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RESEARCH ARTICLE

Sitting Occupations and Physical Intensity of Work as Predictors of Mortality: A Retrospective Study of a Population of Workers in Southern Italy

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Abstract:

Background:

There is mounting evidence for an association between sedentary behaviour at work and an increase in all-cause death.

Objective:

The aim of the present study is to compare the mortality risk between a group of workers who performed sedentary jobs and a group of workers who performed physical jobs.

Methods:

A sample of 2325 subjects aged 65-84 years was randomly selected from the electoral rolls of eight municipalities in the Apulia region of southern Italy. All the participants underwent clinical exams and evaluation of work and lifetime physical activity *via* an interview. The jobs were divided into physical jobs (farmer, worker, attendant) and sedentary jobs (employee, manager, housewife, unemployed). Mortality data were acquired through the civil status office, and the Framingham risk score and the Fried frailty index were calculated.

Results:

We found that compared with subjects who performed sedentary jobs, subjects who performed physical jobs had a lower level of education ($p = 0.005$), a higher level of physical activity in the 30-40-years ($p = 0.021$) and 40-50-years ($p = 0.042$) divisions, and a lower mean Framingham score ($p = 0.048$). The mortality risk was higher for physical job workers than for sedentary job workers (HR = 0.56, 95% CI 0.707 - 0.462). In contrast, after adjusting the result for all covariates, the mortality risk was higher for sedentary job workers than for physical job workers (HR = 1.53, 95% CI 1.021 - 1.056).

Conclusion:

Our results support public health initiatives and policies to encourage adults to move more and sit less at work and throughout their day.

Keywords: Sitting occupation, Workers, Sedentary behaviours, Physical heaviness of work, Mortality risk, Southern Italy.

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1. INTRODUCTION

Traditionally, environmental and occupational risk factors for human health are classified into chemical, carcinogenic, physical and biological types [1 - 20].

Among the physical risks, we can distinguish between those related to heavy physical work and those related to sedentary occupations. Many epidemiological and clinical studies have shown the health benefits of physical activity during leisure time [21]. In contrast, the link between a sedentary lifestyle and poor health has been established [22, 23].

It has also been suggested that physical inactivity at work is a risk factor and that physically demanding work is a protective factor for morbidity and mortality [24, 25]. However, studies on occupational sitting and health risks have not provided such definitive evidence, and many authors do not

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believe that physically demanding work leads to a reduction in mortality and that sedentary work increases mortality risk [26 - 29].

Since the original work by Morris *et al* [30], which demonstrated an increased risk of cardiovascular disease for sitting occupations, a systematic review by van Uffelen *et al* [31] showed inconsistent and conflicting results for the association between occupational sitting and cardiovascular disease, diabetes, cancer and body mass index.

Different definitions and methods for measuring exposure can affect the results, and the variability in the results may also be partly explained by limited statistical power. There have been huge differences in the definitions of physical work. Some studies have defined it according to a high energy expenditure [32, 33], some have defined it according to heavy work tasks, such as lifting and carrying [34, 35], and some have defined it by a combination of both of these definitions [25, 36].

Further research on the relationship between occupational sitting and health risks is particularly important because the vast majority of adults in working age groups in industrialized countries are in professions that require a prolonged sitting posture [37 - 39]. Furthermore, work activity takes up more than half of the waking time [40]. The most recent studies show a decreasing trend for energy expenditure from physical activity in the workplace [41], and on average, workers spend over 70% of their working time in a sitting position [42, 43].

Although this issue is debated in the literature, the prevailing hypothesis is that a sedentary job is associated with a higher mortality rate compared to work with moderate physical intensity [44]. On this basis, the aim of the present study is to compare the mortality risk between a group of workers who performed sedentary jobs and a group of workers who performed physical jobs, all of whom reside in Castellana Grotte, a small town of the Apulia region of southern Italy, and the surrounding area.

2. MATERIALS AND METHODS

Between January 2013 and August 2017, a sample of 2325 subjects (1023 male, 1302 female) aged 65-84 years (average age 73.3), free-living or institutionalized, with median schooling of 6 years, was randomly selected from the electoral rolls of eight Italian municipalities after stratification for age and sex. All subjects are part of “The Great-AGE Study”, an on-going population-based study on ageing conducted in Castellana Grotte, a small town in the Apulia region of southern Italy [45]. Voluntary informed consent was obtained before enrolment from each subject and/or their relatives in case of cognitive impairment.

All the subjects underwent a clinical evaluation in the Clinical Research Unit on frailty at the IRCCS 'Saverio de Bellis' Hospital of Castellana Grotte. Clinical examinations had the aim of defining several pathological phenotypes and delineating the determinants of the main ageing outcomes.

Each participant was administered a screening questionnaire aimed at reconstructing occupational history. The evaluation of work activity was also performed *via* an interview. The following three questions were asked to each participant: “What type of job did you do predominantly for at least 8 h/day for at least 30 years?” ; “Was it a predominantly physical or intellectual type of work?” ; and “For how long did you do such work?” The jobs were divided into physical jobs (farmer, worker, attendant) and sedentary jobs (employee, manager, housewife, unemployed).

Mortality data were acquired through the civil status office and crossed with data recorded by the regional health system. Mortality is defined as the number of deaths in a temporal unit (year), and survival means the number of years from the theoretical onset of a given event until death.

The evaluation of the lifetime physical activity was performed *via* an anamnestic questionnaire administered to the subject or to his caregiver in the presence of evident cognitive decline regarding the physical activity performed during the various phases of life. Physical activity was divided into intervals of 15-30 years, 30-40 years, 40-50 years, 50-65 years, and the last year. It was classified in accordance with the PASE questionnaire (Physical Activity Scale for the Elderly) [46]. Levels of physical activity in the years before the interview were coded into an ordinal scale based on the equivalent metabolic consumption (MET) as follows: bedridden = 0 MET, difficulty in movement = 0.5 MET; sedentary = 2.5 MET; slight = 3.5 MET; moderate = 6.0 MET; intense = 12 MET; and vigorous = 25 MET.

For all participants, the Framingham risk score and Fried frailty index were calculated.

The Framingham risk score is a gender-specific algorithm used to estimate the 10-year risk of Coronary Heart Disease (CHD) for individuals with different combinations of risk factors. Individuals with low risk have a 10% or less CHD risk at 10 years, those with an intermediate risk have a 10-20% risk, and those with a high risk have a 20% risk or more [47].

The Fried frailty index [48] derived from the Cardiovascular Health Study (CHS) is an operational definition of frailty in older subjects based on the presence of any three of the following five characteristics: shrinking, weakness, poor endurance, slowness, and low physical activity.

Exclusion criteria were a history of neoplastic pathology or other diseases with a high risk of mortality and the presence of frailty according to Fried index or cognitive impairment.

Statistical analyses were performed *via* Analysis Of Variance (ANOVA) to identify statistically significant differences between the two groups. The Hazard Ratio (HR) with its 95% confidence interval was calculated with the interval Cox model adjusted for all covariates. The level of statistical significance was set at $p < 0.05$. If Sedentary/Physical jobs have an HR<1 and the upper limit of the 95% confidence interval is <1, sedentary work is associated with a lower risk of mortality compared to physical work. If HR>1 and the lower bound of the 95% confidence interval is >1, sedentary work is associated with a higher risk of mortality compared to physical work.

3. RESULTS

In total, 6 of the 2325 study participants were excluded for evidence of cognitive impairment, 98 for frailty according to the Fried index and 42 for a history of neoplastic pathology or other diseases with a high risk of mortality. The remaining 2179 were divided into a group of 653 workers who performed sedentary jobs and a group of 1526 workers who performed physical jobs.

Table **1** shows the statistical comparison of covariates between the two groups. Workers who performed physical jobs showed a significantly lower level of education (5 *vs* 7; p = 0.005), a significantly higher level of physical activity in the 30-40-years (16.02 *vs* 8.06 Met / Hw; p = 0.021) and 40-50-years (8.01 *vs* 6.03 Met / Hw; p = 0.042) divisions and a lower mean Framingham score (0.25 *vs* 0.38; p = 0.048) than those who performed sedentary jobs. The median time to event (death) was 38 months for physical job workers and 42 months for sedentary job workers.

We then calculated the hazard ratio sedentary/physical jobs (HR = 0.56, 95% CI 0.707 - 0.462) and we found that the mortality risk was lower for sedentary job workers than for physical job workers. In contrast, the hazard ratio after adjusting the result for all covariates listed in Table **1** (HR = 1.53, 95% CI 1.021 - 1.056) showed that the mortality risk was higher for sedentary job workers than for physical job workers (Table **2**).

Table 1. ANOVA covariate descriptions.

Effect	Physical Jobs (n. 1526)	Sedentary Jobs (n. 653)	P-value
Age, y	72.3	74.6	0.079
Sex (males)	44%	43%	0.091
Education, y	5	7	0.005
Physical activity last year	3.5 Met/Hw	3 Met/Hw	0.567
Physical activity after 65 year	3.5 Met/Hw	3.5 Met/Hw	0.654
Physical activity between 50 and 65 years	4 Met/Hw	4 Met/Hw	0.952
Physical activity between 40 and 50 years	8 Met/Hw	6 Met/Hw	0.042
Physical activity between 30- and 40 years	16 Met/Hw	8 Met/Hw	0.021
Physical activity between 15 and 30 years	18 Met/Hw	16 Met/Hw	0.062
Framingham Score	0.25	0.38	0.048

4. DISCUSSION

Our results show that the mortality risk is higher for physical job workers than for sedentary job workers. On the contrary, after adjusting the result for all covariates listed in Table **1**, the mortality risk is higher for sedentary job workers than for physical job workers.

Our findings can be explained by taking into account the differences between the two groups in terms of the confounding factors education, physical activity in the 30-50-years division and the Framingham score. By adjusting the results for all these covariates, the mortality risk was higher for sedentary job workers than for physical job workers. This allows us to hypothesize that conducting moderate physical activity regularly, in every type of daily activity, including work, is healthy for the human organism.

Table 2. Interval Cox model with a modality-by-time interaction, adjusted for covariates.

Effect	Hazard Ratio*	95% CI	P-value
Sedentary/ Physical jobs	0.56	(0.707 – 0.462)	< 0.001
Sedentary/ Physical jobs adjusted	1.35	(1.021 – 1.056)	< 0.001

*HR<1: sedentary work is associated with a lower risk of mortality compared to physical work.
HR>1: sedentary work is associated with a higher risk of mortality compared to physical work.

Although this issue is debated in the literature, our results are in agreement with other studies [24, 25]. Akiko Sakaue *et al* demonstrated that higher levels of physical activity are associated with a reduced risk of cancer and cardiovascular death, while longer occupational sitting time is associated with increased mortality [44]. Tuija M Mikkola *et al* [49] recently conducted a prospective cohort study between 1990 and 2015 involving 5210 men and 4725 women from the Helsinki Birth Cohort Study to examine the relationships of the late-career physical intensity of work and sitting at work with mortality. A national-level job exposure matrix was used to determine the occupation-specific level of the physical intensity of work and sitting. The results show how men in physically heavy work during their late-work career were at higher risk of death than men in physically light work. Among men, high physical intensity of work was positively associated with and sitting at work was negatively associated with all-cause, cardiovascular and external-cause mortality (*e.g.* accidents), but neither was associated with cancer mortality. In women, neither the high physical intensity of work nor sitting at work was associated with mortality. In contrast to these results, Autenrieth *et al* [32] reported a lower risk of all-cause and cardiovascular mortality among those with moderate occupational physical activity compared with those with light occupational physical activity, while Andersen *et al* [50] found a lower all-cause mortality risk in women with heavy manual work compared with women at sitting type of work but did not find associations in men. Furthermore, a meta-analysis of studies reporting risk ratios found an association between higher occupational physical activity and lower mortality in women [51].

When interpreting the results, it should also be taken into account that sitting occupations and physical occupations are related to other, different risk factors. Thus, the results are likely to reflect the effect of a larger set of risk or protection factors, which are correlated with other professional exposures (*i.e.*, sitting occupations rarely include exposure to chemical risk factors). Thus, the target population can modify the results. The results can also be influenced by differences in lifestyles between the workers of the two groups. Non-manual workers have physically lighter work tasks, and they have been found to have better health habits than manual workers [52].

CONCLUSION

In conclusion, we found that the group of workers who performed sedentary jobs had a higher mortality risk than the group of workers who performed physical jobs. Our results support public health initiatives and policies to encourage adults to move more and sit less at work and throughout their day.

LIST OF ABBREVIATIONS

PASE	=	Physical Activity Scale for the Elderly
MET	=	Equivalent Metabolic Consumption
CHD	=	Coronary Heart Disease
CHS	=	Cardiovascular Health Study.

AUTHORS' CONTRIBUTIONS

LV, DC and RS conceived and designed the work; DC, AC and LDM performed the work; DC and RS analysed data and interpreted results; LV, DC, AC, LDM, ESSC, FM, FB and DMC wrote and revised the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All medical and instrumental examinations were performed according to Italian law concerning the protection of workers exposed to occupational risks (D.Lgs. 81/2008).

HUMAN AND ANIMAL RIGHTS

All subjects were informed that data from the research protocol would be treated in an anonymous and collective way, with scientific methods and scientific purposes in accordance with the principles of the Helsinki Declaration.

CONSENT FOR PUBLICATION

Voluntary informed consent was obtained before enrolment from each subject and/or their relatives in case of cognitive impairment.

AVAILABILITY OF DATA AND MATERIALS

The data that supports the findings of this study are available from the corresponding author [L.V], upon reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

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