

# BMJ Open Reciprocal relationship between psychosocial work stress and quality of life: the role of gender and education from the longitudinal study of the Survey of Health, Ageing and Retirement in Europe

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## ABSTRACT

**Objective** To investigate the reciprocal relationship between psychosocial work stress and quality of life (QoL) and to examine whether the relationship can be moderated by gender or education.

**Design** Longitudinal, population-based study.

**Setting** The Survey of Health, Ageing and Retirement in Europe (SHARE).

**Participants** The study population was derived from the SHARE, and there were 2006 participants with good QoL at baseline, 1109 with high job control and 1072 with high job reward, respectively, who were followed up for 2 years to detect incidence of poor QoL, low job control and low job reward.

**Main outcome measures** Logistic regression models were employed to explore the reciprocal relationship between psychological work stress and QoL. Stratification analyses by gender and education were performed.

**Results** Participants with low reward (OR=1.53, 95% CI 1.26 to 1.88) and low control (OR=1.40, 95% CI 1.14 to 1.71) at baseline were at higher risk of poor QoL over the 2-year follow-up. The combination of low reward and low control further increased the risk (OR=1.90, 95% CI 1.46 to 2.48). Stratified analyses revealed that these associations were more pronounced among those who had high levels of education. Further, individuals with poor QoL were at significantly higher risk of having low reward (OR=2.14, 95% CI 1.55 to 2.96) but not low control (OR=1.33, 95% CI 0.98 to 1.79) at the 2-year follow-up, especially among those who had medium levels of education. No gender differences were found.

**Conclusions** There is a reciprocal relationship between psychological work stress and poor QoL. Education may play an important role in the relationship.

## INTRODUCTION

Psychosocial work stress is recognised as one of the major issues in the workplace,<sup>1</sup> and it had become a new occupational harmful factor that affects the health and operational

## Strengths and limitations of this study

- This study prospectively examined the reciprocal relationship between psychosocial work stress and quality of life (QoL) in a cohort study of older adults.
- This is the first study that examined the combined effect of job reward and job control on incident poor QoL.
- Recall bias is minimised as the ascertainment of outcomes occurs after the exposure assessment.
- Information of this study is mainly based on self-report measures, and the effect of information bias on the results is difficult to predict.
- The study population is restricted to participants who were older than 50 years; the relationship between psychosocial work stress and QoL cannot be generalised to younger employees.

capacity of occupational groups in addition to traditional physical, chemical and biological occupational hazards. Considerable evidence has associated psychosocial work stress with different health outcomes.<sup>2-4</sup> Recently, increasing attention has been placed on the association between psychosocial work stress and quality of life (QoL).<sup>5-7</sup>

QoL is defined as an individual's perception of their position in life in the context of culture and value systems in which they live in relation to their goals, expectations, standards and concerns.<sup>8</sup> Poorer QoL has been found to be associated with psychosocial work stress among doctors,<sup>9</sup> nurses<sup>10</sup> and obese people.<sup>11</sup> However, relatively few studies addressed this issue in general population, especially in older adults. With an ageing population, employment rates among older workers have been increasing,<sup>12</sup> and QoL

of older employees deserves more attention. Work-related stress has been associated with a range of adverse outcomes among older workers,<sup>3 4</sup> which may increase their psychosocial work stress.<sup>13 14</sup> Thus, understanding the relationship between psychosocial work stress and QoL among older employees is warranted for the development of preventive strategies for a longer and healthier working life.

Conceptually, the role of gender differences in psychosocial work stress has not been clearly specified due to the different roles in life and at work. On one hand, women experienced higher levels of work stress<sup>15</sup> and poorer quality of life<sup>16</sup> compared with men. On the other hand, some studies showed no gender differences in experience and perceived work stress<sup>17</sup> and QoL.<sup>18</sup> Regarding education, poor QoL has been found to be related with lower levels of education<sup>19 20</sup> and consistent associations have been found between lower levels of education and higher levels of psychosocial work stress.<sup>21</sup> However, higher levels of psychosocial work stress have also been reported among highly educated employees.<sup>22</sup> Thus, it is important to understand the role of gender and education in the association between psychosocial work stress and QoL.

Therefore, the aims of this study are: (1) to investigate the reciprocal associations between psychosocial work stress and quality of life and (2) to examine whether the relationship can be moderated by gender or education.

## METHODS

### Study population

Data were taken from the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE is an ongoing longitudinal study of health, employment and social conditions of Europeans. The survey started in 2004–2005 (wave 1) and the follow-up data collections have been carried out every 2 years. Specific details about the survey were available elsewhere.<sup>23–26</sup>

Data on 30816 participants in wave 1 and wave 2 of SHARE were used in this study. The following exclusion criteria were applied at wave 1: (1) participants below the age of 50 (n=3713), (2) those who were currently unemployed (n=19235) and (3) those with missing information on QoL, job control and job reward related questions (n=3114, 471 individuals missing work related factors and 2643 missing QoL related questions). In total, 4754 of 30816 met the inclusion criteria, with an age range from 50 to 90 years old.

In the longitudinal study, three data sets were acquired from 4754 participants: (1) To study the influence of baseline psychosocial work stress on incidence of poor QoL, we excluded participants who had poor QoL at wave 1 (n=1828) and missing information on QoL at wave 2 (n=920), leaving 2006 subjects for the analysis. (2) To study the influence of baseline QoL on incidence of low job control, we excluded participants who had low control at wave 1 (n=2931) and missing information on job control at wave 2 (n=714), leaving 1109 participants

for this analysis. (3) To study the influence of poor QoL on incidence of low reward, we excluded participants who had low reward at wave 1 (n=2818) and had missing information at wave 2 (n=864), 1072 subjects remained for the analysis.

### Quality of life

The CASP-12 questionnaire was used to measure QoL, which was a short version of CASP-19, and it had been shown to be a validated measure of positive QoL in early old age.<sup>27</sup> It identified four domains: control (C), autonomy (A), self-realisation (S) and pleasure (P). These four aspects were measured with 12 items that were scored as four-Likert scale, with a total score ranging from 12 to 48. Poor QoL was defined as the sum score lower than the country lowest tertile in both wave 1 (n=4754) and wave 2 (n=2006). The internal consistency of the CASP-12 was high ( $\alpha=0.804$ ) in the current study.

### Psychosocial work stress

Psychosocial work stress was assessed by a short battery of items derived from the Job demands-control (JDC) model<sup>28</sup> and the Effort-Reward Imbalance (ERI) model.<sup>29</sup>

In ERI model, the measurement was restricted to the reward dimension. We picked five items (received adequate support, recognition from work, adequate salary, poor job promotion and poor job security) to measure 'reward'. Four-Likert scale was used to calculate a sum score for the reward dimension.

The underlying dimension of JDC model was restricted to the control dimension given the evidence that the explanatory contribution of 'control' exceeded the contribution of 'demand' in several landmark studies.<sup>14 30</sup> Job control was based on a sum score of the two items (I have little freedom to decide how I do my work in job, I have an opportunity to develop new skills) scored on a four-Likert scale.

At wave 1 among 4754 participants, those with job control score or job reward score lower than the country median score were defined as low control or low reward, respectively. The same definitions were applied at wave 2.

Further, a four-category psychosocial work stress was obtained based on the cross-tabulation of the dichotomised job reward and job control variables levels: (1) low reward+low control, (2) low reward+high control, (3) high reward+low control, (4) high reward+high control.

### Demographic and health variables

Information on country, gender, age, education, body mass index (BMI), self-perceived health, chronic diseases, mobility limitations, physical inactivity, smoking, alcohol consumption, depression symptoms and income were collected and taken into account as covariates in the study. Age was treated as a continuous variable, and all others variables were treated as dichotomised variable in the analysis. Gender was dichotomised as male and female. Living arrangement was defined as living with a partner or living alone. Levels of education were categorised as

elementary (preprimary, primary and lower secondary school), medium (upper-secondary school) and high (postsecondary and tertiary school) when stratified by education.<sup>31</sup>

BMI was categorised as underweight ( $<18.5 \text{ kg/m}^2$ ), normal ( $18.5 \text{ kg/m}^2$ – $24.9 \text{ kg/m}^2$ ), overweight ( $25 \text{ kg/m}^2$ – $<30 \text{ kg/m}^2$ ) or obese ( $\geq 30 \text{ kg/m}^2$ ). Smoking status was dichotomised as smoker (currently smoking) and non-smoker (never smoked daily for at least 1 year or stopped smoking currently). Alcohol consumption was dichotomised as alcohol drinker and non-alcohol drinker. Physical inactivity was considered as physically inactive and active.

The European version of self-perceived health was dichotomised into: good or very good versus less than good. Chronic disease was defined as having at least one of the following chronic diseases: heart disease, stroke, diabetes, lung disease, asthma, arthritis or rheumatism and osteoporosis. Mobility limitation was defined as the presence of arm function or fine motor function. Mental health was measured by EURO-D scale, with 12 related questions: depressed mood, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment and tearfulness during the past month. Total score ranged from 0 to 12, and participants with score over four were considered as depression.<sup>32</sup>

Annual total income was imputed by the total amount of main and secondary income, and participants with a total income lower than country-specific lowest tertile were grouped as low income. Country of residence was defined by their regular domicile in the respective SHARE countries.

### Statistical analysis

$\chi^2$  test was employed to examine the differences between baseline demographic and health variables and incident poor QoL or psychosocial work stress developed during the 2-year follow-up as well as the demographic and health variables between participants and non-participants.

Univariate logistic regression was employed to estimate the crude ORs of the prevalence of poor QoL in relation to individual demographic and health variables as well as psychosocial work stress. Multivariate logistic regression was used to estimate the ORs of incident poor QoL in relation to baseline psychosocial work stress and the ORs of incident psychosocial work stress in relation to baseline QoL adjusting for potential confounders.

Correlation analysis was conducted to examine whether there is an overlap between the QoL control dimension and job control. Stratified analyses were performed to examine the associations between psychosocial work stress and QoL by gender and education.

All analyses were conducted using SPSS 21.0.

### Patient and public involvement

There were no patients and public involved in the development of the research question and the selection of outcome measures. On the basis of the SHARE

documentation, there is no detailed information available on the role of patients and the public designing and conducting the study. The results will be disseminated through scientific journals. Patient advisers were not thanked in the contributorship statement/acknowledgements since they are not contributors.

### RESULTS

There were no significant differences between participants and non-participants in all demographic and health variables except that non-participants had higher prevalence of depression than participants (9.67% vs 7.17%). The correlation coefficients between each items of the QoL control domain and each items of job control were less than 0.1.

As shown in [table 1](#), the prevalence of poor QoL in this population was 38.45%, and it was slightly higher in females than in males. Low reward and low control were significantly related to poor QoL, respectively. People with low reward+low control, low reward+high control, high reward+low control at wave 1 were significantly associated with poor QoL as compared with those with both high reward and high control. In contrary, individuals with medium and high education were less likely to have poor QoL compared with those with elementary education.

Baseline demographic characteristics and health status of participants with good QoL and incident poor QoL developed during the 2-year follow-up are described in [table 2](#). A higher incidence of poor QoL was found in individuals with low reward, low control, low reward+low control, low reward+high control, high reward+low control, physical inactivity, less than good health, chronic disease, mobility limitations or depression at baseline.

The relationships between psychosocial work stress and incident poor QoL in total population and stratified by gender and education are shown in [figure 1](#). Low control (OR=1.40, 95% CI 1.14 to 1.71) and low reward (OR=1.53, 95% CI 1.26 to 1.88) were related to increased risk of poor QoL, respectively. When examining the combined effect of low reward and low control, we found that the combination of low reward with low control (OR=1.90, 95% CI 1.46 to 2.48) and low reward+high control (OR=1.49, 95% CI 1.10 to 2.02) further increased the risk of poor QoL as compared with high reward+high control. In stratified analysis, both low reward and low control were significantly associated with a higher risk of poor QoL among female (OR=1.49, 95% CI 1.14 to 2.00 and OR=1.64, 95% CI 1.22 to 2.22, respectively). A higher risk of poor QoL was also associated with low reward among male (OR=1.51, 95% CI 1.14 to 2.00). The risk of poor QoL was significantly associated with low reward (OR=1.62, 95% CI 1.19 to 2.22) and low control (OR=1.56, 95% CI 1.14 to 2.13) among those with high education, but not among those who had elementary or medium education.

In addition, we also used population median to define high and low levels of job reward and control. The ORs of

**Table 1** Number of cases (n), prevalence per 100 (P) and OR with 95% CI of poor QoL in relation to the demographic and health variables

	Participant	Poor QoL cases	Prevalence, per 100 persons	OR (95% CI)
Total population	4754	1828	38.45	
Age, m±SD	55.61±4.36	55.5±4.23	–	0.99 (0.98 to 1.00)
Gender				
Male	2650	1049	39.58	1
Female	2104	779	37.02	0.90 (0.80 to 1.01)
Education*†				
Elementary	1310	596	45.50	1
Medium	1590	639	40.19	0.81 (0.69 to 0.93)
High school+	1776	558	31.42	0.55 (0.47 to 0.64)
Living arrangement				
Living with partner	3852	1415	36.73	1
Living alone	902	413	45.79	1.46 (1.26 to 1.68)
Self-perceived health*				
Good or better than good	3931	1332	33.88	1
Less than good	822	495	60.22	2.94 (2.52 to 3.43)
Chronic diseases*				
None	2018	660	32.71	1
One or more	2734	1168	42.72	1.54 (1.36 to 1.73)
BMI*‡				
Underweight	35	15	42.86	1.37 (0.70 to 2.69)
Normal	1937	698	36.04	1
Overweight	2020	792	39.21	1.18 (1.04 to 1.34)
Obese	689	304	44.12	1.44 (1.21 to 1.72)
Mobility limitations*				
None	3484	1191	34.18	1
One or more	1268	637	50.24	1.95 (1.71 to 2.22)
Smoking				
Smoker	3505	1304	37.20	1
Non-smoker	1249	524	41.95	1.22 (1.07 to 1.39)
Alcohol consumption*				
Drinker	4151	1611	38.81	1
Non-drinker	595	216	36.3	0.91 (0.77 to 1.09)
Physical activity*				
Yes	4653	1786	38.38	1
No	99	42	42.42	1.22 (0.82 to 1.81)
Depression*				
No	3991	1338	33.53	1
Yes	740	480	64.86	3.66 (3.11 to 4.32)
Low income*				
No	2828	1036	36.63	1
Yes	1401	602	42.97	1.30 (1.14 to 1.49)
Low reward				
No	1823	529	29.02	1

Continued

Table 1 Continued

	Participant	Poor QoL cases	Prevalence, per 100 persons	OR (95% CI)
Yes	2818	1280	45.42	2.11 (1.86 to 2.39)
Low control				
No	1936	548	28.31	1
Yes	2931	1299	44.32	1.95 (1.72 to 2.21)
Reward and control				
HR+HC	986	221	22.41	1
HR+LC	950	327	34.42	1.82 (1.49 to 2.21)
LR+HC	837	308	36.80	2.02 (1.64 to 2.48)
LR+LC	1981	972	49.07	3.35 (2.80 to 3.97)

All ORs were crude value.

\*78 participants with missing information in education, 1 in self-perceived Health, 2 in chronic disease, 37 in BMI, 2 in mobility limitation, 8 in alcohol consumption, 2 in physical activity, 23 in depression and 535 in income.

Education: elementary (pre primary, primary and lower secondary school), medium (upper-secondary school) and high (post secondary and tertiary school).

‡Underweight: Below 18.5, normal: 18.5–24.9 overweight: 25–29.9, obese: 30 or higher.

BMI, body mass index; HC, high control; HR, high reward; LC, low control; LR, low reward; QoL, quality of life.

poor QoL associated with low reward (OR=1.38, 95% CI 1.14 to 1.67) and with low control (OR=1.47, 95% CI 1.21 to 1.77) were similarly to the results using country specific values. A slightly higher OR values were found when combining reward and control: low reward+lowcontrol (OR=2.37, 95% CI 1.66 to 3.41), low reward+high control (OR=1.70, 95% CI 1.39 to 2.08), while no significant effect was found between high reward+lowcontrol and QoL compared with using country specific values. We used both specific country median and population median to define high and low levels of job reward and job control, and similar results were observed.

Demographic and health variables of participants with low levels of psychosocial work stress at wave 1 and incidence of high psychosocial work stress occurred during the 2years follow-up (wave 2) are presented in table 3. Higher incidences of low reward were found among those with elementary education, less than good health, poor QoL and non-alcohol drinkers. Those with elementary education were more likely to experience high incidence of low control.

Figure 2 showed the multivariate adjusted ORs and 95% CIs of incident low reward in relation to baseline QoL in total population and subpopulations stratified by education. Participants with poor QoL were more likely to have low reward at follow-up in the total population as well as among those with medium education. No gender differences were found. No significant association was found between poor baseline QoL and incident low control.

We also calculated the ERI ratio to quantify the imbalance between high cost and low gain as: effort/reward (adjusted for the numbers of items). ERI was defined as the score higher than the country-specific upper tertile. The results showed that ERI can predict subsequent poor QoL (OR=1.37, 95% CI 1.10 to 1.71), while no significant

results were found when stratified by gender and education. Poor QoL can also predict subsequent ERI (OR=1.28, 95% CI 1.03 to 1.60), especially among participants with high education (OR=1.58, 95% CI 1.10 to 2.29).

## DISCUSSION

In a representative sample of European workers aged 50–90 years, low reward and low control at baseline were significantly associated with a higher risk of incident poor QoL, respectively. A stronger association was found when low reward combined with low control. The association between psychosocial work stress and poor QoL incidence was more pronounced among participants with high education. Participants with poor QoL at baseline had higher possibility to get low job reward at follow-up compared with people with good QoL, especially among those with medium education. No gender differences were found.

Our findings showed that low job control, but not high demands, predicts subsequent poor QoL. Several possible explanations exist for the association between low job control and reduced QoL: first, the explanatory contribution of ‘control’ exceeded the contribution of ‘demand’;<sup>14 30</sup> second, job control might affect QoL directly while psychological demands appeared to first affect health<sup>33</sup> which in turn affected QoL.<sup>34</sup>

The finding that participants with low reward, but not high effort, had higher probability to suffer poor QoL at follow-up compared with people with high reward was also supported by previous studies.<sup>7 35</sup> There is a study which reported that participants with high effort, but not low reward, had higher probability to suffer poor health.<sup>5</sup> However, the age of participants ranged from 20 to 60 with a mean age of 41.67 which was much younger than

**Table 2** Demographic and health variables of participants with good QoL at baseline (n=2006) and poor QoL status 2 years later, n (%)

Variables	Participant remain good QoL, n=1241	Incident poor QoL, n=765	P value
Age, m±SD	55.67±4.28	55.68±4.23	0.98
Gender male	694 (55.92)	396 (51.76)	0.07
Education*†			0.13
Elementary	304 (24.50)	201 (26.27)	
Medium	381 (30.70)	256 (33.46)	
High school+	549 (44.24)	301 (39.35)	
Living alone	219 (17.65)	128 (16.73)	0.60
Good or better than good perceived health	1140 (91.86)	653 (85.36)	<0.001
One or more chronic diseases	652 (52.54)	455 (59.48)	<0.001
BMI*‡			0.97
Underweight	6 (0.48)	6 (0.78)	
Normal	537 (43.27)	339 (44.31)	
Overweight	527 (42.47)	315 (41.18)	
Obese	164 (13.22)	100 (13.07)	
One or more mobility limitations	254 (20.47)	197 (25.75)	0.02
Current smokers	290 (23.37)	207 (27.06)	0.06
Alcohol drinkers*	162 (13.05)	87 (11.37)	0.39
Physical activity	1224 (98.63)	744 (97.25)	0.02
Depression	99 (7.98)	95 (12.42)	<0.001
Low income*	327 (26.35)	227 (29.67)	0.07
Low reward	613 (49.40)	446 (58.30)	<0.001
Low control	642 (51.73)	456 (59.61)	<0.001
Reward and control			<0.001
HR+HC	69 (29.73)	164 (21.44)	
HR+LC	259 (20.87)	155 (20.26)	
LR+HC	230 (18.53)	145 (18.95)	
LR+LC	383 (30.86)	301 (39.35)	

\*25 participants with missing information in education, 1 in chronic disease, 12 in BMI, 1 in mobility limitation, 5 in alcohol consumption, 7 in depression and 220 in income.

†Education: elementary (pre primary, primary and lower secondary school), medium (upper-secondary school) and high (post secondary and tertiary school).

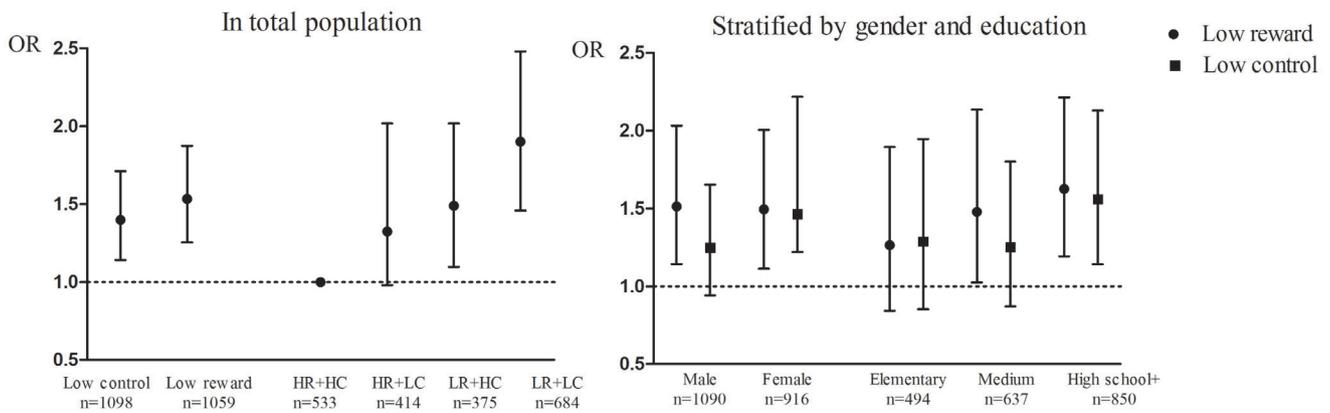
‡Underweight: Below 18.5, normal: 18.5–24.9 overweight: 25–29.9, obese: 30 or higher.

BMI, body mass index; HC, high control; HR, high reward; LC, low control; LR, low reward; QoL, quality of life.

our study (aged 50+). The different finding may be that older workers have more experience to cope with stressful situations compared with the younger; thus, the differences between high and low efforts may be smaller in older workers than in younger workers. Second, most of participants (98.7%) in that study were female, whereas our study has a similar proportion of gender. In addition, our result that ERI was related to poor QoL incident is in line with several previous studies.<sup>5 36</sup>

This study showed that the estimation of poor QoL risk can be substantially improved when combining information from both job control and reward, suggesting that psychosocial stress from different dimensions may

have an additive effect on risk of poor QoL. In all of combined dimensions, low reward+low control had the highest OR in predicting poor QoL incidence. These findings were in line with the evidence that combined effects of the two models on cardiovascular health were considerably stronger than their separate effects,<sup>37</sup> but contrary to a previous study on work related stress and mental distress.<sup>38</sup> Apart from different adverse health outcomes, a possible explanation for the difference may be that advanced technologies have considerably changed the occupational exposures, and the traditional models may not match the modern psychosocial work environment very well. An experimental study showed



**Figure 1** ORs and 95% CIs of incident poor QoL in relation to work stress in total population and stratified by gender and education.

that manipulation rewards may substantially decrease the physiological responses.<sup>39</sup> It is interesting to note that both loss of reward and loss of control have been used as theoretical approaches for psychosocial stress in studying adverse health outcomes,<sup>40</sup> thus, the combination of reward and control may provide a new direction to study psychosocial stress and QoL. More studies are needed to examine the effects of different types of psychosocial work stress on health or well-being outcomes.<sup>30</sup>

Our findings that both male and female employees with low reward or low control had higher possibility to develop poor QoL than their counterparts were in line with some previous studies.<sup>18–41</sup> In contrast, another previous study showed that high effort and low reward were negatively associated with QoL among women but not among men.<sup>42</sup> The different findings may be explained by the following. First, the age of participants in that study was much younger (mean age 35 years) than our study (aged 50+, mean age 55.61). It has been shown that young women had lower life satisfaction than young man in the age range 18–24 years, and it reverses for those aged 25–49. Interestingly, no significant difference was found on life satisfaction between men and women in the 50+ age group.<sup>43</sup> Second, the previous study is a cross-sectional study. Third, potential confounders, such as physical health, mobility and other relevant factors, have been proved to be related to work stress and poor QoL<sup>33–44</sup> and were not adjusted for in that study. Finally, the participants of that study were young workers from military hospital, which means it cannot be generalised to general population.

Our findings are in line with a previous study showing that psychosocial work stress was associated with higher risk of poor QoL among participants with high level education.<sup>45</sup> Participants with high level education might have a higher self-expectation on work ability compared with those with low or medium level education. The imbalance of work status and expectation may cause huge psychological gap among those with higher levels of

education which may lead to a higher risk of poor QoL. It can also be that participants with higher levels of education are used to favourable conditions in their daily life which may lead to lower threshold for the perception of poor QoL. Thus, when they experience higher levels of psychosocial work stress, their perception of poor QoL will increase correspondingly.

To our knowledge, it is the first study that analysed data among participants free from high psychosocial work stress. In accordance with our results, a previous cross-sectional study reported that poor QoL can predict low reward incidence but not low control,<sup>6</sup> while limited longitudinal evidence is available. It has been reported that individuals with poor QoL at baseline had a steeper increase in intended early retirement,<sup>44</sup> disability deficits accumulation and functional limitation progression,<sup>46</sup> which may reduce workers' motivation, efficiency and work ability, leading to low reward and thus vicious circle of low reward and poor QoL began.

Among participants without high psychosocial work stress at baseline, the strongest association between low levels of QoL and high levels of psychosocial work stress was found in those who had medium education. Individuals with medium education might be more sensitive to poor QoL due to their higher expectation for a better life compared with those with lower education. At the same time, they have limited ability to balance the expectation with reality due to more financial constraints as compared with those with high levels of education. This psychological imbalance may lead to decreased threshold for the perception of psychosocial work stress and increased the likelihood for the occurrence of high work stress. It can also be that people with different levels of education experiencing and reporting poor QoL and subsequent job strain differently, leading to the differences in the relationships among people with different educational levels.

This study has several methodological limitations. First, although no significant differences between

**Table 3** Demographic and health variables of participants with low levels of psychosocial work stress at wave 1 and incidence of high psychosocial work stress occurred during the 2 years follow-up (wave 2), n (%)

Variables	Participant remain high reward, n=396	Incident low reward, n=676	P value	Participant remain high control, n=358	Incident low control, n=751	P value
Age, m±SD	55.30±4.04	54.64±3.64	0.06	55.50±4.14	55.24±4.09	0.31
Gender male	226 (57.25)	379 (56.07)	0.80	217 (60.61)	427 (56.86)	0.19
Education*†‡			<0.001			0.05
Elementary	78 (19.70)	194 (28.70)		63 (17.60)	178 (23.70)	
Medium	122 (30.81)	209 (30.92)		111 (31.00)	229 (30.49)	
High school+	193 (48.74)	261 (38.61)		183 (51.12)	339 (45.14)	
Living alone	65 (16.41)	133 (19.67)	0.11	65 (18.16)	139 (18.51)	0.93
Less than good perceived health	30 (7.58)	83 (12.28)	0.02	35 (9.78)	102 (13.58)	0.79
One or more chronic diseases	221 (55.81)	365 (53.99)	0.57	73 (20.39)	158 (21.04)	0.87
BMI*†§			0.49			0.61
Underweight	1 (0.25)	4 (0.59)		2 (0.56)	6 (0.80)	
Normal	178 (44.95)	293 (43.34)		142 (39.66)	335 (44.61)	
Overweight	167 (42.17)	276 (40.83)		152 (42.46)	300 (39.95)	
Obese	50 (12.63)	98 (14.50)		59 (16.48)	107 (14.25)	
One or more mobility limitations*	79 (19.95)	158 (23.37)	0.19	79 (22.06)	186 (24.77)	0.36
Current smokers	95 (23.99)	186 (27.51)	0.22	91 (25.42)	193 (25.70)	0.94
Alcohol drinker†	60 (15.15)	73 (10.80)	0.04	52 (14.53)	98 (13.05)	0.10
Physical activity*†	390 (98.48)	661 (97.78)	0.50	352 (98.32)	741 (98.67)	0.35
Depression*†	47 (11.87)	93 (13.76)	0.40	44 (12.29)	110 (14.65)	0.31
Low income*	127 (32.07)	183 (27.07)	0.14	106 (29.61)	211 (28.10)	0.47
Poor QoL	73 (18.43)	212 (31.36)	<0.001	90 (25.14)	233 (31.03)	0.05

\*Incident of low reward: 15 participants with missing information in education, 5 in BMI, 1 in mobility limitation, 5 in depression and 116 in income.

†Incident of low control: 6 participants with missing information in education, 6 in BMI, 2 in alcohol consumption, 1 in physical activity, 4 in depression and 114 in income.

‡Education: elementary (preprimary, primary and lower secondary school), medium (upper-secondary school) and high (postsecondary and tertiary school).

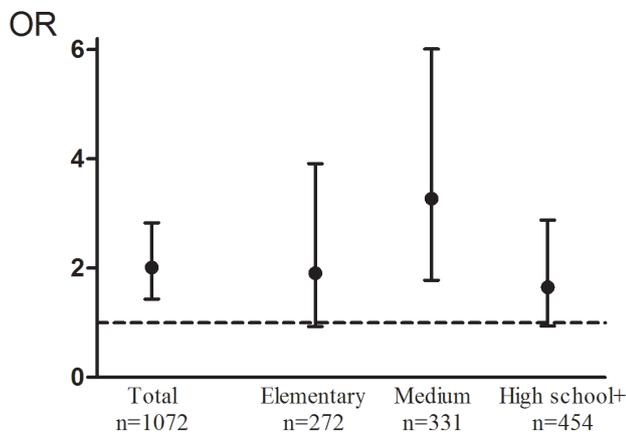
§Underweight: Below 18.5, normal: 18.5–24.9, overweight: 25–29.9, obese: 30 or higher.

BMI, body mass index; QoL, quality of life.

participants and non-participants were found in all demographic and health variables, non-participants had higher prevalence of depression than participants, which may underestimate our results. Second, participants may give untruthful answers on some questions but not on others, and the effect of information bias on the results is difficult to predict. Third, our measurement of psychosocial work stress only included several items of the JDC model and the ERI model; therefore, we may underestimate the true effects. Fourth, we cannot exclude the possibility that residual confounding, such as social relations, work conflicts, might have biased the true associations, and future studies should take into account these potential confounders. Fifth, there might be conceptual and empirical overlaps between the control measurements of QoL and job, but their correlation coefficients were less than 0.1 and the likelihood of overlapping is minimal. Finally, the results

of the current study were based on participants aged 50+; thus, the results cannot be generalised to younger workers.

Despite these limitations, the study has several strengths. First, this study was one of the few studies which prospectively examined the reciprocal relationship between psychosocial work stress and QoL in a cohort of older adults. To date, most studies on quality of life were based on cross-sectional data of patients, and this study had both cross-sectional and longitudinal data in general population. Second recall bias is minimised as the ascertainment of outcome occurred after the exposure assessment. Third, this is the first study that examined the combined effect of job reward and job control on incident poor QoL. Finally, similar results from both country specific median and population median increased our confidence in the results.



**Figure 2** ORs and 95% CIs of incident low reward in relation to QoL in total population and stratified by education. ORs were adjusted for country, gender, age, education, self-perceived health, chronic disease, BMI, mobility limitations, smoking, alcohol consumption, physical activity, depression and income. BMI, body mass index; QoL, quality of life.

## CONCLUSION

Low reward and low control may independently increase the risk of incident poor QoL, especially among those with high levels of education. The effect is stronger when they were combined. On the other hand, poor QoL may increase the risk of incident low reward, especially among those with medium levels of education. No gender difference was found. Reducing psychosocial work stress, particularly among those with higher education may be an effective strategy to improve QoL, which in turn may help decrease employees' psychosocial work stress.

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**Data sharing statement** We undertook a secondary analysis of data obtained under the SHARE Data Access Rules (<http://www.share-project.org/>). SHARE data can be accessed by anyone who abides by those rules.

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## Correction: *Reciprocal relationship between psychosocial work stress and quality of life: the role of gender and education from the longitudinal study of the Survey of Health, Ageing and Retirement in Europe*

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This article was previously published with an error.

Earlier the corresponding author is only listed as Hui-Xin Wang.

The correct corresponding authors are Hui-Xin Wang and Zhen Yan.

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