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*Original Article*

# Analysis of Differences in Suboptimal Health Status between Urban and Rural Residents and Influencing Factor during COVID-19 Pandemic

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## ABSTRACT

**Background:** Since December 2019, Coronavirus disease (COVID-19) has rapidly spread to most places in China and other countries, which may exert further impacts on the physiological and psychological states of urban and rural residents. Therefore, itis necessary to explore their health status during the COVID-19 outbreak. **Methods:** Convenience sampling is selected for a cross-sectional investigation and SHS questionnaires were distributed by WeChat. **Results:** A total of 15681 valid questionnaires from 4988 (31.8%) healthy participants, 9991 (63.7%) participants in SHS and 702 (4.5%) in a morbid state are incorporated. As shown by total scale, psychology and social aspect, SHS prevalence rate of rural residents is above that of urban residents; however, the contrary is the case for their physiological status. Regarding all participants, female gender, with low body mass index (BMI), or in the low-income group are account for the higher SHS prevalence rate. Based on ordinal Logistic regression analysis results, male gender and short time spend on electronic products are protective factors for SHS, while sleep deprivation is a risk factor for both urban and rural residents. ($p$<0.05). **Conclusion:** During the COVID-19 pandemic, the prevalence rate of SHS in rural residents' psychology, society and total scale is higher than that of urban residents. Major influencing factors include gender, time spent on electronic products, sleep time, smoking and social roles. Residents should properly adjust their daily schedule; and related governmental departments should particularly focus on SHS of rural residents and provide diversified life and psychological support during the COVID-19 pandemic.
**Key words:** Suboptimal Health Status (SHS), Urban Residents, Rural Residents, Influencing Factor, Coronavirus Disease (COVID-19).

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## INTRODUCTION

Since December 2019, coronavirus disease (COVID-19) has rapidly spread to most places in China and other countries. Principal transmission routes of COVID-19 include respiratory droplet, contact and aerosol or fecal-oral transmission. All population is susceptible to it.[1] On January 30, 2020, COVID-19 was declared to be a Public Health Emergency of International Concern by World Health Organization. Up to March 30, 2020, the accumulative number of confirmed cases in China reached 81,518 and the cumulative death toll was 3,305.[2] Globally, 693,282 cases had been confirmed accumulatively; the daily increase of confirmed cases reached 58,469; and there were accumulatively 33,106 deaths.[3] Not only are COVID-19 prevention and control publicity posters put up in urban and rural areas of China, but COVID-19 related data and information are also dynamically updated on television and online. In line with relevant research reports, urban and rural residents have gained sufficient understanding of its severity.[4] Under the influence of COVID-19 pandemic, life and work styles of Chinese residents have changed tremendously. This may exert further impacts on the physiological and psychological states of urban and rural residents. Therefore, it is necessary to explore their health status during the COVID-19 outbreak.

Suboptimal health status (SHS), an intermediate state in which the affected individuals are neither healthy nor sick, is also known as "The Third Status". As a functional change in the case of no organic lesions exist in the body. To be specific, people in SHS may feel tired physiologically, become anxious psychologically and suffer interpersonal disorders in social life. In China, the number of people in SHS accounts for about 70% in its total population;[5] and such a number is increasing year by year. Foreign studies have defined similar sub-health status as Chronic Fatigue Syndrome, whose symptoms mainly include Fatigue, memory loss, unexplained muscle pain or joint pain.[6] A sub-health diagnosis cannot be determined by a single test. In terms of treatment, relevant studies in China have shown that Traditional Chinese Medicine means, such as acupuncture, can help improve sub-health symptoms.[7]

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The main purpose of this study is to investigate the differences in the SHS status of urban and rural residents under the epidemic of COVID-19 and explore the influencing factors.

## MATERIALS AND METHODS

### Sample setting

Convenience sampling is selected. On March 5~15, 2020, the links of SHS questionnaires were distributed among Chinese residents on WeChat. Corresponding inclusion criteria: ① Chinese resident's aged ≧18 years old; ② Chinese residents signing the informed consent form.

### Research tools

### Questionnaire of general information

The questionnaire was designed by the research team independently, covering general information of the participants, such as gender, age, height, weight, nationality, place of residence, educational background, occupation, marital status, monthly salary, social role and whether a close contact or an infected patient of COVID-19 or not. BMI can be expressed in the following equation: BMI=Weight/Height Squared (kg/m$^2$). If BMI<18.5 kg/m$^2$, it indicates underweight; 18.5kg/m$^2$ ≦BMI<24.0 kg/m$^2$ represents normal weight; 24.0kg/m$^2$ ≦BMI<28.0 kg/m$^2$ signifies overweight; and BMI≧28 kg/m$^2$ refers to obesity.[8]

### Questionnaire of daily life

The questionnaire was also independently designed by the research team, covering time spent on electronic products, sleep time, times of exercises per week and whether the residents have a history of smoking or alcohol use or not, etc.

### SHS rating scale

SHS Rating Scale prepared by Professor Xu Jun is selected for this study.[9] This scale includes physical, mental and social SHS scales, totally 39 items. The Cronbach's α and KMO coefficients were recalculated to be respectively 0.883 and 0.948, demonstrating good reliability and validity. With regard to three subscales, the sum of their scores is the raw score of total scale. The higher the score is, the better the health status will be. In order to facilitate understanding and comparison, the raw scores of subscales and the total scale were converted into scores of a centesimal system. Subsequent to this conversion, a morbid state is reflected in total points <54; in case of 54 ≦ Total Points ≦ 79, the corresponding participant is proven to be in SHS; and, for Total Points >79, the participant is considered to be healthy.

### Quality control

The links of questionnaires were distributed among residents on WeChat by public health professionals who had received unified training. At the same time, instructions to complete the questionnaire, relevant matters needing attention and purposes were also clearly noted. In addition, uncompleted questionnaires or that with inconsistent logic were abandoned. With the goal of ensuring data accuracy, a double entry approach was utilized. This survey is concerned with 17115 participants in total; and 15681 valid questionnaires are retrieved. The effective recovery rate is 91.6%.

### Statistical analysis

Statistical analysis is conducted by SPSS 23.0. Relevant measurement data are denoted by Mean+Standard Deviation (M±SD), while enumeration data are expressed in frequency or percentage. Univariate analysis employs $c^2$ and rank sum tests and ordinal ploytomous logistic regression analysis is carried out during multivariate analysis. If $p < 0.05$, it signifies their differences are of statistical significance.

## RESULTS

### Basic information

The questionnaire survey involves 17115 participants totally; and 15681 valid questionnaires are collected. The number of urban residents is 7226 (46.1%), while rural residents' is 8455 (53.9%). There are 6156 men (39.3%) and 9525 women (60.7%), aged between 18 and 67 (21.460±4.103) years old. As for their educational background, the undergraduate degree is dominant, covering 15005 participants (95.7%). Most participants are unmarried and the number of them is 15681, accounting for 96.8%. Their BMI ranges from 12.845 kg/m$^2$ to 72.727 (21.848±6.412) kg/m$^2$. A vast majority of these participants (15147; 96.6 %) have no income, or the income is below RMB 5000 per month. There are 609 smokers and 905 drinkers; and, the proportions taken by them are 3.9% and 5.8% respectively. 24 (0.15%) participants have family members of suspected or confirmed COVID-19. Moreover, the number of who close contacting of confirmed or suspected cases is 30 (0.19%).

### SHS of populations in different places of residence

It is reflected in the total scale that SHS prevalence rate of rural residents is above that of urban residents during the COVID-19 pandemic. Physiologically, rural residents have an SHS prevalence rate below that of the urban residents; from psychological and social aspects, SHS prevalence rate of rural residents is higher when compared with that of urban residents (Table 1).

### Relationship between SHS prevalence rates and individual characteristics of urban and rural residents

As far as urban residents are concerned, prevalence rate of females or participants in the low-income group is above male or those in a high-income group respectively. Moreover, SHS prevalence rate of the low BMI group reaches its peak value. By contrast to groups of smokers or drinkers, SHS prevalence rates of non-smokers or non-drinkers are comparatively high. The longer the time spent on electronic products is, the higher the SHS prevalence rate will be. Additionally, different SHS prevalence rates are found from groups with different sleep time ($p < 0.05$, Table 2).

Among rural residents, prevalence rate of females or participants in the low-income group is above male or those in a high-income group respectively. The widowed population is characterized by the highest SHS prevalence rate, while that of married participants with children has the lowest prevalence rate. From the perspective of income, the highest and lowest SHS prevalence rates are respectively found from participants with no income or with monthly income below RMB 5000. By contrast to groups of smokers and drinkers, SHS prevalence rates of non-smokers and non-drinkers are comparatively high. The longer the time spent on electronic products is, the higher the SHS prevalence rate will be.

**Table 1: SHS[1] prevalence rate differences among Chinese urban and rural residents.**

| Category | Urban residents n (%) | Rural residents n (%) | Estimate | *p* |
|---|---|---|---|---|
| Total SHS | 4473（61.9） | 5518（65.3） | 22.110 | <0.001[2] |
| Physical SHS | 3448（47.7） | 3757（44.4） | 22.588 | <0.001[2] |
| Mental SHS | 5019（69.5） | 6100（72.2） | 13.738 | 0.001[2] |
| Social SHS | 4593（63.6） | 5695（67.4） | 56.561 | <0.001[2] |

[1]SHS：Suboptimal Health Status

[2]$p$<0.05

**Table 2: Relationship between SHS[1)] prevalence rates and personal features of urban and rural residents.**

| Variable Health n (%) | | Urban residents | | | | | Rural residents | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SHS n (%) | Disease n (%) | Estimatestatistic | *p* | Health n (%) | SHS n (%) | Disease n (%) | Estimate | *p* | |
| Gender | Male | 1063(37.3) | 1643(57.6) | 145(5.1) | 36.893 | <0.0012) | 1135(34.3) | 2004(60.6) | 166(5.0) | 51.469 | <0.0012) |
| | Female | 1372(31.4) | 2830(64.6) | 173(4.0) | | | 1418(27.5) | 3514(68.3) | 218(4.2) | | |
| Age | 18~44 | 2398(33.7) | 4412(61.9) | 312(4.4) | 2.328 | 0.312 | 2528(30.1) | 5495(65.4) | 384(4.5) | 5.603 | 0.061 |
| | 45~59 | 36(36.7) | 56(57.1) | 6(6.1) | | | 24(51.1) | 23(48.9) | 0(0.0) | | |
| | 60~ | 1(16.7) | 5(83.3) | 0(0.0) | | | 1(100.0) | 0(0.0) | 0(0.0) | | |
| BMI (kg/m$^2$) | Low weight | 623(32.2) | 1234(63.8) | 76(3.9) | 8.278 | 0.0412) | 668(28.4) | 1574(66.8) | 112(4.8) | 3.281 | 0.350 |
| | Normal | 1345(33.8) | 2465(61.8) | 174(4.4) | | | 1455(30.6) | 3078(64.9) | 215(4.5) | | |
| | Overweight | 214(36.8) | 339(58.2) | 29(5.0) | | | 176(33.4) | 333(63.2) | 18(3.4) | | |
| | Obesity | 253(34.8) | 435(59.8) | 39(5.4) | | | 254(30.8) | 533(64.5) | 39(4.7) | | |
| Marital status | Unmarried | 2338(33.7) | 4295(61.9) | 304(4.4) | 1.535 | 0.909 | 2456(29.8) | 5403(65.6) | 379(4.6) | 16.454 | 0.0062) |
| | Married with children | 73(35.6) | 122(59.5) | 10(4.9) | | | 71(48.6) | 72(49.3) | 3(2.1) | | |
| | Married without child | 7(29.2) | 16(66.6) | 1(4.2) | | | 9(47.4) | 10(52.6) | 0(0.0) | | |
| | Divorced | 3(27.3) | 8(72.7) | 0(0.0) | | | 1(25) | 3(75.0) | 0(0.0) | | |
| | Widowed | 0(0.0) | 3(75.0) | 1(25.0) | | | 0(0.0) | 3(100.0) | 0(0.0) | | |
| | Others | 14(31.1) | 29(64.4) | 2(4.5) | | | 16(35.6) | 27(60.0) | 2(4.4) | | |
| Educational background | Primary schools and below | 1(20.0) | 3(60.0) | 1(20.0) | 2.342 | 0.673 | 6(37.5) | 7(43.8) | 3(18.8) | 7.966 | 0.093 |
| | Middle school | 1(16.7) | 5(83.3) | 0(0.0) | | | 34(44.2) | 42(54.5) | 1(1.3) | | |
| | High school | 64(32.7) | 121(61.7) | 11(5.6) | | | 88(34.4) | 162(63.3) | 6(2.3) | | |
| | Undergraduate | 2331(33.7) | 4289(62.0) | 302(4.4) | | | 2415(29.9) | 5294(65.5) | 374(4.6) | | |
| | Graduate | 38(39.2) | 55(56.7) | 4(4.1) | | | 10(43.5) | 13(56.5) | 0(0.0) | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly salary (RMB) | <5000 | 1056(34.4) | 1878(61.0) | 140(4.6) | 13.259 | 0.0102) | 1022(31.4) | 2058(63.4) | 170(5.2) | 21.955 | <0.0012) |
| | 5000-10000 | 84(36.5) | 136(59.2) | 10(4.3) | | | 69(41.6) | 95(57.2) | 2(1.2) | | |
| | 10000-15000 | 19(31.1) | 37(60.7) | 5(8.2) | | | 6(35.3) | 11(64.7) | 0(0.0) | | |
| | >15000 | 19(47.5) | 16(40.0) | 5(12.5) | | | 9(45) | 8(40.0) | 3(15) | | |
| | No income | 1257(32.9) | 2406(63.0) | 158(4.1) | | | 1447(28.9) | 3346(66.9) | 209(4.2) | | |
| Family member confirmed or suspected with COVID-19 | Yes | 3(33.3) | 6(66.7) | 0(0.0) | 0.145 | 0.703 | 3(20.0) | 11(73.3) | 1(6.7) | 0.315 | 0.575 |
| | No | 2432(33.7) | 4467(61.9) | 318(4.4) | | | 2550(30.2) | 5507(65.3) | 383(4.5) | | |
| Infected or contacted with COVID-19 case | Yes | 4(30.8) | 7(53.8) | 2(15.4) | 0.762 | 0.383 | 5(29.4) | 10(58.8) | 2(11.8) | 0.551 | 0.458 |
| | No | 2431(33.7) | 4466(61.9) | 316(4.4) | | | 2548(30.2) | 5508(65.3) | 382(4.5) | | |
| Smoking | Yes | 108(33.5) | 188(58.4) | 26(8.1) | 11.012 | 0.0042) | 92(32.1) | 169(58.8) | 26(9.1) | 15.542 | <0.0012) |
| | No | 2327(33.7) | 4285(62.1) | 292(4.2) | | | 2461(30.1) | 5349(65.5) | 358(4.4) | | |
| Alcohol use | Yes | 156(32.2) | 89(59.7) | 39(8.1) | 16.498 | <0.0012) | 138(32.8) | 249(59.1) | 34(8.1) | 15.707 | <0.0012) |
| | No | 2279(33.8) | 4184(62.1) | 279(4.1) | | | 2415(30.1) | 5269(65.6) | 350(4.3) | | |
| Time spent on electronic products (h) | 0~2 | 70(47.9) | 64(43.8) | 12(8.3) | 228.243 | <0.0012) | 71(54.6) | 51(39.2) | 8(6.2) | 210.566 | <0.0012) |
| | 2~6 | 737(42.4) | 953(54.8) | 48(2.8) | | | 819(37.9) | 1279(59.2) | 63(2.9) | | |
| | 6~12 | 1266(32.5) | 2511(64.4) | 120(3.1) | | | 1346(28.6) | 3179(67.4) | 187(4.0) | | |
| | 12~24 | 362(25.1) | 945(65.3) | 138(9.6) | | | 317(21.8) | 1009(69.5) | 126(8.7) | | |
| Sleep time (h) | 0~5 | 9(23.1) | 21(53.8) | 9(23.1) | 35.923 | <0.0012) | 7(25.0) | 13(46.4) | 8(28.6) | 40.937 | <0.0012) |
| | 5~10 | 2065(33.4) | 3850(62.2) | 271(4.4) | | | 2195(30.0) | 4813(65.7) | 320(4.3) | | |
| | 10~24 | 361(36.1) | 602(60.1) | 38(3.8) | | | 351(31.9) | 692(63.0) | 56(5.1) | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Social role | Doctor | 8(30.8) | 18(69.2) | 0(0.0) | 25.423 | 0.063 | 6(26.1) | 12(52.2) | 5(21.7) | 46.727 | <0.0012) |
| | Nurse | 10(22.3) | 33(73.3) | 2(4.4) | | | 1(16.7) | 5(83.3) | 0(0.0) | | |
| | Hospital technician | 1(20.0) | 3(60.0) | 1(20.0) | | | 1(33.3) | 2(66.7) | 0(0.0) | | |
| | Scientific researcher | 1(50.0) | 0(0.0) | 1(50.0) | | | 2(100.0) | 0(0.0) | 0(0.0) | | |
| | Auxiliary police | 3(100) | 0(0.0) | 0(0.0) | | | 2(50.0) | 2(50.0) | 0(0.0) | | |
| | Public transport service provider | 3(75.0) | 1(25.0) | 0(0.0) | | | 4(30.8) | 8(61.5) | 1(7.7) | | |
| | Government authority | 3(37.5) | 4(50.0) | 1(12.5) | | | 0(0.0) | 2(100.0) | 0(0.0) | | |
| | Community service provider | 15(51.8) | 13(44.8) | 1(3.4) | | | 12(27.9) | 28(65.1) | 3(7.0) | | |
| | Volunteers | 49(33.6) | 91(62.3) | 6(4.1) | | | 83(34.0 | 153(62.7) | 8(3.3) | | |
| | Delivery man Delivery boy | 1(33.3) | 2(66.7) | 0(0.0) | | | 0(0.0) | 0(0.0) | 1(100.0) | | |
| | Courier | 1(50.0) | 1(50.0) | 0(0.0) | | | 0(0.0) | 5(100.0 | 0(0.0) | | |
| | Housewife | 5(18.5) | 20(74.1) | 2(7.4) | | | 14(51.9) | 13(48.1) | 0(0.0) | | |
| | Waiting for work at home | 119(31.8) | 226(60.4) | 29(7.8) | | | 190(36.6) | 305(58.8) | 24(4.6) | | |
| | Home office worker | 117(37.5) | 184(59.0) | 11(3.5) | | | 128(40.2) | 177(55.7) | 13(4.1) | | |
| | Student | 2059(33.8) | 3772(61.9) | 259(4.3) | | | 2036(28.9) | 4680(66.5) | 317(4.5) | | |
| | Others | 39(26.4) | 104(70.3) | 5(3.3) | | | 74(35.2) | 125(59.6) | 11(5.2) | | |
| | CDC member | 1(50.0) | 1(50.0) | 0(0.0) | | | 0(0.0) | 1(50.0) | 1(50.0) | | |

[1] SHS：Suboptimal Health Status

[2] $p<0.05$

Additionally, different SHS prevalence rates are found from groups with different sleep time. As far as social roles are concerned, SHS prevalence rate for working staff of government authority and courier comes to the top of the list, which is followed by nurses, hospital technicians, students, community service providers, volunteers, public transport service providers, others, people waiting for work at home, home office workers, doctors, centers for disease control (CDC) workers, auxiliary police and housewives. In this scenario, SHS prevalence rate among science researchers and delivery men reaches its minimum level ($p < 0.05$, Table 2).

### Multivariate analysis on SHS prevalence rates of urban and rural residents

To conduct a multivariate analysis of SHS prevalence rates of urban residents, independent and dependent variables are defined. In detail, the former includes gender, BMI, education background, marital status, personal monthly income, social roles during the COVID-19 pandemic, with a history of smoking or not, with a history of alcohol use or not, time spent on electronic products and sleep time; and the latter consists of health status evaluated according to the total scale. These variables are all incorporated in the ordinal ploytomous logistic regression analysis model. It is also clarified that inclusion and rejection rates of these variables are set at 0.05 and 0.10 respectively. As proven by the statistical data, for all residents, male gender is a protective factor from SHS or being in a morbid state; considering the time spent on electronic products, three time periods of 0~2h, 2~6h and 6~12h serve as protective factors for such residents when compared with those spending more than 12 hrs on electronic products. In comparison with sleep time of 10~24h, 0~5h can be deemed as a risk factor. For rural residents, being not a CDC staff can protect a resident from SHS or a morbid state compared with members in CDC, while Smoking is a risk factor ($p < 0.05$, Table 3 and Table 4).

## DISCUSSION

### Differences between urban and rural residents in SHS

The research findings show that the SHS prevalence rate of rural residents is lower than that of urban residents during the COVID-19 pandemic based on the physiological scale, while their SHS prevalence rates in psychology, society and total scale are higher than that of urban residents. It has been demonstrated by multiple studies that rural residents generally outperform urban residents in their physical quality.[10-12] As urban residents have less time out during the COVID-19 outbreak, their regular diets and daily schedules undergo some changes and their time spent on physical activities is reduced. In the countryside with a vast area and a low population density, rural residents have much activity space and more freedom. Consequently, it is much more likely for urban residents to suffer from SHS in physical aspects compared with rural residents. For this reason, we suggest that urban residents should maintain their regular diets and follow their normal daily schedules during the COVID-19 pandemic; in addition, indoor exercise duration should also be properly extended.

It is found in this research that the psychological SHS and social SHS prevalence rate of rural residents are greater than that of urban residents. During COVID-19 pandemic, both government and all walks of life have taken many effective prevention and control measures. However, these measures still fail to completely relieve the anxiety and fear among residents. On the one hand, there are some information which are false or without official confirmation in the mass of the COVID-19 related sources. Such unreliable information likely panic people. Urban residents are more capable of differentiating the information because of their higher education background and their exposure to a wider range of knowledge, thus they will not be easily affected. Comparatively, rural residents are more prone to believing and spreading the false information, which gives rise to more negative emotions. In this consideration, the government should take more rigorous measures to supervise release of COVID-19 related information and provide official ways for people to identify the information. Also, the false and unreliable information should be timely disproved and corrected quickly. On the other hand, time of rural neighborhood affective interaction is shortened and normal interpersonal relationship suffers severe impacts due to their sticking to social distancing, avoiding going-out or gathering in the COVID-19 pandemic. They are less connected than they were before the COVID-19 outbreak. In addition, many people from rural households need to go to the downtown areas to make a living or attend school, while some of them are stranded in other places due to COVID-19 prevention. Family members only spend a short time together and family support conditions are poorer than those in cities. Consequently, it is more likely to induce psychological SHS and social SHS. In cities, family members and neighbors get along with each other in similar ways, so they get a slight influence on their relationship. Therefore, both the government and society need to help the left-behind elderly and children in the countryside and keep a watchful eye on their daily necessities and mental health.

**Table 3: Multivariate analysis on SHS[1] prevalence rates of urban residents.**

| Variable | | OR | Estimate | Std. Error | Wald | *p* | 95%CI |
|---|---|---|---|---|---|---|---|
| Gender[3] | Male | 0.856 | -0.155 | 0.054 | 8.368 | 0.004[2] | -0.261~-0.050 |
| Time spent on electronic products (h)[4] | 0~2 | 0.368 | -1.001 | 0.177 | 31.872 | <0.001[2] | -1.349~-0.653 |
| | 2~6 | 0.401 | -0.915 | 0.077 | 142.982 | <0.001[2] | -1.065~-0.765 |
| | 6~12 | 0.597 | -0.516 | 0.067 | 59.702 | <0.001[2] | -0.647~-0.385 |
| Sleep time (h)[5] | 0~5 | 3.019 | 1.105 | 0.366 | 9.097 | 0.003[2] | 0.387~1.824 |
| | 5~10 | 1.207 | 0.188 | 0.070 | 7.200 | 0.007[2] | 0.051~0.326 |

[1] SHS：Suboptimal Health Status

[2] $p<0.05$;

[3] The control group of gender was female;

[4] The time spent on electronic products in the control group was 12~24 hr;

[5] The control group of sleep time was 10-24h.

**Table 4: Multivariate analysis of SHS prevalence rates of rural residents.**

| Variable | | OR | Estimate | Std. Error | Wald | p | 95%CI |
|---|---|---|---|---|---|---|---|
| Gender[3] | Male | 0.825 | -0.192 | 0.051 | 14.485 | <0.001[2] | -0.291~-0.903 |
| Smoking[4] | Yes | 1.335 | 0.289 | 0.144 | 4.052 | 0.044[2] | 0.008~0.570 |
| Time spent on electronic products (h)[5] | 0~2 | 0.253 | -1.374 | 0.188 | 53.352 | <0.001[2] | -1.745~-1.006 -1.745~-1.006 |
| | 2~6 | 0.434 | -0.834 | 0.074 | 125.529 | <0.001[2] | -0.979~-0.688 |
| | 6~12 | 0.638 | -0.449 | 0.067 | 45.576 | <0.001[2] | -0.579~-0.319 |
| Sleep time (h)[6] | 0~5 | 4.007 | 1.388 | 0.432 | 10.347 | 0.001[2] | 0.524~2.234 |
| | 5~10 | 1.115 | 0.109 | 0.068 | 2.552 | 0.110 | -0.025~0.242 |
| Social role[7] | Doctor | 0.042 | -3.153 | 1.514 | 4.338 | 0.037[2] | -6.120~-0.186 |
| | Nurse | 0.051 | -6.927 | 1.711 | 3.010 | 0.083 | -6.320~0.385 |
| | Hospital technician | 0.023 | -3.749 | 1.888 | 3.943 | 0.047[2] | -7449~-0.049 |
| | Scientific researcher | NA[8] | NA[8] | NA[8] | NA[8] | NA[8] | -23.834~-23.834 |
| | Auxiliary | 0.007 | -4.937 | 1.755 | 7.913 | 0.005[2] | -8.378~-1.497 |
| | Public transport service provider | 0.019 | -3.915 | 1.557 | 6.321 | 0.012[2] | -6.969~-0.863 |
| | Government authority | 0.052 | -2.953 | 2.167 | 1.857 | 0.173 | -7.201~1.295 |
| | Community service provider | 0.023 | -3.791 | 1.476 | 6.595 | 0.010[2] | -6.685~-0.898 |
| | Volunteer | 0.014 | -4.301 | 1.447 | 8.839 | 0.003[2] | -7.137~-1.466 |
| | Delivery man | NA[8] | NA[8] | NA[8] | NA[8] | NA[8] | 18.098~18.098 |
| | Courier | 0.071 | -2.645 | 1.763 | 2.251 | 0.134 | -6.102~0.811 |
| | Housewife | 0.011 | -4.466 | 1.494 | 8.932 | 0.003[2] | -7.395~-1.537 |
| | Waiting for work at home | 0.014 | -4.289 | 1.442 | 8.842 | 0.003[2] | -7.117~-1.462 |
| | Home office worker | 0.011 | -4.550 | 1.445 | 9.918 | 0.002[2] | -7.381~-1.718 |
| | Student | 0.017 | -4.089 | 1.441 | 8.056 | 0.005[2] | -6.913~-1.265 |
| | Others | 0.016 | -4.100 | 1.446 | 8.047 | 0.005[2] | -6.935~-1.265 |

[1] SHS: Suboptimal Health Status
[2] $p<0.05$;
[3] The control group of gender was female;
[4] The control group smoking was the non-smoking group;
[5] The time spent on electronic products in the control group was 12~24 hr;
[6] The control group of sleep time was 10-24h;
[7] The control group of social role was CDC members;
[8] Means the sample size is too small to calculate.

## Influencing factors of SHS

### Influence of gender on SHS

As demonstrated in this research, female residents are more vulnerable to SHS. In modern society, roles assumed by women become more diversified. In addition to working pressure, they take on more family responsibilities, such as daily household chores, caring for the elderly and children's education. Apparently, women are under more pressure in these aspects.[13] Furthermore, menstrual periods and climacterium aggravate their strain of mental effort. During the outbreak of COVID-19, self-protection consciousness of residents is improved; and they also make more active responses to relevant prevention. In this context, not only is the time spent at home extended, but household duties become heavier. Consequently, the female is more occupied in looking after the elderly and children, which can apply certain influence on their physical and mental health. For the reasons above, social roles of women should be affirmed to a greater extent and pay attention to their mental health during the COVID-19 pandemic. In addition, the traditional family values should be altered as well, so that men can undertake more family responsibilities.

### Influence of time spent on electronic products per day on SHS

According to our research results, an excessively long time spent on electronic products may lead to an increase in SHS risks. Under the influence of COVID-19, online teaching is proposed and companies and enterprises are encouraged to implement online working. In this way,

residents spend much time on electronic products. Accordingly, time of physical exercises and activities is decreased. This may place certain negative influences on physical health of residents, including mental fatigue and muscular soreness. In more severe cases, these residents may suffer from some diseases, such as agrypnia, endocrine dyscrasia and other symptoms associated with cervical vertebra and vertebra lumbalis.[14] Additionally, long time of electronic product use may also affect their mental state. For example, ever-developing modern network and online games provide residents with great convenience and diversified contents. However, it is hard for residents to avoid the unsavory and violent contents in them. Once residents are excessively exposed to unhealthy information, they are likely to be subject to cognitive changes and value deviation.[15] In the context of online teaching and working, the time spent on electronic products should be reasonably allocated with the goal of avoiding negative impacts incurred by long-time use. Furthermore, the significance of using electronic products should be correctly recognized so that inappropriate content can be abandoned and adverse influence on mental health be avoided.

### Influence of sleep time per day on SHS

It is proven in this paper that reduction in sleep time among residents may increase the risk of SHS. Sleep is a necessary process that maintains the normal vital movement of human beings. Insufficient sleep may cause a series of changes in physical functions, behavior and emotions and may even lead to incapacity of body systems.[16] If the score of negative emotional status of people increases, while the score of positive emotional status declines progressively,[17] SHS might be formed. Under the influence of COVID-19, some residents feel nervous, upset and panic and even suffer from more serious problems such as sleep disorders.[4] As shown by relevant studies, science of health preserving of the traditional Chinese medicine, such as Ba Duan Jin exercise and five-notes music therapy, has a considerably significant positive influence on treatment of anxiety, agrypnia and depression.[18] Moreover, it even possesses certain advantages unique to SHS prevention and treatment. Doing exercises like rope skipping, bodybuilding exercises and Yoga at home can contribute to eliminating mental stress.

### Influence of smoking on SHS

Our findings show that smoking is subjected to a high risk of SHS, which is consistent with the findings of other literature.[19] Smoking can induce many diseases, especially pulmonary diseases, cardiovascular disease and cancers and so on,[20] and these diseases are threats to physical health. COVID-19 is believed to cause pulmonary lesions; and, major symptoms consist of cough.[1] On this occasion, residents are commonly in fear of the coughing symptom during the COVID-19 outbreak. It has been even reported online that someone calls the police because its neighbor has a cough. Some smokers may cough as hazardous substances produced by cigarettes stimulate tracheal mucosae.[21] Consequently, they frequently doubt that whether they have already been infected with COVID-19 because of their cough, which gives rise to mental stress. Under this circumstance, control over smoking should be reinforced in rural areas. No smoking signs should be correspondingly bettered and vivid publicity materials that are easy to understand should also be provided. Furthermore, rural residents should learn about systematic smoking cessation methods and receive necessary mental intervention. At last, COVID-19 related knowledge should also be popularized among them, for the purpose of alleviating the unnecessary panic.

### Influence of social roles on SHS

During the COVID-19 pandemic, CDC members in the countryside have a higher risk of being in SHS compared with other social roles. As an organizer of COVID-19 prevention and control, they are also confronted with many difficulties and under extremely heavy pressure. People working at the front line, such as CDC members and medical staff, are all exposed to certain mental problems during the COVID-19 pandemic.[22,23] Considering that only a small number of the staff working at the front line are incorporated in this research, more studies should be made to verify its influence.

## CONCLUSION

The spread of COVID-19 has exerted a tremendous impact on China and the whole world. It not only has a heavy strike in social order, economy and culture, but poses a great challenge to physical and mental health of residents. Through analysis and investigations on SHS differences of urban and rural residents in China during the COVID-19 pandemic and relevant influencing factors, it is found that SHS prevalence rates of rural residents are above those of urban residents according to their total scale, mental subscale and social subscale. As for influencing factors on SHS, the protective factors are proven to be male gender and short time spent on electronic products, while insufficient sleep and smoking are risk factors.

Hence, it is deemed that closer attention should be paid to SHS of rural residents during the COVID-19 pandemic. Especially for their mental health, more caring and support should be provided. Concrete countermeasures can be described as follows: 1) balance the distribution of resources between urban and rural areas; 2) accelerate the construction of rural mental health institutions; 3) cultivate and provide more psychological professionals for the countryside; 4) perfect a rural psychological counseling service system; 5) hold mental health knowledge lectures and provide counseling services regularly; and, 6) effectively improve mental health conditions of rural residents. In this way, the mental health status of rural residents is effectively improved and the SHS prevalence rate can be thus reduced.

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This study has been examined and approved by the Medical Ethics Committee of Hospital (No. KY-2020-016)

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

## ABBREVIATIONS

**COVID-19:** Coronavirus Disease; **SHS:** Suboptimal Health State; **BMI:** Body Mass Index; **CDC:** Centers for Disease Control.

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