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Epidemiology of self-rated health in rural China: a population-based cross-sectional study

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Self-rated health (SRH) has been shown to be a good predictor of mortality. Data on SRH and its associated factors in the Chinese general population are limited. This study aims to assess the epidemiology of SRH in rural Anyang, China. SRH (categorized as “healthy”, “fair” or “unhealthy”) was measured in a population-based study of 2,814 adults (including 697 couples) aged 25 to 69 who were recruited from rural Anyang in 2014. Of 2,814 subjects, 63.1% rated their health as “healthy”, whereas 28.1% and 8.8% rated their health as “fair” and “unhealthy”. Compared to males, females had a higher likelihood of reporting a better SRH. Health ratings declined with increasing age, unmarried status, lower education levels. Poor SRH was positively correlated with medical history as well as high levels of fasting plasma glucose and total cholesterol, but not with unhealthy lifestyle indicators including smoking, drinking, and obesity. High household income was predictive of better SRH in men but not in women. Among couples, a positive spousal SRH concordance was observed, although the strength of this concordance was low. These findings will be useful for formulation of appropriate strategies for improving risk perception and promoting general health in economically developing regions.

Self-rated health (SRH), which is a subjective perception of an individual’s health status, refers to a single-item health evaluation in which people are asked to assess their current health status on a five-point scale which ranges from very good to very poor^{1,2}. Many international studies have consistently demonstrated that SRH is a good predictor of mortality and is closely associated with morbidity and disability^{2–4}. Moreover, SRH has been found to have good test-retest reliability⁵ and has been recommended for health monitoring by the World Health Organization and the European Union Commission⁶.

The prevalence and determinants of SRH have been extensively investigated mainly in economically developed countries. Medical health status and its subsequent functional outcomes are widely recognized as major determinants when people rate their health^{7,8}. However, the relationship between certain socioeconomic factors, health behaviors, clinical parameters and SRH varies depending on demographic and geographic factors^{9–14}. In contrast with abundant data available from developed regions, studies in economically developing countries including China are not adequate and have generally been restricted to particular subpopulations, such as elderly people and floating population who refers to migrants without local household registration^{11, 15, 16}. Furthermore, comprehensive assessments of the correlates of SRH among general Chinese populations are scarce. Most previous studies only evaluated the potential effects of interview data such as lifestyle characteristics on SRH ratings^{11, 15, 16}. Other factors such as biochemical indicators, which may reflect subclinical physiologic conditions, have not been sufficiently investigated in existing studies carried out in China.

In addition, data concerning SRH spousal correlation is limited both in economically developed and developing regions. It has been suggested that good SRH is positively associated with spouses’ optimism¹⁷. In theory, environment and lifestyles shared by a couple could result in shared health risk¹⁸. However, factors which couples do not share such as genetic characteristics may cause spousal SRH discrepancy. The presence or absence of SRH correlation and the degree of SRH concordance in couples remains unclear.

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To overcome these limitations and fill important research gaps, this population-based cross-sectional study seeks to (1) investigate the distribution of SRH and its determinants including socio-demographic characteristics, behavioral factors, physical status and clinical measurements in rural China, and (2) assess the correlation and concordance of spousal SRH in this population.

Materials and Methods

Study subjects. A population-based prospective cohort study of risk factors for esophageal cancer in rural Anyang, China, has been described elsewhere¹⁹. The current investigation utilized a subset including 5 of the 9 target villages which were cluster-sampled in the parent cohort study conducted in 2014. Eligibility criteria for enrolment were as follows: (1) permanent residency in the target villages; (2) age 25–69; (3) no prior diagnosis of cancer or mental illness; (4) no history of infection with HBV, HCV or HIV; (5) willingness to participate in the follow-up program and provide informed consent. All participants provided written informed consent, and the study was approved by the Institutional Review Board of the School of Oncology, Peking University. The methods were carried out in accordance with the approved guidelines.

Questionnaire survey. A one-on-one computer-aided interview was administered in a private room by a trained interviewer, and information on SRH, demographic characteristics (age, gender and marital status), socioeconomic variables (number of family members living together, type of employment, education level, and household annual income), indicators of healthy or unhealthy lifestyle (cigarette smoking, alcohol drinking, and body mass index), and disease status (history of disease) were collected during these interviews. SRH was initially recorded in 5 levels (very good, good, fair, poor, and very poor), and then categorized into 3 groups which included “healthy” (very good and good), “fair” and “unhealthy” (poor and very poor) for statistical analyses. Annual household income was categorized as low, moderate and high on the basis of annual income of $\leq 10,000$, 10,001–30,000 or $> 30,000$ RMB. Cigarette smoking was defined as consuming one cigarette or more per day for ≥ 12 months, and alcohol consumption was defined as drinking Chinese liquor at least twice per week for ≥ 12 months. A former smoker or drinker was characterized as an “ever” user who had not smoked or consumed alcohol in the preceding 12 months. Body mass index (BMI) was calculated as $\text{weight}/\text{height}^2$ (kg/m^2) and categorized into 4 groups: underweight ($\text{BMI} < 18.5$), normal weight ($18.5 \leq \text{BMI} < 24.0$), overweight ($24.0 \leq \text{BMI} < 28.0$), and obesity ($\text{BMI} \geq 28.0$)²⁰. History of disease was referred to as any disease(s) diagnosed by medical doctors.

Clinical measurement. Blood samples were obtained after overnight fasting. Clinical parameters were categorized as follows: fasting plasma glucose (FPG) (Normal: $\text{FPG} < 6.1$, borderline high: $6.1 \leq \text{FPG} < 7.0$, high: $\text{FPG} \geq 7.0$ mmol/L), total cholesterol (TC) (Normal: $\text{TC} < 5.2$, borderline high: $5.2 \leq \text{TC} < 6.2$, high: $\text{TC} \geq 6.2$ mmol/L), triglycerides (TG) (Normal: $\text{TG} < 1.7$, borderline high: $1.7 \leq \text{TG} < 2.3$, high: $\text{TG} \geq 2.3$ mmol/L), high-density lipoprotein (HDL) (Normal: $\text{HDL} < 3.4$, borderline high: $3.4 \leq \text{HDL} < 4.1$, high: $\text{HDL} \geq 4.1$ mmol/L) and low-density lipoprotein (LDL) (Normal: $\text{LDL} \geq 1.0$, low: $\text{HDL} < 1.0$ mmol/L)^{21,22}. TC, TG, LDL and HDL were measured enzymatically on an automatic analyzer (Hitachi 7600–020, China) with reagents purchased from Sichuan Xin Cheng Bio-Tech Co., Ltd. FPG was measured on the fasting blood glucose meter (Yicheng 5D-2, China). All clinical measurements were performed by the clinical laboratory staff of Hua County Hospital, Anyang, China.

Statistical analyses. The chi-square test was used to determine differences in self-rated health across model covariates. Due to the order of the outcome categories and satisfaction of the proportional odds assumption (measured by likelihood ratio tests and the Brant test), univariate and multivariate ordered logistic regressions adjusting for intracluster correlation (cluster variable: village) were conducted to estimate the relationships between explanatory variables and SRH. Potential risk factors that were statistically significant in univariate analyses, together with related variables which have been previously reported were included in multivariate models (Linear regression models were used to determine whether any variables in the multivariate models were highly collinear. In this study, all variance inflation factors were below 3.0 and therefore within the acceptable range). The odds ratios (ORs) and 95% confidence intervals (CIs) were calculated treating the group “healthy” as the reference group. Only a single odds ratio that described the odds of increasing by 1 category of the outcome for a 1-unit change in the explanatory variables was reported. For couple concordance analysis, Spearman’s rank test and weighted kappa statistics employing a linear set of weights (e.g., 1.0, 0.5, and 0.0) were used. The kappa statistics examine the level of agreement beyond what would happen by chance. The kappa value 0 indicates that the degree of agreement is no more than would be expected by chance, while the kappa value 1 indicates a perfect agreement.

Statistical analyses were performed using STATA version 12.0 software (STATA Corporation, College Station, TX, USA). *P* values less than 0.05 (two-sided) were considered to be significant.

Results

Participant characteristics. Of 3,457 eligible residents, 2,814 (81.4%) were enrolled. The main reason why the other 643 individuals, who were generally more likely to be younger men, did not participate was loss of contact due to employment outside of Anyang. The median age of these 2,814 participants was 49 (interquartile range, 43–60), with a female to male ratio of 1.6 (Table 1). Most of these subjects were married (94.2%), engaged in farming (73.2%), were lifetime non-smokers (74.5%) and lifetime non-drinkers (83.3%). The percentages of subjects had 1–2, 3–5, and ≥ 6 family members living together were 19.1%, 54.7%, and 26.3%, respectively. Almost half of the participants were illiterate or had a primary school level of education (48.5%). Subjects with low, moderate or high levels of household annual income each accounted for approximately one third of the study population. More than 60.0% of subjects were overweight or obese (64.4%). Fifteen percent had clinical disease

Variables ^a	Self-rated health				P values ^b
	Total, No. (%)	Healthy, No. (%)	Fair, No. (%)	Unhealthy, No. (%)	
Total	2,814 (100)	1,776 (63.11)	791 (28.11)	247(8.78)	
Demographic characteristics					
Age (years)					<0.001
Median (IQR)	49 (43–60)	48 (41–57)	53 (46–63)	58 (49–65)	
25–40	496 (17.63)	403 (22.69)	82 (10.37)	11 (4.45)	
41–56	1,348 (47.90)	894 (50.34)	359 (45.39)	95 (38.46)	
57–69	970 (34.47)	479 (26.97)	350 (44.25)	141 (57.09)	
Gender					<0.001
Male	1,066 (37.88)	508 (28.60)	457 (57.77)	101 (40.89)	
Female	1,748 (62.12)	1,268 (71.40)	334 (42.23)	146 (59.11)	
Marital status					<0.001
Never married, divorced or widowed	161 (5.80)	75 (4.27)	63 (8.08)	23 (9.50)	
Married	2,616 (94.20)	1,680 (95.73)	717 (91.92)	219 (90.50)	
Socioeconomic characteristics					
Number of family members living together					<0.001
1–2	437 (19.07)	212 (14.65)	166 (26.39)	59 (27.31)	
3–5	1,253 (54.67)	843 (58.26)	311 (49.44)	99 (45.83)	
≥6	602 (26.27)	392 (27.09)	152 (24.17)	58 (26.85)	
Type of employment					<0.001
Farming	2,034 (73.24)	1,304 (74.30)	533(68.33)	197 (81.40)	
Non-farming	743 (26.76)	451 (25.70)	247 (31.67)	45 (18.60)	
Education level					<0.001
Illiteracy or Primary school	1,299 (48.52)	776 (46.05)	373 (49.01)	150 (64.94)	
Junior middle School or above	1,378 (51.48)	909 (53.95)	388 (50.99)	81 (35.06)	
Annual household income					<0.001
Low (≤10,000 RMB)	785 (34.31)	416 (28.81)	271 (43.15)	98 (45.37)	
Moderate (10,001–30,000 RMB)	706 (30.86)	473 (32.76)	168 (26.75)	65 (30.09)	
High (>30,000 RMB)	797 (34.83)	555 (38.43)	189 (30.10)	53 (24.54)	
Healthy lifestyle indicators					
Smoking status					<0.001
Lifetime non-smoker	2,070 (74.54)	1,429 (81.42)	472 (60.51)	169 (69.83)	
Former smoker	158 (5.69)	61 (3.48)	71 (9.10)	26 (10.74)	
Current smoker	549 (19.77)	265 (15.10)	237 (30.38)	47 (19.42)	
Drinking status					<0.001
Lifetime non-drinker	2345 (83.33)	1,536 (86.49)	595 (75.22)	214 (86.64)	
Former drinker	66 (2.35)	26 (1.46)	30 (3.79)	10 (4.05)	
Current drinker	403 (14.32)	214 (12.05)	166 (20.99)	23 (9.31)	
Body mass index, kg/m²					0.364
Normal weight (18.5 ≤ BMI <24.0)	964 (34.94)	606 (34.75)	283 (36.42)	75 (31.51)	
Overweight (24.0 ≤ BMI <28.0)	1,163 (42.15)	742 (42.55)	313 (40.28)	108 (45.38)	
Obesity (BMI ≥ 28.0)	615 (22.29)	389 (22.31)	174 (22.39)	52 (21.85)	
Underweight (BMI < 18.5)	17 (0.62)	7 (0.40)	7 (0.90)	3 (1.26)	
Physical status and clinical parameters					
Presence of current or past disease					<0.001
No	2,387 (84.83)	1,573 (88.57)	646 (81.67)	168 (68.02)	
Yes	427 (15.17)	203 (11.43)	145 (18.33)	79 (31.98)	
FPG					<0.001
FPG < 6.1 mmol/L	1,981 (92.96)	1,269 (94.63)	542 (92.33)	170 (83.74)	
6.1 ≤ FPG < 7.0 mmol/L	67 (3.14)	36 (2.68)	21 (3.58)	10 (4.93)	
FPG ≥ 7.0 mmol/L	83 (3.89)	36 (2.68)	24 (4.09)	23 (11.33)	
TC					0.026
TC < 5.2 mmol/L	1,860 (70.67)	1,206 (72.22)	510 (69.39)	144 (63.44)	
5.2 ≤ TC < 6.2 mmol/L	607 (23.06)	370 (22.16)	177 (24.08)	60 (26.43)	
TC ≥ 6.2 mmol/L	165 (6.27)	94 (5.63)	48 (6.53)	23 (10.13)	
TG					<0.001
TG < 1.7 mmol/L	1,840 (69.91)	1,197 (71.68)	511 (69.52)	132 (58.15)	
Continued					

Variables ^a	Self-rated health				P values ^b
	Total, No. (%)	Healthy, No. (%)	Fair, No. (%)	Unhealthy, No. (%)	
1.7 ≤ TG < 2.3 mmol/L	411 (15.62)	244 (14.61)	120 (16.33)	47 (20.70)	
TG ≥ 2.3 mmol/L	381 (14.48)	229 (13.71)	104 (14.15)	48 (21.15)	
LDL					0.070
LDL < 3.4 mmol/L	2,279 (86.59)	1,458 (87.31)	638 (86.80)	183 (80.62)	
3.4 ≤ LDL < 4.1 mmol/L	283 (10.75)	167 (10.00)	81 (11.02)	35 (15.42)	
LDL ≥ 4.1 mmol/L	70 (2.66)	45 (2.69)	16 (2.18)	9 (3.96)	
HDL					0.455
HDL ≥ 1.0 mmol/L	2,070 (74.54)	1,429 (81.42)	472 (60.51)	169 (69.83)	
HDL < 1.0 mmol/L	182 (6.91)	110 (6.59)	52 (7.07)	20 (8.81)	

Table 1. Socio-demographic characteristics and laboratory parameters by self-rated health among 2,814 adults in rural China, 2014. Abbreviations: FPG, fasting plasma glucose; TC, total cholesterol; TG, triglycerides; HDL, high-density lipoprotein; LDL, low-density lipoprotein. ^aNumbers do not add to total subjects due to missing data. ^bP values derived from chi-square tests.

currently or in the past. Proportions of subjects with borderline high/high levels of FPG, TC, TG, LDL and HDL were 7.0%, 29.3%, 30.1%, 13.4%, and 25.5% respectively.

Distribution of SRH. More than half of the study population rated their health as “healthy” (63.1%), whereas 28.1% and 8.8% rated their health as “fair” or “unhealthy” (Table 1). Compared to males (47.7% of whom rated their health as “healthy”, 42.9% as “fair”, and 9.5% as “unhealthy”), females (72.5% of whom rated their health as “healthy”, 19.1% as “fair”, and 8.4% as “unhealthy”) had a higher likelihood of reporting a better SRH (OR = 0.29, 95% CI: 0.18–0.46) (Table 2). Health ratings declined with increasing age (*P* value for trend = 0.001) (Table 2).

Risk factor analysis. In multivariate analyses, married status (Adjusted OR = 0.81, 95% CI = 0.70–0.93, married vs. never married, divorced or widowed), non-farming (Adjusted OR = 0.77, 95% CI = 0.68–0.88, non-farming vs. farming) and possession of higher levels of education (Adjusted OR = 0.73, 95% CI = 0.59–0.91, junior middle school or above vs. illiteracy or primary school) increased the likelihood of reporting a better SRH (Table 2). Subjects with a history of disease had worse SRH (Adjusted OR = 2.02, 95% CI = 1.66–2.45, with current or past disease vs. without current or past disease). The association with SRH increased significantly with the abnormal levels of FPG (*P* value for trend = 0.019) and was markedly elevated among individuals with a high level of FPG (Adjusted OR = 2.11, 95% CI = 1.31–3.40, FPG ≥ 7.0 mmol/L vs. FPG < 6.1 mmol/L). However, there was no such statistical association observed for the borderline high level of FPG and SRH (Adjusted OR = 1.19, 95% CI = 0.62–2.27, 6.1 ≤ FPG < 7.0 mmol/L vs. FPG < 6.1 mmol/L) after adjustments. Similarly, elevated level of TC was statistically correlated with poorer SRH (*P* value for trend = 0.021). Categorized by TC level, the high level of TC increased the likelihood of reporting a worse SRH (Adjusted OR = 1.54, 95% CI = 1.16–2.06, TC ≥ 6.2 mmol/L vs. TC < 5.2 mmol/L), however, there was no such statistical association found for the borderline high level of TC and SRH (Adjusted OR = 1.08, 95% CI = 0.90–1.30, 5.2 ≤ TC < 6.2 mmol/L vs. TC < 5.2 mmol/L). Abnormality of TG, LDL, and HDL showed no statistical correlation with SRH.

The multiplicative interactions between age, gender and other explanatory variables were analyzed respectively. Except for annual household income, none of the other variables showed significant interaction with gender when other explanatory variables were controlled. Therefore, only the effect of annual household income on SRH stratified by gender was explored (Table 3). In multivariate analyses, there was a clear gradient correlation between annual household income and SRH in males. That is, the higher the annual household income, the better SRH (*P* value for trend = 0.018; Adjusted OR = 0.36, 95% CI = 0.19–0.71, high (>30,000 RMB) vs. low (≤10,000 RMB)). However, there was no such independent association in females (Table 3).

Spousal SRH concordance. As shown in Table 4, of 697 couples in which both partners provided SRH data, there was a statistically significant spousal concordance for SRH, although the degree of concordance was low (Weighted kappa = 0.09, *P* = 0.001). Spearman’s rho test also showed that the SRH of one partner was mildly but significantly correlated with that of the other partner (Spearman’s rho = 0.12, *P* = 0.001).

Discussion

To our knowledge, this is the first study assessing both the determinants and spousal concordance for SRH for general population in rural China. Of the male and female respondents, 9.5% and 8.4% reported “unhealthy” SRH in rural China. Poor SRH was positively correlated with disease status and abnormality of some clinical parameters but not with presence of unhealthy lifestyle indicators including smoking, drinking, and obesity. High household income was predictive of better SRH among males but not among females. Among couples, a statistically significant positive spousal concordance for SRH was observed, although the concordance strength was low. These findings will be useful to formulate appropriate strategies for health intervention.

Our study showed that 8.8% of respondents rated their health status as “unhealthy”, while more than 60% reported “healthy” SRH. These proportions were in the middle of the wide range reported by prior studies from Asian countries^{11, 15, 16, 23, 24}. The variation found among populations may largely explain the heterogeneity of proportions across studies. It is well known that advancing age and low education levels are positively associated with

Variables	Univariate		Multivariate ^a	
	OR	(95% CI)	OR	(95% CI)
Age (years)				
25–40	1.00	Ref.	1.00	Ref.
41–56	2.23	(1.95, 2.54)	1.93	(1.20, 3.09)
57–72	4.59	(3.39, 6.20)	3.00	(1.59, 5.66)
<i>P</i> value for trend ^b	<0.001		0.001	
Gender				
Male	1.00	Ref.	1.00	Ref.
Female	0.39	(0.25, 0.61)	0.29	(0.18, 0.46)
Marital status				
Never married, divorced or widowed	1.00	Ref.	1.00	Ref.
Married	0.50	(0.41, 0.61)	0.81	(0.70, 0.93)
Number of family members living together				
1–2	1.00	Ref.	1.00	Ref.
3–5	0.48	(0.42, 0.54)	1.18	(0.81, 1.71)
≥6	0.53	(0.46, 0.62)	1.08	(0.85, 1.37)
<i>P</i> value for trend ^b	<0.001		0.741	
Type of employment				
Farming	1.00	Ref.	1.00	Ref.
Non-farming	1.07	(0.81, 1.42)	0.77	(0.68, 0.88)
Education level				
Illiteracy or Primary school	1.00	Ref.	1.00	Ref.
Junior middle school or above	0.72	(0.64, 0.82)	0.73	(0.59, 0.91)
Annual household income				
Low (≤10,000 RMB)	1.00	Ref.	1.00	Ref.
Moderate (10,001–30,000 RMB)	0.57	(0.43, 0.76)	0.82	(0.62, 1.09)
High (>30,000 RMB)	0.50	(0.37, 0.67)	0.78	(0.57, 1.07)
<i>P</i> value for trend ^b	<0.001		0.128	
Smoking status				
Lifetime non-smoker	1.00	Ref.	1.00	Ref.
Former smoker	3.23	(2.27, 4.58)	1.20	(0.95, 1.51)
Current smoker	2.11	(1.31, 3.39)	1.02	(0.67, 1.55)
<i>P</i> value for trend ^b	0.001		0.978	
Drinking status				
Lifetime non-drinker	1.00	Ref.	1.00	Ref.
Former drinker	2.60	(1.98, 3.41)	0.99	(0.61, 1.60)
Current drinker	1.47	(1.10, 1.97)	0.82	(0.51, 1.33)
<i>P</i> value for trend ^b	0.003		0.429	
Body mass index, kg/m²				
Normal weight (18.5 ≤ BMI < 24.0)	1.00	Ref.	1.00	Ref.
Overweight (24.0 ≤ BMI < 28.0)	0.99	(0.87, 1.12)	0.91	(0.77, 1.08)
Obesity (BMI ≥ 28.0)	1.00	(0.89, 1.11)	0.84	(0.68, 1.03)
Underweight (BMI < 18.5)	2.40	(1.29, 4.46)	1.90	(0.50, 7.25)
<i>P</i> value for trend ^b	0.357		0.173	
Presence of current or past disease				
No	1.00	Ref.	1.00	Ref.
Yes	2.30	(1.60, 3.32)	2.02	(1.66, 2.45)
FPG				
FPG < 6.1 mmol/L	1.00	Ref.	1.00	Ref.
6.1 ≤ FPG < 7.0 mmol/L	1.59	(1.18, 2.16)	1.19	(0.62, 2.27)
FPG ≥ 7.0 mmol/L	2.84	(2.26, 3.56)	2.11	(1.31, 3.40)
<i>P</i> value for trend ^b	<0.001		0.019	
TC				
TC < 5.2 mmol/L	1.00	Ref.	1.00	Ref.
5.2 ≤ TC < 6.2 mmol/L	1.20	(1.09, 1.31)	1.08	(0.90, 1.30)
TC ≥ 6.2 mmol/L	1.47	(1.12, 1.94)	1.54	(1.16, 2.06)
<i>P</i> value for trend ^b	<0.001		0.021	
Continued				

Variables	Univariate		Multivariate ^a	
	OR	(95% CI)	OR	(95% CI)
TG				
TG < 1.7 mmol/L	1.00	Ref.	1.00	Ref.
1.7 ≤ TG < 2.3 mmol/L	1.32	(1.02, 1.71)	1.20	(0.99, 1.45)
TG ≥ 2.3 mmol/L	1.31	(0.85, 2.01)	1.13	(0.66, 1.94)
<i>P</i> value for trend ^b	0.083		0.454	
LDL				
LDL < 3.4 mmol/L	1.00	Ref.	1.00	Ref.
3.4 ≤ LDL < 4.1 mmol/L	1.29	(0.80, 2.07)	0.93	(0.48, 1.78)
LDL ≥ 4.1 mmol/L	1.06	(0.57, 2.01)	0.52	(0.20, 1.37)
<i>P</i> value for trend ^b	0.100		0.125	
HDL				
HDL ≥ 1.0 mmol/L	1.00	Ref.	1.00	Ref.
HDL < 1.0 mmol/L	1.17	(0.89, 1.54)	0.83	(0.55, 1.27)

Table 2. Cumulative univariate and multivariate analyses of factors associated with self-rated health among 2,814 adults from rural China, 2014. Abbreviations: OR, odds ratio; CI, confidence interval; FPG, fasting plasma glucose; TC, total cholesterol; TG, triglycerides; HDL, high-density lipoprotein; LDL, low-density lipoprotein. ^aAll variables were included in cumulative multivariate analyses. ^b*P* values for trend were calculated by cumulative univariate and multivariate analyses, treating categorical variables as continuous variables.

Variables	Male					Female				
	No. (%)	Univariate		Multivariate ^b		No. (%)	Univariate		Multivariate ^b	
		OR	(95% CI)	OR	(95% CI)		OR	(95% CI)	OR	(95% CI)
Annual household income										
Low (≤10,000 RMB)	329 (41.02)	1.00	Ref.	1.00	Ref.	456 (30.69)	1.00	Ref.	1.00	Ref.
Moderate (10,001–30,000 RMB)	230 (28.68)	0.58	(0.30, 1.14)	0.76	(0.43, 1.34)	476 (32.03)	0.64	(0.39, 1.03)	0.81	(0.53, 1.25)
High (>30,000 RMB)	234 (30.30)	0.36	(0.19, 0.71)	0.55	(0.34, 0.88)	554 (37.28)	0.68	(0.49, 0.94)	0.87	(0.50, 1.51)
<i>P</i> value for trend ^a		0.005		0.018			0.023		0.662	

Table 3. Cumulative univariate and multivariate analyses of the association between household annual income and self-rated health among 2,814 adults (gender-stratified models) from rural China, 2014. Abbreviations: OR, odds ratio; CI, confidence interval. ^a*P* values for trend were calculated by cumulative univariate and multivariate analyses, treating the annual household income as continuous variable. ^bAll variables including demographic characteristics, socioeconomic characteristics, healthy lifestyle indicators, physical status and clinical parameters were included in cumulative multivariate analyses.

poor SRH^{10, 11}. Our results further confirmed this correlation. With regard to gender, reports of its association with SRH have not been fully consistent^{25–27}. In this study, SRH in women overall appeared to be better compared with SRH in men. Since poorer SRH reflects a higher burden of diseases²⁸, gender disparity in SRH ratings could be partially explained by the fact that men in this population were more likely to report having a disease history (Male vs. Female: 31.4% vs. 13.2%, driven by a higher prevalence of upper digestive tract disorders, respiratory disease, and cardiovascular illness; data not shown).

It has been suggested previously that high household income is predictive of better SRH⁹. Notably, in this study, an independent association between annual household income and SRH was found in males but not in females. This gender disparity in the relationship of family income and health has also been observed by other researchers^{23, 24}. It could be explained partially by specific sociological factors. For instance, household income is largely dependent on men's income in rural China, which may affect their control over family resources, access to health care and decision-making power²⁹. Accordingly, the impact of income inequality (e.g., low-income households vs. high-income households) on health is more likely to be observed in men (major controllers) than in women. However, the mechanism by which income inequality is linked to health and SRH yet to be convincingly established.

Consistent with most previous studies, current or past disease was strongly associated with poorer SRH^{2, 28}. For clinical parameters, the degree of association increased with the abnormal levels of FPG and TC even after adjusting for disease status and other potential confounders. Additionally, high levels of FPG (≥7.0 mmol/L) and TC (≥6.2 mmol/L) were significantly associated with poorer SRH. The correlations between biochemical indexes and SRH observed by us and others groups may be the result of physical sensations associated with disease progression, such as fatigue and poor sleep patterns, indicating that SRH has a biologic basis and it may serve as a barometer of physiologic states^{13, 14}. For borderline high levels of FPG and TC as well as abnormality of TG, LDL and HDL, their association with SRH were not statistically significant after adjustments. This can be partially explained by the

Respondents' SRH	Spouses' SRH			Total
	Healthy	Fair	Unhealthy	
Healthy	263	42	30	335 (48.06%)
Fair	207	65	27	299 (42.90%)
Unhealthy	38	17	8	63 (9.04%)
Total	508 (72.88%)	124 (17.79%)	65 (9.33%)	697

Table 4. Concordance between respondents' SRH and spouses' SRH among 697 couples from rural China, 2014^a. Abbreviations: SRH, self-rated health. ^aWeighted Kappa was calculated to evaluate the concordance between respondents' SRH and spouses' SRH. To identify correlation between respondents' SRH and spouses' SRH, chi-square analysis and Spearman's rank test was used. Weighted Kappa = 0.09, $P = 0.001$; Spearman's rho = 0.12, $P = 0.001$; chi-square [4] = 15.02, $P = 0.005$.

fact that rural residents rarely underwent biochemical examinations and most were unaware of the abnormality of clinical parameters. Thus, in contrast to high levels of clinical indexes which may influence health perception and relate to SRH ratings, marginally elevated levels of biochemical indicators without accompanying symptoms and signs would be unlikely to have an impact on SRH reporting^{13,14}. For unhealthy lifestyle indicators (such as smoking, drinking, and obesity), a null association was observed, in contrast with results from economically developed regions³⁰. Taken together these findings may reflect the fact that adults in rural China often lack basic knowledge about disease prevention and are thus not aware that risk factor exposure may have adverse health effects³¹. In support of this assumption, other studies found that obesity is not regarded as unhealthy, but rather as a matter of good fortune in Chinese culture especially in rural area. This is especially true in rural areas, where it is believed that only rich people could afford to eat more and gain weight³². In view of the fact that physical health but not unhealthy lifestyles which are regarded as major causes of modern-day disease³³, plays an important role in SRH in rural China, more measures for health promotion and intervention are recommended for rural individuals to improve lifestyle and risk perception. Further research is needed to confirm our findings.

Our study also augments knowledge regarding spousal SRH concordance in heterosexual couples based on a large sample. As expected, we found that the SRH of one partner was significantly associated with that of the other partner, although the degree of spousal concordance was low. This phenomenon may arise from the combined effect of shared and non-shared factors. The contribution of sharing a similar environment, social network, and financial resources (including specific factors such as age, education level and annual household income) to similarity in spousal SRH could be attenuated to some extent by effects of non-shared factors (including smoking status, BMI and history of disease) for respondents and their partners (Supplementary Table S1). Moreover, differing genetic characteristics in couples could also reduce the degree of concordance. Thus, life features shared in couples could lead to the observed significant though low SRH concordance. This finding may serve as a first step toward developing couple-based interventions to jointly improve SRH for both partners.

This study has several limitations. First, the possibility of a selection bias (e.g. bias introduced by exclusion of individuals aged below 25 and above 69) may undermine the generalizability of our findings to a wider population. Second, bias potentially introduced by the individuals who did not participate must be noted, as such bias may have blurred the age/gender-related association. Third, with the exception of clinical parameters, all information was self-reported data. Recall bias or under-reporting of risk factors cannot be excluded, although interviews were administered by well-trained interviewers in a one-on-one private setting. Fourth, our findings may be subject to potential endogeneity bias. Additionally, information about depression, health service utilization and social networks was not collected, and their association with SRH could thus not be evaluated. Finally, owing to its cross-sectional nature, the temporal order of observed associations with SRH cannot be established.

In conclusion, this study adds to current understanding of self-rated health and its determinants. SRH differed significantly with socio-demographic characteristics, disease status, and clinical parameters, but did not vary with healthy lifestyle indicators in rural China. Among couples, the shared lifestyle features may lead to a significant although low SRH concordance. These findings will be useful for future improvement in subjective well-being and objective health in economically developing regions.

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Author Contributions

Y.K. and H.C. were involved in the design and supervision of the survey. F.L., C.Z., Y.L., Q.D., D.H., Y.P., X.L., Z.H., M.L., Y.L., J.L., T.N., C.G., R.X., and L.Z. were involved in conducting the field work. F.L. and C.Z. performed the statistical analyses and wrote the manuscript text. All authors reviewed the manuscript.

Additional Information

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