

Determinants of managers' self-rated health in Chinese petroleum-producing enterprises

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Abstract

Background Self-rated health (SRH) is widely used by health institutions due to its validity, reliability, predicted power for mortality and morbidity and simplicity of collection. However, limited research has been conducted to measure the health and explore the determinants of SRH among managers, especially in petroleum enterprises in China. The purpose of this study was to measure the overall health and identify the determinants of SRH among managers in petroleum production enterprises in China. We committed to provide evidence to improve managers' health status by exploring the determinants of SRH.

Methods From March 2017 to December 2018, 417 managers participated and were categorized into different gender and age groups. The effective rate was 84.2%. The scores for physical, mental and social health subscales were converted to binary categorical variables, and univariate and multivariate logistic regression analyses were used to identify the determinants of SRH.

Results The mean scores for SRH measurement scale (MS) dimensions ranged from 65.69 ± 18.13 (mean \pm SD) for positive emotion (M2) to 91.81 ± 15.18 for daily physical activities (B2). The findings showed that lower-income and medium-managerial-level managers in the 41- to 50-year-old age group and lower-income male participants were more likely to be of poor mental health, while lower-income managers in the middle age groups and middle-aged female managers tended to report poor social health.

Conclusions This study is the first in the Chinese energy industry to report on SRH and its determinants among managers stratified by age and gender. We found that income and managerial level are the main determinants among the managers, especially for those of middle age. Psychological counseling and a harmonious and mutually supportive working environment can contribute to addressing the special needs of managers in Chinese petroleum-producing enterprises.

Background

Over the past several decades, the overall health of the Chinese population has steadily improved; therefore, today, the focus of primary medical care has shifted from infectious diseases to chronic diseases^[1, 2]. Self-rated health (SRH) is considered a valuable source of information on subjective health status^[3], especially in tracking chronic diseases, and it forms an essential supplement to objective health measurements. In addition, researchers have found that SRH is a strong predictor of subsequent mortality^[3, 4], with a high reliability, validity and predictive power for a variety of illnesses and conditions^[5]. In addition, SRH has economic benefits and is suitable for the measurement of the health status of the population on a large scale^[5]. To date, SRH has been used for population health monitoring by WHO, the Centers for Disease Control and Prevention in the United States and the European Union Commission^[6–8].

The determinants of SRH have been researched adequately in Western countries. The literature reports that socio-economic situations and demographic factors can affect health outcomes. For instance, Gilmore et al^[9] and Asfar et al^[10] found differences in SRH between men and women. Roberts^[11] and Damian et al^[12] reported the relationship between SRH and age. Cai et al^[13], Lorraine et al^[14] and Tajvar et al^[15] reported the relationship between SRH and income. Further, Demirchyan and Thompson^[16] and Lorraine et al^[14] demonstrated that education level is a determinant of SRH. The study by Damian et al^[12] indicated that the influence of social class on health is significantly modified by age. Researchers have found that the determinants of health differ between males and females.

Having healthy managers is crucial for organizations to remain productive and competitive, because the health of managers is meaningful not only for the managers themselves, but also for the organization and for its staff^[17]. However, managers have long been recognized as being among the most stressed members of the workforce^[18]. According to research by Nyberg and co-workers, even though managers tend to report high satisfaction with their work and life compared with non-managers^[19], previous studies have indicated that many managers perceived their work as stressful, mainly resulting from their responsibility for reaching corporate objectives^[20, 21]. Some managers suffer continuously from a shortage of social support, personal life–work interference and high workload. Research has found that employees in the petroleum and gas industries are exposed to numerous physical and psychosocial stressors such as cramped physical environments, long work shifts, isolated location, noise, operating hazards and a lack of social support^[22, 23].

Some studies have found that for different groups of people, the determinants of health may be different, due to the differences in cultural backgrounds and labor organization among countries and the specifications of the energy industry. Health status and determinants among managers in the petroleum industries in China need to be researched. Limited studies have been conducted about SRH and its determinants in managers in China, especially in the petroleum production industries.

In this study, we aimed to assess the SRH of managers in petroleum enterprises in China, to identify the determinants among them, to find the vulnerable groups and focus on improving their health status.

Methods

Data collection

Research population

This was a cross-sectional study of a cluster sampling of managers selected from among the general managers in petroleum-producing enterprises in China. There are 31 provinces in mainland China, which can be divided into four parts – the north-east region, the western region, the middle region and the

eastern region – according to the level of economic development and administrative divisions. We selected Guangdong, Tianjin to represent the eastern region and Heilongjiang to represent the north-east region. Sichuan, Yunnan, Inner Mongolia represented the western region in this study. The sampling method was based on a stratified purpose sampling approach, and therefore the survey of the managers in these provinces can well represent all petroleum managers in China. In each selected province, we used cluster sampling and enrolled all of the managers who took part in health management lectures specifically for petroleum enterprise managers.

From March 2017 to December 2018, the participants were gathered in a meeting room after the lecture and completed the questionnaires in 10 to 15 minutes. The integrity of the returned questionnaires was checked by our investigators in the field. Questionnaires with more than 30% missing data were excluded from the analysis.

Questionnaire

The questionnaire included SRH measurement scale (SRHMS) and general information questions. Unlike the single-item measures of SRH, such as “How do you rate your health today?”, SRHMS includes physical, mental and social subscales to measure the overall health status of the general population. SRHMS is consistent with the definition of health by the WHO: Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity^[24]. Previous research has demonstrated that SRHMS is reliable, valid and sensitive and suitable for use in the Chinese population, so we selected SRHMS as a tool to measure self-rated health status in this research.

SRHMS consisted of 48 items which were divided into 9 dimensions: physical symptoms and organic functions (B1), daily physical activities (B2), physical mobility (B3), positive emotion (M1), psychosocial symptoms and negative emotions (M2), cognitive function (M3), role activity and social adaptability (S1), social resources and social contact (S2) and social support (S3). The nine dimensions were merged into physical health, mental health and social health subscales. The summarized scores of SHRMS and each subscale can be represented by SCZT, BZT, MZT and SZT, respectively.

A 10-cm horizontal line was used in the scale to rate each item. Raw scores ranged from 0 to 10 cm, including fractions of a centimeter. Every 48 items had a maximum possible score of 10 and a minimum possible score of 0. The maximum possible score was 440 because four items were not counted in the total score. In addition, items 4, 5, 7, 24, 25, 26, 27, 28, 29 and 30 were scored inversely, which means that a higher number indicates poorer status (i.e., 1.5 = 8.5, 9 = 1, and 2 = 8, etc.).

Demographic characteristics

Previous empirical researches^[5, 25] reported that demographic factors such as gender, age, marital status and region affected health outcome. In this study, the demographic characteristics included age, gender and regions.

Age was divided into three groups: 30-40, 41-50 and 51-60 years. Region study was divided into east, north-east and west for a total of three groups.

Socio-economic status

The relationship between socio-economic status (SES) and SRH has been documented in many studies. The main indicators of SES were education, employment and income^[12, 26]. Individuals with lower SES are more likely to have poorer SRH than those with high SES^[12, 15, 25]. Objective measures were used to evaluate SES in this study. In this research, education was divided into three classes: junior college degree, Bachelor's degree and Master's and Doctoral degrees. We used managerial level as the indicator of employment, categorized into Primary, Medium and High. Income was captured as monthly income and was categorized into three classes [less than 10,000 (RMB), 10,001-15,000 (RMB) and more than 15,001 (RMB)] (Table 1).

Table 1 Variables used to construct the demographic characteristics and socio-economic status

	Value 1	Value 2	Value 3
Demographic status			
Age (years)	30 - 40	41 - 50	51 - 60
Gender	Male	Female	
Regions			
	East	North-east	West
Socio-economic status			
Education degree	junior college degree	Bachelor's degree	Master's and Doctoral degrees
Managerial level	Lower	Medium	Higher
Monthly income	≤ 10,000	10,001-15,000	≥ 15,001

Field work

All participants completed the questionnaire in the meeting room after lectures. During this time, the interviewer provided only necessary explanations of unclear questions.

Data

The raw score of each of the nine SRHMS dimensions was derived by summing the item scores and converting to a value for the dimension from 0 (worst possible health status measured by the questionnaire) to 100 (best possible health status). The raw score was then recalculated across the dimension as follows:

[Due to technical limitations, the formula could not be displayed here. Please see the supplementary files to access the formula.]

Statistical analysis was carried out with SPSS 25.0 for Windows. The statistical description of the demographic characteristics was performed by the use of frequencies, percentages, means and standard deviations.

We analyzed data by using both descriptive and analytical approaches. First, we examined the normality of the data (the scores of three subscales) and found that the score distributions were slightly negatively skewed. So, second, we converted each score of the three subscales to a binary variable. Third, we used univariate logistic regression analysis to indicate the determinants of SRH. Finally, we enrolled the variables showing association below $P = .1$ into a multivariate logistic regression model.

For the purposes of logistic regression analysis, the scores of the physical health subscale (BZT), the mental health subscale (MZT) and the social well-being subscale (SZT) were used, and, relative to the median scores, the research sample was divided into two groups: those who scored equal to or greater than the median (BZT, 80.38, $n = 237$; MZT, 71.73, $n = 230$; SZT, 73.26, $n = 223$) and those who scored below the median (BZT, 80.38, $n = 180$; MZT, 71.73, $n = 187$; SZT, 73.26, $n = 194$). Two-sided P values less than .05 were considered significant.

The data were analyzed by logistic regression separately for males and females and for different age groups, whereby each exploratory variable was entered separately into the univariate logistic regression. Poor SRH was used as the reference category. Results were presented as odds ratios (OR), and 95% confidence intervals (95% CI) were calculated separately for poor and normal SRH.

Ethical considerations

This study received approval from the Ethics Committee of the School of Public Health, Sun Yat-sen University. All participants gave their oral consent for the investigation. We kept the information about the participants confidential.

Results

Demographic characteristics of the participants

In total, 495 managers completed the questionnaire, but 78 of them failed to complete it; the other 417 managers were enrolled in the data analyses. The response rate was 84.2%. The missing values in the SRHMS dimensions were imputed as follows: if up to 30% of the items in one dimension were completed, the mean value of the completed items was used to impute the missing values. If more than 30% of the items were missing, the dimension score was excluded from the statistical analysis.

The descriptive statistics for the study variables are displayed in Table 2: 361 (86.57%) managers were male, while 56 (13.43%) managers were female; 29 (6.95%) had a junior college degree, 315 (75.74%) had a Bachelor's degree and 73 (14.51%) had Master's and Doctoral degrees. Two hundred (47.96%) managers earned less than 10,000 (RMB) per month, 127 (30.46%) managers earned between 10,000

(RMB) and 15,000 (RMB) per month and 90 (21.59%) managers earned more than 15,000 (RMB) per month.

Table 2 Frequency distribution of the participants' demographic and socio-economic characteristics (n = 328)

Characteristic	Number	Percent (%)
Socio-demographic characteristic		
Gender		
Female	361	86.57
Male	56	13.43
Age (years)		
≤ 40	119	28.54
41-50	222	53.24
≥ 51	76	18.23
Regions		
North-east	25	6.00
West	202	48.44
East	190	45.56
Socio-economic status		
Managerial level		
Lower	24	5.76
Medium	198	47.48
Higher	195	46.76
Education level		
Junior college degree	29	6.95
Bachelor's degree	315	75.54
Master's and Doctoral degrees	73	17.51
Monthly income (RMB)		
≤ 10,000	200	47.96
10,001-15,000	127	30.46
≥ 15,000	90	21.58

Scores of SRHMS

The means (SD) of the SRHMS summary are presented in Table 3. The mean scores of the physical, mental and social health subscales were 80.38 (10.44), 71.73 (13.45) and 73.26 (12.74). The transformed scores measured by SRHMS are presented in Table 3. Mean scores of SRHMS dimensions ranged from 65.69 (18.13) for positive emotion (M2) to 91.81 (15.18) for daily physical activities (B2).

In general, managers in Chinese petroleum production enterprises have a relatively higher SRHMS score for daily physical activities (B2 = 91.81) and physical mobility (B3 = 87.53) than for the other dimensions.

The scores for the 9 dimensions and three subscales are higher than the scores for the population in similar occupations in 6 provinces in China except for the scores for the social support dimension^[27].

Table 3 Scores of SRHMS and mean scores of SRH of all the managers (n=417)

Scale	Minimum	Maximum	Mean	SD
BZT	20.59	100.00	80.38	10.44
B1	32.43	100.00	67.10	10.58
B2	0.00	100.00	91.81	15.18
B3	0.00	100.00	87.53	14.16
MZT	24.00	98.00	71.73	13.45
M1	18.00	100.00	81.01	13.04
M2	18.57	98.57	65.69	18.13
M3	13.33	100.00	70.34	15.27
SZT	28.33	100.00	73.26	12.74
S1	40.00	100.00	80.11	11.74
S2	17.00	100.00	71.44	16.67
S3	0.00	100.00	67.15	18.07
SCZT	44.55	97.05	75.49	9.62

Determinants of SRH

Table 4 Determinants of poor SRH among different age groups (n=417)

Variable	Category	30-40 years (n = 61) OR (95%CI)	41-50 years (n = 182) OR (95%CI)	51-60 years (n = 85) OR (95%CI)
Physical health subscale				
Demographic characteristic				
Gender	Male	0.62 (0.22,1.74)	1.43 (0.65,3.17)	1.44 (0.33,6.24)
	Female	1	1	1
Regions	East	0.81 (0.38,1.70)	0.98 (0.56,1.71)	1.53 (0.56,4.18)
	North-east	1.18 (0.70,20.01)	0.99 (0.37,2.75)	1.11 (0.17,7.30)
	West	1	1	1
Socio-economic status				
Education degree	Junior college degree	1.40 (0.08,25.14)	0.28 (0.08,1.06) *	1.33 (0.18,9.73)
	Bachelor's degree	1.06 (0.43,2.62)	0.5 (0.26,1.02) *	2.50 (0.46,13.50)
	Master's and Doctoral degrees	1	1*	1
Managerial level	Lower	1.13 (0.26,5.01)	0.13 (0.02,1.02)	0.41 (0.04,4.17)
	Medium	1.40 (0.57,3.42)	0.89 (0.52,1.54)	0.61 (0.21,1.76)
	Higher	1	1	1
Monthly income (RMB)	≤ 10,000	0.48 (0.12,0.19)	1.22 (0.63,2.34)	0.53 (0.18,1.58)
	10,001-15,000	0.76 (0.18,3.24)	1.33 (0.66,2.70)	1.10 (0.31,3.88)
	≥ 15,000	1	1	1
Mental health subscale				
Demographic characteristic				
Gender	Male	1.04 (0.37,2.91)	1.29 (0.58,2.85)	2.06 (0.48,8.93)
	Female	1	1	1
Regions	East	0.65 (0.31,1.37)	0.80 (0.46,1.39)	0.92 (0.34,2.48)
	North-east	0.85 (0.05,14.33)	1.00 (0.37,2.75)	0.67 (0.10,4.35)
	West	1	1	1
Socio-economic status				
Education degree	Junior college degree	-	1.28 (0.38,4.31)	1.94 (0.32,11.76)
	Bachelor's degree	1.43 (0.58,3.55)	0.88 (0.44,1.75)	1.61 (0.35,7.39)
	Master's and Doctoral degrees	1	1	1
Managerial level	Lower	0.72 (0.17,3.13)	0.20 (0.02,1.56)	3.12 (0.30,32.03)
	Medium	1.03 (0.43,2.45)	1.83 (1.06,3.18) ***	0.78 (0.28,2.17)
	Higher	1	1**	1
Monthly income (RMB)	≤ 10,000	2.19 (0.51,9.48)	2.55 (1.30,5.01) ***	0.46 (0.15,1.36)
	10,001-15,000	1.58 (0.35,7.17)	1.08 (0.51,2.28)	1.18 (0.33,4.25)
	≥ 15,000	1	1***	1
Social well-being subscale				
Demographic characteristic				
Gender	Male	0.96 (0.34,2.69)	0.70 (0.32,1.53)	7.77 (0.92,65.56) *
	Female	1	1	1
Regions	East	0.99 (0.47,2.08)	0.99 (0.57,1.72)	1.08 (0.40,2.93)
	North-east	-	1.70 (0.61,4.71)	0.30 (0.03,2.84)
	West	1	1	1
Socio-economic status				
Education degree	Junior college degree	-	0.71 (0.21,2.43)	6.00 (0.57,63.68)
	Bachelor's degree	1.10 (0.45,2.74)	0.92 (0.46,1.82)	6.75 (0.78,58.59) *
	Master's and Doctoral degrees	1	1	1
Managerial level	Lower	1.13 (0.26,5.01)	0.75 (0.20,2.80)	3.38 (0.33,34.65)
	Medium	1.40 (0.57,3.42)	1.25 (0.73,2.15)	0.56 (0.20,1.63)
	Higher	1	1	1
Monthly income(RMB)	≤ 10,000	0.36 (0.08,1.56)	2.22 (1.15,4.31) *	1.02 (0.34,3.00)
	10,001-15,000	0.33 (0.07,1.49)	1.73 (0.85,3.52) **	1.33 (0.38,4.73)
	≥ 15,000	1	1	1

OR, Odds ratio; 95% CI, 95% Confidence intervals

* $P < .1$, ** $P < .05$, *** $P < .01$

Table 4 shows the results of the subsample analysis stratified by age groups. Among the managers aged 41 to 50 years, earning less than 10,000 (RMB) increased the risk of being in poor mental health [OR = 2.55, 95% CI (1.30, 5.01), $\leq 10,000$ (RMB) vs. $\geq 15,000$ (RMB)], while having the medium managerial level (OR = 1.83, 95% CI = 1.06-3.18, Medium vs. Higher) decreased the likelihood of being in poor social health (Table 4). However, in other age groups, a similar situation has not been found.

Table 5 Determinants of poor SRH among males and females (n = 417)

Variable	Category	Male OR (95%CI)	Female OR (95%CI)
Physical health subscale			
Demographic characteristic			
Age (years)	30-40	0.98 (0.52,1.82)	2.25 (0.42,12.09)
	41-50	1.15 (0.66,2.03)	1.16 (0.24,5.58)
	51-60	1	1
Regions	East	0.93 (0.60,1.43)	1.77 (0.56,5.53)
	North-east	1.05 (0.43,2.56)	1.00 (0.08,13.02)
	West	1	1
Socio-economic status			
Education degree	Junior college degree	0.44 (0.17,1.16) *	0.75 (0.04,14.97)
	Bachelor's degree	0.76 (0.44,1.30)	1.07 (0.16,7.01)
	Master's and Doctoral degrees	1	1
Managerial level	Lower	0.44 (0.15,1.28)	0.47 (0.04,4.90)
	Medium	0.81 (0.53,1.24)	2.67 (0.81,8.81)
	Higher	1	1
Monthly income (RMB)	≤ 10,000	0.91 (0.53,1.55)	0.75 (0.18,3.22)
	10,001-15,000	1.12 (0.63,2.00)	2.40 (0.44,12.98)
	≥ 15,000	1	1
Mental health subscale			
Demographic characteristic			
Age (years)	30-40	0.90 (0.48,1.66)	1.78 (0.33,9.55)
	41-50	0.72 (0.41,1.26)	1.16 (0.24,5.58)
	51-60	1	1
Regions	East	0.73 (0.47,1.12)	1.37 (0.43,4.32)
	North-east	0.70 (0.29,1.72)	4.00 (0.31,52.07)
	West	1	1
Socio-economic status			
Education degree	Junior college degree	1.27 (0.51,3.13)	2.00 (0.08,51.59)
	Bachelor's degree	1.07 (0.62,1.82)	2.86 (0.30,27.52)
	Master's and Doctoral degrees	1	1
Managerial level	Lower	0.87 (0.32,2.35)	0.37 (0.04,3.84)
	Medium	1.37 (0.89,2.09)	1.63 (0.51,5.21)
	Higher	1	1
Monthly income (RMB)	≤ 10,000	1.81 (1.05,3.13) **	1.11 (0.26,4.67)
	10,001-15,000	1.21 (0.68,2.18)	0.67 (0.12,3.76)
	≥ 15,000	1	1
Social well-being subscale			
Demographic characteristic			
Age (years)	30-40	0.78 (0.42,1.45)	5.60 (0.57,55.43)
	41-50	0.95 (0.54,1.65)	10.46 (1.16,94.48) **
	51-60	1	1*
Regions	East	1.00 (0.65,1.53)	1.04 (0.34,3.15)
	North-east	0.94 (0.39,2.29)	2.67 (0.21,34.20)
	West	1	1
Socio-economic status			
Education degree	Junior college degree	0.93 (0.37,2.32)	0.75 (0.04,14.97)
	Bachelor's degree	1.17 (0.68,2.00)	1.27 (0.19,8.30)
	Master's and Doctoral degrees	1	1
Managerial level	Low	0.72 (0.27,1.95)	3.71 (0.54,25.59)
	Medium	1.03 (0.68,1.58)	1.63 (0.51,5.21)
	High	1	1
Monthly income (RMB)	≤ 10,000	1.44 (0.84,2.47)	1.11 (0.26,4.67)
	10,001-15,000	1.20 (0.67,2.13)	1.75 (0.33,9.30)
	≥ 15,000	1	1

OR, Odds ratio; 95% CI, 95% Confidence intervals

* $P < .1$, ** $P < .05$, *** $P < .01$

Result of the univariate logistic regression analysis stratified by gender are presented in Table 5. The important determinants of poor SRH are income for males and age for females. For males, earning less than 10,000 (RMB) increased the risk of being in poor mental health [OR = 1.81, 95% CI = 1.05-3.13, $\leq 10,000$ (RMB) vs. $\geq 15,000$ (RMB)], while females aged 41-50 years were more likely to be in poor social well-being (OR = 10.46, 95% CI = 1.16-94.48, 41-50 vs. 51-60 years).

Table 6 Determinants of SRH among different age groups (n = 417)

Variable	Category	30-40 years (n = 61) OR (95%CI)	41-50 years (n = 182) OR (95%CI)	51-60 years (n = 85) OR (95%CI)
Mental health subscale				
Demographic characteristic				
Managerial level	Low	0.46 (0.09,2.34)	0.10 (0.01,0.86) **	6.52 (0.57,74.46)
	Medium	0.81 (0.31,2.11)	1.31 (0.72,2.39)	1.20 (0.38,3.74)
	High	1	1**	1
Socio-economic status				
Monthly income (RMB)	$\leq 10,000$	2.52 (0.56,11.32)	2.69 (1.30,5.59) ***	0.36 (0.11,1.15)
	10,001-15,000	1.55 (0.34,7.05)	1.03 (0.49,2.19)	.22 (0.33,4.46)
	$\geq 15,000$	1	1***	1
Social well-being subscale				
Demographic characteristic				
Gender	Male	1.37 (0.45,4.10)	0.79 (0.36,1.75)	6.87 (0.77,3.10) *
	Female	1	1	1
Socio-economic status				
Education degree	Junior college degree	-	0.68 (0.20,2.35)	5.81 (0.52,65.41)
	Bachelor's degree	1.28 (0.48,3.41)	0.91 (0.45,1.82)	5.99 (0.66,54.11)
	Master's and Doctoral degrees	1	1	1
Monthly income (RMB)	$\leq 10,000$	0.33 (0.07,1.52)	2.18 (1.12,4.26) **	0.97 (0.31,3.10)
	10,001-15,000	0.29 (0.062,1.38)	1.68 (0.82,3.44)	1.08 (0.28,4.12)
	$\geq 15,000$	1	1*	1

OR, Odds ratio; 95% CI, 95% Confidence intervals

* $P < .1$, ** $P < .05$, *** $P < .01$

Results of multivariate logistic regression stratified by different age groups are shown in Table 6 and indicate that, among the 41- to 50-year-old age group, managers earning less than 10,000 (RMB) were more likely to be in poor mental health, while lower-level managers were significantly less likely to be in poor mental health.

When taking gender, education level and monthly income into consideration, we found that among managers in the 41- to 50-year-old age group, compared with the managers earning more than 15,000 (RMB), those who earned less than 10,000 (RMB) were more likely to exhibit poor social well-being.

Discussion

In general, based on the findings of this study, we found that monthly income and managerial level are the main determinants of SRH in managers in petroleum enterprises in China, and the result was modified by age and gender.

Age disparity

In the univariate logistic regression analysis, we found that monthly income and managerial level played an important role in mental health among the middle age group, while we find no association among demographic characteristic, SES and SRH among the other two age groups.

When we put monthly income, managerial level, gender and education degree into the multi-univariate logistic regression, we found that, in the middle age group, lower-level managers were more likely to be in good mental health, while lower-income managers tended to report poor mental and social well-being. Managers in middle age (ages 41 to 50 years in this study) carry an enormous burden from both occupation and life. In this stage of life, most of the managers (95.4%) were above the medium managerial level and had to bear life burdens such as their children's university fees and their parents' health expenditures, which create a daunting occupational and family responsibility. Therefore, they are more likely to react to the influencing factors.

Income is a component of socio-economic status and is considered so important for health that it was even regarded as one of the determinants of health. Empirical research also revealed the relationship between health and income. For example, Cai et al^[13], Lorraine PJ et al^[14] and Tajvar et al^[15] found that people with higher income reported better health, because sufficient income enables individuals not only to meet the needs of daily life but also to participate in society, enjoy hobbies, holidays and luxuries. Molarius et al^[28] reported that lower income increases the risk of mental disorders. There are several theories addressing the mechanisms about how individual income influences people's health. The 'absolute income effect' states that people with higher individual income are able to devote more resources to healthy goods and services that can improve their health directly, while the 'relative income effect' states that the health of those in the lower-income hierarchy is affected because their lower social position increases the likelihood that they will experience stress and frustration, leading to worse health.

Compared with the other two age groups, managers between the ages of 41 and 50 needed more money to cover the costs of their children's education and their parents' health, as well as occasional travel, participation in community events, and so on. This can help to explain why lower-income managers are more likely to report poor mental health. When gender and the other SES indicators were taken into consideration, monthly income also showed an effect on social health in the 41- to 50-year-old age group, possibly related to the fact that lower-income managers had a smaller-scale social network and limited social support. In addition, to save time and money, they decreased their social time, which increased the risk of poor social health.

In the 41- to 50-year-old age group, compared with higher-level managers, the medium-level managers were more likely to be in poor mental health. This difference could be attributed to the fact that higher-level managers usually have more influence, control and freedom to act, as well as better social support, than do lower-level managers. The main role of medium-level managers in traditional Chinese petroleum enterprises is to organize and perform, which means that they have primary responsibility for a specific job. However, they have fewer resources and power to finish the job than do higher-level managers. This can also explain why lower-level managers in the 41- to 50-year-old age group were less likely to report poor mental health when gender and all of the SES indicators were combined in the multi-univariate logistic regression analysis. The job descriptions for lower-level managers are less complicated, and they have less responsibility in the job, which results in better mental health.

Gender disparity

Previous studies conducted in the general population had indicated that women were more likely to report poor health^[5, 15] due to their disadvantages in acquiring resources and occupational opportunities. The studies conducted among managers also found that female managers tended to report poorer health than male managers^[18, 29]. Female managers reported more psychosomatic concerns, higher emotional demands, low control and low support in their work^[18, 30]. Conversely, gender disparity in SRH did not exist in this research: Female managers did not report poorer SRH than males in all three subscales. We believe that the weak tie between gender and SRH was related to the relatively fair salary and medical insurance system in Chinese petroleum enterprises. Compared with male managers, female managers did not show obvious disadvantages in accessing resources such as social resources and occupational opportunities.

In the univariate logistic regression analysis stratified by gender, we found that, among the female managers, being in the 41- to 50-year-old age group increased the risk of reporting poor social health compared with the 51- to 60-year-old age group. As we stated before, managers in the 41- to 50-year-old age group are more likely to react to influencing factors. In the dominant Chinese traditional cultural background, females bear more responsibility to care for the family than do males. In this stage of life, to take care of the family as well as improve income, they devote more time and resources to the family but not to holidays and community and social activities.

Among the male managers, compared with the higher-income group, managers earning less than 10,000 RMB per month were more likely to be in poor mental health. In traditional Chinese culture, household income is provided mainly by men. On the one hand, income denotes men's dominant positions in a family, but on the other hand, it also means that men are more likely to be influenced by income than are women. Thus, the income disparities are more likely to be observed in males but not in females. According to the 'relative income effect', lower income puts male managers into a lower social position, which increases stress and frustrated emotion.

We found no significant differences in physical health among different gender and age subgroups. The reasons may be related to the sufficient medical knowledge of the participants as well as to the health management program that was introduced to the petroleum enterprises in China in 2007. This program, including an employee assistance program (EAP) and health, safety and environment management systems (HSE MS) reduces the risks inherent in manufacturing procedures and improves the physical health status of the employees^[31, 32].

The study is the first in the Chinese energy industry to report on SRH and its determinants among managers stratified by age and gender. However, several limitations in this research need to be taken into consideration: First, the research design was cross-sectional; hence, it was difficult to establish cause-effect relationships among SRH, socio-demographic characteristics and socio-economic status^[33]. A prospective study design should be implemented to investigate these relationships in the future. Second, all the information was self-reported data^[34], so recall bias cannot be excluded.

Conclusions

This study may contribute to describing the general health status and identifying the determinants of self-rated health of managers in petroleum production enterprises in China.

The study found that the middle-age managers (ages 41–50 years in this study) with lower income and at the medium managerial level and lower-income male managers were more likely to be in poor mental health, while the female and lower-income managers in the middle age group were more likely to be in poor social health.

It will be important to take income and managerial level into consideration when designing health promotion and intervention programs for the special needs of managers, especially those of middle age, in Chinese petroleum production enterprises.

Psychological counseling is needed for the managers in the 41- to 50-year-old age group because they bear enormous burdens in both work and life, especially those who earn less and are at the medium managerial level. For female managers in the same age group, the creation of a harmonious and mutually supportive working environment will be beneficial to improve their social well-being.

Availability Of Data And Materials

Data is available for other researchers in an unidentified form, after agreement with the research group.

Abbreviations

SRH:self-rated health; MS:measurement scale; SRHMS:SRH measurement scale; EAP:employee assistance program; HSE MS:health, safety and environment management systems.

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Declarations

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Authors' contributions

Paiyi Zhu, Lingling Zhang, Yixiang Huang, Jianwei Guo, Yong Zhang and Peien Zhou conceived of the study, participated in its design and coordination. Yixiang Huang designed the study and collected the data, Yong Zhang and Jianwei Guo managed the data and searched the literatures, Peien Zhou checked the dataset, Paiyi Zhu analysed the data, drafted and revised the manuscript, Lingling Zhang and Yixiang Huang commented on the draft and helped to revise it. All the authors have read and approved the final manuscript.

Ethics approval and consent to participate

The study was approved by Ethics Committee of the School of Public Health, Sun Yat-sen University, and participation in this study was voluntary and anonymous. All the answers were treated strictly confidential, the procedure of this study was in accordance with ethical standards at this time.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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