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Overweight and coronary risk factors results from a western Austrian survey

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Previous reports have stated that overweight is an important factor in the development of various chronic diseases. Therefore it is a major indicator for the health status of a population. A number of studies have shown that overweight is particularly important for the development of coronary heart disease[1]. Its significance is mainly reported to be due to the association with primary coronary risk factors, such as an increase of relative risks for hypertension, hypercholesterolemia and diabetes[2]. In addition in long term follow-up an independent effect on coronary heart disease has been identified[3].
Objectives of this analysis are to estimate the prevalence of weight categories in a population in western Austria, and to investigate the importance of overweight as a secondary risk factor for coronary heart disease. Associations of weight categories with fasting levels of total cholesterol, HDL cholesterol, triglycerides, blood glucose, and systolic blood pressure are reported.

Population and Methods

The study population consisted of participants in the baseline survey of the WHO Countrywide Integrated Non-communicable Diseases Intervention programme (CINDI), which was performed in Vorarlberg, the westernmost state of Austria, in 1986. For the survey a sample of 2400 men and women aged 25 to 64 years (300 per sex and ten year age group) was randomly selected from electoral lists and invited to participate. Details of the protocol and guidelines, and of the methods used in the Austrian survey, are published elsewhere[4,5].
Briefly, randomly selected people were invited to a medical examination in general practitioners' offices. The examination included sampling of fasting blood and measurements of height and weight. People on dietary or drug treatment were not excluded from the analysis. Blood pressure was measured with standard sphygmomanometers, in the sitting position. Measurements of height and weight were done after the participants had taken off their shoes and upper garments. Total cholesterol, HDL cholesterol, triglycerides, and blood glucose were determined enzymatically[6–9]. External quality assessment was made in collaboration with the World Health Organization Lipid Research Center in Prague.

1328 participating men and women, or 55.3 percent of the random sample, are included in the analysis. The main reason for the low response rate was the financial limitations, which prohibited a more intensive invitation procedure. Response rate varied in men from 47.7 percent in the age group 25 to 34 years to 59.3 percent in the age group 55 to 64 years, in women from 47.0 percent in the age-group 25 to 34 years to 67.3 percent in the age group 45 to 54 years. The absolute number of participants per sex and ten year age group is presented in table 1.
The body-mass-index is calculated as the weight in kilograms divided by the height in meters squared (kg/m^2). Weight categories are defined by the body-mass-index. Cut-off points are 25.0 kg/m^2 (moderate overweight) and 30.0 kg/m^2 (severe overweight)[10]. Owing to the small number of people with a body-mass-index exceeding 40.0 kg/m^2 (2 men and 10 women), risk factor levels for this weight category are not presented. Prevalence of weight categories is calculated sex-specifically for ten-year age groups, and age-standardized to the SEGI world standard population[11] in the total age range (table 1).
Unadjusted means and standard deviations of coronary risk factors by weight category and sex are presented. We further present age-adjusted means of risk factors by relative weight and sex, computed by analysis of covariance (table 2).
For further analyses, variables were log-transformed and tested for normal distribution with non-parametric tests. Univariate analysis included Pearson correlation coefficients of weight categories and primary coronary risk factors by sex.

Tab. 1. Prevalence (%) of weight categories[a] by age and sex.

Age (years)	25–34	35–44	45–54	55–64	25–64[b]
Men (n)	143	155	159	178	635
BMI[c] <25.0 kg/m^2	62.9	44.5	39.0	38.2	48.6
BMI 25.0–29.9 kg/m^2	30.8	48.8	49.1	48.3	42.8
BMI ≧30.0 kg/m^2	6.3	7.1	11.9	13.5	8.6
Women (n)	141	166	202	184	693
BMI <25.0 kg/m^2	84.4	70.5	50.5	33.7	63.8
BMI 25.0–29.9 kg/m^2	8.5	19.9	31.2	42.9	23.0
BMI ≧30.0 kg/m^2	7.1	9.6	18.3	23.4	13.3

[a] According to Garrow (10).
[b] Age-standardized to SEGI world population (11).
[c] Body-mass-index.

Tab. 2. Unadjusted means and standard deviations (age-adjusted means[a]) of cardiovascular risk factors by weight and sex.

Body-mass-index (kg/m²)		<25.0	25.0–29.9	≧30.0
Men(n)		289	283	63
Age	(years)	43.1±11.8	46.9±10.5	48.7±10.0
Total cholesterol	(mg/dl)	218.8±43.1 (220.9)	235.1±43.2 (233.7)	240.3±41.7 (237.1)
HDL cholesterol	(mg/dl)	60.6±14.2 (60.6)	54.4±14.2 (54.4)	51.0±14.2 (50.9)
Triglycerides	(mg/dl)	130.7±122.4 (132.6)	180.2±135.8 (178.9)	225.9±124.4 (223.0)
Fasting glucose	(mg/dl)	90.6±15.3 (91.1)	94.0±16.7 (93.6)	98.6±15.6 (97.8)
Systolic BP[b]	(mmHg)	128.7±16.5 (129.5)	136.3±16.4 (135.8)	141.5±18.6 (140.4)
Women (n)		400	187	106
Age	(years)	41.9±10.6	51.0±9.8	50.5±9.8
Total cholesterol	(mg/dl)	216.1±41.6 (222.4)	243.5±50.4 (234.5)	239.1±47.3 (231.1)
HDL cholesterol	(mg/dl)	70.1±16.5 (70.7)	63.3±15.1 (62.4)	58.0±14.1 (57.2)
Triglycerides	(mg/dl)	99.9±118.7 (104.3)	134.4±72.6 (128.1)	160.9±113.8 (155.2)
Fasting glucose	(mg/dl)	85.4±11.1 (86.3)	89.2±12.4 (87.8)	96.1±19.7 (94.9)
Systolic BP[b]	(mmHg)	124.9±17.2 (127.3)	138.6±20.2 (135.1)	147.0±20.0 (143.8)

[a] Age-adjusted by analysis of covariance.
[b] Systolic blood pressure.

Tab. 3. Pearson correlation coefficients and partial regression coefficients[a] of weight categories with log-transformed coronary risk factors.

	Pearson	p	partial[a]	p
Men				
Age	+0.176	0.000	–	–
Total cholesterol	+0.187	0.000	+0.152	0.000
HDL cholesterol	−0.252	0.000	−0.246	0.000
Triglycerides	+0.312	0.000	+0.303	0.000
Fasting glucose	+0.169	0.000	+0.131	0.001
Systolic BP[b]	+0.264	0.000	+0.227	0.000
Women				
Age	+0.351	0.000	–	–
Total cholesterol	+0.233	0.000	+0.090	0.017
HDL cholesterol	−0.285	0.000	−0.291	0.000
Triglycerides	+0.372	0.000	+0.289	0.000
Fasting glucose	+0.270	0.000	+0.182	0.000
Sysrolic BP[b]	+0.430	0.000	+0.320	0.000

[a] Controlling for age.
[b] Systolic blood pressure.

Further, multiple regression analysis was performed for testing associations of weight categories with primary risk factors when controlling for age. We chose the method of stepwise forward entry, including age first and weight category second. Sex-specific partial regression coefficients are presented (table 3).

Results

Table 1 shows the prevalence of normal weight (body-mass-index below 25.0 kg/m²), moderate overweight (body-mass-index 25.0 to 29.9 kg/m²), and severe overweight (30.0 kg/m² or more) respectively. Age standardized prevalence of moderate overweight is 42.8 percent in men and 23.0 percent in women. The prevalence of severe overweight is 8.6 percent in men and 13.3 percent in women. In both sexes prevalence of normal weight decreases continuously with advancing age. Prevalence of severe overweight, on the contrary, increases continuously in both sexes with advancing age, as does the prevalence of moderate overweight in women. The increase of prevalence with age is found particularly in women. 66.3 percent of women in the age group 55 to 64 years are moderate or severely overweight, compared to 15.6 percent in the age group 25 to 34 years. The respective prevalences in men are 61.8 percent and 37.1 percent.

Table 2 shows the age-adjusted mean levels of total cholesterol, HDL cholesterol, triglycerides, fasting blood glucose and systolic blood pressure by weight category and sex. Overweight men and women have lower levels of HDL cholesterol, and higher levels of total cholesterol, triglycerides, fasting blood glucose and systolic blood pressure. These differences are graded from moderate to severe overweight in both sexes with respect to all primary risk factors, with the exception of total cholesterol in women. Weight categories are significantly associated with all investigated parameters both in univariate analysis (Pearson correlation) coefficients and multivariate analysis (partial regression coefficients of weight categories controlling for age). The level of significance of associations (in both sexes and in all risk factors is $p < 0.001$) (in univariate analysis) as well as in multivariate analysis, with the exception of total cholesterol in women ($p = 0.017$).

Discussion

The categories of moderate overweight and severe overweight are based on a former classification [10]. Moderate overweight is defined as a body-mass-index from 25.0 to 29.9 kg/m^2, severe overweight as a body-mass-index of 30.0 kg/m^2 or more. This classification has the advantage of being independent of behavioural factors causing differences in body-mass-index between men and women. Further, results for prevalence become comparable between populations. The disadvantage of this categorization is that possible endogenous factors (e.g. hormones) confounding differences between sexes are excluded.
In the Second National Health and Nutrition Examination Survey (NHANES II) overweight categories are based on the sex-specific 85th and 95th percentiles of 20 to 29 year old participants. In NHANES II a body-mass-index that equals or exceeds 27.8 in men and 27.3 women is defined as "overweight". The indices for "severe overweight" in the US study are 31.1 in men and 32.3 in women [2]. The 85th percentile of the youngest age group in our study population (age 25 to 34 years) is 27.5 for men and 25.3 for women. The body-mass-index of the 95th percentile is 30.6 in men and 32.2 in women. Age correlates significantly with weight categories, in both men and women. This might partly be explained by behavioural changes, such as lower physical activity with increasing age. But the two-fold higher correlation for women compared with men indicates that other factors, especially hormonal changes (e.g. estrogen-deficiency in post-menopausal women), might also confound these differences. After adjusting for age, levels of risk factors remained almost unchanged in men, due to small age-differences between weight categories. In women, however, they generally decreased, with the exception of differences in HDL cholesterol, which slightly increased. The slight increase in HDL differences in women after adjusting for age is unexpected and might be due to chance. In a recent publication HDL cholesterol means showed no trend with advancing age [12].
When the additive or even multiplicative effects of risk factors on cardiovascular diseases are considered [13,14], overweight participants have a substantially higher risk of developing coronary heart disease. The increase of risk is graded from moderate to severe overweight with respect to all parameters, except total cholesterol in women. In all parameters investigated and in both sexes, trends across categories of relative weight are significant, both with and without controlling for age.
HDL cholesterol is of major importance for coronary heart disease. Low HDL cholesterol is an independent coronary risk factor, and high levels of HDL cholesterol have a cardioprotective effect [15–17]. In the treatment group of the Helsinki Heart Study with 5 years of follow-up an increase of 8 percent in HDL cholesterol predicted a 23 percent reduction of coronary heart disease incidence [18].
In the present study the unadjusted mean of HDL-cholesterol in normal weight men was 60.0 mg/dl, compared to 54.5 mg/dl in moderately overweight men and 51.0 mg/dl in severely overweight men. The respective levels in women were 70.1 mg/dl, 63.3 mg/dl, and 58.0 mg/dl. Thus, men with moderate overweight have 10.2 percent lower HDL cholesterol levels than normal weight participants and women 9.7 percent lower. Differences between normal weight and severe overweight are 16.0 percent in men and 17.3 percent in women. When adjusting for age, differences in HDL-cholesterol levels remain the same in men, while they increase in women (normal weight vs. moderate overweight 11.7 percent, severe overweight 19.1 percent respectively).
When interpreting the results it has to be considered that neither dietary nor drug treatment of investigated primary risk factors was controlled. As overweight people are more likely to have hyperlipidemia, hypertension and diabetes, they are more likely to be undergoing treatment. Therefore not controlling for treatment might affect the results. Also, the importance of relative weight as a risk factor is markedly influenced by the distribution of fat and the subcutaneous fat, as a recent publication of the Swiss WHO-MONICA project shows [19]. Neither of these parameters was included in our analysis. Finally, it has to be acknowledged that the response rate was low, which might cause a selection bias. Probably people with increased health awareness would have been more inclined to participate. This increased awareness might have led to a better-than-average state of health. On the other hand, increased awareness may have been the result of a reduced state of health.
In summary, despite the limitations mentioned, our study clearly shows the importance of relative weight as an indicator of increased coronary risk. Weight categories were significantly associated with each risk-factor, both in men and women, and both with an without controlling for age. Age-standardized, more than one half of the male and one third of the female population is overweight.

Changes in life-style, especially weight reduction, are known to be effective in improving risk factors[20], and are therefore of major importance for this population at high risk for cardiovascular diseases.

Summary

Objectives of the study are to estimate prevalence of weight categories in a western Austrian population and to determine differences in primary coronary risk factors between weight categories in adults. The study population consists of 635 males and 693 females aged 25 to 64 years from the state Vorarlberg in western Austria. Age-standardized prevalence of body-mass-index 25.0 to 29.9 kg/m^2 is 42.8% in men and 23.0% in women. The prevalence of a body-mass-index of 30.0 kg/m^2 or more is 8.6% in men and 13.3% in women. Categories of relative weight correlated in both sexes significantly with all investigated risk factors, i.e. total cholesterol, HDL cholesterol, triglycerides, fasting blood glucose and systolic blood pressure. Significance remained in multivariate regression analysis in all parameters for both sexes, when controlling for age. Thus, the survey clearly shows the importance of relative weight as an indicator of elevated coronary risk and the importance of overweight for public health.

Résumé

Excès de poids et risques cardio-vasculaires: résultats d'une étude de population dans l'ouest de l'Autriche

Le but de cette étude est d'estimer la distribution du poids corporel dans la population et de mettre en évidence les différences de facteurs de risque cardio-vasculaires entre ces catégories. 635 hommes et 693 femmes, âgés de 25 à 64 ans et domiciliés dans le Vorarlberg (ouest de l'Autriche) constituent la population de l'étude. Après standardisation selon l'âge, la distribution de la population entre les bornes de l'indice corporel choisi comme référence (de 25,0 à 29,9 kg/m^2) concerne 42,8 % des hommes et 23 % des femmes. L'indice corporel est au-delà de 30 kg/m^2 pour 8,6% des hommes et 13,3% des femmes. Dans les deux sexes, il existe une corrélation significative de l'indice corporel avec tous les facteurs de risque cardio-vasculaire recherchés (cholestérol total, cholestérol HDL, triglycérides, glucose sanguin, pression sanguine). La signification statistique persiste en analyse de régression multivariée, introduisant tous les paramètres et après contrôle de l'âge et du sexe. Ainsi, cette étude montre le rôle de l'indice corporel comme risque cardio-vasculaire et l'impact sanitaire de l'excès de poids dans la population générale.

Zusammenfassung

Übergewicht und koronare Risikofaktoren. Ergebnisse einer Bevölkerungserhebung in Westösterreich

Ziel der Untersuchung war die Abschätzung der Prävalenz von Gewichtskategorien in einer westösterreichischen Bevölkerung und die Bestimmung von Unterschieden in primären koronaren Risikofaktoren. Die Studienpopulation besteht aus 635 Männern und 693 Frauen im Alter von 25 bis 64 Jahren aus dem Bundesland Vorarlberg. Die alterstandardisierte Prävalenz von Body-Mass-Indizes von 25.0 bis 29.9 kg/m^2 betrug bei Männern 42,8% und bei Frauen 23,0%. Die Prävalenz von Body-Mass-Indizes ab 30,0 kg/m^2 betrug bei Männern 8,6% und bei Frauen 13,3%. Die Kategorien des relativen Gewichtes korrellierten bei beiden Geschlechtern signifikant mit jedem untersuchten Risikofaktor. Diese sind Gesamtcholesterin, HDL-Cholesterin, Triglyzeride, Nüchternblutzucker und systolischer Blutdruck. Auch in der multivariaten Analyse unter Kontrolle des Alters blieb der signifikante Effekt des relativen Gewichtes auf alle Risikofaktoren bei beiden Geschlechtern bestehen. Damit zeigt diese Untersuchung die Bedeutung des relativen Gewichtes als Indikator des Koronarrisikos und die sozialmedizinische Bedeutung des Übergewichtes.

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