

The elderly population's social networks and HIV perceptions: Evidence from China

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ABSTRACT

Background: Previous studies have found that people with low participation in social activities and living alone were prone to have risky sexual behaviors, while people with high participation in social activities were less prone to have risky sexual behaviors. Based on the above assumptions, we conducted an analysis on elderly population's social networks and human immunodeficiency virus (HIV) risky behaviors in China. In the survey study, considering the sensitivity of sexual behavior, HIV risk behavior of the elderly population is more difficult to measure, so the intermediate variable of HIV perceptions was used instead of the sexual behavioral variable. **Methods:** A cross-sectional study was conducted in July to September 2023 among the elderly aged ≥ 50 years in China to measure the social networks with the Social Support Rate Scale (SSRS) and to measure the HIV perceptions of the elderly with the degree of knowledge of acquired immunodeficiency syndrome (AIDS) prevention and treatment and the degree of discrimination of HIV/AIDS patients, and the data were statistically analyzed with SPSS 27.0 software. Statistical analysis methods included descriptive analyses such as frequency, percentage, mean \pm standard deviation, and median, two independent samples *t*-test analysis, and multivariate logistic regression model analysis. **Results:** Among the 1022 elderly people surveyed, the proportion of those with weak and strong levels of social support was 46.9% and 53.1%, respectively; the proportion of those with low, medium, and high levels of HIV knowledge perceptions was 4.8%, 5.9%, and 89.3%, respectively; and the proportion of those with low, medium, and high levels of attitudinal perceptions was 24.7%, 35.0%, and 40.3%, respectively. Based on the Goodman-Kruskal Gamma test, it was found that there was a positive correlation between social support and HIV knowledge perceptions in the elderly population, and there was a negative correlation between social support and HIV attitudinal perceptions in the elderly population. Ethnicity, current occupation or pre-retirement occupation, personal average after-tax monthly income, attitudinal perceptions, and social support were the influencing factors for the knowledge perceptions in the elderly population ($P < 0.05$); literacy, number of children, mode of residence, personal average monthly income after tax, knowledge perceptions, and social support were the influencing factors of attitudinal perceptions in the elderly population ($P < 0.05$). **Conclusions:** There is a correlation between social networks and HIV perceptions in China's elderly population, which is positively correlated with HIV knowledge perceptions and negatively correlated with HIV attitudinal perceptions, and it is important to improve the HIV prevention and knowledge of the elderly population and reduce their HIV-related discrimination.

Keywords: AIDS, elderly population, HIV perceptions, social networks, social support

Introduction

The acquired immunodeficiency syndrome (AIDS) is caused by the human immunodeficiency virus (HIV), which is mainly transmitted sexually and is a malignant infectious disease with a very high morbidity and mortality rate, and as one of the major global public health problems, it seriously jeopardizes human health. According to Joint United Nations Programme on HIV/

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How to cite this article: Shen J, Xu J. The elderly population's social networks and HIV perceptions: Evidence from China. J Family Med Prim Care 2024;13:5575-83.

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Received: 19-04-2024

Revised: 20-05-2024

Accepted: 30-05-2024

Published: 09-12-2024

Access this article online

Quick Response Code:



Website:
<http://journals.lww.com/JFMP>

DOI:
10.4103/jfmpc.jfmpc_651_24

AIDS (UNAIDS), by the end of 2022, there will be a total of approximately 39 million people living with HIV worldwide, with the number of people aged ≥ 50 years living with HIV globally increasing from 5.4 million in 2015 to 8.1 million in 2022.^[1] Similarly, the number of older HIV-infected persons/AIDS patients ≥ 50 years of age in China has increased rapidly in recent years, from 32,850 cases in 2015 to 51,856 cases in 2022. Among them, the number of HIV-infected patients ≥ 60 years old rose from 17,451 cases in 2015 to 27,004 cases in 2022, and the proportion of reported ≥ 60 years old HIV-infected patients in 2022 to all reported HIV-infected patients in the same period reached 25.1%.^[2] Compared with young people, the elderly population is highly susceptible to unsafe and high-risk sexual behaviors due to low literacy, lack of knowledge about HIV, misconceptions in perceptions and attitudes, and extremely low condom use.^[3] Most with HIV/AIDS are infected through heterosexual routes and are predominantly in the form of low-grade clandestine prostitution with high mobility.^[4]

Elderly people have declining physical functions and weakened immune system functions; once infected with HIV, they will face the “double threat” of chronic diseases and AIDS; the patient’s health further deteriorates, increasing the physical and mental burden of the patient. In 2017, the State Council issued the “China’s 13th Five-Year Plan of Action for Containing and Preventing AIDS”, which included the elderly in the key missionary population,^[5] and the prevention and control of AIDS in the elderly population are imminent.

Social networks refer to the intricate networks of social relationships between people formed through constant contact in society.^[6] According to a review of the literature on social networks and AIDS in China and abroad, there are fewer relevant empirical studies, and the only international studies focused on study of men who have sex with men (MSM) and commercial sex, and previous studies of social networks in the elderly population have mostly focused on their relationship with physical and mental health, with fewer studies on the interrelationships between social networks and HIV risk behaviors in the elderly population. Koram^[7,8] and others found that enhancing social networks increased HIV high-risk behaviors among young drug users, MSM, and other populations; Danhui Wang^[9] found that helping older populations strengthen their social networks was effective in reducing HIV risk behaviors. It is evident that enhancing social networks has different effects on different populations, with some promoting HIV risk behaviors and others hindering their occurrence. The current consensus among social experts is that improving HIV perceptions (HIV knowledge perceptions and HIV attitudinal perceptions) can effectively reduce HIV risk behaviors and lower the risk of HIV infection. Since it is difficult to measure HIV risk behaviors among the elderly in the survey, the present study used HIV perceptions as an intermediate variable to replace the final behavioral variable and investigated the characteristics of the social networks of the current elderly population and its relationship with HIV perceptions to analyze the interrelationships between the social

networks and HIV perceptions so as to provide evidence for the reduction of HIV risk behaviors among the elderly population.

Methods

Study population

In China, “elderly population” are defined as “people ≥ 60 years of age”, but in the field of HIV research, ≥ 50 years of age is generally used as the threshold for categorization of the population in order to differentiate it from the usual sexually active population (15–49 years of age group).^[10] HIV treatments such as antiretroviral therapy are becoming increasingly effective, but they also have increased complications and side effects that affect various organ systems.^[11] Because of the effects of antiretroviral therapy drugs or the virus, immunosenescence is faster in people with HIV/AIDS than in the general population,^[12–14] and HIV accelerates the aging process by approximately 4.9 years,^[15] and people with HIV/AIDS who are 50 years of age may be advancing into the old age of a healthy person. In order to analyze the social networks characteristics of the elderly population and their relationship with HIV perceptions, this study selected people ≥ 50 years of age as the study population.

Data collection

From July to September 2023, a cross-sectional study method was used to distribute and collect electronic questionnaires with the help of two platforms, Sojump and Credano, to obtain valid data after screening noncompliant and abnormal data and then enter the statistics and analysis stage. Sojump and Credano are two more commonly used tools in academic survey research,^[16–18] of which Credano has a sample database of more than 2 million participants, with a sufficiently large sample size, in which the selected samples are random and representative.^[19] The questionnaire included the general demographic characteristics, HIV perceptions, and social networks of the respondents.

Sociodemographic characteristics including age, gender, ethnicity, education level, household registration type, marital status, number of children, mode of residence, current occupation or pre-retirement occupation, and average monthly income of an individual after tax.

HIV perceptions include HIV knowledge perceptions and HIV attitudinal perceptions. In order to accurately assess the knowledge of HIV, the “basic knowledge of HIV” in the “China AIDS Prevention and Control Supervision and Evaluation Framework” (Article 8) was used as the title,^[20] and the reliability test was conducted on the eight questions, and the results showed that the Cronbach’s alpha coefficient was 0.836, which was a good reliability. The total score ranged from 0 to 8, with higher scores indicating a higher level of HIV health-related knowledge, and the total score was divided equally into three knowledge categories. The total score of knowledge perceptions was divided into three knowledge levels; 0–3 points were set as low awareness, 4–5 points were set as medium awareness, and 6–8 points were set

as high awareness, in which the percentage of people with high knowledge (answering ≥ 6 questions correctly) can be defined as the knowledge rate of HIV prevention and treatment^[21]; nine questions were set in the HIV attitudinal perceptions section on attitudes toward people living with HIV/AIDS, and the nine questions were subjected to a reliability test. The results showed that the Cronbach's alpha coefficient was 0.842, which had a good reliability. Nine questions were reverse-scored according to the degree of discrimination, with nondiscrimination scored as "1", uncertainty scored as "2", and discrimination scored as "3", and the total score ranged from 9 to 27, with higher scores indicating a positive attitude toward HIV patients. The higher the score, the more discriminatory the attitude toward people living with HIV/AIDS. Attitudinal perceptions were equalized into three levels of discrimination, with scores of 9 to 15 defined as low discrimination, 16 to 21 defined as medium discrimination, and 22 to 27 defined as high discrimination.

Social networks

The Social Support Rate Scale (SSRS) compiled by Shuiyuan Xiao^[22] and others in 1987 was used to determine the strength of the social networks of the population by the strength of social support. The Cronbach's alpha coefficient of the scale is 0.836, which has good reliability. The scale contains three dimensions of objective support, subjective support, and utilization of social support, with ten entries. Objective support refers to the active utilization of support, that is, the extent to which one can rely on others when needed; subjective support refers to the degree of satisfaction with the support received, rating the subjective experience of support; and utilization of support refers to the objective resources that can be utilized. From Articles 1 to 4 and from 8 to 10, only one is chosen; 1, 2, 3, and 4 items had 1, 2, 3, and 4 points; Article 5 is divided into A, B, C, and D with four total points, each item from none to full support was 1 to 4 points; from Articles 6 and 7, if the answer is "no source", it will be 0 points: the answer "the following sources" will be 0 points. If the answer to items 6 and 7 is "no source", it will be scored 0 points; if the answer is "the following sources", it will be scored several points if there are several sources. The total score of social support is the sum of the ten entries; objective support is the sum of the scores of 2, 6, and 7; subjective support is the sum of the scores of 1, 3, 4, and 5; and the utilization of support is the sum of the scores of 8, 9, and 10;^[22] the total score ranges from 12 to 66, and the higher the score, the better the individual's level of social support is. 12–43 indicates weak support, and 44–66 indicates strong support.^[23]

Statistical analysis

Data were organized using Excel, and SPSS 27.0 software was used to statistically analyze the general demographic characteristics of the survey respondents, HIV knowledge perceptions, attitudinal perceptions, and social support, which mainly included descriptive analysis, correlation analysis, multifactor analysis, and other statistical analysis methods. Frequency, percentage, mean \pm standard deviation, median,

and so on were used to conduct descriptive analysis of sociodemographic characteristics such as age, gender, ethnicity, and literacy level of the elderly population, HIV knowledge perceptions, attitudinal perceptions, and social support; the two independent samples *t*-test model was used to analyze whether the differences in knowledge perceptions and attitudinal perceptions of the elderly population with different levels of social support were statistically significant the HIV knowledge perceptions or attitudinal perceptions as dependent variables, age, gender, ethnicity, literacy, other sociodemographic characteristics, and social support as independent variables using the multiple logistic regression model to analyze the influence factors of HIV knowledge perceptions or attitudinal perceptions in the elderly population; $P < 0.05$ indicates that the difference is statistically significant.

Results

Basic information

A total of 1022 study subjects were investigated, all of whom were ≥ 50 years old, with the youngest being 50 years old and the oldest being 85 years old, with a mean age of (57.35 ± 5.30) years old and more females (52.5%, 537/1022) than males (47.5%, 485/1022), and were of the Han nationality (97.7%, 999/1022), high school, secondary and tertiary education (45.8%, 468/1022), urban household registration (76.6%, 783/1022), married (93.3%, 964/1022), number of children ≤ 1 (61.4%, 628/1022), living with spouse/children/parents (99.3%, 960/1022) current occupation or preretirement occupation are enterprise and public institution employees (63.2%, 646/1022), and the average monthly income of an individual after tax ≤ 5000 RMB (40.6%, 415/1022) are dominant. See Table 1.

HIV perceptions in the elderly population

HIV knowledge perceptions

The summary statistics of the scores of the eight questions answered by the study participants on the knowledge of AIDS prevention and treatment were as follows: The lowest score was 0, the highest score was 8, and the average score was (6.96 ± 1.768), with a median score of 8 points. Elderly people who scored ≤ 3 points (low awareness) accounted for (4.8%, 49/1022), those who scored 4–5 points (medium awareness) accounted for (5.9%, 60/1022), and those who scored 6–8 points (high awareness) accounted for (89.3%, 913/1022), as shown in Figure 1. The rate of knowledge on AIDS prevention and treatment among the elderly population was (89.3%, 913/1022). The question "Is it possible to get AIDS by sharing syringes with HIV-infected people?" had the highest percentage of correct answers (95.2%, 973/1022), and the question "Can mosquito bites spread AIDS?" had the lowest percentage of correct responses (64.5%, 659/1022).

Attitudinal perceptions

Summary statistics of responses to the nine questions reflecting attitudes toward people living with HIV/AIDS, with a

Table 1: Sociodemographic characteristics of the elderly population

	Variant	Quantities	Percentage
Age (years)	50-60	801	78.4
	61-70	193	18.9
	≥71	28	2.7
Gender	male	485	47.5
	female	537	52.5
Ethnicity	the Han nationality	999	97.7
	others	23	2.3
Education level	junior high school and below	177	17.3
	high school and secondary and college	468	45.8
	bachelor's degree and above	377	36.9
Household Registration Type	urban	783	76.6
	rural	239	23.4
Marital status	unmarried	25	2.4
	married	964	93.3
	divorced or widowed	43	4.2
Number of children (number)	≤1	628	61.4
	2	337	33.0
	≥3	57	5.6
Mode of residence	live alone	55	5.4
	with spouse/children/parents	960	93.9
	others	7	0.7
Current occupation or pre-retirement occupation	employees of party and government organizations	75	7.3
	enterprise and public institution employees	646	63.2
	self-employed	122	11.9
	peasants	85	8.3
	nonemployed or unemployed	45	4.4
	others	49	4.8
Average monthly income of an individual after tax (RMB)	≤5000	415	40.6
	5001-7500	318	31.1
	≥7501	289	28.3

minimum score of 10, a maximum score of 27, a mean score of (19.16 ± 4.454) , and a median score of 20 are provided. The percentage of older people who scored 9–15 points (low discrimination) was (24.7%, 252/1022), the percentage of older people who scored 16–21 points (medium discrimination) was (35.0%, 358/1022), and the percentage of older people who scored 22–27 points (high discrimination) was (40.3%, 412/1022). See Figure 2.

Social support for the elderly population

The total social support score of the 1022 study participants was (43.99 ± 7.785) , with an objective support score of (10.69 ± 2.959) , a subjective support score of (25.25 ± 4.175) , and a utilization of support score of (8.05 ± 2.285) . The percentage of older people with a total social support score of 12 to 43 (weak support) (46.9%, 479/1022) and a total social support score of 44 to 66 (strong support) (53.1%, 543/1022) is provided. See Figure 3.

In the weakly supported elderly population, the mean knowledge perceptions score was (6.54 ± 2.127) with a median of 7, and the mean attitudinal perceptions score was (19.49 ± 4.213) with a median of 20; in the strongly supported elderly population, the mean knowledge perceptions score was (7.33 ± 1.267) with a median of

8, and the mean attitudinal perceptions score was (18.86 ± 4.641) points with a median of 20. Analyzed by two independent samples *t*-test, respectively, it was found that the difference in knowledge perceptions of the elderly with different levels of social support was statistically significant, $P < 0.001$, and the difference in attitudinal perceptions of the elderly with different levels of social support was also statistically significant, $P < 0.05$. See Table 2.

Multifactor analysis

In this study, the influencing factors of knowledge perceptions and attitudinal perceptions were analyzed separately, and knowledge perceptions (low, medium, and high awareness) or attitudinal perceptions (low, medium, and high discrimination) of the elderly population were used as the dependent variables, and since the dependent variable ending was an ordered categorical variable, an ordered multicategorical logistic regression model was preferred, and the results of the test of parallelism, $P < 0.05$, were not passed by the test, so the unordered multicategorical logistic regression model was chosen. Separately, the knowledge perceptions and attitudinal perceptions of the elderly population were used as dependent variables, and sociodemographic characteristics such as age, gender, ethnicity, education level, and social support were used as independent variables for unordered multicategorical logistic regression analysis.

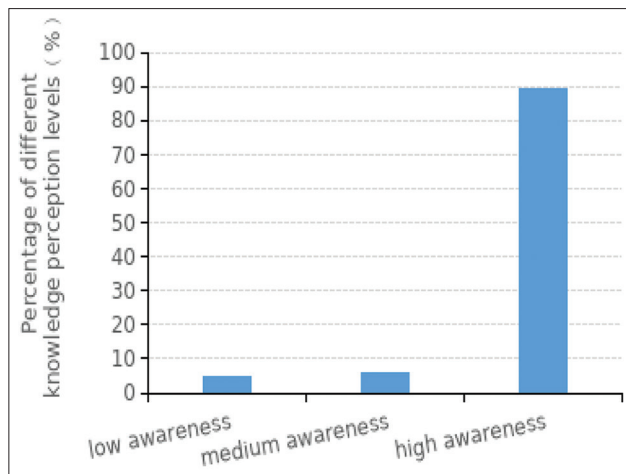


Figure 1: HIV knowledge perceptions among the elderly population

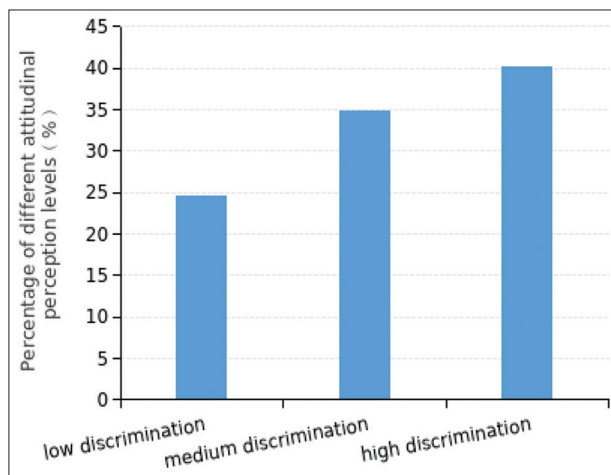


Figure 2: HIV attitudinal perceptions among the elderly population

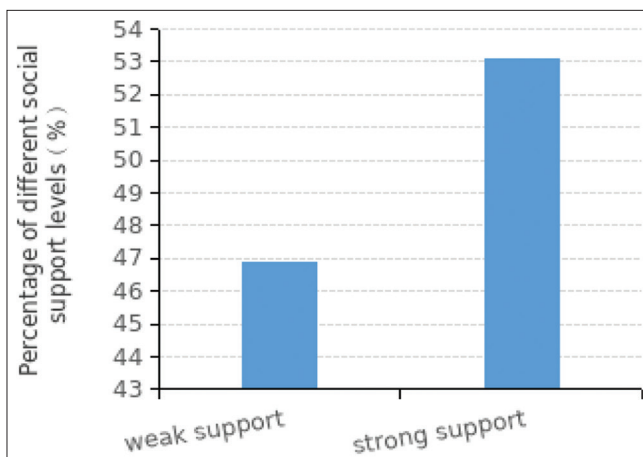


Figure 3: Social support among the elderly population

The low level of HIV knowledge perceptions was used as the reference group to compare the medium and low levels of HIV knowledge perceptions in the elderly population, and the results showed that compared with the Han nationality, other ethnic groups (OR = 125036038) had a higher level of AIDS prevention

and treatment knowledge; compared with the nonemployed or unemployed people, self-employed people (OR = 5.607) had a higher level of AIDS prevention and treatment knowledge; compared with the HIV attitudinal perceptions, high discrimination level compared to medium discrimination level (OR = 5.741) AIDS prevention and treatment knowledge is higher; compared to social support strong support level, weak support level (OR = 0.253) AIDS prevention and treatment knowledge of the elderly is lower.

Using the low level of HIV knowledge perceptions as the reference group, the results of comparing the high and low levels of HIV knowledge perceptions in the elderly population showed that compared with the nonemployed or unemployed people, the level of HIV prevention and treatment knowledge was higher among the self-employed people (OR = 4.655); compared with the average monthly income of an individual of ≥ 7501 RMB after tax, the lower the monthly income (5001 RMB to 7500 RMB OR 0.171; $\leq 5,000$ RMB OR = 0.136), the lower the level of AIDS prevention and treatment knowledge; the higher the level of discrimination (low discrimination OR = 30.105; medium discrimination OR = 6.788), the lower the level of AIDS prevention and treatment knowledge among older people when compared to the high level of perceived discrimination in HIV attitudes; and the weaker the level of support (OR = 0.276) when compared to the strong level of support from the social support of the older people had a lower level of knowledge about HIV prevention and treatment than those with a strong level of social support (OR = 0.276).

Using HIV attitudinal perceptions with a low discrimination level as the reference group, the results of comparing medium and low discrimination levels of HIV attitudinal perceptions in the elderly population showed that the lower the monthly income (5001 RMB to 7500 RMB OR = 1.748; ≤ 5000 RMB OR = 2.464), the more discriminatory older people were toward people with HIV/AIDS compared to the average monthly income of individuals ≥ 7501 RMB after taxes; older people with medium awareness (OR = 3.823) were more discriminatory toward people with HIV/AIDS compared to older people with high awareness, and older people with a weak level of support (OR = 1.735) were more discriminatory toward people with HIV/AIDS compared to the strong level of support from social support.

The results of comparing high and low discrimination levels of HIV attitudinal perceptions in the elderly population using a low discrimination level of HIV attitudinal perceptions as the reference group showed that compared with bachelor's degree and above, the elderly with high school and secondary and college education (OR = 2.191) were more discriminatory toward people with HIV/AIDS; compared with the number of children ≥ 3 , the number of children ≤ 1 (OR = 3.783) were more discriminatory against people living with HIV/AIDS; older people who lived alone (OR = 0.293) and in other residences (OR = 0.038) were less discriminatory against people

Table 2: HIV perception scores among older people with different levels of social support

	\bar{x} , M, s		P
	weak support	strong support	
Knowledge perceptions (points)	6.54, 7, 2.127	7.33, 8, 1.267	<0.001
Attitudinal perceptions (points)	19.49, 20, 4.213	18.86, 20, 4.641	0.023

living with HIV/AIDS than those who lived with their spouse/children/parents, and older people with an average after-tax monthly income of ≥ 7501 RMB per month compared to those with an average after-tax monthly income of 5001 RMB to 7500 RMB per month (OR = 2.673) and monthly income ≤ 5000 RMB (OR = 2.577) were more discriminatory toward people living with HIV/AIDS; compared to high levels of perceived HIV knowledge, the lower the level of knowledge (low awareness OR = 31.317; medium awareness OR = 4.558), the more discriminatory older people were toward people living with HIV/AIDS, and compared to strong levels of supportive social support, when the level of supportive social support was weaker (OR = 1.455), older people were more discriminatory toward people with HIV/AIDS. See Table 3.

Discussion

HIV perceptions and social support in the elderly population overall

In this study, HIV perceptions in the elderly population consisted of two parts: knowledge perceptions and attitudinal perceptions. It was found that the average knowledge perceptions core of the elderly population was (6.96 ± 1.768), with a median score of 8. The three levels of low, medium, and high awareness accounted for 4.8%, 5.9%, and 89.3%, respectively, and were mainly concentrated in the high awareness level. The knowledge rate of AIDS prevention and treatment among the elderly population (answering ≥ 6 questions correctly) was 89.3%, which was higher than that of the elderly population in Fangshan District of Beijing and other areas^[24-26] and lower than that of the elderly population in Guangxi and other areas^[27] and had not yet reached “The knowledge rate of AIDS prevention and treatment among the elderly reaches more than 90%”.^[28] The elderly population has some discrimination against people with HIV infection/AIDS, and the proportion of elderly people with low, medium, and high discrimination levels of attitudinal perceptions was 24.7%, 35.0%, and 40.3%, respectively, and the average score of attitudinal perceptions was (19.16 ± 4.454).

The total score of social support for the elderly was (43.99 ± 7.785), of which the objective support score was (10.69 ± 2.959), the subjective support score was (25.25 ± 4.175), and the utilization of support score was (8.05 ± 2.285), and the mean value of all scores except subjective support was lower than that of the national norms.^[29] The levels of weak and strong social support in the elderly population were 46.9% and 53.1%, respectively.

Analysis of the relationship between HIV perceptions and social support in the elderly population

The *t*-test of two independent samples showed that there were significant differences in the overall mean scores of HIV knowledge perceptions and attitudinal perceptions between different levels of social support, $P < 0.05$. The mean score of knowledge perceptions of older people with a weak support level (6.54 ± 2.127) was lower than the mean score of knowledge perceptions of older people with a strong support level (7.33 ± 1.267); that is, older people with a weak support level had poorer knowledge of AIDS. The mean score of the knowledge of prevention and treatment among the elderly with a weak support level (19.49 ± 4.213) was higher than that of the elderly with a strong support level (18.86 ± 4.641), which means that the elderly with a weak support level were more discriminatory against HIV/AIDS patients.

The Gamma correlation analysis showed that there was a correlation between HIV knowledge (low, medium, and high awareness) and social support (weak support and strong support) in the elderly population, and knowledge perceptions was moderately positively correlated with social support, with a correlation coefficient of $G = 0.508$, while HIV attitudinal perceptions in the elderly population was weakly negatively correlated with social support, with a correlation coefficient of $G = -0.108$.

After multivariate unordered logistic regression analysis, the main factors influencing the perceptions of HIV knowledge in the elderly population were ethnicity, current occupation or pre-retirement occupation, average monthly income of an individual after tax, attitudinal perceptions, and social support. Medium knowledge level (medium awareness) was compared against low knowledge level (low awareness), in which the highest correlation was ethnicity (other ethnicity OR = 125036038), followed by attitudinal perceptions (medium discrimination OR = 5.741), current occupation or pre-retirement occupation (self-employed OR = 5.607), and social support (weak support OR = 0.253), respectively, and social support was a protective factor for knowledge perceptions, weak support. The level of knowledge about HIV prevention and treatment among older people was 0.253 times higher than that of strongly supported older people; high knowledge level (high awareness) was compared against low knowledge level (low awareness), where the highest correlation was attitudinal perceptions (low discrimination OR = 30.105; medium discrimination OR = 6.788), followed by current occupation or pre-retirement occupation, (self-employed OR = 4.655), social support (weak support OR = 0.276), and average monthly income of an individual after tax (5001–7500 RMB OR = 0.171; ≤ 5000 RMB OR = 0.136), and social support was a protective factor for knowledge perceptions, with the level of knowledge about HIV prevention and treatment among weakly supported older people being 0.276 times higher than that of the strongly supported older people.

Table 3: Multiple unordered logistic regression analysis of HIV perceptions in the elderly population

	Model 1 (medium awareness/low awareness)		Model 2 (high awareness/low awareness)		Model 3 (medium discrimination/low discrimination)		Model 4 (high discrimination/low discrimination)	
	<i>B</i>	Exp (<i>B</i>)	<i>B</i>	Exp (<i>B</i>)	<i>B</i>	Exp (<i>B</i>)	<i>B</i>	Exp (<i>B</i>)
b	1.300		3.143		-1.095		-2.020	
Age (years) (≥ 71 as reference)								
50-60	-0.276	0.759	0.892	2.440	0.024	1.024	-0.231	0.794
61-70	0.495	1.640	1.177	3.244	-0.391	0.676	-0.352	0.703
Gender (female as reference)								
Male	0.506	1.658	0.486	1.626	0.208	1.231	0.274	1.316
Ethnicity (the Han nationality as a reference)								
Others	18.644***	125036038	18.052	69130555.9	-0.076	0.927	-0.053	0.949
Education level (Bachelor's degree and above as a reference)								
Junior high school and below	-0.017	0.983	-0.053	0.948	0.277	1.319	0.588	1.800
High school and secondary and college	-0.157	0.854	0.643	1.902	0.240	1.272	0.784***	2.191
Household registration type (rural as a reference)								
Urban	-0.102	0.903	0.402	1.495	0.140	1.151	-0.463	0.630
Marital status (married by reference)								
unmarried	-0.673	0.510	-0.082	0.922	-1.152	0.316	0.003	1.003
Divorced or widowed	-0.958	0.384	-0.573	0.564	0.911	2.487	0.783	2.187
Number of children (≥ 3 as reference)								
≤ 1	-0.326	0.722	-0.883	0.414	0.730	2.075	1.331**	3.783
2	-0.564	0.569	-0.991	0.371	0.058	1.060	0.574	1.776
Mode of residence (with spouse/children/parents as reference)								
Others	-1.351	0.259	-2.021	0.133	-1.282	0.277	-3.268*	0.038
live alone	0.018	1.018	-1.053	0.349	-0.463	0.629	-1.229*	0.293
Current occupation or pre-retirement occupation (nonemployed or unemployed as a reference)								
Employees of party and government organizations	0.323	1.381	0.925	2.521	-0.304	0.738	0.870	2.387
Enterprise and public institution employees	0.158	1.171	1.609	2.911	0.021	1.021	0.788	2.199
Self-employed	1.724*	5.607	1.538*	4.655	-0.417	0.659	-0.057	0.944
Peasants	-0.551	0.576	0.175	1.191	-0.144	0.866	0.429	1.536
Others	0.140	0.869	0.731	2.078	0.536	1.709	-0.805	2.238
Average monthly income of an individual after tax (RMB) (≥ 7501 as reference)								
≤ 5000	-0.320	0.726	-1.995*	0.136	0.902***	2.464	0.947***	2.577
5001-7500	-0.704	0.495	-1.767*	0.171	0.559*	1.748	0.983***	2.673
Knowledge perceptions (high awareness as a reference)								
low awareness					1.559	4.754	3.444***	31.317
medium awareness					1.341**	3.823	1.517**	4.558
Attitudinal perceptions (high discrimination as a reference)								
low discrimination	1.983	7.264	3.405**	30.105				
medium discrimination	1.748***	5.741	1.915***	6.788				
Social support (strong support as a reference)								
weak support	-1.375**	0.253	-1.289**	0.276	0.551**	1.735	0.375*	1.455

Level of significance: ***denotes $P < 0.001$ **denotes $P < 0.01$ *denotes $P < 0.05$

After multivariate unordered logistic regression analysis, the main factors influencing the perceptions of HIV attitudes in the elderly population were education level, number of children, mode of residence, average monthly income of an individual after tax, HIV knowledge perceptions, and social support. The level of discrimination in the perceptions of HIV attitudes was compared to the level of low discrimination, with the highest correlation being the perceptions of HIV knowledge (medium awareness OR = 3.823), followed by average monthly income

of an individual after tax (≤ 5000 RMB OR = 2.464; 5001 RMB to 7500 RMB OR = 1.748) and social support (weak support OR = 1.735). Social support was a risk factor for attitudinal perceptions, and the discrimination level of weakly supported older people toward people with HIV/AIDS was 1.735 times higher than that of the strongly supported older people. Levels were compared against low discrimination level, with the highest correlation being HIV knowledge perceptions (low awareness OR = 31.317; medium awareness OR = 4.558), followed

by number of children (≤ 1 OR = 3.783), average monthly income of an individual after tax (5001 RMB to 7500 RMB OR = 2.673; ≤ 5000 RMB OR = 2.577), education level (high school and secondary and college education OR = 2.191), social support (weak support OR = 1.455), and mode of residence (living alone OR = 0.293; other modes of residence OR = 0.038). Social support was a risk factor for attitudinal perceptions, and the level of discrimination against people with HIV/AIDS among weakly supported older people was 1.455 times higher than that among strongly supported older people.

There are correlations between social networks and HIV perceptions, which are positively correlated with HIV knowledge perceptions and negatively correlated with HIV attitudinal perceptions; that is, the weaker the social networks, the worse the HIV perceptions of the older people, but it does not mean that the older people will definitely develop HIV risk behaviors because HIV perceptions are only one intermediate variable, and there are a lot of other influencing factors from HIV perceptions to the development of HIV risk behaviors.

Conclusions

This study suggests that the HIV perceptions and social support of the elderly population ≥ 50 years old in China need to be further improved, and the elderly population who are the Han nationality, nonemployed or unemployed, have a low average monthly income after tax, have a high level of discrimination against people with HIV/AIDS, and have a weak social support can be subsequently taken as a key population group, and targeted or diversified publicity and intervention activities should be adopted to emphasize the key points and strengthen the knowledge of AIDS health in a sustained manner. Publicize so that the elderly can acquire more comprehensive and systematic AIDS-related knowledge, thus comprehensively improving the level of knowledge of AIDS prevention and treatment among the elderly population; strengthen the anti-discrimination publicity against AIDS for the elderly population who have high school and secondary and college education, the number of children ≤ 1 , live alone or in other living modes, have a low average after-tax monthly income, have a low level of HIV knowledge perceptions, and have weak social support so as to reduce the level of discrimination against people living with HIV/AIDS patients. Through the above interventions, we will help the elderly population to build comprehensive social networks, improve the strength of social support for the elderly population, and encourage them to reduce their HIV risk behaviors so as to protect the sexual health of the elderly population.

Limitations

The size of the elderly population aged 50 and above is huge, but this study only surveyed 1022 older people, which is a small sample size, and chose older people who can use smartphones as the survey object, so the sample represents certain limitations and cannot fully reflect the actual situation of social networks

and HIV perceptions of the elderly population in China; the social networks of the elderly population affects HIV perceptions, which does not mean that it necessarily influences the risk behaviors of HIV, and the perceptions of HIV are only one intermediate variable from the social networks to the risk behaviors of HIV.

Ethics approval and consent to participate

The study protocol and consent procedure were approved by Ethics Committee of School of Public Health, Zhejiang University School of Medicine (ZGL202203-6).

Consent for publication

All authors have agreed with the content and approved the submission of the manuscript.

Acknowledgments

We are grateful to all study participants for their valuable participation.

Financial support and sponsorship

This work was supported by, Project of Evaluation of Chronic Disease Health Management Policies (project number 2023-SKY-A07054-0010), Fundamental Research Funds for the Central Universities and China Medical Board (project number 20-391).

Conflicts of interest

There are no conflicts of interest.

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