RelAtIonshIP oF PhysICAl ACtIvIty AnD eAtIng behAvIoUr wIth obesIty AnD tyPe 2 DIAbetes MellItUs: soFIA lIFestyle (sls) stUDy

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ABSTRAcT
Objective: Physical inactivity and excessive food consumption play a major role in the etiology of obesity and type 2 diabetes mellitus (T2DM). The aim of the present study was to investigate the relationship of physical activity (PA) and eating behaviour with obesity and T2DM in citizens of Sofia, Bulgaria.

Patients and Methods: A total of 511 randomly chosen participants completed a validated questionnaire concerning age, body height and weight, medical history, and motivation for a lifestyle change. The Baekke PA questionnaire and the Three Factor eating Questionnaire were also completed.

Results: Body mass index (BMI) was significantly higher among subjects in the lowest compared with the middle (P = 0.002) and with the highest tertile of leisure time PA (P < 0.001), also between the lowest and the highest tertile group of sport PA (P = 0.001). BMI differed significantly in the highest vs. the middle (P = 0.04), as well as vs. the lowest (P = 0.017) tertile of uncontrolled eating behaviour. The prevalence of T2DM was significantly greater in the lowest vs. the middle (P = 0.027) and the highest (P = 0.02) tertile of leisuretime PA. In a multiple regression analysis both leisure time PA and uncontrolled eating were independently associated with BMI (β = -0.13, 95% CI -1.83 to -0.11, P = 0.03 and β = 0.32, 95% CI 0.23 to 0.44, P < 0.001).

Conclusions: We found a strong inverse relationship between the level of PA during leisure time (including sport), BMI, and the prevalence of T2DM. Uncontrolled eating behaviour was also found to have a significant effect on BMI.

Key words: obesity, type 2 diabetes, eating behaviour, increased energy intake, physical activity

INTRODUCtION
Global prevalence of obesity and type 2 diabetes mellitus (T2DM) is constantly increasing leading to excessive morbidity and mortality. At present over 250 and 190 million individuals worldwide are diagnosed with respectively obesity¹ and T2DM², with their number expected to keep on growing. In Bulgaria the prevalence of these metabolic disorders has dramatically increased over the last few decades. According to data from the International Obesity Task Force, as much as 19% of the adult population in this country is currently found to be obese.¹ Official information about the exact prevalence of T2DM in Bulgaria has not been published since 1996³; however, after extrapolation of available data prevalence of around 8.5% has been estimated.² Furthermore, Bulgaria is known to have one of the highest T2DM-related mortality rates in Europe.⁴ Besides some genetic and environmental factors, physical inactivity and excessive food consumption are considered to play a major role in the etiology of both obesity and T2DM.⁵,⁶ In general the citizens of Bulgaria, especially those living in the urban areas, are believed to be physically inactive and to have poor dietary habits. However, there is little objective data about the level of physical

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Received 22 November 2010; Accepted for publication 19 January 2011
activity, the nutritional habits, and their relationship with disease history in this population. The aim of the present study was to investigate the level of physical activity and the nutritional habits, their association with obesity and T2DM, as well as the motivation for a lifestyle change among the urban population of Sofia, Bulgaria.

PATIENTS AND METHODS

Sofia Lifestyle (SLS) Study

SLS study was a survey-based investigation conducted between August 2007 and May 2010 among the citizens of Sofia, Bulgaria. Over 1800 randomly chosen individuals were contacted personally or via e-mail at their workplace or during free time. Five hundred and eleven of them agreed to participate in the survey and completed a self-administered questionnaire containing 54 items divided into three sections: general information, physical activity level, and nutritional habits.

General Information

This section comprised 20 items concerning gender, age, height, body weight, cigarette smoking, alcohol consumption; own and family history of T2DM, hypertension, high cholesterol levels (HLP), and cardiovascular disease (CVD); self-perception of nutritional habits and physical activity, and motivation for a lifestyle change. Taking into account that many, if not all of the respondents to the self-administered questionnaire may be unable to recall their actual blood pressure, plasma glucose or cholesterol levels, they were asked if they had ever been diagnosed as having T2DM, hypertension, HLP, or CVD. Cigarette smoking was reported with yes or no questions and alcohol consumption was divided into three categories: never, occasionally, and on regular bases. Self-perception of nutritional habits was reported as healthy/unhealthy and physical activity level as sufficient/insufficient. Individual height and body weight were used for calculation of body mass index (BMI).

Physical Activity Level

Physical activity level was assessed using the Baecke physical activity questionnaire (BQ).7 Developed in 1982 BQ is one of the most widely used tools for assessment of physical activity levels in large-scale studies.7 It contains 16 items classified into three groups and distinguishes three components of physical activity: work, sport, and non-sport leisure time physical activity. Each component contains several questions which are scored on a five-point Likert scale (never, seldom, sometimes, often, and very often). In our case the questionnaire was calculated as described by Baecke et al.7 and each component could receive a score ranging from one (minimum) to five (maximum). The original BQ was translated in Bulgarian using the translation/re-translation procedure by two independent professional translators.

Nutritional Habits

For evaluation of the nutritional habits of the participants in the present study a revised version of Stunkard and Messick’s Three Factor Eating Questionnaire (TFEQ-R18) was used.9 TFEQ-R18 measures three different aspects of eating behaviour: cognitive restraint (conscious control of food intake targeting weight loss or weight control; 6 items), uncontrolled eating (excessive food intake due to constant feeling of hunger or lack of self-control; 9 items), and emotional eating (overeating in periods of negative mood; 3 items) and has good validity and reproducibility in the general population.9 Every item of the questionnaire is scored from 1 to 4 and the scores are summed to obtain scale score for cognitive restraint (6 - 24), uncontrolled eating (9 - 36), and emotional eating (3 - 12). Higher score indicates higher cognitive restraint, uncontrolled, or emotional eating, respectively. TFEQ-R18 was also translated in Bulgarian using the translation/re-translation procedure by two independent professional translators.

Statistical Analyses

Data are presented as n, mean ± SD, or percentage (%) as respectively indicated. Two sided Student t-tests and chi-square tests were used for comparisons between genders. Correlation analyses were performed using Pearson or Spearman correlation coefficient, as appropriate. One-way ANOVA was applied when comparisons between tertile groups of physical activity and eating behaviour with respect to BMI were performed. Chi-square tests were used when T2DM prevalence was compared between tertile groups of physical activity and eating behaviour. Multiple linear regression analysis was conducted using the forced entry method. All statistical analyses were executed using SPSS for Windows, version 17.0 (SPSS Inc., Chicago, IL).

RESULTS

Characteristics of the survey participants (n = 511) are presented in Table 1. Mean age was 36.9 ± 15.4 years for men and 40.1 ± 15.2 years for women (P
> 0.05). Men had significantly higher BMI when compared to women (27.1 ± 5.6 vs. 23.7 ± 5.4 kg/m², respectively; P < 0.001) and the prevalence of overweight was significantly greater among them (36 vs. 17.6%, respectively; P = 0.001). Four point eight percent of the participants had a history of T2DM, 13.1% of hypertension, 12.5% of HLP, and 15.7% of CVD. No sex differences were observed with respect to disease history.

Leisure time physical activity (PA) was found to be significantly inversely correlated with BMI (P < 0.001), history of T2DM (P = 0.016), hypertension (P = 0.038), and HLP (P = 0.027). Sport PA also correlated significantly with BMI (P = 0.004), history of hypertension (P = 0.011), and HLP (P = 0.045), whereas no correlation of work PA with either BMI or disease history was observed. Of all examined aspects of eating behaviour only uncontrolled eating correlated significantly with BMI (P = 0.004) and with history of T2DM (P = 0.04; Table 2).

We further compared BMI and prevalence of T2DM in tertile groups of respectively leisure time PA, sport PA, and uncontrolled eating behaviour. BMI was found to be significantly higher in subjects in the lowest when compared to subjects

### Table 1. Characteristics of the survey participants (n = 511)

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
<th>P for sex differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>234</td>
<td>277</td>
<td>511</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>36.9 ± 15.4</td>
<td>40.1 ± 15.2</td>
<td>38.6 ± 15.3</td>
<td>0.183</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.1 ± 5.6</td>
<td>23.7 ± 5.4</td>
<td>25.3 ± 5.7</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>Own history of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 2 diabetes (%)</td>
<td>3.9</td>
<td>5.5</td>
<td>4.8</td>
<td>0.456</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>13</td>
<td>13.2</td>
<td>13.1</td>
<td>0.577</td>
</tr>
<tr>
<td>High cholesterol levels (%)</td>
<td>13</td>
<td>12.1</td>
<td>12.5</td>
<td>0.521</td>
</tr>
<tr>
<td>Cardiovascular disease (%)</td>
<td>17.1</td>
<td>14.2</td>
<td>15.7</td>
<td>0.780</td>
</tr>
<tr>
<td>Family history of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 2 diabetes (%)</td>
<td>13</td>
<td>25.3</td>
<td>19.6</td>
<td>0.035*</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>23.4</td>
<td>34.1</td>
<td>29.2</td>
<td>0.088</td>
</tr>
<tr>
<td>High cholesterol levels (%)</td>
<td>9.1</td>
<td>15.4</td>
<td>12.5</td>
<td>0.160</td>
</tr>
<tr>
<td>Cardiovascular disease (%)</td>
<td>19</td>
<td>20</td>
<td>19.6</td>
<td>0.536</td>
</tr>
<tr>
<td>Current smokers (%)</td>
<td>35</td>
<td>50.5</td>
<td>43.5</td>
<td>0.031*</td>
</tr>
<tr>
<td>Alcohol consumption (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occasional (%)</td>
<td>71.4</td>
<td>73.6</td>
<td>72.6</td>
<td>0.570</td>
</tr>
<tr>
<td>Regular (%)</td>
<td>5.2</td>
<td>2.2</td>
<td>3.6</td>
<td>0.291</td>
</tr>
<tr>
<td>Overweight (%)</td>
<td>36</td>
<td>17.6</td>
<td>25.9</td>
<td>0.001*</td>
</tr>
<tr>
<td>Obesity (%)</td>
<td>25.3</td>
<td>14.3</td>
<td>19.3</td>
<td>0.475</td>
</tr>
</tbody>
</table>

Data are presented as n, mean ± SD, or %. * P < 0.05 between genders. Overweight = BMI ≥ 25.0 ≤ 29.9 kg/m²; Obesity = BMI ≥ 30 kg/m².

### Table 2. Correlation of work, sport, and leisure physical activity and the three aspects of eating behaviour with BMI and disease history

<table>
<thead>
<tr>
<th></th>
<th>Leisure time PA</th>
<th>Sport PA</th>
<th>Work PA</th>
<th>Cognitive restraint</th>
<th>Uncontrolled eating</th>
<th>Emotional eating</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m²)</td>
<td>-0.295†</td>
<td>-0.220*</td>
<td>NS</td>
<td>NS</td>
<td>0.222*</td>
<td>NS</td>
</tr>
<tr>
<td>Own history of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2DM</td>
<td>-0.186*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>0.159*</td>
<td>NS</td>
</tr>
<tr>
<td>Hypertension</td>
<td>-0.160*</td>
<td>-0.195*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>HLP</td>
<td>-0.171*</td>
<td>-0.160*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>CVD</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

* P < 0.05; † P < 0.001; PA - physical activity;
in the middle (27.7 ± 6.9 vs. 24.5 ± 4.5 kg/m²; P = 0.002) and in the highest tertile of leisure time PA (27.7 ± 6.9 vs. 23.8 ± 4.9 kg/m²; P < 0.001; Fig. 1A). A statistically significant difference with respect to BMI was also observed between the lowest and the highest tertile groups of sport PA (27.1 ± 5.9 vs. 23.4 ± 3.4 kg/m²; P = 0.001; Fig. 1B). In addition, subjects in the highest tertile group of uncontrolled eating behaviour had significantly higher BMI when compared with the middle (26.7 ± 6 vs. 24.7 ± 5.7 kg/m²; P = 0.04) as well as to the lowest tertile group (26.7 ± 6 vs. 24.2 ± 5.2 kg/m²; P = 0.017; Fig. 1C). These associations were also replicated when BMI was compared in tertile groups of leisure time PA, sport PA, and uncontrolled eating behaviour separately among men and women (data not shown).

Similarly, the prevalence of T2DM was significantly higher in the lowest when compared to the middle (10% vs. 3.3%; p = 0.027) and to the highest (10% vs. 1.9%; p = 0.02) tertile of leisure time PA (Fig. 2A). In tertile groups of sport PA, although there was a trend towards decrease in T2DM prevalence (8.4% vs. 4.7% vs. 2.1% in the lowest, middle, and highest group, respectively; Fig. 2B) no statistical significance was observed (P > 0.05). The prevalence of T2DM differed also among tertile groups of uncontrolled eating behaviour (Fig. 2C).
behaviour (2.6% vs. 5% vs. 8.4% in the lowest, middle, and highest group, respectively; Fig. 2C) however the difference was not statistically significant (P > 0.05).

Using multiple regression analysis we investigated the impact of leisure time PA, sport PA, and uncontrolled eating behaviour on BMI after age and sex adjustment. As shown in Table 3 leisure time PA and uncontrolled eating were independently associated with BMI (\( \beta = -0.13, 95\% \text{ CI} -1.83 \text{ to } -0.11, P = 0.03 \)) and (\( \beta = 0.32, 95\% \text{ CI} 0.23 \text{ to } 0.44, P < 0.001 \)) whereas sport PA was not.

### Table 3. Results of a multiple regression analysis with BMI as a dependent and leisure time physical activity, sport physical activity, and uncontrolled eating behavior as independent variables

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>( \beta )</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncontrolled eating behavior</td>
<td>0.34</td>
<td>0.32</td>
<td>0.23 to 0.44</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Leisure time physical activity</td>
<td>-0.97</td>
<td>-0.13</td>
<td>-1.83 to -0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Sport physical activity</td>
<td>-0.59</td>
<td>-0.09</td>
<td>-1.40 to 0.21</td>
<td>NS</td>
</tr>
</tbody>
</table>

The model included all 511 participants and was adjusted for age and sex as potential confounders. Adjusted \( R^2 = 0.082 \).

Fifty eight percent of the respondents (46% vs. 54%, men vs. women, respectively; \( P > 0.05 \)) perceived their nutritional habits as unhealthy and 66.7% (41% vs. 59%, men vs. women, respectively, \( P > 0.05 \)) considered their daily physical activity insufficient. Ninety seven percent (97.3%) were, however, highly motivated to engage in regular physical activity or to limit food intake in order to improve their health. No gender differences with respect to motivation for a lifestyle change were detected.

**DISCUSSION**

The major findings of the present study investigating the relationship of physical activity (PA) and nutritional habits with obesity and T2DM in a population known to have one of the highest T2DM-related mortality rates in Europe were as follows: 1) significantly higher BMI in subjects with low leisure time and sport PA levels; 2) positive association between uncontrolled eating behaviour and BMI; 3) independent association of both leisure time PA and uncontrolled eating behaviour with BMI; 4) higher prevalence of T2DM in subjects with low leisure time PA level.

It is well known that obesity is a direct consequence of chronically maintained positive energy balance that may be caused by decreased energy expenditure (e.g. physical inactivity), increased food intake or combination of both. A vast body of scientific evidence has already unequivocally demonstrated the relationship between physical inactivity and obesity. Martinez-Gonzales et al. for instance investigated the association between leisure time PA, sedentary behaviour and BMI among 15 239 European representatives and reported independent inverse association between body weight and PA. Their results were recently confirmed by Oppert and co-workers in a French population.

In the present study we found that individuals with lower levels of leisure time and sport PA are characterized by increased BMI and vice versa, which is in accordance with these previous observations. Interestingly, we observed almost equal BMI among subjects in the middle and in the highest tertile of leisure time PA, which indicates that even engagement in moderate PA during free time may already have beneficial effect on body weight. A clear trend towards decrease in BMI with increasing sport PA was also found. Statistical difference was, however, observed only between the lowest and the highest tertile group, but this may be due to the relatively small sample size of our study.

With respect to occupational PA, although some controversies still exist, our results are in accordance with the majority of the studies reporting no association between PA at work and body weight. Hence, our findings may be used in support of the notion of Martínez-González et al. that reduced energy expenditure during leisure time is one of the main determinants of the obesity epidemic.

In addition, we found that individuals with high uncontrolled eating behaviour scores that are more susceptible to binge eating and excessive food consumption have significantly higher BMI. This is in agreement with previous observations that the present epidemic of obesity is also caused by increased energy consumption.

In the present study BMI was found to be significantly different among genders. However, after it was examined in tertile groups of respectively
leisure time PA, occupational PA, sport PA, and uncontrolled eating behaviour separately among men and women, the associations observed in the whole studied population were replicated. This indicates that the link between BMI, physical activity and energy consumption is not only valid in general, but also in both genders.

Moreover, we observed an independent association of both leisure time PA and uncontrolled eating behaviour with BMI, even after adjustment for age and sex as potential confounders. Uncontrolled eating appears to have a greater impact on BMI than leisure time PA. Thus, our results confirm the widely accepted hypothesis that both reduced PA and increased food consumption are responsible for the increasing rate of obesity, and also support the implication that energy intake may have a greater effect on body weight than energy expenditure.14 This suggestion seems logical since excessive energy consumption is hard to be compensated for by even vigorous physical activity.

The importance of unhealthy lifestyle (e.g. physical inactivity and over nutrition) as a determinant of T2DM is already well established.5,6,15 In 1991, Helmrich et al.6 published one of the earliest reports on the association between PA and T2DM demonstrating that each 500 kcal increment in weekly energy expenditure may reduce the risk of developing diabetes with up to 6%. This association has since been confirmed by many prospective observational studies such as the Nurses’ Health Study.5 In recent years many large-scale intervention studies have demonstrated than even moderate changes in lifestyle can substantially reduce the risk of developing T2DM. The Diabetes Prevention Study (DPS)16 and the Diabetes Prevention Program (DPP)17 are typical examples in this respect. Both studies have reported reduction of 58% in the incidence of T2DM after modification of nutritional habits and increase in PA among individuals at high risk.16,17 We also observed significantly higher prevalence of T2DM among individuals that reported the lowest levels of leisure time PA which is in agreement with the previous reports.5,6 No difference in diabetes prevalence was, however, found among the middle and the highest tertile of leisure time PA, which similarly to our findings with respect to BMI comes to demonstrate that substitution of moderate PA for sedentary behaviour during leisure time may already have a pronounced effect for the prevention of T2DM.

In the present study no statistical difference in the prevalence of diabetes was found between tertile groups of respectively sport PA and uncontrolled eating behaviour. However, a clear trend towards increase in diabetes prevalence with decreasing sport PA and increasing uncontrolled eating behaviour can be distinguished. A potential explanation of this observation can be the relatively small sample size of our study which may have prevented the results from reaching statistical significance, since both of the examined parameters are well known diabetes risk factors.5,6

We also found that increased level of PA during free time (including leisure time activities and sport) is not only associated with lower BMI and decreased prevalence of T2DM but also with significantly lower prevalence of relevant cardio-metabolic disturbances such as hypertension and high cholesterol levels. Thus, our results once again highlight the importance of physical inactivity as a major risk factor for cardio-metabolic disease, on one hand, and the significance of increased PA in their prevention, on the other.15

In addition, BMI in the present study was significantly higher, and the prevalence of overweight significantly greater in men than in women. Typically men have higher BMI than women and we have previously observed this in the same population.18 In the present study, however, men are at lower age, which makes the difference in BMI between genders even greater after sex adjustment (data not shown).

Another interesting finding is the significantly higher number on smokers among the women which participated in the survey. This difference is hard to be interpreted, however, a tendency towards increase in smoking among women has already been observed in this country19, which may, to some extent, be attributed to the considerable urbanization accompanying the transition period.

A relatively big number from the study participants were aware about their unhealthy nutritional habits and insufficient daily PA. Remarkably, almost all of them reported motivation for lifestyle modification particularly by change in dietary pattern and increase in PA. This finding should, however, be carefully interpreted, since it does not necessary mean that participants will take part in lifestyle modification programs, if such are offered.

Some potential limitations of the present study are the cross-sectional design which limits any inference about the direction of causality, the utilization of questionnaire for assessment of physical activity and dietary habits, since under- or over reporting is often observed; and the relatively small
sample size which restricts us from drawing definitive conclusions. This, however, is the first study to report interaction between different aspects of physical activity and nutritional behaviour among the citizens of Sofia, Bulgaria. Hence, it does not only extend previous findings in this population known with its excessive prevalence of cardiometabolic disturbances and CVD-related mortality, but also adds to the understanding of the current epidemic of obesity and T2DM.21-26.

CONCLUSIONS

In conclusion we observed a strong inverse relationship between the level of physical activity during leisure time, BMI, and the prevalence of type 2 diabetes. Uncontrolled eating behaviour was also found to have a significant effect on BMI. Both leisure time PA and uncontrolled eating behaviour were independently associated with BMI, uncontrolled eating, however, appeared to have a greater effect. Since this is the first study to demonstrate relationship of distinct aspects of physical activity and nutritional behaviour with body weight and disease history in this population, further research should be performed including larger number of participants in order that better insight in these associations be gained.

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ВЗАИМОСВЯЗЬ ФИЗИЧЕСКОЙ АКТИВНОСТИ И НАВЫКОВ ПИТАНИЯ С ОЖИРЕНИЕМ И САХАРНЫМ ДИАБЕТОМ ТИПА 2: SOFIA LIFESTYLE (SLS) STUDY

Ц. Стефанов, А. Векова, Д. Кюркчияв, Т. Темелкова-Кюркчияв

РЕЗЮМЕ

ВВедение: Пониженная физическая активность и чрезмерное потребление пищевых продуктов занимают основное место в этиологии ожирения и сахарного диабета типа 2 (СДТ2).

Цель: Исследовать взаимосвязь физической активности (ФА) и навыков питания с ожирением и СДТ2 среди населения Софии, Болгария.

Пациенты и методы: На случайном принципе подобрано 511 человек, интервьюированных с использованием действительного вопросника относительно их возраста, роста, массы тела, медицинского анамнеза и мотивации для изменения образа жизни. Вопросник относительно ФА Baecke и Three Factor Eating Questionnaire также пополнен участниками.

Результаты: Индекс массы тела (ИМТ) значительно выше среди участников в самый низкий терцил ФА в свободное время, по сравнению с индексом участников, попадающих в средний (Р = 0.002) и в самый высокий терцил (Р < 0.001). Сигнификантная разница установлена также и между самым низким и самым высоким терцилами ФА в свободное время (Р = 0.001). С точки зрения навыков питания снигнификантные разницы в ИМТ наблюдаются между самым высоким и средним (Р = 0.04), как и между самым высоким и самым низким терцилами (Р = 0.017) фактора "неконтролируемый прием пищи". Распространение СДТ2 значительно выше среди участников, попадающих в самый низкий терцил ФА в свободное время по сравнению с участниками, попадающими в средний терцил (Р = 0.027) и в самый высокий терцил (Р = 0.02). При помощи мультивариантного регрессионного анализа как ФА в свободное время, так и фактор "неконтролируемый прием пиши" оценены как независимые детерминанты ИМТ (β = -0.13, 95% CI -1.83 to - 0.11, P = 0.03 and β = 0.32, 95% CI 0.23 to 0.44, P < 0.001).

Заключение: Авторы установили сильную обратно пропорциональную связь между уровнем ФА в свободное время (в том числе и спорт), ИМТ и распространением СДТ2. Фактор "неконтролируемый прием пищи" также имел снигнификантый эффект на ИМТ.