



Healthy Years of Life Lost in Shaanxi Province, Western China: An Evidence from the 2018 National Health Service Survey

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Abstract

Aims: To analyze the association with health-related factors and the disease risk and Healthy Years of Life Lost (HYLL).

Methods: The missing data was inserted using multiple interpolation methods. The self-reported healthy life expectancy was estimated using Sullivan method, and HYLL is the difference between life expectancy and health-adjusted life expectancy. Logistic regression model was used to judge the association between health-related factors and disease risk.

Results: The HYLL at 10 years old is 11.36 years old, and the HYLL is higher in female than male since 55 years old. In the total population, lower years of education (OR=1.526, 95% CI [1.263-1.845]), no tooth brushing (1.847, 1.514-2.253), and overweight or obesity (1.280, 1.101-1.487) are more likely to occur sick. Risk association of health-related factors with disease varies between sexes and areas.

Conclusion: Social factors, lifestyle factors and metabolic factors are exposed to disease risk and HYLL. Health education in rural areas and female groups should be strengthened, and additional attention should be paid to the additional HYLL caused by occupational health and oral health.

Keywords: Self-reported health; Healthy life expectancy; Quality of life; Health-related factor; Healthy years of life lost

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Introduction

Health-Adjusted Life Expectancy (HALE), also known as Healthy Life Expectancy (HLE), is an comprehensively index to evaluate the complete health of population, was calculated by adding the prevalence of disease and injury to the life table [1-2]. Prevalence is usually affected by some factors, and prevention and control of health-related factors leading to disease and injury are currently effective means to prevent health loss and improve the quality of life. According to the Global Burden of Disease (GBD), about 48.3% of global loss of life in 2017 was attributed to the exposure relationship of 476 diseases and injuries risk [3]. A study of the burden of disease in China shows that individual behaviors including smoking, alcohol consumption, lack of physical activity, etc is steadily rising [4]. In addition, the results show that the proportion of the gradually urbanized Chinese population exposed to risk factors such as obesity, lack of exercise, and occupational health is increasing [5]. The existing evidence also suggests that the interaction between health-related factors increases the risk of disease and causes loss of life [6,7]. However, the association between Healthy Years of Life Lost (HYLL) and health-related factors and the susceptibility to such

effects across genders and areas is unclear, and these potential health decisions are expected to be further explored. Therefore, identifying the risk factors associated with the disease helps to promote decline the healthy years of life lost and improve the management of early prevention, which is particularly important for promoting health for everyone and implementing a healthy China strategy.

To explore the association between health-related factors and healthy years of life lost, this study based on the Sixth Health Service Survey in Shaanxi province in western China, estimated HALE-SR and then calculated the HYLL, and focused on the relationship between health-related factors and disease risk.

Methods

Study design

The data of population and death of this study are from the Full Population Database (FPD) of Shaanxi Province. And we used the Shaanxi Statistical Yearbook 2018, a systematic and comprehensive annual journal to adjust the age-specific birth rate. Prevalence and impact factor data came from the 2018 Sixth National Health Services Survey of Shaanxi Province (SHSS2018), the largest health services survey in Shaanxi Province. Located in the inland hinterland of inland China, Shaanxi Province is one of the important birthplaces of the Chinese nation and Chinese culture, which has jurisdiction over twelve prefecture-level cities and has a population of 39.52 million in 2020 [8]. In this study, 6,912 residents over 10-year-old were finally included according to the multistage stratified cluster random sampling method. A detailed description of the SHSS2018 was published previously [9-11]. We defined the people who were hospitalized due to illness, injury and poisoning within the year before the respondent self-reported as the sick group, and calculated the prevalence of the age-specific.

Definition of the variables and health-related factors

In this study, urban areas refer to municipal districts with administrative divisions as prefecture-level cities or above, and rural areas refer to areas with administrative divisions of counties (including county-level cities). Marital status including having spouse (married) and no spouse (unmarried, widowed, divorced and others). This study defined three categories of eight health-related factors as social factors (including years of education and occupation type), lifestyle factors (including smoking, alcohol consumption, physical exercise, health checkup, and tooth brushing), and metabolic factors (including overweight or obesity).

In social factors, we divided the level of education into 9 years and below (including never went to school, primary school and junior high school) and over 9 years including high school (junior college, specialized secondary schools, skilled workers schools), undergraduate and postgraduate. The type of self-reported occupation as workers, farmers, active servicemen, freelancers, self-employed and others is defined as the first occupation (No.1), and the occupation such as administrative personnel (national civil servants, staff, enterprise managers) and technical workers (professional and technical personnel) as the second occupation (No.2).

Among lifestyle factors, people who have self-reported current smoking or have quit were defined as having smoking experience, and those who never smoked as those with no smoking experience. People who had reported having drinking within 30 or 30 days of the past 12 months were defined as drinking, otherwise as no drinking. The behavior of self-reported average weekly conscious physical

exercise (including morning exercise, recess exercise, PE classes, extracurricular sports classes, workshop exercises, square dancing, walking exercise, walking, running, etc.) over the past 30 days was defined as performing physical exercise, otherwise defined as no physical exercise. The behavior of having received a health checkup within nearly 12 months (excluding the checkup for illness) was defined as having health checkup and others as not having health checkup. The definition of tooth brushing is having one or more daily brushing, and the average of less than one or no daily brushing is defined as no tooth brushing. For metabolic factors, the Body Mass Index (BMI) was calculated by the ratio of the square of self-reported height (m²) and weight (kg). We define overweight or obesity as their BMI over 24.0 (m²/kg), otherwise, was not overweight or obesity.

Statistical analysis

The characteristics of participants were summarized as means with SDs for continuous variables. Chi-square test and Fisher's exact test were used to evaluate the statistical significance of the differences in participants.

This study adjusted the population number and deaths in FPD according to the China Statistical Yearbook. Missing data entries were filled using Multiple Imputation Method (MI) according to the integrated Shaanxi deaths in 2018. People over 10 years old were divided into 16 age groups (for example, the 10-year-old group was 10 to 14 years old, the 15-year-old group was 15 to 19 years old, and so on). Age-specific mortality was the ratio of age-specific population and age-specific deaths, and finally the mortality rate of the elderly from 70 to 80 was corrected using the Kannisto extrapolation model. In this study, Myer's Index and fit test were used to evaluate the data quality of the sampling survey. Both Myer's Index (The Myer's Index of the sample survey data of this study was 5.97) and fit test indicating that there is no statistically significant difference between the distribution of the age structure indicators of the data in this study and the overall population, and the sample is very representative. An additional Table S1 shows this in more detail Table S1. Prevalence of specific age groups was calculated using the number of age-specific population and the number of hospitalizations for disease or injury poisoning in health service surveys. The mortality rate and prevalence were simultaneously brought into the life table by Sullivan method to obtain HALE-SR. The Healthy Years of Life Lost (HYLL) was calculated by the difference of life expectancy and health-adjusted life expectancy with self-report. The estimation process is shown in Figure 1.

Logistic regression model analyzed the risk association between health-related factors and disease. The model was adjusted for sex, areas and prefecture-level cities. Multicollinearity diagnostics indicated an absence of collinearity between individual health-related factors. An additional Table S2 shows this in more detail Table S2. We calculated Odds Ratios (ORs) and 95% Confidence Interval (CI) by Maximum Likelihood Estimate (MLE) to explain probable associations between disease and health-related factors by Wald test, and we also analyzed this potential association between health-related factors and disease in sexes and regions, and a two-sided p value less than 0.05 was considered significant.

The level of health-related factors that including education over 9 years, occupation type of No.2, no smoking exercise, no alcohol consumption, physical exercise, health checkup, tooth brushing and not overweight or obesity was defined as getting one score. Social factor score 0 to 2, lifestyle factor score 0 to 5 and metabolic factor

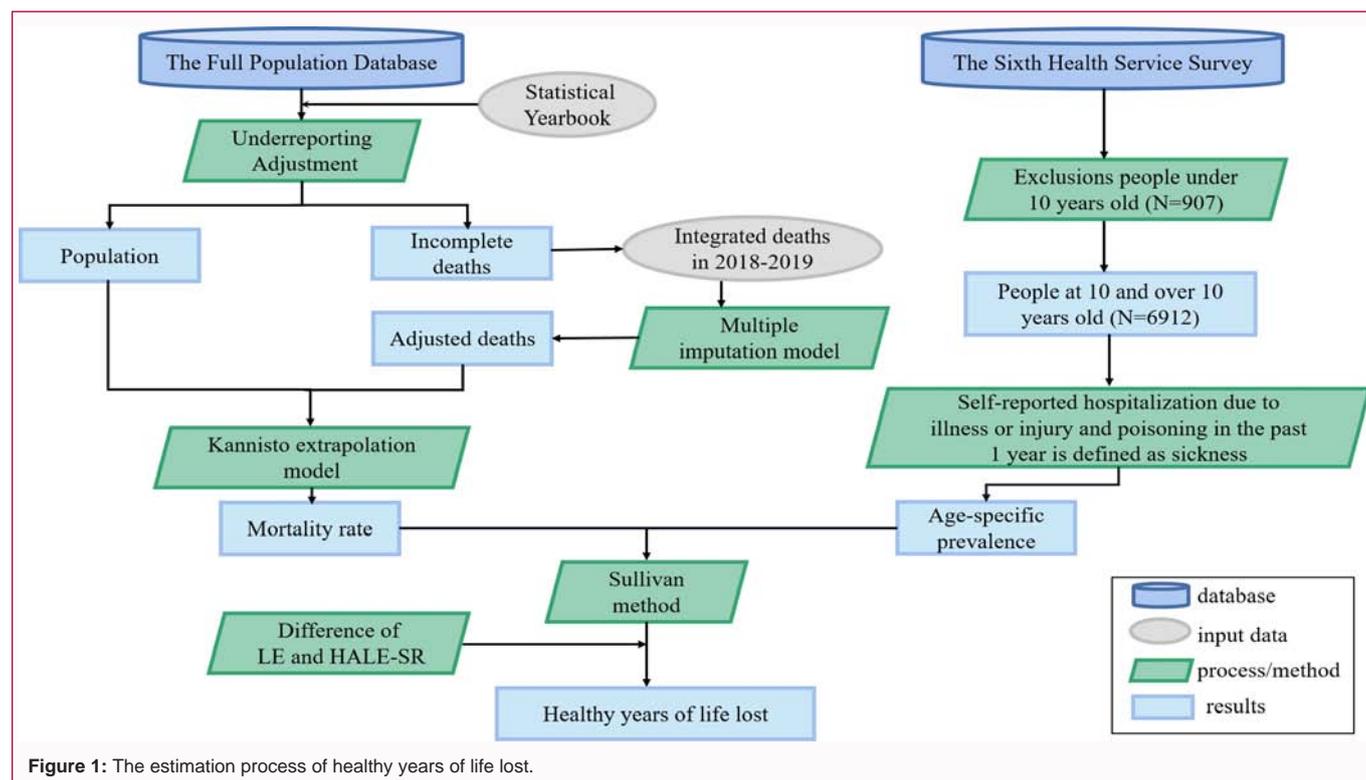


Figure 1: The estimation process of healthy years of life lost.

score 0 to 1. The higher score for each type of factors indicate lower risk. Logistic regression model were also used to judge the association between health-related factor scores and disease risk, and $P < 0.05$ was considered statistically significant.

All statistical analyses involved using the software R.4.0.4, SAS9.4, Stata15.

Results

Population characteristics

General characteristics of the study population are detailed in Table 1. A total of 6,921 individuals with 864 suffering from disease were included in the analysis. The average ages of the sick people and not sick people were 60.57 ± 14.34 and 47.71 ± 17.89 years. The prevalence of disease was 12.27% and 12.72% for male and female, and 12.41% and 12.65% in urban and rural areas, respectively. In marital conditions, people with a spouse are more likely to get sick. The prevalence was highest among people with 9 years or less education, no alcohol consumption, no physical health checkup, no tooth brushing and overweight or obesity individuals ($P < 0.05$) (Table 1).

Healthy years of life lost

In 2018, life expectancy at 10 years old was 69.84 years, female (70.52 years) is higher than male (69.23 years), and urban areas (70.17 years) is higher than rural areas (69.37 years). The HALE-SR in Shaanxi Province at 10 years old was 61.91 years, female (62.52 years) was higher than male (61.91 years), and rural areas (61.94) was higher than urban areas (61.84 years). Figure 2 shows the distribution of the healthy years of life lost and the rate of HYLL in age groups. The healthy years of life lost are gradually reduced with the increase of age, but the loss rate is getting larger and larger. The rate of HYLL in urban areas is greater than that in rural areas, and the rate of HYLL in male begins to be greater than that of female since the age of 55

years old (Figure 2).

Association of health-related factor score and disease risk

Figure 3 shows the association between health-related factor scores and disease risk. The risk of diseases associated with each 1-point increment in social factor decreased among all participants (OR=0.828, 95% CI [0.741-0.925]), especially in female (0.765, 0.647-0.904) and in rural areas (0.512, 0.359-0.730), and it has the same phenomenon in metabolic factor in all participants (0.810, 0.699-0.940), female (0.712, 0.578-0.876) and rural areas (0.736, 0.576-0.941). By contrast, the risk of disease per 1-point increment in lifestyle factor score decreased slightly in all participants (1.076, 1.012-1.145) and male (1.119, 1.028-1.218) (Figure 3).

Association of health-related factors with disease risk

The association of health-related factors with disease risk shows in Figure 4. It was more likely to cause disease among them who received education of 9 years and less (OR=1.526, 95% CI [1.263-1.845]), no tooth brushing (1.847, 1.514-2.253) and overweight or obesity (1.280, 1.101-1.487). The occupation of NO.1 (0.738, 0.583-0.936), alcohol consumption (0.756, 0.615-0.931), no physical exercise (0.854, 0.734-0.994) and no health checkup (0.773, 0.668-0.896) can reduce the risk of disease in Shaanxi (Figure 4).

Education of 9 years and less (1.468, 1.126-1.914) and no tooth brushing (1.595, 1.214-2.096) can increase the risk of illness among male, and the first type of occupation (0.653, 0.476-0.895), alcohol consumption (0.756, 0.615-0.931), no physical exercise (0.854, 0.734-0.994), no health checkup (0.773, 0.668-0.896) will reduce the disease risk. Among female, a lower degree of education (1.550, 1.179-2.038), no tooth brushing (2.170, 1.618-2.909) and overweight or obesity (1.488, 1.205-1.836) were associated with increasing the prevalence of diseases, while there was no related association between health checkup and disease risk (0.718, 0.586-0.879).

Table 1: Population characteristics of the Sixth Health Service Survey in Shaanxi Province, western China (N=6912).

	Sick (n=864)	Not sick (n=6048)	P value
Age (years)	60.57 ± 14.34	47.71 ± 17.89	<0.001
Sex			0.573
Male	408 (12.27)	2918 (87.73)	
Female	456 (12.72)	3130 (87.28)	
Areas			0.765
Urban area	528 (12.41)	3728 (87.59)	
Rural area	336 (12.65)	2320 (87.35)	
Marriage status			<0.001
No spouse	127 (9.07)	1273 (90.93)	
Have spouse	737 (13.37)	4775 (86.63)	
Prefecture-level city			0.016
Xi'an city	191 (12.98)	1281 (87.02)	
Xianyang city	156 (10.41)	1343 (89.59)	
Baoji city	343 (12.55)	2391 (87.45)	
Ankang city	174 (14.42)	1033 (85.58)	
Education			<0.001
Over 9 years	214 (9.79)	1973 (90.21)	
9 years and less	650 (13.76)	4075 (86.24)	
Occupation^a			0.751
NO.2	121 (12.82)	823 (87.18)	
NO.1	743 (12.45)	5225 (87.55)	
Smoking			0.385
No experience	640 (12.71)	4395 (87.29)	
Having experiences	224 (11.93)	1653 (88.07)	
Drinking			0.004
No	691 (13.15)	4565 (86.85)	
Yes	173 (10.45)	1483 (89.55)	
Physical exercise			0.17
Yes	521 (12.96)	3498 (87.04)	
No	343 (11.86)	2550 (88.14)	
Health checkup			<0.001
Yes	471 (14.03)	2885 (85.97)	
No	393 (11.05)	3163 (88.95)	
Tooth brushing			<0.001
Yes	704 (11.54)	5397 (88.46)	
No	160 (19.73)	651 (80.27)	
Overweight or obesity			0.012
No	542 (11.79)	4056 (88.21)	
Yes	322 (13.92)	1992 (86.08)	

Mean ± standard deviation, frequency (percentage)

^a Occupation as workers, farmers, active servicemen, freelancers, self-employed and others is defined as the first occupation (No.1), and the occupation such as administrative personnel (national civil servants, staff, enterprise managers) and technical workers (professional and technical personnel) as the second occupation (No.2).

Lower years of education among urban residents (1.508, 1.21-1.845), having smoking experiences (1.394, 1.095-1.774), and no tooth brushing (1.648, 1.246-2.181) showed a strong association with disease, whereas the first type of occupation (0.679, 0.525-0.879),

Table 2: The distribution of health-adjusted life expectancy with self-reported in age groups.

Age group (Year)	Overall (years)	Male (years)	Female (years)	Urban (years)	Rural (years)
10-14	61.91	61.32	62.52	61.84	61.94
15-19	57.1	56.53	57.7	57.05	57.13
20-24	52.33	51.82	52.85	52.26	52.39
25-29	47.5	46.98	48.02	47.44	47.56
30-34	42.88	42.45	43.32	42.78	43
35-39	38.11	37.6	38.62	37.95	38.36
40-44	33.56	33.13	33.99	33.39	33.83
45-49	29.01	28.64	29.38	28.82	29.33
50-54	24.67	24.37	24.95	24.46	24.99
55-59	20.57	20.24	20.86	20.38	20.86
60-64	16.69	16.39	16.95	16.49	17
65-69	13.34	13.06	13.58	13.1	13.7
70-74	10.32	10.08	10.5	9.99	10.81
75-79	7.58	7.17	7.93	7.22	8.13
80-84	4.94	4.73	5.1	4.57	5.53
85+	2.85	2.66	2.99	2.61	3.28

alcohol consumption (0.612, 0.470-0.797), no physical exercise (0.725, 0.589-0.892) reduce the risk of illness. In rural areas, 9 years of education and below (1.830, 1.170-2.860) and no tooth brushing (2.022, 1.520-2.690) result in increased resident prevalence, whereas having smoking experiences (0.608, 0.437-0.846) and no health checkup (0.657, 0.517-0.834) decrease the disease risk.

Discussion

This study using self-reported health data provides new insights into healthy years of life lost and differences in disease risk with health-related factors in people over 10 in Shaanxi Province in western China. Starting from the age of 55 years, the healthy years of life lost of female was higher than men, and the increased scores of social factors and metabolic factors are significantly associated with lower risk of disease and lower HYLL. Lower education, no tooth brushing and overweight or obesity is the main risk factors leading to the lower quality of people's life in Shaanxi province.

Several results of previous studies confirmed that female have a longer lifespan than male, but the quality of life was lower, and the difference of lifespan in gender is gradually narrowing [12-15]. The results of this study show that HALE-SR for female at 10-year-old in Shaanxi Province was higher than male about 1.2 years, the HYLL of female have gradually surpassed male since the age of 55 years old, and the gap of HALE-SR between men and women gradually decreased with increasing age. In addition to the weak effects of body structure, health differences in gender are gradually attributed to the gap of incidence of health-related factors such as smoking, alcohol consumption, physical exercise are decreasing [12,16]. Between urban area and rural area, this study showed higher healthy life expectancy in rural populations than urban, which was different from other studies [5,17]. With the development of urbanization in China, urbanization affects the health of the population in many aspects. Air pollution, types of occupation, and changes in dietary and activity habits can all pose challenges to the health of urban residents [18]. The cognition of self-health is becoming more and more important in primary care, the findings of this study found an additional increased

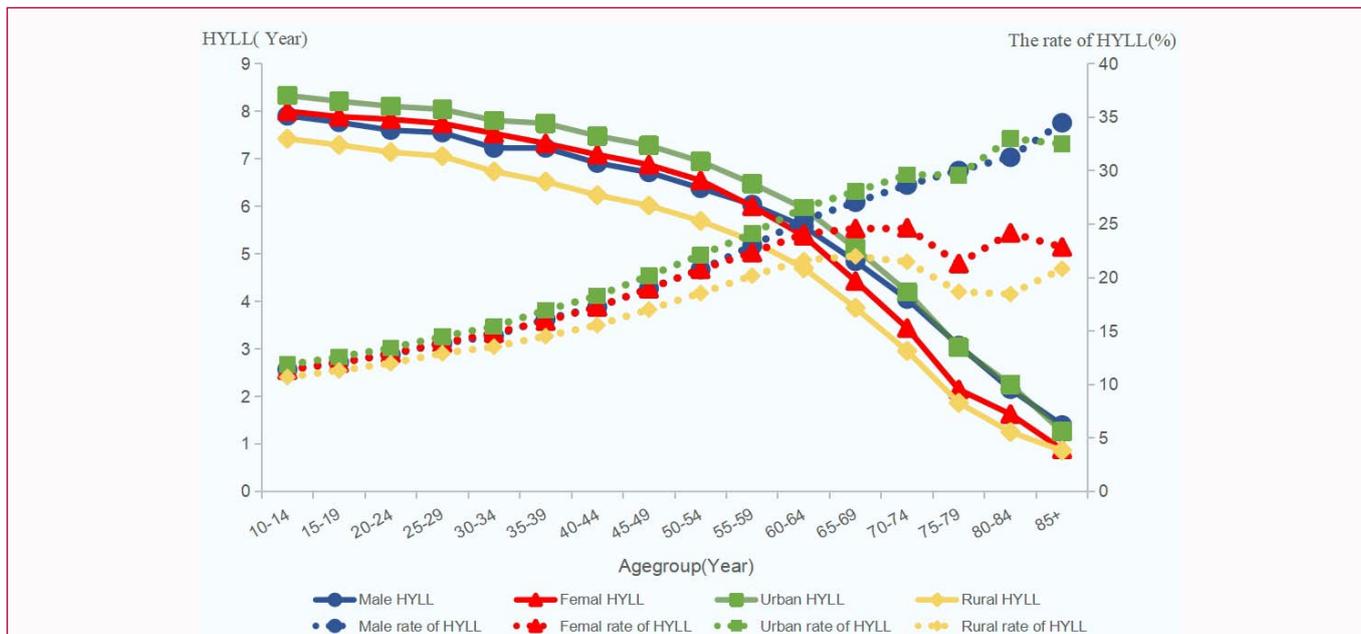


Figure 2: Healthy years of life lost and the rate of healthy years of life lost in specific age group.

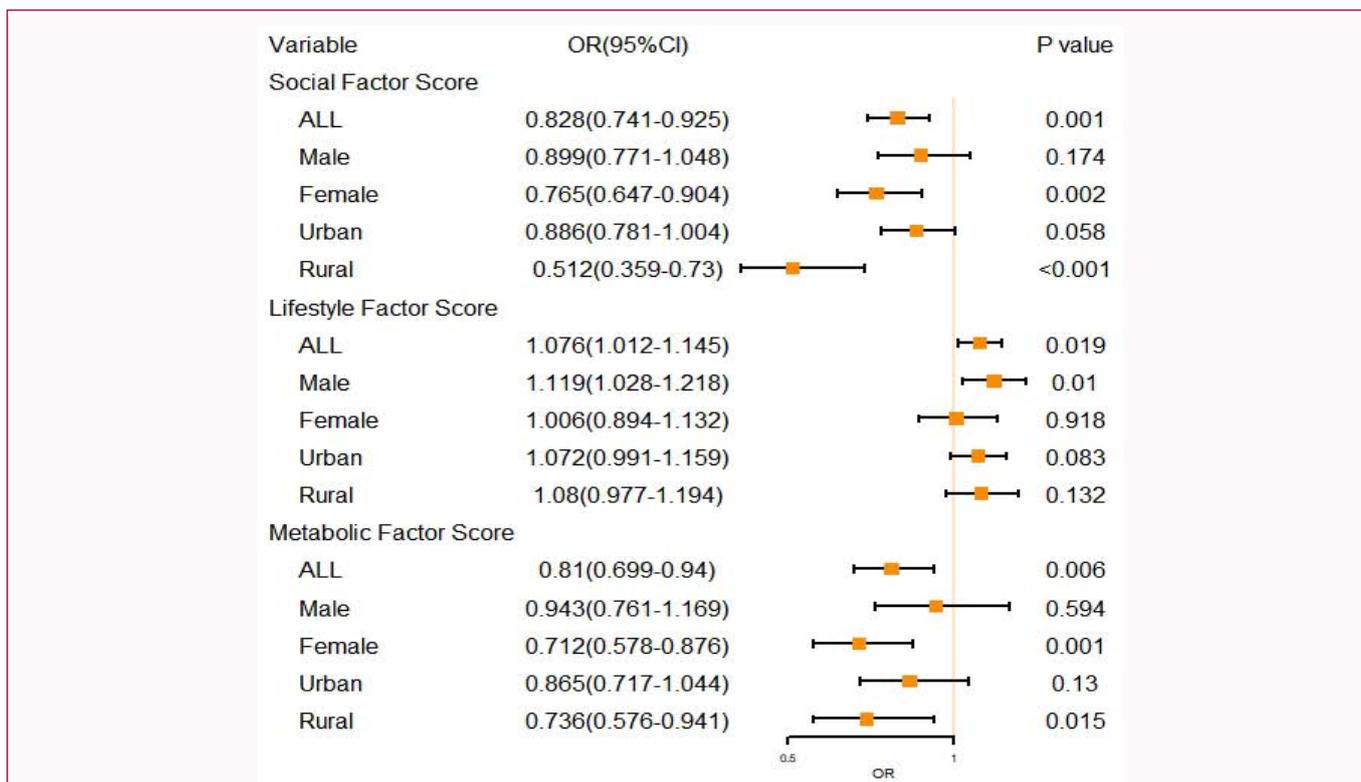


Figure 3: Odds ratios of incident diseases associated with each 1-point increment in health-related factor scores by sexes and areas.

risk for residents undergoing health checkup. This may be attributable to the poor awareness of self-health for people in rural area, which lead to unknowingly sickness. And the self-reported health is higher in urban areas. Therefore, the government should strengthen the health publicity and education for rural areas, popularize health knowledge, improve the health literacy of residents, and implement the three early preventions of early detection and then early diagnosis and early treatment.

We have observed that in the overall health-related factor score, in addition to lifestyle factors, social factors and metabolic factors increase by one point, the population's risk of disease will decrease, and the HYLL will also decrease. Therefore, a more active healthy style approach is promoted to improve health. For specific health factors, overweight or obesity has been shown to increase the risk of multiple diseases such as cardiovascular disease, diabetes, musculoskeletal, etc., [19-21]. The prevalence of overweight or obesity is getting worse

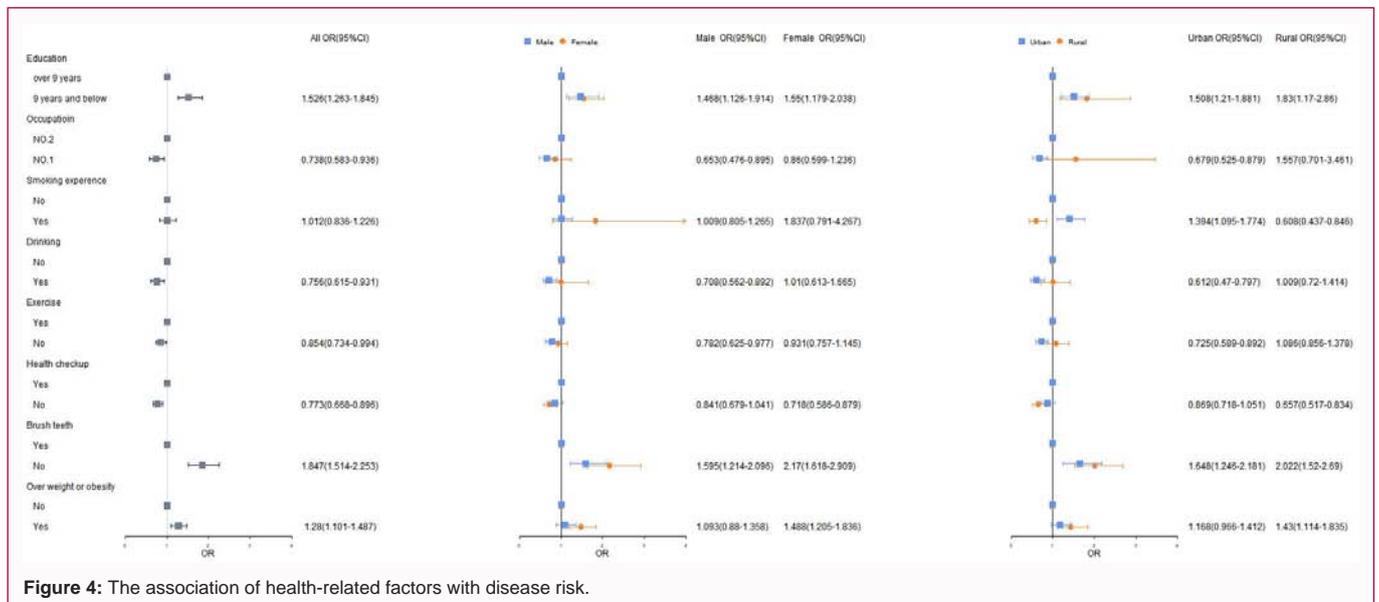


Figure 4: The association of health-related factors with disease risk.

in China, from 0.06% since 1980 to 5.30% in 2015 in China, and then to over 50% for Chinese adults with overweight or obesity in 2020, and 60% for the children under the age of 6 years old [22,23]. The rates of overweight or obesity varies between the sexes and areas. The results of this study show that overweight or obesity in Shaanxi Province of western China increases disease risk in women and rural area. Changes in dietary structure, physical exercise have significant associations with the occurrence of overweight or obesity, and a series of related health problems will pose great challenges to population health if the prevalence of overweight or obesity continues to increase, and the effective measures must be taken to intervene in the occurrence and prevalence of overweight or obesity as soon as possible.

Oral disease is an increasingly serious public health problem which have a significant adverse impact on quality of life [24,25]. In this study, the incidence of tooth brushing events was significantly associated with a reduced HYLL and declined disease risk of population prevalence. Previous studies have also shown that no tooth brushing is significantly associated with the risk of chronic non-communicable diseases such as cardiovascular disease, diabetes, and cancer compared to tooth brushing [26-29]. At the same time, studies have shown that excessive sugar intake and smoking can mutually affect dental health and lead to disease [30]. In this study, on the contrary, physical exercise increases the risk of disease and loses more healthy lifespans. This may due to the physical exercise still cannot offset the adverse health effects of smoking, the second type occupation and overweight or obesity, particularly prominent in male and urban populations, and there may be interactions between health-related factors and numerous studies have explored the impact of factors other than genes on the evolution of the disease, noting that interactions between lifestyle factors and environmental factors can affect the disease risk of the population [7]. Similarly, the results show that having regular health checkup will increase the risk of illness. This is also a low level of education leads to defects in people's perception of physical health. In women and rural area, education level affects the population's cognition of health, thus making the health checkup results generally positive, and increasing the risk of disease. The health risks of high smoking rate and sedentary people have gradually deepened [31-35], the government plans to consider

tobacco control [36], and more attention is needed to occupational health and oral health.

To the best of our knowledge, this is the first study to discuss health-related factors associated with disease risk and healthy year's life lost between different genders and regions by population self-reported database in China. Key strengths of our study include providing a reference for accurately seeking factors influencing population disease and improving population quality of life. But there are still some limitations. Firstly, the results of this study are based on a short-term self-reported health survey where subjective health cognition indirectly biased prevalence result in the lower estimation of HALE-SR. Secondly, genetic factors, dietary patterns, and environmental factors are also health-related factors affecting the disease [37,38], and may have interactions with social factors, lifestyle factors, and metabolic factors.

Conclusion

This study estimated healthy years of life lost for people in Shaanxi Province, western China, and analyzed the association of eight health-related factors with disease risk. Our results suggest people living with more healthy style, and it should strengthen the health education of rural and female groups to enhance the awareness of self-health. While promoting tobacco control actions and encouraging physical exercise, additional attention needs to be paid to the new health crises caused by occupational health and oral health.

Author Contributions

XL M, QW, JC, WM, LR, YC and ZY W analyzed and interpreted the data regarding the disease and the health-related factors. XH G, XZ and QM coordinated the subject. XL M was a major contributor in writing the manuscript, and QM edited the manuscript. All authors read and approved the final manuscript.

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