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Brief report

Body shape, body size and cigarette smoking relationships

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Abstract

Objectives: The aim of the present study was to explore whether smoking is positively related with the abdominal obesity.
Methods: Cross-sectional data was analyzed from a random sample of 1,342 subjects, stratified by their age and gender. Cigarette smoking habits were assessed and anthropometric measures obtained during the health examination.
Results: Statistically significant differences in waist circumference and waist-hip ratio were found among males in some of the age groups, body mass index however, was lower in older smokers. There were no differences between female smokers and non-smokers in all parameters.
Conclusion: The results of the study do not support the hypothesis that smoking affects an abnormal fat distribution profile predominantly in the form of central adiposity as reported earlier.

Keywords: Smoking – Body weight – Body measures – Body mass index – Body-weight changes.

Chronic non-communicable diseases have a number of risk factors in common of which obesity and smoking are two of the most important. There were 4.83 millions of premature deaths that could be attributed to smoking in the year 2000, among them 1.69 million due to heart and vascular diseases[1]. Furthermore, CDC reports about 20 % of all heart and vascular diseases are caused by smoking[2]. On a global level, morbidity and mortality is constantly growing[3].
Increased body weight is an independent risk factor for the heart and vascular diseases, hypertension, dyslipidaemias and type II diabetes[4]. General obesity, expressed in body mass index (BMI) is one of the dominant indicators for the morbidity in the developed world. Even more important seems to be the distribution of excessive accumulation of fat as an important evaluation factor. Abdominal distribution of fat of visceral, central, or android type, is in contrast with the peripheral gynoid type. Two parameters are adopted in the clinical use for the evaluation of the fat distribution: waist circumference and the waist-hip ratio (WHR). Both proved to be reliable prognostic factors for the evaluation of the coronary disease risk[5,6].
Some studies showed that smoking is negatively related to BMI, which means that smokers tend to have lower BMI than non-smokers[7], which was not supported by other studies[8].
The results of various studies on the association between smoking and obesity vary. Not all authors confirm any effect of smoking on different types of obesity. Shimokata supported the hypothesis established previously that smoking is positively associated with abdominal obesity despite lowering BMI[9]. However, after several subsequent studies the relationship still remains uncertain and the literature review often shows inconsistent results[10–15]. Therefore, the objective of the present study was to explore whether smoking is positively related with the abdominal obesity.

Methods

The study was designed as a non-interventional cross-sectional survey and was based on the data obtained through the CINDI project performed between September 1996 and March 1997[16]. Study subjects eligible for inclusion in the study were inhabitants of Ljubljana, the capital of Slovenia, and its periphery, aged between 25 and 65 years. All-together

approximately 350000 subjects were eligible for inclusion in the study. A random sample of 2182 subjects, stratified by their age and gender, was invited to take part in the study by the Primary Health Care Centre Ljubljana. An invitation letter was sent explaining the study aims and objectives as well as the role of their participation. After they agreed to participate in the study the home-care nurses from the Primary Health Care Centre Ljubljana interviewed the participants at home in order to collect the administrative and clinical information including: date of birth, gender, current number of cigarettes smoked per day and their smoking status in the past.

At the time of the interview the participants were invited to visit the Primary Health Care Centre Ljubljana, where physicians assured the questionnaire is filled in correctly and clinically examined the participants. Additional information was included in the questionnaire including: weight, height, waist and hip circumference. Both, nurses and physicians underwent a training course before their actual involvement in the study in order to ensure a uniform completion of the questionnaire. All together 20 nurses and 10 physicians were involved in the study.

Body height and weight were measured during the clinical examination. Height was measured using a free-standing stadiometer in bare feet in a standing position. The subject was standing with his or her back to the height rule and with the back of the head, back, buttocks, calves and heels touching the wall. The top of the external auditory meatus was in level with the inferior margin of the bony orbit. The examiner placed the triangle on the height rule and slid it down to the head so that the subject's hair was pressed flat. The examiner recorded the information on the survey form to the nearest centimetre.

The subjects were barefoot and in light clothes when body weight was measured. The scale was balanced with both weights at zero and the balance bar aligned. The subject stood in the centre of the platform. The examiner read the weight and recorded it on the form, to the nearest 0,2 kg.

Waist and hip circumference were recorded by a standard tape measure. A non-stretch tape was used for this purpose. Waist circumference was measured at the smallest circumference between the last ribs and the top of the pelvis, on the superior anterior iliac crest with the abdomen relaxed and at the end of normal expiration. Where there was no natural waist line, the measurement was taken at the level of the umbilicus. Hip circumference was taken at the widest point around the hips, over the major trochanters.

Participation in the study and the analysis of the data was assured to be on a voluntary and anonymous basis, restricting the access of personal data to the physician who had a direct contact with patients. The study was approved by the Commission for Medical Ethics of the Republic of Slovenia.

For the purpose of the study a smoker was defined as a person who smokes one or more cigarettes a day. Study subjects were categorized into current smokers, former smokers and non-smoker. Additionally, a sub-analysis was run by defining a smoker as a person who smoked 10 or more cigarettes a day (moderate smoker), as well as 20 or more cigarettes a day (heavy smoker). BMI was calculated using the standard formula: body weight in kilograms divided by the square of the height in meters.

A nonparametric Kruskal Wallis H test was used in order to explore the effect of smoking status on BMI, WHR, hip circumference and waist circumference in each stratum defined by age and gender. Furthermore, Mann Whitney U test was used to test differences between study subject as defined by their smoking status (current smoker vs non-smoker and former smoker, as well as non-smoker vs former smoker). The statistical analysis was performed in SPSS 14.0.

Results

All together, 1 342 inhabitants of Ljubljana and its periphery participated in the study. The response rates ranged from 45 % to 84 % across the strata. The response rate seemed to rise with age and was higher among females than males, although the differences were not found to be statistically significant (^{2} = 0,186; p = 0,980). Based on the nature of the study and no extra stimulation of participants no specific reasons were detected as reasons for non-participation.

Percentage of smokers ranged from 13 % to 42 % across the gender and age strata. A higher percentage of smokers was observed among younger study subjects (^{2} = 49,293; p <0,000). The percentage of smokers was indicated to be equal or higher among males than females in all age groups except in the age group 35–44, although the influence of gender on the percentage of smokers was not found to be statistically significant.

There were statistically significant differences in waist circumference among males in age groups of 35–44 years and 45–54 years as well in WHR in the age group of 45–54 years. In all cases current smokers had the lowest value, followed by non-smokers and than former smokers. Statistical significant differences were found between current male smokers and former male smokers in waist circumference in the age category 35–44 and 45–54, between current male smokers and former male smokers in WHR in the age category 45–54, and between male non-smokers and former male smokers in the waist circumference in the age category 45–54. The results were in concordance with BMI where current smokers had the lowest value, followed by non-smokers and former smok-

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Table 1. Influence of present daily smoking on Body Mass Index, Waist-Hip Ratio, hip circumference and waist circumference among males stratified by age.

Age category	Status	Body Mass Index			Hip circumference (cm)			Waist circumference (cm)			Waist-Hip Ratio		
		Mediana (min-max)	N	p*	Mediana (min-max)	N	p*	Mediana (min-max)	N	p*	Mediana (min-max)	N	p*
	Non-smoker	24.7 (17.2–32.1)	66		98 (63–116)	66		85 (64–109)	66		0.87 (0.72–1.27)	66	
25–34	Current smoker	24.6 (17.6–33.9)	49	0.436	98 (49–118)	49	0.746	88 (67–117)	49	0.374	0.88 (0.74–1.67)	49	0.198
	Former smoker	25.1 (20.7–32.6)	20		98 (57–113)	21		90 (70–103)	21		0.90 (0.82–1.56)	21	
	Non-smoker	26.1 (21.6–43.6)	62		102 (84–121)	62		92 (76–124)	62		0.92 (0.81–1.14)	62	
35–44	Current smoker	25.5 (20.4–40.1)	59	0.023	101 (86–122)	59	0.206	90 (71–118)	59	0.029	0.90 (0.76–1.02)	59	0.0716
	Former smoker	27.9 (19.2–40.3)	41		103 (87–126)	42		96 (72–126)	42		0.93 (0.75–1.06)	42	
	Non-smoker	26.7 (21.7–37.4)	70		102 (88–130)	71		96 (55–140)	71		0.92 (0.51–1.28)	71	
45–54	Current smoker	25.9 (20.0–33.9)	45	0.001	101 (86–116)	44	0.092	94 (74–115)	44	0.003	0.91 (0.82–1.03)	45	0.0012
	Former smoker	28.4 (22.7–40.8)	49		105 (90–118)	49		99 (80–120)	49		0.95 (0.81–1.08)	49	
	Non-smoker	27.9 (21.9–38.3)	79		102 (86–134)	79		97 (81–130)	79		0.95 (0.83–1.11)	81	
55–64	Current smoker	25.9 (20.1–32.4)	42	0.010	98 (89–117)	43	0.058	93 (78–118)	43	0.126	0.94 (0.84–1.11)	43	0.204
	Former smoker	28.4 (20.0–37.3)	56		102 (79–120)	55		99 (65–127)	55		0.96 (0.81–1.13)	56	

* Statistical significance based on the Kruskal Wallis H test

ers. Specifically, statistically significant differences in BMI were found between current male smokers and former male smokers in all age categories except 25–34, male non-smokers and former male smokers in the age category 45–54, and male non-smokers and current male smokers in the age category 55–64.

Among females there were no statistically significant differences in hip, waist circumference and WHR in all of the age-groups. The same result was obtained for BMI in most of the age- groups. The only exception was in the group of the oldest females (age group 55–64 years) where current smokers had the lowest BMI followed by former smokers and non-smokers. However, a statistically significant result was only found between non-smokers and current smokers in the age group 55–64.

A sub-analysis that used more strict definitions of smokers (smoking more than 10 or smoking more than 20 cigarettes per day) has given similar results. The statistically significant differences have been found for the same parameters in the same age strata. Furthermore, in case of moderate smokers differences have been also found among males in WHR in the age group of 25–34 years and in hip and waist circumference in the age group of 55–64 years. The values followed a classical pattern where the lowest value was found among current smokers, followed by non-smokers and former smokers. In case of male heavy smokers the differences in hip and waist circumference in the age group of 55–64 years were also found but not the differences in WHR in the age group of 25–34 years. Additionally, a difference was found among males in hip circumference in the age group of 45–54 and in WHR among females in the age group 25–34. In both cases values followed the classical pattern where current smokers had the lowest value, followed by non-smoker and former smokers.

Discussion

The results of the present study do not support the hypothesis that smoking affects an abnormal fat distribution profile predominantly in the form of central adiposity as reported earlier[8–12]

Some of the results of the presents study was consistent with some previously published studies. Namely, former male smokers had a higher BMI than non-smokers and current smokers.[13,14,17] Nevertheless, female smokers were not found to have any difference in BMI from former as well as non-smokers except the oldest females. The results contradict the belief of many young girls and women, reported by Honjo, that tobacco smoking helps them to become or stay slim[18].

Table 2. Influence of present daily smoking on Body Mass Index, Waist-Hip Ratio, hip circumference and waist circumference among females stratified by age.

Age category	Status	Body Mass Index			Hip circumference (cm)			Waist circumference (cm)			Waist-Hip Ratio		
		Mediana (min-max)	N	p*	Mediana (min-max)	N	p*	Mediana (min-max)	N	p*	Mediana (min-max)	N	p*
	Non-smoker	22.1 (16.8–42.2)	77		95 (67–138)	77		72 (60–104)	77		0.76 (0.66–1.29)	77	
25–34	Current smoker	22.1 (16.7–35.5)	50	0.612	95 (79–113)	50	0.639	72 (60–92)	50	0.490	0.79 (0.64–0.91)	50	0.080
	Former smoker	23.8 (18.8–56.2)	10		98 (65–110)	10		79 (50–102)	10		0.80 (0.76–0.94)	10	
	Non-smoker	25.0 (18.5–33.7)	70		98 (63–118)	70		78 (62–100)	70		0.79 (0.69–1.36)	70	
35–44	Current smoker	23.6 (18.7–43.1)	66	0.817	96 (78–145)	67	0.707	73 (59–126)	67	0.443	0.79 (0.66–1.30)	67	0.932
	Former smoker	24.5 (18.4–49.2)	23		97 (70–146)	23		76 (68–116)	23		0.79 (0.73–1.31)	23	
	Non-smoker	27.5 (16.7–46.0)	125		104 (70–135)	125		85 (59–193)	125		0.82 (0.68–1.86)	125	
45–54	Current smoker	26.9 (19.0–40.3)	41	0.746	103 (87–140)	41	0.435	81 (65–119)	41	0.156	0.81 (0.58–0.93)	41	0.193
	Former smoker	27.4 (20.0–36.2)	14		102 (58–120)	16		83 (58–107)	16		0.82 (0.72–1.19)	16	
	Non-smoker	28.4 (19.1–43.3)	163		104 (80–145)	162		87 (67–130)	162		0.83 (0.72–1.25)	163	
55–64	Current smoker	25.7 (19.0–35.6)	29	0.008	100 (84–123)	29	0.187	86 (66–107)	29	0.292	0.83 (0.75–0.96)	29	0.357
	Former smoker	26.8 (17.7–38.0)	27		104 (80–128)	27		85 (63–110)	27		0.81 (0.71–0.98)	27	

* Statistical significance based on the Kruskal Wallis H test

This information might influence the current smokers to stop their otherwise unhealthy habit or prevent young people to become addicted.

The present analysis was based on a cross-sectional study and does not include information about history of tobacco smoking, which could potentially affect the study findings. However, there is no consensus how to model different aspects of smoking history taking into account several smoking-related variables such as duration and intensity. While some studies only account for smoking status (non-smoker/current smoker/former smoker), others report detailed information on the number of cigarettes or packs smoked per day, duration of smoking, age at the initiation, and/or time since cessation as reported by some authors[19].

Other possible confounders such as education, alcohol intake, sports activity and health status had a potential bias on the study results. Due to the limitations of the study data, stratified sampling according to the age and gender, as well the sample size in each of the strata multivariable analysis was not possible. Therefore, the only two potential confounders that are taken into account in the current analysis were age and gender.

Study results that would confirm smoking to have an effect on the overall obesity and/or abnormal fat distribution predominantly in the form of central adiposity could be of great importance in the tobacco alert campaigns and could be of use against direct and/or indirect tobacco advertising that tends to idealize the body image of smokers[20].

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