Original article

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Metabolic syndrome among operators using video display units in call centers

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Objectives Reports about medical consequences from sedentary work are contradictory. They may be associated with the metabolic syndrome, a collection of cardiovascular risk factors including hypertension, dyslipidemia, insulin resistance, and central obesity. No data are currently available on workers using visual display units (VDU), a potential high-risk group, given the sedentariness inherent in this work.

Methods The prevalence of metabolic syndrome was evaluated among 1547 VDU users with a mean age of 29.7 years and among a control group of 892 persons with a mean age of 30.2 years who performed nonsedentary work, selected on the basis of similar demographic data. A physical examination and laboratory tests useful for the diagnosis of the metabolic syndrome were performed.

Results The prevalence of metabolic syndrome was 3.10% for the VDU users versus 2.01% for the controls [odds ratio (OR) 2.048, 95% confidence interval (95% CI) 1.169–3.587, P=0.012). Significance persisted after control for confounding factors (eg, smoking and leisure-time activity) in a multivariate analysis (OR 1.555, 95% CI 1.03– 2.690, P<0.05).

Conclusions The metabolic syndrome should be carefully considered when health surveillance programs for VDU users are implemented.

Key terms central obesity; dyslipidemia; hypertension; insulin resistance; job task; occupational health; sedentariness.

The term metabolic syndrome describes a constellation of cardiovascular risk factors, including hypertension, abdominal obesity, dyslipidemia, and insulin resistance. It is increasingly recognized worldwide, and a recent survey indicates that almost one-fourth of the adult population in the United States has this syndrome (1). Excess weight and lack of physical activity are two important determinants of the metabolic syndrome (2). On the other hand, chronic stress has been recently reported to be associated with the syndrome, especially in the work environment (3). Since white-collar workers generally spend a large part of the day at work, it seems reasonable to suppose that this kind of job is characterized by high levels of sedentariness or by job demands that may represent an important risk factor for the syndrome. Indeed, it is increasingly appreciated that worksites represent one of the most promising settings for early-detection and follow-up interventions for the metabolic syndrome (4). Users of visual display units (VDU) represent a potential risk group for metabolic syndrome, given the sedentariness inherent in their work, and the possibility of chronic stress (5). Since there is a suggestion that the early recognition of the syndrome may be crucial for preventing morbidity and mortality related to cardiovascular complications (6), it should be interesting to focus on workers under 45 years of age, for whom preventive measures may have a major impact, given the relatively extended period of time before retirement.

The aim of our study was therefore to investigate whether VDU usage represents a work condition associated with an increased prevalence of metabolic

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syndrome among young workers; furthermore, some factors regarding VDU work (namely, the possible presence of chronic stress, the pattern of daily workhours, and work seniority), possibly causally related to the metabolic syndrome, were also explored.

Study population and methods

Call-center workers of an Italian telecommunications company, examined during a health surveillance campaign promoted by occupational health physicians, were considered eligible for the study. They were enrolled according to the following criteria: (i) VDU work for at least 25 (mean 29.7, range 25–36) hours per week, (ii) age <45 years, and (iii) no family history of hypertension, diabetes, or hyperlipidemia. At the same time, a population of workers engaged in computer use for <20 (mean 12.6, range 0–18) hours per week, but fulfilling the other two selection criteria, was recruited as a control group. In addition, the controls were included in the study only if comparable exposure was present in terms of workhours per week, the pattern of daily workhours (daily or shift workers), social status (an annual income of more or less than EUR 2000 and more or less than 1 year of education), and similar work seniority. The controls, employed with different activities in a large teaching hospital, underwent a clinical examination by the same team of occupational health physicians caring for the VDU users.

Different criteria have been proposed by different institutions for the definition of metabolic syndrome (7–9). In our study, we defined the syndrome according to the updated criteria of the National Cholesterol Education Program (7), because these criteria are simple to use in a clinical setting, have the advantage of avoiding emphasis on a single cause, and have been validated in a large number of studies. According to these criteria, the metabolic syndrome is present when three or more of the following conditions are present in the same person: waist ≥102 cm for men and ≥88 cm for women, serum triglycerides ≥1.695 mmol/l (150 mg dl), high-density lipoprotein cholesterol <1.036 mmol/l (40 mg dl) for men and <1.295 mmol/l (50 mg dl) for women, blood pressure ≥130 or ≥85 mm Hg or treatment for hypertension, and plasma glucose ≥5.6 mmol/l (100 mg dl). The workers with a known diagnosis of type-1 diabetes or those with recognized or suspect (ie, those <35 years of age without an adequate diagnostic work-up) secondary hypertension were excluded. Data on smoking habits were obtained from a questionnaire in which the participants who smoked daily were considered smokers. The blood pressure of all the participants was measured twice, and the mean of the two measurements was taken as the actual value. Waist circumference was measured at the high point of the iliac crest to the nearest 0.1 cm during minimal respiration at the end of normal expiration. Standard laboratory methods were used for the serum parameters. Since leisure-time physical activity may represent an important factor influencing the development of the metabolic syndrome, we investigated this factor by adapting a validated questionnaire (10) and classifying the participants' activity according to a previous report (11). Briefly, we calculated the weekly number of minutes spent in each activity. The total number of minutes spent per week in performing the activities was calculated by summing the weekly minutes for each activity. We divided the total weekly minutes into two categories, <150 and ≥151 minutes/week of moderate to vigorous physical activity (11). Physical activities of light intensity were not reported. We defined activity causing only light sweating or a slight-to-moderate increase in breathing or heart rate when performed for at least 10 minutes as moderate physical activity (eg, raking leaves, mowing the lawn, or heavy cleaning), vigorous physical activity as activity causing heavy sweating or a large increase in breathing or heart rate (eg, running or fast cycling).

An assessment of job stress was performed according to the Job Content Questionnaire (12), which evaluates the two dimensions of job characteristics, work demands (5 items), and decision latitude (9 items). For each question, the respondents rated the degree to which they agreed or disagreed with statements describing their job or job environment. The scores for the two categories were dichotomized at the median and combined into the following four groups: (i) job situations characterized by high demand and low decision latitude ("job strain"), (ii) job situations with high demand and high decision latitude ("active"), (iii) job situations with low demand and low decision latitude ("passive"), and (iv) job situations with low demand and high decision latitude ("relaxed"). All of the participants were divided into two main groups according to the postulation of the strain model, a low-strain group (relaxed + passive + active group) and a high-strain group.

Informed written consent was obtained from all the workers participating in the study, which was approved by the ethics committee of our institutions.

Statistical analysis

When not otherwise stated, the data have been expressed as means and standard deviations. A two-tailed value of $P<0.05$ was considered statistically significant. Student's t-test was used for comparing the continuous variables, whereas nonparametric tests (chi-square or Fisher's exact test, as appropriate) were used for the evaluation of the discrete variables. Multiple logistic regression

Table 1. Demographic characteristics and a summary of the clinical evaluation of the users of video display units (VDU) and of the controls.

Group	Age (years) at the time of the examination		Male gender (%)	Current smokers (%)	Years at work (range)	Moderate-to-vigorous physical activity (>150 min/week)(%)	High job strain (%)	Shift workers (%)
	Mean	SD						
VDU users (N=1547)	29.7	4.2	54.5	38.3	1–6	19.6	33.6	30
Controls (N = 892)	30.2	3.8	55.6	42.6	1–6	17.8	31.2	38

was used to evaluate the possible confounding role of variables such as smoking, leisure-time physical activity, and job stress. Other potentially confounding variables were not included in the model, since the exposed and controls were matched for the other characteristics (age, gender, work schedule, education, income, work seniority, and family history).

Results

The total population of VDU users potentially eligible for the study comprised 2627 workers. Altogether 288 (8.7%) did not attend the baseline examination, and 677 did not meet the entry criteria and were therefore excluded from the study. A total of 125 of the remaining 1722 workers did not agree to participate in the study. Moreover, reliable data concerning answers to the questionnaires or anthropometric or laboratory parameters were not available for 50 workers. Among the 1702 consecutive controls examined during the same time period as the VDU users, 613 were not eligible due to a lack of entry criteria or to mismatches with VDU users for preestablished parameters, 85 refused to participate in the study, and incomplete or unreliable data were obtained for 112 controls. Therefore, the data presented in the study regard 1547 VDU users and 892 controls that fulfilled all of the selection criteria.

Table 1 shows the demographic and main clinical characteristics of the two groups. No significant difference was detected for the various parameters evaluated.

A 30% increase in the prevalence of the metabolic syndrome was detected among the VDU users versus the controls. The syndrome was diagnosed for 48 (3.10%) VDU users versus 18 (2.01%) controls [odds ratio (OR) 2.0, 95% confidence interval (95% CI) 1.2–3.6, P=0.012]. The difference between the groups persisted in a multivariate analysis controlling for potential confounding factors for at least one component of the syndrome, such as smoking and moderate or vigorous physical activity during leisure time (OR 1.6, 95% CI 1.0–2.7, P<0.05).

Table 2. Prevalence of single components of the metabolic syndrome in the two populations. (HDL = high-density lipoprotein cholesterol)

Group	Visceral obesity (%)	High blood glucose (%)	High serum triglycerides (%)	Low serum HDL (%)	Abnormal blood pressure (%)
VDU users (N=1547)	4.9	11.7	12.6	25.4	8.9
Controls (N=892)	2.4	5.2	6.6	12.6	6.1
P-value	0.002	<0.0001	<0.0001	<0.0001	<0.0001

Table 2 shows the prevalence of the single components of the metabolic syndrome in the two study groups. Each component was significantly more frequently detected among the VDU users than among the controls (P<0.0001 in all of the comparisons, except for the presence of visceral obesity, which was associated with VDU usage with a lower statistical significance, P<0.002).

When more than three abnormal parameters were considered, the syndrome was twice as prevalent among the VDU users than among the controls (11–0.7% versus 3–0.3%, P=0.04).

Discussion

This is the first study showing that young VDU users have an increased prevalence of the metabolic syndrome when they are compared with workers involved in activities involving a less intensive use of a VDU. This finding can probably be accounted for by factors associated with the type of work and the environment; in particular sedentariness is believed to play an important role, since it has been recently shown that reduced physical activity represents a strong risk factor for the development of the syndrome, especially in young persons (11). In fact, insulin resistance is the central event in the pathogenesis of the syndrome (13), and it has been recently shown that sedentariness is the most important factor responsible for altered muscle mitocondrial functions and fat oxidative capacity, the two main factors leading

to hyperinsulinism (14). Sparse data are available on the causal role of the work environment in the development and progression of this syndrome. Chandola et al (3) recently suggested that chronic stress at work may be an important factor for the development of the syndrome, whereas other investigators found that manual work was an independent risk factor (15). Another potential work-related factor affecting the development of the syndrome may be represented by the pattern of the work schedule in that some cross-sectional studies have reported an increased prevalence of the syndrome among shift workers in comparison with day workers (16, 17). None of these factors, however, may have influenced our findings, since the exposed and controls were well matched for social class and work schedule and the level of chronic stress did not significantly differ between the two study groups, although a slightly higher prevalence of intense levels of job strain was found among the VDU users.

The prevalence of the syndrome in our series is much lower than that reported in other studies of adult populations (18, 19), although there is a substantial heterogeneity according to gender and ethnicity (1, 20). It should be noted, however, that our population was a rather selected one, being composed of young people, without any clear genetic predisposition. Furthermore, we excluded workers with a diagnosis of type-1 diabetes, because it is an autoimmune disorder whose development is virtually not influenced by factors such as sedentariness or dietary habits (21). For similar reasons, we excluded workers with known or suspected secondary hypertension from the analysis because this kind of hypertension is due to an underlying organic disorder, unrelated to environmental factors. Since the mean age of our population was less than 30 years, almost all of the patients with diabetes had type-1 diabetes, and most of the hypertensive patients had known or suspected secondary hypertension. This factor led to a further decrease in the expected prevalence of metabolic syndrome.

The study has some limitations. For example, it is well recognized that some dietary habits pose a relevant risk for the development of metabolic syndrome (22). However, we feel that there is no reason for VDU users to have dietary habits that differ from those of other workers belonging to the same social class, and there is no study reporting a high-risk diet in this population. Our choice to exclude from the analysis persons with a family history of conditions predisposed to metabolic syndrome, or those for whom a secondary cause of hypertension was only suspected, may have introduced a selection bias. It should be noted, however, that the metabolic syndrome, possibly associated with genetic predisposition and suspect secondary hypertension, was more frequent among the VDU users than among the unexposed workers (data not reported) and that therefore the detected difference in the rate of metabolic syndrome between the two groups would have increased if these persons were included.

In conclusion, this study shows an increased prevalence of metabolic syndrome among workers using a VDU for most of their worktime. The practical implications of this finding are (i) the need to investigate for the presence of the overt syndrome or some of its clinical and metabolic components in this group of workers since, once developed, the syndrome is strongly predictive of adverse cardiovascular events (23), (ii) the need to institute medical counseling in this group of workers, especially on the health consequences of developing metabolic syndrome, and (iii) the need to include appropriate changes in the work organization, both at the individual level (eg, by encouraging physical activity at the workplace) and, in general terms, by reducing job constraint and job demands.

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