Psychiatry Research 272 (2019) 196–205

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

# Sleep quality mediating the association of personality traits and quality of life among underground workers and surface workers of Chinese coal mine: A multi-group SEM with latent response variable mediation analysis

Ma Kai-Li[a], Wang Hui[a], Gao Xue[a], Huang Jian-Jun[b], Sun Chen-Ming[c], Qiao Nan[a], Zhang Hai-Xia[a], Lu Qing[d], Que Xi-Mei[a], Li Lu[a], Wang Tong[a,*]

[a] Department of Health Statistics, School of Public Health, Shanxi Medical University, 56 Xinjiannanlu Street, Taiyuan 030001, China
[b] Department of Neurosurgery, General Hospital of Datong Coal Mining Group, Datong 037000, China
[c] Department of Urology, General Hospital of Daton Coal Mining Group, Datong 037000, China
[d] Department of Epidemiology and Biostatistics, Michigan State University, East Lansing, Michigan, MI 48824, USA

ARTICLE INFO

*Keywords:*
Personality
Sleep quality
Quality of life
Indirect effect
Latent response variable

ABSTRACT

The aim of this study was to examine whether the association between personality traits and quality of life (QOL) was mediated by sleep quality in coal miners and to explore whether the relationship between surface workers and underground workers was different. The cross-sectional study including 3090 coal mine workers aged 20 to 65 years from Shanxi province of China was conducted. Personality traits, QOL and sleep quality were respectively assessed using Eysenck Personality Questionnaire-Revised Short Scale for Chinese, World Health Organization Quality of Life-BREF, and sleep status questionnaire. The multi-group SEM with latent response variable method was conducted to evaluate the association between personality traits and QOL mediated by sleep quality. The difference of indirect effects between two subgroups was examined by Wald chi-square test. For surface workers, underground workers and overall sample, passive personality traits had a negative impact on QOL through poor sleep quality, whereas the active personality traits acted the opposite. However, the difference of indirect effect between two subgroups was not statistically significant. These results indicated that sleep quality may act as a partial mediator in the relationship between personality traits and QOL, and the relationship may not be affected by working environment.

## 1. Introduction

The definition of quality of life (QOL) developed by World Health Organization (WHO) is “an individual's perceptions of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns” (WHOQOL Group, 1994). Quality of life is playing an increasingly momentous role in evaluating health policy and medical intervention (Li et al., 2004). It is an intuitive reflection of living conditions and health status of individuals. A high QOL is regarded as a sign of successful development (Wrosch and Scheier, 2003). The assessment of QOL has been performed in general population (Cramer et al., 2006), prostate-cancer survivors (Sanda et al., 2008), breast-cancer patients (Montazeri, 2008), lung-cancer patients (Gooneratne et al., 2007), HIV infection patients (Hsiung et al., 2005), etc. Coal mining is a high-risk occupational business (Homer, 2009). Owing to the harsh working conditions in coal mines (Cao et al., 2012), research on QOL and its risk factors for coal miners is particularly important.

There are numerous risk factors that have been reported for QOL, including diabetes (Luyster and Dunbarjacob, 2011; Rubin and Peyrot, 1999), obesity (Flegal et al., 2005), and MetS (Sullivan et al., 2007). Sleep quality has become one of the factors that cannot be neglected. It is well known that sleep is an integral part of life and one of the vital behavioral factors in maintaining health (Kim et al., 2015). Sleep also affects the two primary effector systems, the hypothalamus-pituitary-adrenal axis and the sympathetic nervous system, which regulates adaptive and innate immune responses (Irwin, 2015). Sleep-related problems appear in various areas of life, including cognitive

* Corresponding author. Tel.: +86-351-4135397; Fax: +86-351-4135998.
*E-mail addresses:* 201600510595@b.sxmu.edu.cn (K.-L. Ma), annieyuner@163.com (H. Wang), gaoxue1217@126.com (X. Gao), hjj1958@126.com (J.-J. Huang), bun005@126.com (C.-M. Sun), qiaonan_sxmu@sina.com (N. Qiao), zhx.196@163.com (H.-X. Zhang), qlu@epi.msu.edu (Q. Lu), queximei17@163.com (X.-M. Que), qian.lu93@163.com (L. Li), tongwang@sxmu.edu.cn (T. Wang).

https://doi.org/10.1016/j.psychres.2018.12.006
Received 28 January 2018; Received in revised form 2 December 2018; Accepted 2 December 2018
Available online 07 December 2018

performance, emotional well-being, work and leisure activities, and general physical and mental well-being (Strine and Chapman, 2005). Many previous studies illustrated that poor sleep quality was strongly correlated with impairments in QOL (Araghi et al., 2013; Gooneratne et al., 2007). Previous studies have also shown that sleep quality could be regarded as a potentially predictor of QOL (Elder et al., 2007; Luyster and Dunbarjacob, 2011) and poor quality of sleep may have adverse effects on emotional well-being and physical functioning, leading to decline in health-related QOL (Luyster and Dunbarjacob, 2011).

Besides sleep quality, personality traits also have obtained increasing attention in recent years. In general, personality is defined as "an individual's characteristic patterns of thought, emotion, and behavior, together with the psychological mechanisms, hidden or not, behind those patterns" (Funder, 1997). Previous researches indicated that personality had an influence on QOL (Cramer et al., 2006; Härtl et al., 2010; Rubin and Peyrot, 1999). For example, Cramer, et al. implicated that comparing with sociodemographic variables, such as somatic health and axis I disorder, personality disorders seemed to be more significant predictors of QOL (Cramer et al., 2006). In addition, a previous study investigating the relationship between personality traits and QOL of breast cancer indicated that higher scores for neuroticism were related to a poorer QOL while optimism was incapable of predicting the QOL 2 years later (Härtl et al., 2010). Nonetheless, Wrosch et al. found that optimism was associated with high levels of QOL (Wrosch and Scheier, 2003). Overall, previous researches suggest that QOL could be impacted by personality traits.

Moreover, the association between personality traits and sleep quality has been discussed in many studies. A study investigating this relationship in young Korean women demonstrated that personality may be one of the factors contributing to poor quality of sleep (Kim et al., 2015). Personality traits may play a causal role in the development of insomnia and act as a predictor of sleep quality (van de Laar et al., 2010). Additionally, researchers have studied the mechanisms of how personality affected sleep. For instance, Vantieghem et al. indicated that emotion suppression should be considered as an intermediate variable (Vantieghem et al., 2016). Williams and Moroz examined the pathway of personality with stress-related sleep disruption and implicated that neuroticism and conscientiousness were negatively and positively associated with sleep quality, respectively (Williams and Moroz, 2009). In short, most existing researches show that personality traits, especially neuroticism and conscientiousness, are related to sleep quality.

Although the relationships among personality, sleep quality and QOL are closely relevant, few studies have evaluated the effect of personality characteristics to QOL directly mediating by sleep quality. Moreover, most research on personality traits had only concentrated on neuroticism and conscientiousness traits. Besides, the main interested outcomes were clinical events. There were rarely any studies investigating the impact of personality on QOL among coal miners.

So far, a paucity of research examines the relationship between personality traits and QOL mediating by subjective sleep quality through multi-group SEM with latent response variable approach in coal miners. Based on previous literatures, the hypothetical model in this study is that the passive personality traits will have a negative impact on QOL mediated by poor sleep quality, whereas the active personality traits will act oppositely. Moreover, most studies indicated that the underground coal miners were always working in a limited space and performing different tasks, and they had to face various threats from physical factors, such as vibration, humidity, radiation, high temperature and noise (Liu et al., 2015). The working environments for underground workers and surface workers are different. Therefore, in order to explore whether the difference of environments affects the relationship between personality and QOL, the whole sample was divided into two subgroups, i.e., underground workers and surface workers, according to the workplace. The first aim of this study was to examine whether the hypothetical model in two subpopulations among coal miners was suitable by using multi-group SEM with latent response variable approach. The second aim of this study was to compare whether the indirect effects of surface workers subgroup and underground workers subgroup were identical and to calculate the indirect effect in whole sample.

## 2. Methods

### 2.1. Study population

The cross-sectional, population-based survey was conducted at the north of Shanxi Province, which has abundant coal resources with 87 coalmines, from July 2013 to December 2013. Information such as name, gender, date of birth and work type was provided by the administrative department of the coalmine group. A two-stage cluster stratified sampling method was used in the sampling. In the first stage, there were ten coalmines being selected randomly from 87 coalmines in three coal group areas (Pingwang Region, Kouquan Trench, Yungang Trench). Then, in the second stage, a stratified random sampling method was used to select participants by their age, gender and work type. Individuals who voluntarily signed the informed consent, could communicate well with interviewers, and follow all requirements were included in the study. Excluded individuals were pregnant or breast-feeding women, persons with severe mental illnesses or drug addiction, patients with surgery within one month, and patients with autoimmune diseases, abnormal thyroid function, cancer or other disease history. A total of 4341 workers aged 18 to 65 years old were recruited to participate in physical examinations and the face-to-face interviews. After excluding 1251 participants with missing information on EPQ, sleep status and QOL, 3090 (43.88% surface workers and 56.12% underground workers) coalminers who didn't have obstructive sleep apnea syndrome and cognitive disorder and aged from 20 to 65 were included for the final analysis.

### 2.2. Biochemical assessments and measurement of anthropometrics

All methods of data collection were carried out by trained and certified investigators according to standardized protocols, based on the use and interpretation of anthropometry by the WHO Expert Committee (Eveleth, 1996). Blood samples were taken from the antecubital vein of subjects in the morning after at least a 10-hour fast. All blood samples were promptly taken back to the hospital via cold chain transport, and were measured by the hospital's laboratory, which met the standards of the National Reference laboratory. Lipid profile and glycaemia were measured by the SIEMENS ADVIA 1800 Automatic Biochemical analyzer (JEOL Ltd, Tokyo, Japan). Height, weight, and waist circumstance were measured twice by trained investigators with the participants lightly dressed and without shoes. The height and weight were measured at the level of 0.01 m and 0.1 kg, respectively. The average of the two measurements of waist circumstance, which was taken with band tape at the midpoint between the last rib and the iliac crest, was used for the final analysis. Body mass index (BMI, $kg/m^2$) was calculated based on the mean of two measurements of weight and height. The formula used for calculating BMI is weight divided by the square of the height. On the basis of the Working Group on Obesity in China criteria, individuals were classified into four categories: underweight, normal weight, overweight and obesity, of which the corresponding BMI values were $<18.5$, 18.5-23.99, 24.0-27.99, and $\geq 28.0\ kg/cm^2$, respectively. Diastolic and systolic blood pressure was calculated by the average of three times measurements at two-minute intervals using standard mercury sphygmomanometers. The subjects were seated in a quiet and calm environment and rested for at least five minutes before the first measurement, with the right arm placed in the position at heart level. The criterion recommended by the 2009 International Diabetes Federation (IDF) was used to define MetS (Alberti et al., 2009) . Diabetes

was diagnosed by combined the American Diabetes Association 2013 criteria (American Diabetes Association, 2013) and the history of diabetes treatment.

### 2.3. Assessment of general information and covariates

After the collection of blood samples and the measurement of anthropometrics, the self-administered questionnaires were filled out by participants during face-to-face interviews. All investigators were trained in a unified and rigorous procedure. The baseline information questionnaire contained demographic characteristics, socioeconomic status, life style, and medical history. In our study, age (< 35;35-45; ≥ 45 years), gender (male or female), smoking status (nonsmoker or smoker), alcohol consumption (nondrinker or drinker), tea consumption (no or yes), educational level (less than high school; junior college or senior high school; bachelor or above), marital status (married; divorced or separated; single), experience of work shifting (have or not have), workplace (surface or underground), monthly income (< 4000;4000-6000; ≥ 6000 RMB), sleep duration (hours/day) and medical history were used. The definition of current smokers was that individuals have smoked more than one cigarette every day during the past month (Lasser et al., 2000). Individuals were considered as current drinkers if they had consumed alcohol more than once per month in the past year (Xiang et al., 2009). The assessments of physical activity level (low; moderate; vigorous) and energy intake (kcal/day) were carried out via the International Physical Activity Questionnaire (IPAQ) and semi-quantitative food frequency questionnaire. The International Physical Activity Questionnaire has six domains including work-related activity, transport-related activity, housework activity, leisure-exercise-related activity, periods of sitting and sleep. According to frequencies of different domains and the metabolic equivalent of test score, the physical activity level was categorized into three grades: low, moderate and vigorous (Fan et al., 2014). The calorie intake of participants was calculated via multiplying the dietary intake of 20 food groups per day included in semi-quantitative food frequency with unit heat of every food group. The calorie of each food group was calculated based on the Chinese food composition Table 2009 edition. Diabetes (have or not have) (Rubin and Peyrot, 1999), MetS (have or not have) (Sullivan et al., 2007) and weight status (underweight, normal weight, overweight and obesity) (Flegal et al., 2005) were considered as confounders in the study because of their confounding effects on QOL.

### 2.4. Assessment of personality

The personality traits of participants were measured using the Eysenck Personality Questionnaire-Revised Short Scale for Chinese (EPQ-RSC) translated by Qian et al. (Eysenck, 1991; Qian et al., 2000). It is a self-report questionnaire with 48 items, which are divided into four subscales: psychoticism (P), neuroticism (N), extraversion (E) and personality stablity (L) (Cheng et al., 2013; Qian et al., 2000). Each item is measured on a dichotomous scale (1 = Yes, 0 = No). After the reverse scoring of seventeen items, the raw scores of the four subscales were calculated by summing the corresponding items. According to Chinese norms, the original scores were transformed into T scores (Peng, 1989; Qian et al., 2000). The EPQ-RSC has been extensively used in many researches to measure the personality traits in China (Lu et al., 2014; Wei et al., 2011; Zhong et al., 2008). It has also been demonstrated satisfactory reliability and validity of neuroticism, extraversion and stablity except that these of the psychoticism were relatively lower by Qian et al. (Qian et al., 2000). Individuals who have higher scores on psychoticism or neuroticism might be susceptible to neurotic or psychotropic tendencies, while the participants with higher scores on extraversion or stablity dimension would tend to optimism or emotional stability (Peng, 1989; Qian et al., 2000).

### 2.5. Assessment of sleep quality

Measures of sleep status in a prolonged period were from self-administered questionnaire, which were developed with reference to the relevant studies on sleep quality (Buysse et al., 1989; Haselimashhadi et al., 2009; Mesas et al., 2011). There were six questions involving sleep duration, snoring, use of sleeping medications, overall subjective sleep quality, manifestations of poor sleep, and causes of poor sleep. The manifestations of poor sleep consist of early awakening, difficulty of falling asleep, night awaking frequently, waking up and then having difficulties of falling asleep. Similar to some studies (Gildner et al., 2014; Haselimashhadi et al., 2009; Zeng et al., 2018), the subjects rated their overall sleep quality on a three-point scale (1 = Good, 2 = Modest, 3 = Poor). The other questions were used to reduce subjective bias in the survey. For example, during the investigation, if participants selected the good sleep quality but responded to the manifestations of poor sleep, then the investigator would ask the participants again about his/her subjective sleep quality to ensure data quality.

### 2.6. Assessment of quality of life

The WHOQOL-BREF was applied to measure the quality of life. It is a 26-item self-reported generic questionnaire, an abbreviated version of the WHOQOL-100 (Skevington et al., 2004; WHOQOL Group, 1998). The first two items reflecting the overall quality of life and the general health satisfaction are not included in the scoring system. The remaining 24 items are scored in four domains: Physical health (7 items), Psychological (6 items), Social relations (3 items) and Environment (8 items) (Skevington et al., 2004; WHOQOL Group, 1998). Each item uses a five-point scale. Domain scores were calculated by multiplying the mean of all items within the domain by four after the reverse scoring of three negative forms items (WHOQOL Group, 1998). Previous research has showed that WHOQOL-BREF was regarded as a valid and reliable alternative of WHOQOL-100 (Skevington et al., 2004; WHOQOL Group, 1998) and had been used in many countries and various populations (Skevington et al., 2004; Skevingtonc and Mccratec, 2012), such as Korean (Wan et al., 2013), China (Xia et al., 2012). A higher score in each domain means a higher quality of life in the corresponding facet (WHOQOL Group, 1998).

### 2.7. Ethical approval

The study was approved by Shanxi Medical University Ethics Committee and all participants in the study voluntarily joined with informed consents.

### 2.8. Statistical analysis

All collected data were double-entered and managed by Epi info version 3.5.1 (CDC, Atlanta, GA, USA). Statistical analyses were performed using the SAS version 9.2 software (SAS Institute, Inc., Cary, NC, USA) and the MPLUS version 7.4 (Muthen & Muthen, Stoner Ave., Los Angeles, CA, USA). Before the analysis, the normality of continuous variables was checked. Normally distributed continuous variables were presented as mean ± SD and categorical variables were described by frequencies and percentages. The comparisons of normally distributed continuous variables were implemented by the Student's *t*-test, while the chi-square test was performed for categorical variables. For different types of variables, partial Pearson or Spearman correlation coefficients were used to examine the relationships among personality traits, sleep quality and each domains of QOL after controlling for other covariates. Before regression analysis, multicollinearity diagnostics were conducted on all covariates and the four personality traits. Then, in order to examine the relationship between personality and sleep quality in surface workers and underground workers separately, the

adjusted odds ratios (OR) and their 95% confidence intervals (95%) were estimated by multivariable logistic regression adjusting for covariates. Multivariable linear regression was used to evaluate the association between dimensions of personality traits and domains of QOL after controlling for relevant covariates (model a) or further adjusting for sleep quality (model b).

A multi-group SEM with latent response variable approach (Muthén, 2011; Muthén and Asparouhov, 2015) was conducted via MPLUS 7.4 to explore how sleep quality might influence the association between personality traits and quality of life among surface workers and underground workers. Considering the measurement error and non-normality (Muthén, 2011), sleep quality was considered as a latent mediator variable in the mediation analysis. Given that relevant covariates (i.e., age, gender, smoking, alcohol consumption, consumption of tea, education, marital status, experience of work shifting, monthly income, physical activity level, energy intake, sleep duration, obesity, diabetes and MetS) may have influence on sleep quality and QOL (Bernhard et al., 1998; Flegal et al., 2005; Rubin and Peyrot, 1999; Sickel et al., 1999; Sullivan et al., 2007), these variables were adjusted in the mediation analysis. The indirect effects of two subgroups were estimated by the WLSMV estimator and the bias-corrected bootstrap resampling method with 5000 bootstrapped resamples. Many researchers also recommended to utilize the bias-corrected bootstrap CI to assess the statistical significance of indirect effects because it is more powerful than other methods in large samples and it does not base on the normal theory (Hayes and Scharkow, 2013; MacKinnon et al., 2004; Mallinckrodt et al., 2006). The indirect effect is statistically significant if the bias-corrected bootstrap CI doesn't include zero (MacKinnon et al., 2004; Mallinckrodt et al., 2006). In order to test the difference of indirect effect between two subgroups, the Wald chi-square Test was performed. All statistical tests were two-tailed and a $p$ value $< 0.05$ was considered as statistically significant.

## 3. Results

### 3.1. Characteristics of the study population

In the study, 3090 participants were divided into two subgroups according to their workplace. There were 1356 (43.88%) surface workers and 1734 (56.12%) underground workers. All descriptive analysis and the association analysis among personality, sleep quality, and QOL were conducted in two subgroups, respectively.

Table 1 shows the sample characteristics and descriptive statistics for all variables in surface workers and underground workers. The differences of age, gender, smoking status, alcohol consumption, education, work shifting, monthly income, physical activity level, energy intake, sleep duration, waist circumstance, systolic and diastolic blood pressure, high-density lipoprotein, T scores of neuroticism, scores of social relations and environment, and the overall QOL between two subpopulations were statistically significant.

### 3.2. Correlations between personality, sleep quality and QOL

The partial Pearson product moment correlations between personality traits and QOL, as well as the partial Spearman rank correlations between sleep quality, personality traits and QOL controlling for other covariates are summarized in Table 2. Psychoticism was negatively associated with extraversion, personality stablity, physical health, psychology and social relation, but was positively associated with neuroticism. Based on the correlation analysis, we didn't find the evidence of significant association between psychoticism and environment domain or sleep quality ($p > 0.05$). Extraversion was positively associated with personality stablity, physical health, psychology, social relation and environment, and was negatively associated with psychoticism, neuroticism and sleep quality ($p < 0.001$). Neuroticism was negatively correlated to extraversion, personality stablity and four domains of QOL, but was positively correlated to psychoticism and sleep quality ($p < 0.001$). Personality stablity was positively associated with four domains of QOL and extraversion, but was negatively associated with psychoticism, neuroticism and sleep quality ($p < 0.001$).

### 3.3. Multicollinearity diagnostics

According to the variance inflation factors (VIF) and tolerance values, the multicollinearity diagnostics were carried out before the regression analysis. The commonly criteria values for tolerance and VIF (0.10 and 10, respectively) may be insufficient to identify multicollinearity (Keith, 2014). Thus, tolerance value above 0.17 and VIF below 6 recommended by Keith, were used to detect multicollinearity (Keith, 2014). The results (see the Appendix A. supplementary table S1) showed that all VIF were less than 2.5, and all tolerance values were greater than 0.5. Therefore, there is no sufficient evidence showing that the covariates and T scores of personality traits were in collinearity.

### 3.4. The relationship between personality, sleep quality and QOL

Table 3 shows the results of multivariable logistic regression and multiple linear regression analysis. The results of multivariable logistic regression showed that only among underground workers extraversion was significantly related to reduce risk of poor sleep quality by adjusting for age, gender, smoking status, alcohol consumption, consumption of tea, education, marital status, experience of work shifting, monthly income, physical activity level, energy intake, sleep duration, obesity, diabetes and MetS. For both underground workers and surface workers, neuroticism was significantly related to higher risk of poor sleep quality (*OR*: 1.03, 95%*CI*: (1.02, 1.04); *OR*: 1.04, 95%*CI*: (1.03, 1.05), respectively). The results of multiple linear regression analysis showed that neuroticism and extraversion in the two subgroups was negatively and positively associated with physical health after adjusting age, gender and other relevant variables, respectively. By further adjusting for sleep quality, the coefficients of neuroticism and extraversion among two subgroups were slightly attenuated and the sleep quality was negatively related with physical health. Similar results were obtained for psychology, social relation, and environment. Besides, psychoticism among underground workers was negatively associated with psychology, while personality stablity was positively related to environment in two subgroups, even by further adjusting for sleep quality.

### 3.5. Mediation analysis

Fig. S1 (see the Appendix A. supplementary Fig. S1) displays our hypothesized relationships between personality traits, sleep quality and quality of life. All latent variables (denoted by ellipses) were adjusted for age, gender and other relevant covariates. Mediation analysis was conducted for surface workers and underground workers separately. All of the standardized regression coefficients shown in fig. S2, fig. S3 (see the Appendix A. supplementary Fig. S2 and Fig. S3) and Fig. 1 were statistically significant ($p < 0.05$). The results of multi-group SEM with latent response variable mediator analysis are shown in Table 4.

#### 3.5.1. Underground workers subpopulation

The multi-group SEM analysis revealed that there was a partial mediation effect in the relationship between personality traits and QOL through sleep quality. The total effect, the direct effect of personality traits, and the indirect effect through sleep quality were all significant. Moreover, the results illustrated a small and negative indirect effect with statistical significance existed in underground workers ($-0.041$, 95%*CI*: ($-0.059$, $-0.024$)), and the percentage of indirect effect on total effect was 5.76%.

**Table 1**
Characteristics of the study population.

| | Total($n$ = 3090) | Underground($n$ = 1734) | Surface($n$ = 1356) | $P$ value |
|---|---|---|---|---|
| Age(years)($n$, %) | | | | **0.0008** |
| < 35 | 882(28.54) | 522(30.1) | 360(26.55) | |
| 35–45 | 1181(38.22) | 684(39.45) | 497(36.65) | |
| ≥ 45 | 1027(33.24) | 528(30.45) | 499(36.8) | |
| Gender($n$, %) | | | | **< 0.0001** |
| Male | 2602(84.21) | 1727(99.6) | 875(64.53) | |
| Female | 488(15.79) | 7(0.4) | 481(35.47) | |
| Smoking status($n$, %) | | | | **< 0.0001** |
| Nonsmoker | 1308(42.33) | 546(31.49) | 762(56.19) | |
| Smoker | 1782(57.67) | 1188(68.51) | 594(43.81) | |
| Alcohol consumption($n$, %) | | | | **< 0.0001** |
| Nondrinker | 1797(58.16) | 904(52.13) | 893(65.86) | |
| Drinker | 1293(41.84) | 830(47.87) | 463(34.14) | |
| Consumption of tea($n$, %) | | | | 0.8885 |
| No | 2049(66.31) | 1148(66.21) | 901(66.45) | |
| Yes | 1041(33.69) | 586(33.79) | 455(33.55) | |
| Education($n$, %) | | | | **< 0.0001** |
| Less than high school | 711(23.01) | 465(26.82) | 246(18.14) | |
| Junior college/senior high school | 1952(63.17) | 1112(64.13) | 840(61.95) | |
| Bachelor or above | 427(13.82) | 157(9.05) | 270(19.91) | |
| Marital status($n$, %) | | | | 0.0803 |
| Married | 2913(94.27) | 1624(93.66) | 1289(95.06) | |
| Divorced/widowed/separated | 49(1.59) | 26(1.5) | 23(1.7) | |
| Never Married | 128(4.14) | 84(4.84) | 44(3.24) | |
| Work shifting($n$, %) | | | | **< 0.0001** |
| No | 1613(52.2) | 676(38.99) | 937(69.1) | |
| Yes | 1477(47.8) | 1058(61.01) | 419(30.9) | |
| Monthly income($n$, %) | | | | **< 0.0001** |
| < 4000,yuan | 776(25.11) | 217(12.51) | 559(41.22) | |
| 4000–6000,yuan | 1298(42.01) | 906(52.25) | 392(28.91) | |
| ≥ 6000,yuan | 1016(32.88) | 611(35.24) | 405(29.87) | |
| Physical activity level($n$, %) | | | | **< 0.0001** |
| Low | 301(9.74) | 139(8.02) | 162(11.95) | |
| Moderate | 887(28.71) | 405(23.36) | 482(35.55) | |
| Vigorous | 1902(61.55) | 1190(68.63) | 712(52.51) | |
| Weight status($n$, %) | | | | 0.3866 |
| Underweight | 65(2.1) | 30(1.73) | 35(2.58) | |
| Normal weight | 1264(40.91) | 704(40.6) | 560(41.3) | |
| Overweight | 1214(39.29) | 689(39.73) | 525(38.72) | |
| Obesity | 547(17.7) | 311(17.94) | 236(17.4) | |
| MetS($n$, %) | | | | 0.3888 |
| No | 1929(62.43) | 1094(63.09) | 835(61.58) | |
| Yes | 1161(37.57) | 640(36.91) | 521(38.42) | |
| Diabetes($n$, %) | | | | 0.4453 |
| No | 2954(95.6) | 1662(95.85) | 1292(95.28) | |
| Yes | 136(4.4) | 72(4.15) | 64(4.72) | |
| Sleep quality($n$, %) | | | | 0.9449 |
| Good | 1769(57.25) | 996(57.44) | 773(57.01) | |
| Modest | 1098(35.53) | 615(35.47) | 483(35.62) | |
| Poor | 223(7.22) | 123(7.09) | 100(7.37) | |
| Energy intake(kcal/day) | 2706.18 ± 1021.29 | 2883.29 ± 1021.66 | 2479.7 ± 975.38 | **< 0.0001** |
| Sleep duration(h/day) | 7.29 ± 1.53 | 7.19 ± 1.55 | 7.41 ± 1.51 | **< 0.0001** |
| BMI(kg/cm2) | 24.76 ± 3.56 | 24.82 ± 3.53 | 24.68 ± 3.61 | 0.274 |
| Waist circumstance(cm) | 89.85 ± 9.84 | 90.33 ± 9.01 | 89.23 ± 10.78 | **0.0025** |
| Glycaemia(mmol/L) | 4.97 ± 1.26 | 4.96 ± 1.34 | 4.98 ± 1.14 | 0.653 |
| Systolic blood pressure(mmHg) | 126.26 ± 17.29 | 126.83 ± 16.44 | 125.54 ± 18.31 | **0.041** |
| Diastolic blood pressure(mmHg) | 78.79 ± 14.04 | 79.83 ± 14.13 | 77.46 ± 13.81 | **< 0.0001** |
| Triglyceride(mmol/L) | 1.87 ± 1.70 | 1.89 ± 1.69 | 1.85 ± 1.71 | 0.5403 |
| High-density lipoprotein(mmol/L) | 1.21 ± 0.35 | 1.20 ± 0.34 | 1.23 ± 0.35 | **0.0412** |
| Personality(T Score) | | | | |
| Psychoticism | 48.27 ± 7.09 | 48.19 ± 7.15 | 48.36 ± 7.02 | 0.4989 |
| Neuroticism | 50.2 ± 10.87 | 50.68 ± 11.13 | 49.59 ± 10.5 | **0.0053** |
| Extraversion | 52.43 ± 9.01 | 52.50 ± 8.93 | 52.33 ± 9.11 | 0.6185 |
| Stablity | 53.46 ± 9.61 | 53.51 ± 9.8 | 53.4 ± 9.36 | 0.7585 |
| QOL(Score) | | | | |
| Physical health | 13.86 ± 2.15 | 13.82 ± 2.15 | 13.91 ± 2.14 | 0.269 |
| Psychological | 13.1 ± 2.01 | 13.06 ± 2.07 | 13.16 ± 1.93 | 0.1583 |
| Social relations | 14.31 ± 2.47 | 14.18 ± 2.51 | 14.48 ± 2.42 | **0.0008** |
| Environment | 12.32 ± 2.47 | 12.11 ± 2.51 | 12.59 ± 2.4 | **< 0.0001** |
| Overall QOL | | | | **< 0.0001** |
| Very poor | 34(1.1) | 26(1.5) | 8(0.59) | |
| Poor | 86(2.78) | 51(2.94) | 35(2.58) | |
| General | 1652(53.46) | 979(56.46) | 673(49.63) | |
| Good | 1102(35.66) | 556(32.06) | 546(40.27) | |
| Very good | 216(6.99) | 122(7.04) | 94(6.93) | |

Note: Data are presented by mean ± SD or frequencies (percentage).

#### 3.5.2. Surface workers subpopulation

The mediator role of sleep quality in the relationship between personality traits and QOL showed similar results in the underground-worker subpopulation. A small, negative, significant indirect effect existed in the surface workers subpopulation (−0.044, 95%*CI*: (−0.078, −0.022)), and the percentage of indirect effect on total effect was 6.53%.

The CFI, TLI, RMSEA of multi-group SEM model were 0.902, 0.862 and 0.040, respectively. These fit indices indicated that the multiple-group model was a good fitting model.

#### 3.5.3. Overall sample

The Wald chi-square test was then performed in order to test the difference of indirect effects between surface workers and underground workers (see Table 4). The results of the Wald chi-square test showed that the difference of indirect effects between two subgroups was not statistically significant ($p > 0.05$). To explore the indirect effect of personality traits and QOL mediating by sleep quality in the whole sample, a latent variables mediation analysis was conducted among whole sample. The results could also be found in the Table 4. A partial mediation effect in the relationship between personality traits and QOL through sleep quality was also significant in the whole samples (−0.041, 95%*CI*: (−0.057, −0.027)), and the percentage of indirect effect on the total effect was 5.85%. In addition, the CFI, TLI, RMSEA of the full samples model were 0.887, 0.832 and 0.044, respectively.

## 4. Discussion

Although studies have examined the relationships between personality traits, sleep quality and QOL (Cramer et al., 2006; Kim et al., 2015; Luyster and Dunbarjacob, 2011), few studies have examined the relations of the three variables in a single model. To our knowledge, the current study is the first study to explore the role of sleep quality in the relationship between personality traits and quality of life in coal miners using the multi-group SEM with latent response variable approach. Overall, individuals with good sleep quality had better experience of QOL than that of poor sleepers. Likewise, the passive personality traits with psychoticism, neuroticism or introverted tendencies, were related to a poorer QOL, whereas the active personality traits with lower psychoticism, lower neuroticism or extraverted tendencies, acted in the opposite direction. We also found for both surface workers and the underground workers, sleep quality partially mediated the relation between personality and QOL.

There are consistent evidences regarding the association of QOL with both sleep quality (Elder et al., 2007; Gooneratne et al., 2007; Luyster and Dunbarjacob, 2011) and personality (Cramer et al., 2006; Härtl et al., 2010; Rubin and Peyrot, 1999). Similarly, the relationship between personality and sleep quality has been widely recognized (Kim et al., 2015; van de Laar et al., 2010). However, although personality has been regarded as a predictor of QOL (Cramer et al., 2006), it has not been fully confirmed that whether sleep quality acts as a confounder or a mediator in the relationship. Our study examines the relationship between personality and QOL, and indicates the mediating role of sleep quality in this association.

The relationship between sleep quality and QOL is well known. Poor sleep quality may be one cause of lower life satisfaction and impairments in QOL (Luyster and Dunbarjacob, 2011). In addition to a direct impact on quality of life, poor quality of sleep is also associated with many diseases, thereby reducing the quality of life. For instance, Jennings et al, indicated that there were significant associations between sleep quality and metabolic syndrome as well as several of its core components (Jennings et al., 2007). Besides, many studies found that sleep quality was strongly associated with depression in different populations (Huang et al., 2016; Skouteris et al., 2008). In our study, similar to others (Elder et al., 2007; Luyster and Dunbarjacob, 2011), poorer sleepers had worse QOL than good sleepers among surface workers and underground workers.

It has been shown that personality is a considerable predictor for QOL in general population and clinical patients (Cramer et al., 2006; Härtl et al., 2010; Rubin and Peyrot, 1999). Numerous studies implicated that high levels of neuroticism and depression (Huang et al., 2016), stress (Härtl et al., 2010), anxiety (Filipović et al., 2013) etc. were interrelated. Consistent with previous studies (Bal and Sahin, 2011; Härtl et al., 2010), our data showed that individuals with neuroticism or introverted tendencies in both subgroups, had lower QOL than others with emotional homeostasis or extroversion. However, when the effect of sleep quality was controlled, the association between personality traits and QOL was slightly attenuated in two subpopulations. According to the result from the Wald chi-square test, there was no difference on the indirect effects between underground workers and surface workers. In our opinion, this might be due, at least in part, to the assumption that the personality traits of adults are considered as being rather stable (Gerlach et al., 2015) so that the impact of different work environments on personality is relatively small.

As expected, passive personality traits had a negative impact on QOL mediated by self-administrated poor sleep quality, whereas the

**Table 2**
Correlations between personality, sleep quality, and QOL controlling for other covariates[a].

| | Personality (*t* Score) | | | | QOL (Score) | | | | Sleep quality |
|---|---|---|---|---|---|---|---|---|---|
| | Psychoticism | Neuroticism | Extraversion | Stablity | Physical health | Psychological | Social relations | Environment | |
| Personality(T Score) | | | | | | | | | |
| Psychoticism | 1 | | | | | | | | |
| Neuroticism | 0.07*** | 1 | | | | | | | |
| Extraversion | −0.11*** | −0.20*** | 1 | | | | | | |
| Stablity | −0.10*** | −0.37*** | 0.10*** | 1 | | | | | |
| QOL(Score) | | | | | | | | | |
| Physical health | −0.04* | −0.33*** | 0.21*** | 0.14*** | 1 | | | | |
| Psychological | −0.09*** | −0.27*** | 0.28*** | 0.12*** | 0.50*** | 1 | | | |
| Social relations | −0.05** | −0.34*** | 0.30*** | 0.17*** | 0.49*** | 0.52*** | 1 | | |
| Environment | −0.03 | −0.36*** | 0.24*** | 0.19*** | 0.51*** | 0.55*** | 0.57*** | 1 | |
| Sleep quality | 0.02 | 0.18*** | −0.09*** | −0.06*** | −0.30*** | −0.17*** | −0.18*** | −0.15*** | 1 |

Note: [a] The controlled covariates were age, gender, smoking status, alcohol consumption, consumption of tea, education, marital status, work shifting, monthly income, physical activity level, weight status, MetS, diabetes, energy intake, sleep duration;
Pearson partial correlations were calculated between each domains of personality and QOL;
Spearman partial correlations were calculated between sleep quality and each domains of personality or QOL.

*** $p < 0.001$
** $p < 0.01$
* $p < 0.05$

**Table 3**
Estimated standardized coefficients between personality, sleep quality, and QOL controlling for other covariates in underground workers and surface workers.

| | Sleep quality | | | | Physical health | | | | Psychological | | | | Social relation | | | | Environment | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model1[a] | | | | Model2[a] | | Model2[b] | | Model3[a] | | Model3[b] | | Model4[a] | | Model4[b] | | Model5[a] | | Model5[b] | |
| | Estimate | *P* value | *OR* | *OR*95%*CI* | Estimate | *P* value | Estimate | *P* value | Estimate | *P* value | Estimate | *P* value | Estimate | *P* value | Estimate | *P* value | Estimate | *P* value | Estimate | *P* value |
| Underground workers($n$ = 1734) | | | | | | | | | | | | | | | | | | | | |
| Personality | | | | | | | | | | | | | | | | | | | | |
| Psychoticism | −0.02 | 0.44 | 1.00 | 0.98,1.01 | 0.01 | 0.71 | 0.00 | 0.83 | −0.06 | **0.01** | −0.06 | **0.01** | 0.00 | 0.97 | 0.00 | 0.90 | 0.01 | 0.54 | 0.01 | 0.58 |
| Neuroticism | 0.19 | **<0.0001** | 1.03 | 1.02,1.04 | −0.31 | **<0.0001** | −0.27 | **<0.0001** | −0.21 | **<0.0001** | −0.19 | **<0.0001** | −0.28 | **<0.0001** | −0.26 | **<0.0001** | −0.32 | **<0.0001** | −0.31 | **<0.0001** |
| Extraversion | −0.10 | **<0.001** | 0.98 | 0.97,0.99 | 0.17 | **<0.0001** | 0.16 | **<0.0001** | 0.23 | **<0.0001** | 0.22 | **<0.0001** | 0.24 | **<0.0001** | 0.23 | **<0.0001** | 0.19 | **<0.0001** | 0.19 | **<0.0001** |
| Stablity | 0.03 | 0.27 | 1.01 | 1.00,1.02 | 0.00 | 0.90 | 0.01 | 0.64 | 0.02 | 0.50 | 0.02 | 0.42 | 0.04 | 0.10 | 0.04 | 0.07 | 0.05 | **0.03** | 0.05 | **0.02** |
| Sleep quality | – | – | – | – | – | – | −0.23 | **<0.0001** | – | – | −0.10 | **<0.0001** | – | – | −0.12 | **<0.0001** | – | – | −0.09 | **0.00** |
| *R* Square/ adjusted *R* square | | | | | 0.18 | 0.17 | 0.23 | 0.22 | 0.20 | 0.19 | 0.21 | 0.20 | 0.20 | 0.19 | 0.21 | 0.21 | 0.21 | 0.20 | 0.21 | 0.20 |
| Surface workers($n$ = 1356) | | | | | | | | | | | | | | | | | | | | |
| Personality | | | | | | | | | | | | | | | | | | | | |
| Psychoticism | 0.04 | 0.16 | 1.01 | 1.00,1.03 | −0.02 | 0.33 | −0.02 | 0.49 | −0.03 | 0.27 | −0.02 | 0.34 | 0.01 | 0.80 | 0.01 | 0.71 | 0.02 | 0.47 | 0.02 | 0.42 |
| Neuroticism | 0.23 | **<0.0001** | 1.04 | 1.03,1.05 | −0.28 | **<0.0001** | −0.22 | **<0.0001** | −0.22 | **<0.0001** | −0.19 | **<0.0001** | −0.27 | **<0.0001** | −0.25 | **<0.0001** | −0.26 | **<0.0001** | −0.25 | **<0.0001** |
| Extraversion | −0.04 | 0.23 | 0.99 | 0.98,1.01 | 0.11 | **<0.0001** | 0.10 | **<0.0001** | 0.20 | **<0.0001** | 0.20 | **<0.0001** | 0.25 | **<0.0001** | 0.25 | **<0.0001** | 0.16 | **<0.0001** | 0.16 | **<0.0001** |
| Stablity | −0.01 | 0.87 | 1.00 | 1.00,1.01 | 0.02 | 0.54 | 0.02 | 0.50 | 0.00 | 0.90 | 0.00 | 0.91 | 0.06 | **0.02** | 0.06 | **0.02** | 0.08 | **0.01** | 0.08 | **0.01** |
| Sleep quality | – | – | – | – | – | – | −0.28 | **<0.0001** | – | – | −0.14 | **<0.0001** | – | – | −0.10 | **0.00** | – | – | −0.07 | **0.01** |
| *R* Square/ adjusted *R* square | | | | | 0.17 | 0.15 | 0.23 | 0.22 | 0.19 | 0.18 | 0.21 | 0.20 | 0.20 | 0.19 | 0.21 | 0.20 | 0.18 | 0.17 | 0.18 | 0.17 |

Note: [a] adjusting age, gender, smoking status, alcohol consumption, consumption of tea, education, marital status, work shifting, monthly income, physical activity level, weight status, MetS, diabetes, energy intake, sleep duration.
[b] further adjusting sleep quality;
model1 is the association between sleep quality and personality by logistic regression;
model2 is the association between Physical health, sleep quality and personality by multiple linear regression;
model3 is the association between Psychological, sleep quality and personality by multiple linear regression;
model4 is the association between Social relations, sleep quality and personality by multiple linear regression;
model5 is the association between Environment, sleep quality and personality by multiple linear regression.

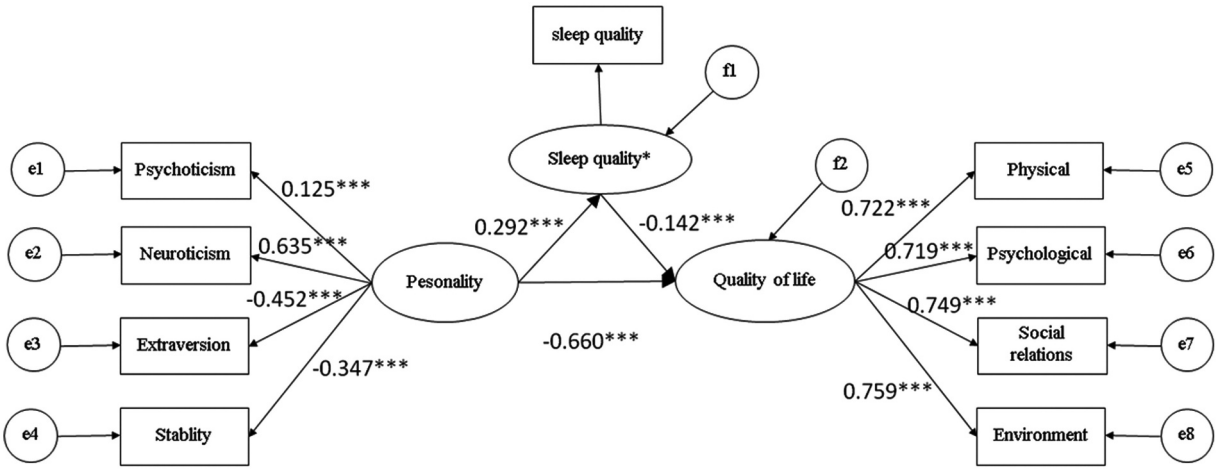


**Fig. 1.** Standardized estimation of the relationship between personality, sleep quality, and QOL in the whole sample.

active personality traits acted the opposite in two subgroups of coal miners. This was in line with previous studies indicating that high neuroticism was linked to greater experience of poor QOL and sleep issues, whereas high extroversion was related to higher QOL and better sleep (Cramer et al., 2006; Härtl et al., 2010; Huang et al., 2016). Besides, it was revealed in our mediation analysis that sleep quality had an influence on the association between personality traits and QOL, and that the influence of personality traits and QOL was partially mediated by sleep quality. Hence, in addition to the pathway shown in our study, there might be other mediators mediating the association between personality traits and QOL. For example, self-efficacy and adherence as mediating factors between personality traits and health-related quality of life were found in the study of Wrosch and Scheier (Wrosch and Scheier, 2003). Despite the small indirect effect sizes in two subgroups and whole sample, these indirect effects were all significant. This was consistent with previous researches about personality, in which personality traits explained a relatively small but significant variation on sleep quality (Kim et al., 2015; Vantieghem et al., 2016) or QOL (Kempen et al., 1997; Weber et al., 2015). Nevertheless, there was sufficient evidence that sleep disturbance and sleep deprivation were related to mental and somatic ill-health, higher risk of potentially premature mortality (Cappuccio et al., 2010) and work disability (Lallukka et al., 2014). Blair and colleagues found that poor sleep quality predicted higher serum IL-8 (Blair et al., 2015), which is a chemokine and a potent chemoattractant concerned with endothelial dysfunction (Gerszten et al., 1999). Besides, sleep deprivation and sleep disturbance impair adaptive immunity and promote inflammation (Irwin, 2015). Obviously, poor sleep brought a notable burden on health (Cappuccio et al., 2010). Hence, behavioral treatments aimed at improving sleep may reduce systemic, cellular, and genomic markers of inflammation, thereby affecting the risk of cardiovascular or other inflammatory diseases (Irwin, 2015). Given the growing prevalence of sleep disturbance as well as the hazards of sleep-related diseases, it is worthwhile to take some actions because even minor improvements can have a considerable impact on public health (Kim et al., 2015). Moreover, it may be beneficial to better understanding of the mechanisms connecting personality characteristics, sleep quality, and QOL in coal miners.

However, several studies examined the changes in personality traits and found that some diseases could have influence on the manifestation of personality, such as obesity (Gerlach et al., 2015), Alzheimer (Tautvydaitė et al., 2017), Parkinson (Lewis et al., 2015), etc. However, the study population was coal miners, most of whom were adults and the personality traits were considered as being rather stable in adulthood (Gerlach et al., 2015). Besides, the survey excluded the individuals who had severe mental illnesses, drug addicts, surgery within

**Table 4**
Mediation analysis of personality, sleep quality, and QOL.

| Population | Hypothesized model | *β* | *P* Value | 95%*CI* | CFI/TLI | $\chi^2$ | *df* | RMSEAWald (95%*CI*) | *P* Value of Wald $\chi^2$ test [a] |
|---|---|---|---|---|---|---|---|---|---|
| Underground workers | Personality→Sleep quality→QOL | | | | 0.902/ 0.862 | 832.672 | 242 | 0.04 (0.037, 0.043) | 0.9323 |
| | Total effect | −0.712 | **<0.001** | **−0.782, −0.659** | | | | | |
| | Indirect effect | −0.041 | **<0.001** | **−0.059, −0.024** | | | | | |
| | Direct effect | −0.671 | **<0.001** | **−0.766, −0.619** | | | | | |
| Surface workers | Personality→Sleep quality→QOL | | | | | | | | |
| | Total effect | −0.674 | **<0.001** | **−0.741, −0.614** | | | | | |
| | Indirect effect | −0.044 | **0.001** | **−0.078, −0.022** | | | | | |
| | Direct effect | −0.630 | **<0.001** | **−0.711, −0.562** | | | | | |
| Whole sample | Personality→Sleep quality→QOL | | | | 0.887/ 0.832 | 814.169 | 115 | 0.044 (0.042, 0.047) | – |
| | Total effect | −0.701 | **<0.001** | **−0.752, −0.649** | | | | | |
| | Indirect effect | −0.041 | **<0.001** | **−0.057, −0.027** | | | | | |
| | Direct effect | −0.660 | **<0.001** | **−0.719, −0.601** | | | | | |

Note: Adjusting for age, gender, smoking status, alcohol consumption, consumption of tea, education, marital status, work shifting, monthly income, physical activity level, weight status, MetS, diabetes, energy intake, sleep duration;

[a] Wald chi-square test was performed in the subgroups analysis in order to test the difference of indirect effects between surface workers and underground workers.

one month, abnormal thyroid function, autoimmune diseases, cancer or other acute history at the first and subjects in the present study had not obstructive sleep apnea syndrome and cognitive disorder. And diabetes, obesity, MetS were considered as covariates as well. Hence, the negative impact of illness on personality could be ignored to some extent.

Results obtained from the current findings may facilitate individuals with sleep issues and low QOL to make personalized intervention strategies (Huang et al., 2016). For example, it may be feasible to assess personality traits for patients before proposing treatments suiting to individuals, thereby contributing to improve the therapeutic effect. Moreover, it is necessary for individuals with negative personality profiles to provide psychological counseling in order to improve their sleep quality and QOL.

There are also some limitations of the study needs to be addressed. Firstly, the design of this study was cross-sectional, therefore, a certain causal relationship between personality and QOL mediating by sleep quality cannot be made and should be confirmed by further prospective studies. Secondly, although we applied the strict quality control to assure the quality of data collection, reporting bias cannot be ruled out. In spite of using latent variables analysis method to correct the bias of sleep quality to some extent, there is no information on validity and reliability of the sleep questionnaire and objective measures of sleep quality based on polysomnography or actigraphy would be preferred. Thirdly, the relationships considered in present study only focused on a single mediator variable. Notwithstanding that the results of the study facilitated further understanding the association of personality and QOL, future studies would be necessary to clarify the more specifically role of each potential mediator and multiple mediation analysis can be used to simultaneously examine the indirect effects of multiple mediators.

With the improvement of people's health consciousness, more and more people pay attention to sleep problems and quality of life. Overall, our findings are important from a public health perspective because the results show that sleep quality plays, both in surface laborers and underground coal miners, a vital role in the relationship between personality and QOL. We also found that passive personality traits had a negative impact on QOL mediated by self-administrated poor sleep quality, whereas the active personality traits acted in the opposite direction in the two subgroups of coal miners. Therefore, good quality of sleep might be regarded as an intermediate outcome for evaluating interventions aimed at improving quality of life.

## Acknowledgements

This work was supported by the National Natural Science Foundation of China (grant number 81872715). Authors would like to thank the coalmine workers for their time and participation in our study. Authors also gratefully acknowledge all interviewers for collecting questionnaire survey data, all doctors and laboratory inspectors for general examination, physical examination and biochemical examination, and the support of Graduate Student Innovation Center in Shanxi Province of China.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.12.006.

## References

Alberti, K., Eckel, R., Grundy, S., Zimmet, P., Cleeman, J., Donato, K., 2009. Harmonizing the metabolic syndrome: a joint interim statement of the international diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American heart association; world heart federation; international atherosclerosis society; and international association for the study of obesity. Circulation 120 (16), 1640–1645.

American Diabetes Association, 2013. Standards of medical care in diabetes-2013. Diabetes Care. 36 (Suppl 1), S11–S66.

Araghi, M.H., Jagielski, A., Neira, I., Brown, A., Higgs, S., Thomas, G.N., et al., 2013. The complex associations among sleep quality, anxiety-depression, and quality of life in patients with extreme obesity. Sleep 36 (12), 1859.

Bal, M.D., Sahin, N.H., 2011. The effects of personality traits on quality of life. Menopause 18 (12), 1309–1316.

Bernhard, J., Hürny, C., Coates, A.S., Peterson, H.F., Castiglionegertsch, M., Gelber, R.D., et al., 1998. Factors affecting baseline quality of life in two international adjuvant breast cancer trials. Br. J. Cancer 78 (5), 686.

Blair, L.M., Porter, K., Leblebicioglu, B., Christian, L.M., 2015. Poor sleep quality and associated inflammation predict preterm birth: heightened risk among African Americans. Sleep 38 (8), 1259.

Buysse, D.J., Monk, T.H., Berman, S.R., Kupfer, D.J., 1989. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 28 (2), 193–213.

Cao, Q.G., Li, K., Liu, Y.J., Sun, Q.H., Zhang, J., 2012. Risk management and workers' safety behavior control in coal mine. Saf. Sci. 50 (4), 909–913.

Cappuccio, F., Miller, M.A., Lockley, S.W., 2010. Sleep, Health, and Society: From Aetiology to Public Health. Oxford University Press, Oxford.

Cheng, Q.M., Kong, C.Q., Chang, S.Y., Wei, A.H., 2013. Effects of psychological nursing intervention on personality characteristics and quality of life of patients with esophageal cancer. Clin. Res. Hepatol. Gastroenterol. 37 (3), 283–288.

Cramer, V., Torgersen, S., Kringlen, E., 2006. Personality disorders and quality of life. A population study. Compr. Psychiatry 47 (3), 178–184.

Elder, S.J., Pisoni, R.L., Akizawa, T., Fissell, R., Andreucci, V.E., Fukuhara, S., et al., 2007. Sleep quality predicts quality of life and mortality risk in haemodialysis patients: results from the Dialysis Outcomes and Practice Patterns Study (DOPPS). Nephrol. Dial. Transplant. 23 (3), 998–1004.

Eveleth, P.B., 1996. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. American Journal of Human Biology: the Official Journal of the Human Biology Association 8 (6), 786–787.

Eysenck, H.J., 1991. Manual of the Eysenck Personality Scales (EPS Adult). Hodder & Stoughton, London.

Fan, M., Lyu, J., He, P., 2014. Chinese guidelines for data processing and analysis concerning the International Physical Activity Questionnaire. Zhonghua liu xing bing xue za zhi 35 (8), 961–964.

Filipović, B.F., Randjelovic, T., Ille, T., Markovic, O., Milovanović, B., Kovacevic, N., et al., 2013. Anxiety, personality traits and quality of life in functional dyspepsia--suffering patients. Eur. J. Intern. Med. 24 (1), 83–86.

Flegal, K.M., Graubard, B.I., Williamson, D.F., Gail, M.H., 2005. Excess deaths associated with underweight, overweight, and obesity. JAMA 293 (15), 1861–1867.

Funder, D.C., 1997. The Personality Puzzle. W.W. Norton.

Gerlach, G., Herpertz, S., Loeber, S., 2015. Personality traits and obesity: a systematic review. Obes. Rev. 16 (1), 32–63.

Gerszten, R.E., Garcia-Zepeda, E.A., Lim, Y.-C., Yoshida, M., Ding, H.A., Gimbrone Jr, M.A., et al., 1999. MCP-1 and IL-8 trigger firm adhesion of monocytes to vascular endothelium under flow conditions. Nature 398 (6729), 718.

Gildner, T.E., Liebert, M.A., Kowal, P., Chatterji, S., Snodgrass, J.J., 2014. Associations between sleep duration, sleep quality, and cognitive test performance among older adults from six middle income countries: results from the Study on Global Ageing and Adult Health (SAGE). J. Clin. Sleep Med. 10 (06), 613–621.

Gooneratne, N.S., Dean, G.E., Rogers, A.E., Nkwuo, J.E., Coyne, J.C., Kaiser, L.R., 2007. Sleep and quality of life in long-term lung cancer survivors. Lung Cancer 58 (3), 403–410.

Härtl, K., Engel, J., Herschbach, P., Reinecker, H., Sommer, H., Friese, K., 2010. Personality traits and psychosocial stress: quality of life over 2 years following breast cancer diagnosis and psychological impact factors. Psycho-Oncology 19 (2), 160–169.

Haselimashhadi, N., Dadd, T., Pan, A., Yu, Z., Lin, X., Franco, O.H., 2009. Sleep quality in middle-aged and elderly Chinese: distribution, associated factors and associations with cardio-metabolic risk factors. BMC Public Health 9 (1), 1–11.

Hayes, A.F., Scharkow, M., 2013. The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis: does method really matter? Psychol. Sci. 24 (10), 1918–1927.

Homer, A.W., 2009. Coal mine safety regulation in China and the USA. J. Contemp. Asia 39 (3), 424–439.

Hsiung, P.C., Fang, C.T., Chang, Y.Y., Chen, M.Y., Wang, J.D., 2005. Comparison of WHOQOL-BREF and SF-36 in patients with HIV infection. Qual. Life Res. 14 (1), 141–150.

Huang, V., Peck, K., Mallya, S., Lupien, S.J., Fiocco, A.J., 2016. Subjective sleep quality as a possible mediator in the relationship between personality traits and depressive symptoms in middle-aged adults. PLoS One 11 (6), e0157238.

Irwin, M.R., 2015. Why sleep is important for health: a psychoneuroimmunology perspective. Annu. Rev. Psychol. 66 (1), 143.

Jennings, J.R., Muldoon, M.F., Hall, M., Buysse, D.J., Manuck, S.B., 2007. Self-reported sleep quality is associated with the metabolic syndrome. Sleep 30 (2), 219–223.

Keith, T.Z., 2014. Multiple Regression and Beyond. Prentice Hall, Upper Saddle River, NJ.

Kempen, G.I., Jelicic, M., Ormel, J., 1997. Personality, chronic medical morbidity, and health-related quality of life among older persons. Health Psychol. 16 (6), 539.

Kim, H.N., Cho, J., Chang, Y., Ryu, S., Shin, H., Kim, H.L., 2015. Association between personality traits and sleep quality in young Korean women. PLoS One 10 (6), e0129599.

Lallukka, T., Kaikkonen, R., Härkänen, T., Kronholm, E., Partonen, T., Rahkonen, O., et al., 2014. Sleep and sickness absence: a nationally representative register-based follow-up study. Sleep 37 (9), 1413.

Lasser, K., Boyd, J.W., Woolhandler, S., Himmelstein, D.U., Mccormick, D., Bor, D.H.,

2000. Smoking and mental illness: a population-based prevalence study. JAMA 284 (20), 2606–2610.
Lewis, C., Maier, F., Horstkötter, N., Zywczok, A., Witt, K., Eggers, C., et al., 2015. Subjectively perceived personality and mood changes associated with subthalamic stimulation in patients with Parkinson's disease. Psychol. Med. 45 (1), 73–85.
Li, L., Young, D., Xiao, S., Zhou, X., Zhou, L., 2004. Psychometric properties of the WHO Quality of Life questionnaire (WHOQOL-100) in patients with chronic diseases and their caregivers in China. Bull. World Health Organ. 82, 493–502.
Liu, L., Wen, F., Xu, X., Wang, L., 2015. Effective resources for improving mental health among Chinese underground coal miners: perceived organizational support and psychological capital. J. Occup. Health 57 (1), 58–68.
Lu, F., Huo, Y., Li, M., Chen, H., Liu, F., Wang, Y., et al., 2014. Relationship between personality and gray matter volume in healthy young adults: a voxel-based morphometric study. PLoS One 9 (2), e88763.
Luyster, F.S., Dunbarjacob, J., 2011. Sleep quality and quality of Life in adults with type 2 diabetes. Diabetes Educ. 37 (3), 347–355.
MacKinnon, D.P., Lockwood, C.M., Williams, J., 2004. Confidence limits for the indirect effect: distribution of the product and resampling methods. Multivar. Behav. Res. 39 (1), 99–128.
Mallinckrodt, B., Abraham, W.T., Wei, M., Russell, D.W., 2006. Advances in testing the statistical significance of mediation effects. J. Couns. Psychol. 53 (3), 372–378.
Mesas, A.E., López-García, E., León-Muñoz, L.M., Graciani, A., Guallar-Castillón, P., Rodríguez-Artalejo, F., 2011. The association between habitual sleep duration and sleep quality in older adults according to health status. Age Ageing 40 (3), 318.
Montazeri, A., 2008. Health-related quality of life in breast cancer patients: a bibliographic review of the literature from 1974 to 2007. J. Exp. Clin. Cancer Res. 27 (1), 32.
Muthén, B., 2011. Applications of Causally Defined Direct and Indirect Effects in Mediation Analysis Using SEM in Mplus. Unpublished manuscript. https://www.statmodel.com/download/causalmediation.pdf.
Muthén, B., Asparouhov, T., 2015. Causal effects in mediation modeling: an introduction with applications to latent variables. Struct. Equ. Model. 22 (1), 12–23.
Peng, K., 1989. Psychological Test: Theory and Practice. Huaxia Press, Beijing.
Qian, M., Wu, G., Zhu, R., Zhang, S., 2000. Development of the revised Eysenck personality questionnaire short scale for Chinese (EPQ-RSC). J. Chin. Psychol. Acta Psychologica Sinica 32 (3), 317–323.
Rubin, R.R., Peyrot, M., 1999. Quality of life and diabetes. Diabetes Metab. Res. Rev. 15 (3), 205–218.
Sanda, M.G., Dunn, R.L., Michalski, J., Sandler, H.M., Northouse, L., 2008. Quality of life and satisfaction with outcome among prostate-cancer survivors. N. Engl. J. Med. 358 (12), 1250–1261.
Sickel, A.E., Moore, P.J., Adler, N.E., Williams, D.R., Jackson, J.S., 1999. The differential effects of sleep quality and quantity on the relationship between SES and health. Ann. N. Y. Acad. Sci. 896 (1), 431–434.
Skevington, S.M., Lotfy, M., O'Connell, K.A., Group, W., 2004. The World Health Organization's WHOQOL-BREF quality of life assessment: psychometric properties and results of the international field trial. A report from the WHOQOL group. Qual. Life Res. 13 (2), 299–310.
Skevingtonc, S.M., Mccratec, F.M., 2012. Expecting a good quality of life in health: assessing people with diverse diseases and conditions using the WHOQOL-BREF. Health Expect. 15 (1), 49–62.
Skouteris, H., Germano, C., Wertheim, E.H., Paxton, S.J., Milgrom, J., 2008. Sleep quality and depression during pregnancy: a prospective study. J. Sleep Res. 17 (2), 217–220.
Strine, T.W., Chapman, D.P., 2005. Associations of frequent sleep insufficiency with health-related quality of life and health behaviors. Sleep Med. 6 (1), 23–27.
Sullivan, P.W., Ghushchyan, V., Wyatt, H.R., Wu, E.Q., Hill, J.O., 2007. Impact of cardiometabolic risk factor clusters on health-related quality of life in the U.S. Obesity 15 (2), 511–521.
Tautvydaitė, D., Antonietti, J., Henry, H., von Gunten, A., Popp, J., 2017. Relations between personality changes and cerebrospinal fluid biomarkers of Alzheimer's disease pathology. J. Psychiatr. Res. 90, 12–20.
van de Laar, M., Verbeek, I., Pevernagie, D., Aldenkamp, A., Overeem, S., 2010. The role of personality traits in insomnia. Sleep Med. Rev. 14 (1), 61–68.
Vantieghem, I., Marcoen, N., Mairesse, O., Vandekerckhove, M., 2016. Emotion regulation mediates the relationship between personality and sleep quality. Psychol. Health 31 (9), 1064–1079.
Wan, H.K., Hahn, S.J., Im, H.J., Yang, K.S., 2013. Reliability and validity of the Korean World Health Organization Quality of Life (WHOQOL)-BREF in people with physical impairments. Ann. Rehabil. Med. 37 (4), 488–497.
Weber, K., Canuto, A., Giannakopoulos, P., Mouchian, A., Meiler-Mititelu, C., Meiler, A., et al., 2015. Personality, psychosocial and health-related predictors of quality of life in old age. Aging Ment. Health 19 (2), 151–158.
Wei, L., Duan, X., Yang, Y., Liao, W., Gao, Q., Ding, J.R., et al., 2011. The synchronization of spontaneous BOLD activity predicts extraversion and neuroticism. Brain Res. 1419 (2), 68–75.
WHOQOL Group, 1994. Development of the WHOQOL: rationale and current status. Int. J. Ment. Health 23 (3), 24–56.
WHOQOL Group, 1998. Development of the World Health Organization WHOQOL-BREF Quality of Life assessment. Psychol. Med. 28 (3), 551–558.
Williams, P.G., Moroz, T.L., 2009. Personality vulnerability to stress-related sleep disruption: pathways to adverse mental and physical health outcomes. Pers. Individ. Differ. 46 (5–6), 598–603.
Wrosch, C., Scheier, M.F., 2003. Personality and quality of life: the importance of optimism and goal adjustment. Qual. Life Res. 12 (1), 59–72.
Xia, P., Li, N., Kit-Tai, H., Liu, C., Lu, Y., 2012. Quality of life of Chinese urban community residents: a psychometric study of the mainland Chinese version of the WHOQOL-BREF. BMC Med. Res. Methodol. 12 (1), 37.
Xiang, Y.T., Ma, X., Lu, J.Y., Cai, Z.J., Li, S.R., Xiang, Y.Q., et al., 2009. Alcohol-related disorders in Beijing, China: prevalence, socio-demographic correlates, and unmet need for treatment. Alcoholism 33 (6), 1111–1118.
Zeng, Y., Wu, J., Yin, J., Chen, J., Yang, S., Fang, Y., 2018. Association of the combination of sleep duration and sleep quality with quality of life in type 2 diabetes patients. Qual. Life Res. (9), 1–8.
Zhong, J., Wang, A., Qian, M., Zhang, L., Gao, J., Yang, J., et al., 2008. Shame, personality, and social anxiety symptoms in Chinese and American nonclinical samples: a cross-cultural study. Depress. Anxiety 25 (5), 449–460.