walking and moderate intense activities. So, the findings are not parallel with the literature. These contradictions may be due to the fact that Turkish women do not have a habit of participation in physical activities and regularly take part in moderate intense activities. Besides, their physical activities are limited to housework and walking at an easy or casual pace instead of brisk walking may be effective in this case.

CONCLUSION

In conclusion, diabetes risk scores of male students are inversely pertinent with walking, moderate intense, vigorous and total activities. The time spent sitting has a positive relation with diabetes risk scores. Vigorous physical activities and total activities are found to be important in reducing diabetes risk scores of women. Based upon these results, it can be concluded that the link between diabetes risk score and physical activity/inactivity in male students is stronger than in female students. Regularly practiced vigorous total physical activities play an important role in reducing diabetes risk scores among male and female students.

RECOMMENDATIONS

University students should be encouraged to participate in physical activities. Promoting physical activities is a very important tool for reducing type 2 diabetes risk factors and for improving the health and life quality of young people.

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