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ORIGINAL RESEARCH

Associations Between Health Literacy and Chronic Disease Prevalence Among Employees in Chinese Petroleum Companies: A Cross-Sectional Study

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Background: Employees in the petrochemical industry are exposed to numerous occupational hazards, contributing to a higher prevalence of chronic diseases. Health literacy, which reflects an individual's ability to access, understand, and use health information, is a critical factor in managing chronic diseases. However, its specific role in this workforce is not well understood.

Objective: This study investigates the associations between health literacy and the prevalence and number of chronic diseases among employees in a Chinese petrochemical company.

Methods: In March 2022, a cross-sectional survey collected 39,491 valid responses from employees of a large petrochemical company in Shandong Province, China. Health literacy was measured using the National Health Literacy Monitoring Questionnaire, while chronic disease prevalence and number were self-reported. Logistic and linear regression were used to examine associations between health literacy and chronic disease prevalence and count, respectively.

Results: Among respondents, 72.1% reported at least one chronic disease, and 53.9% were classified as having adequate health literacy. The domain of Health-Related Skills had the lowest qualification rate (46.4%), and the dimension of Chronic Disease Prevention and Control was the lowest-scoring dimension (33.0%). Overall health literacy was not significantly associated with chronic disease prevalence but was negatively associated with the number of chronic diseases (B = −0.05, 95% CI: −0.08 - −0.02, $p < 0.001$). Notably, higher literacy in Chronic Disease Prevention and Control was significantly associated with both reduced prevalence (OR = 0.95, 95% CI: 0.90–1.00, p = 0.034) and fewer chronic diseases (B = −0.01, 95% CI: −0.02–0.00, p = 0.004).

Conclusion: While overall health literacy was not significantly associated with chronic disease prevalence, it was negatively associated with the number of chronic diseases. Moreover, health literacy in Chronic Disease Prevention and Control showed significant associations with both lower prevalence and fewer chronic diseases.

Keywords: health literacy, chronic disease, petrochemical companies, health management, health promotion

Introduction

The petrochemical industry is critical in China's economic development, yet it poses significant occupational hazards that demand comprehensive risk management strategies.[1] These hazards include ergonomic challenges from physically demanding tasks, exposure to hazardous chemicals, inherent industrial risks, psycho-social stress linked to high-intensity work environments, and biological threats from harmful substances.[2,3] Moreover, unhealthy lifestyle factors, such as poor dietary habits, smoking, and physical inactivity, further compound these risks, contributing to a disproportionately high prevalence of chronic diseases among workers in this sector.[4]

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The petrochemical workforce experiences a notably higher prevalence of chronic diseases than the general population, as documented in an emerging body of research. For example, a survey of 123 oil workers in Western Siberia reported an 86.2% chronic disease prevalence,[5] while studies of offshore employees and refinery workers found rates ranging from 14.8% to 16.3% for hypertension.[6,7] In contrast, national data indicate a 34.3% chronic disease prevalence in the general Chinese population.[8] However, existing research on chronic diseases among petrochemical industry employees often involves small samples and focuses on individual conditions.

One important factor influencing the prevalence of chronic diseases is health literacy. According to the World Health Organization, health literacy refers to "the personal knowledge and competencies accumulated through daily activities, social interactions, and across generations." Health literacy deficiency represents a widespread global challenge. According to the European Health Literacy Survey, nearly half of adults across eight European countries exhibited inadequate or problematic health literacy, with prevalence rates ranging from 29% in the Netherlands to 62% in Bulgaria.[9] Similarly, in China, the 2024 National Health Literacy Survey reported that only 31.87% of the general population possessed adequate health literacy.[10]

Extensive research highlights the critical role of health literacy in influencing health outcomes.[11–14] Among these outcomes, the link between health literacy and chronic disease is especially notable, with individuals suffering from chronic conditions frequently showing limited health literacy.[15] Health literacy is crucial in improving the physical and mental quality of life for those suffering from chronic diseases.[16] Additionally, evidence indicates that initiatives to enhance health literacy led to favorable outcomes for chronic disease patients, including increased knowledge, improved general health, and better psychological well-being. This improvement is marked by decreased depression and anxiety levels and increased self-efficacy.[17] In response, multiple countries have launched programs through their occupational health and safety departments to bolster health literacy.[18] Given the combined exposure to occupational hazards and behavioral risk factors in this workforce, understanding the role of health literacy in this context is particularly important for informing targeted interventions.

To better understand this relationship, this study adopts the Knowledge-Attitude-Behavior (KAB) model as a theoretical framework. The KAB model describes behavior change as a sequential process, where individuals first acquire knowledge, which shapes their attitudes, ultimately leading to behaviors. According to this model, employees with higher health literacy are more likely to recognize chronic disease risk factors (knowledge), develop positive attitudes toward prevention (attitude), and adopt healthier behaviors such as regular check-ups and lifestyle modifications (behavior). Given this framework and prior literature, this study hypothesizes that health literacy is negatively associated with both the prevalence and number of chronic diseases among employees in the petrochemical industry.

Methods

Research Design and Participants

This cross-sectional study was conducted in one of the largest state-owned petrochemical companies in China, located in Shandong Province. The company was selected due to its extensive scale, diverse operational functions, and comprehensive workforce structure. During the formal investigation phase, an online survey was launched on the company's internal website on April 1, 2022, and remained accessible for one week, and all employees were invited to participate. Among approximately 108,000 employees, 45,024 individuals voluntarily participated in the survey. All procedures strictly adhered to relevant ethical guidelines and regulations. To maintain response integrity and mitigate potential dishonesty, the survey was designed to allow a maximum of two screen switches per respondent during completion. This measure was implemented to ensure the reliability of the data collected by preventing respondents from potentially exiting the survey interface to search for answers. The online survey platform included an automatic detection feature that tracked screen switches. Participants were informed before beginning the survey that switching screens more than twice or taking longer than 40 minutes to complete the survey would render their responses invalid due to potential cheating (eg, searching for answers to the health literacy questions). These cutoff thresholds were determined based on findings from a pilot study and expert consultation conducted prior to the formal survey. Of the 45,024 responses received, 5078 were excluded based on these criteria, with an additional 455 responses excluded due to missing core data. Given the low proportion and the assumption that the data were missing at random, listwise deletion was adopted. This process resulted in 39,491 valid responses, yielding an effective response rate of 87.7%.

Measures

The questionnaire used in this research comprises three distinct sections:

Socio-demographic information: This section collects details about the participants' sex, age, marital status, education, job position, and monthly income.

Health Literacy Assessment

For this section, we utilized the "2020 National Health Literacy Monitoring Questionnaire" formulated by the National Health Commission, which is specifically designed for the Chinese population. This instrument has been widely adopted in various health literacy studies across China, demonstrating robust psychometric properties, including reliability and validity. In the questionnaire, the three domains—Basic Knowledge and Attitudes, Health-Related Skills, and Healthy Behaviors and Lifestyles—are assessed based on the accuracy of respondents' answers to individual questions. Each question is scored as either correct or incorrect, and the total score for each domain is calculated by summing the scores of all related questions. Further, it can also be divided into six dimensions: Scientific Views of Health, Health Information, Infectious Disease Prevention and Control, Chronic Disease Prevention and Control, Safety and First Aid, and Primary Medical Care. The total score of the questionnaire, reflecting the overall health literacy level of the respondents, ranges from 0 to 73 points. Respondents were classified as having a high health literacy level based on their total score if they correctly answered over 80% of the questions, as well as within each specific domain or dimension. Those who did not meet this threshold were classified as having a low health literacy level. The 80% threshold was set according to the official standard of the National Health Commission, which has been consistently used in China's National Health Literacy Survey since 2012. This threshold serves as a benchmark for both academic and policy-related assessments in China.[19] Based on previous studies, in the statistical analysis, total scores were treated as a continuous variable in the linear regression model, while qualification status was used as a binary variable (high = 1; low'= 0) in the logistic regression model.

Chronic Disease Prevalence

This section aims to ascertain the presence of chronic diseases among respondents using a self-reported questionnaire specifically designed to assess chronic conditions. Despite potential limitations, such as recall bias and the lack of clinical validation, self-reported data remains a valid and practical method for estimating the prevalence of chronic diseases in large population studies.[20,21] The questionnaire included a question asking, "Which of the following chronic diseases do you have?" Respondents were provided with a list of common chronic diseases, such as hypertension, diabetes, cardiovascular disease, and respiratory diseases. Chronic diseases were defined according to the World Health Organization as long-term health conditions that require ongoing medical attention or limit daily activities. Additionally, there was an open-ended option labeled "Other" to capture any conditions not listed. The term "number of chronic conditions" specifically refers to the total count of currently existing chronic diseases reported by the respondents. Based on this question, two variables were generated for analysis. The first variable indicates whether or not a respondent has any chronic disease, treated as a binary variable. The second variable quantifies the number of chronic diseases reported by each respondent, treated as a continuous variable.

Statistical Analysis

Descriptive statistics, specifically frequency (N) and percentage (%), were employed to delineate the socio-demographic attributes of the study participants as well as to assess the health literacy scores across different domains and dimensions. A one-way Analysis of Variance (ANOVA) was conducted to assess chronic disease prevalence among different socio-demographic groups. Binary logistic regression was applied to explore associations between health literacy levels and chronic disease prevalence in the cohort. Furthermore, linear regression analysis was employed to assess whether there is an association between health literacy and the number of chronic diseases. The results were articulated in terms of Odds Ratios (ORs) and regression coefficients (B values), accompanied by their respective 95% Confidence Intervals (CIs). This provides a comprehensive measure of the strength and direction of the associations, offering insights into both the likelihood of disease occurrence as indicated by ORs and the expected change in disease count as reflected by B values.

The threshold for statistical significance was established at $P < 0.05$. All statistical computations and analyses were executed utilizing the SPSS 22.0. This study was approved by the Ethics Committee of Traditional Chinese Medicine

Hospital in Dongying District (Approval No. ZYY-LL-006). All participants were informed about the purpose and procedures of the study and provided their written informed consent prior to participation. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Results

Socio-Demographic Characteristics

The sociodemographic characteristics of the participants in this study are shown in Table 1. The majority of participants were male (58.7%), married (90.8%), and aged between 40 and 49 years (55.3%). Regarding education, more than half of the participants had earned a bachelor's degree or higher (55.4%). The predominant occupation was operator (60.2%), and most participants reported a monthly income of less than 4000 RMB (91.0%). Chi-square tests demonstrated statistically significant associations across all examined variables, including gender, age, marital status, education

Table 1 Socio-Demographic Characteristics of the Respondents

Characteristics	Overall; n (%)	Health Literacy (High)	Health Literacy (Low)	$\chi 2$	*P*
Gender; n (%)					
Male	23,187(58.7)	13,605	9582	514.647	< 0.001
Female	16,304(41.3)	7682	8622		
Age group; n (%)					
<30	478(1.2)	222	256	112.915	< 0.001
30–39	6753(17.1)	3851	2902		
40–49	19,997(50.6)	10,302	9695		
≥ 50	12,263(31.1)	6912	5351		
Marital status; n (%)					
Married	35,863(90.8)	19,174	16,689	32.931	< 0.001
Single	1058(2.7)	594	464		
Divorced or widowed	2570(6.5)	1,519	1051		
Education; n (%)					
Junior High School	641(1.6)	346	295	85.660	< 0.001
High School or Vocational high school	16,952(42.9)	10,742	9636		
Bachelor's Degree	20,378(51.6)	9214	7738		
Master's Degree or Higher	1520(3.8)	985	535		
Job position; n (%)					
Operator	23,757(60.2)	3262	3207	849.117	< 0.001
Technician	9265(23.5)	14,127	9630		
Manager	6469(16.4)	3898	5367		
Monthly income (RMB); n (%)					
< 2000	1223(3.1)	9992	8056	69.917	< 0.001
2000–4000	18,048(45.7)	743	480		
4000–6000	16,636(42.1)	8755	7881		
> 6000	3584(9.1)	1797	1787		
Number of diseases					
0	11,003(27.9)	5691	5312	114.101	< 0.001
1	11,120(28.2)	5917	5203		
2	8378(21.2)	4523	3855		
3	5207(13.2)	2825	2382		
4 or more	3783(9.6)	2331	1452		
Health literacy					
High	21,287 (53.9)	–	–	–	–
Low	18,204 (46.1)	–	–	–	–

level, job position, monthly income, and the number of reported diseases, highlighting the relevance of these socio-demographic factors in relation to health literacy levels.

Prevalence of Chronic Diseases

Among the 39,491 participants, 72.1% reported having at least one chronic disease (Figure 1). Fatty liver was the most common disease (33.0%), followed by hypertension (24.0%), *Helicobacter pylori* infection (17.7%), elevated uric acid (16.1%), and dyslipidemia (16.0%). As Table 1 shows, analysis of disease prevalence per participant revealed that 28.2% had one disease, 21.2% had two, 13.2% had three, and 9.6% reported having four or more. Among those with one or more chronic diseases, the average number of conditions was 1.6 (±1.49).

Health Literacy Scores

Among the surveyed employees, 53.9% (21,287 individuals) met the qualification criteria, with an average score of 56.11. Within the three domains, Healthy Behaviors and Lifestyles had the highest percentage of individuals classified as high at 66.0%, followed by Basic Knowledge and Attitudes with 61.0%, and Health-Related Skills with the lowest at 46.4%. For the six dimensions, the highest percentage of individuals classified as high is in Safety and First Aid at 86.1%. This is followed by Scientific Views of Health, Infectious Disease Prevention and Control, Health Information, and Primary Medical Care. The lowest percentage is observed in Chronic Disease Prevention and Control at 33.0%.

Prevalence of Chronic Diseases by Socio-Demographic Groups

Marked variations in the prevalence of chronic diseases across diverse demographic and occupational groups are revealed (Table 2). Statistically significant disparities were found in each category analyzed, encompassing sex, age, educational attainment, marital status, occupation, monthly income, and health literacy ($P < 0.001$). Additionally, all these factors, except educational attainment, were markedly associated with the average number of chronic diseases reported ($P < 0.001$).

Associations of Health Literacy With Chronic Disease Prevalence

Insights into how various aspects of health literacy are associated with the prevalence of chronic diseases among participants are provided by the logistic regression analysis results, with all coefficients estimated after adjusting for

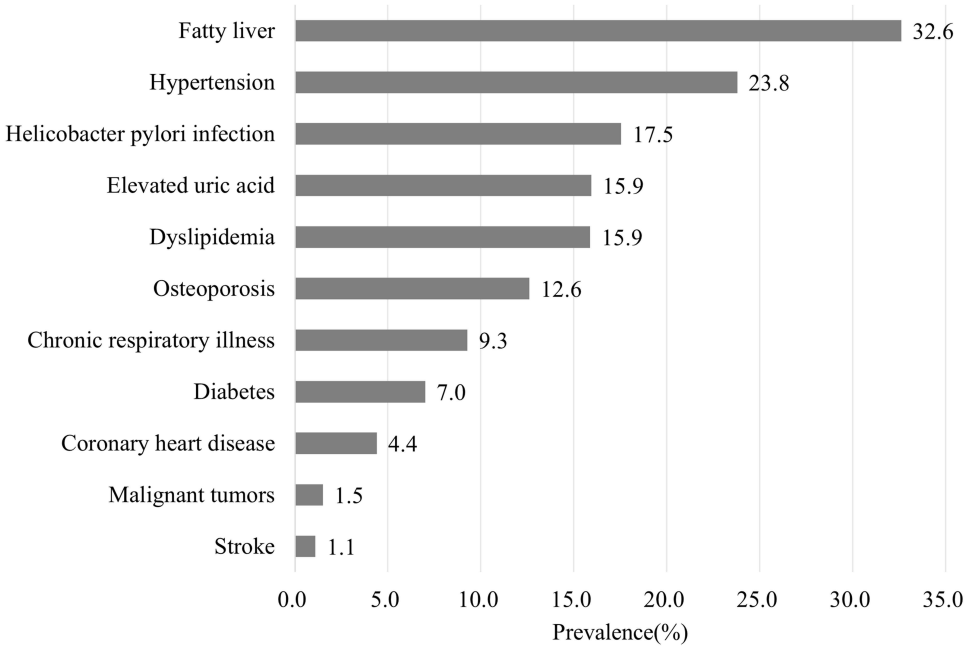

Figure 1 Prevalence of chronic disease among participants (n = 39,491).

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Table 2 Prevalence of Chronic Disease by Socio-Demographic Groups

		Prevalence (%)	$\chi 2$	*P*	Average Number of Disease	*F*	*P*
Sex	Male	81.4	2414.5	< 0.001	1.9	61.4	< 0.001
	Female	58.9			1.0		
Age group (years)	<30	39.5	1289.3	< 0.001	0.6	416.4	< 0.001
	30–39	59.6			1.2		
	40–49	71.6			1.5		
	≥ 50	82.8			2.0		
Education	Junior High School	81.4	3.8	< 0.001	1.6	124.0	0.057
	High School or Vocational high school	69.6			1.5		
	Bachelor's Degree	75.9			1.6		
	Master's Degree or Higher	60.3			1.6		
Marital status	Married	72.7	152.6	< 0.001	1.6	33.0	< 0.001
	Single	55.5			1.1		
	Widowed	70.7			1.5		
	Divorce	71.3			1.5		
Job position	Manager	75.2	156.4	< 0.001	1.6	97.4	< 0.001
	Operator	73.2			1.6		
	Technician	67.2			1.4		
Monthly income (RMB)	< 2000	75.3	39.9	< 0.001	1.9	68.9	< 0.001
	2000–4000	70.7			1.5		
	4000–6000	73.4			1.6		
	> 6000	72.6			1.6		
Health literacy	High	73.3	29.2	< 0.001	1.7	11.1	< 0.001
	Low	70.8			1.5		

Notes: The prevalence of chronic diseases was analyzed using the chi-squared test, while the average number of illnesses was analyzed using analysis of variance (ANOVA), with F-values reported.

sex, age, education, marital status, job position, and monthly income (Table 3). Three distinct models were utilized to assess different components of health literacy.

Model 1 included Overall health literacy and demographic factors such as age, gender, and education level as independent variables, with the prevalence of chronic diseases as the dependent variable. This model focused on overall health literacy and found a non-significant association with chronic disease prevalence, with an odds ratio (OR) of 1.02 (95% CI: 0.97–1.07, p=0.472).

Model 2 examined specific domains of health literacy, including Basic Knowledge and Attitudes, Healthy Behaviors and Lifestyles, and Health-Related Skills, as independent variables, with the prevalence of chronic diseases as the dependent variable. This analysis revealed non-significant associations across all these domains.

Model 3 investigated the relationship between six dimensions of health literacy as independent variables and the prevalence of chronic diseases as the dependent variable. Significant findings include a positive association between Scientific Views of Health and the prevalence of chronic diseases (OR=1.08, 95% CI: 1.01–1.14, p=0.015). In contrast, a significant negative association was observed for Chronic Disease (OR=0.95, 95% CI: 0.90–1.00, p=0.034), indicating that better literacy in managing chronic diseases is associated with lower prevalence.

Associations Between Health Literacy and Specific Types of Chronic Diseases

Logistic regression analyses were conducted to examine the associations between health literacy and the five most prevalent chronic diseases among the petrochemical industry workforce: fatty liver, hypertension, *Helicobacter pylori* infection, elevated uric acid, and dyslipidemia, controlling for demographic variables such as age, gender, education level, marital status, and income.

Table 3 Logistic Regression Analysis Examining the Factors Influencing the Prevalence of Chronic Diseases Among the Participants

	Model 1			Model 2			Model 3		
	B (SE)	*P*	*B (SE)*	*OR (95% CI)*	*P*	*OR (95% CI)*	*B (SE)*	*P*	*OR (95% CI)*
Overall Health literacy	0.02 (0.028)	0.472	1.02 (0.97–1.07)	–	–	–	–	–	–
Basic Knowledge and Attitudes	–	–	–	−0.02 (0.03)	0.380	0.98 (0.93–1.03)	–	–	–
Healthy Behaviors and Lifestyles	–	–	–	0.03 (0.03)	0.236	1.04 (0.98–1.09)	–	–	–
Health-Related Skills	–	–	–	0.04 (0.03)	0.135	1.04 (0.99–1.09)	–	–	–
Scientific Views of Health	–	–	–	–	–	–	0.07 (0.03)	0.015	1.08 (1.01–1.14)
Infectious Disease Prevention and Control	–	–	–	–	–	–	−0.04 (0.03)	0.146	0.96 (0.91–1.02)
Chronic Disease Prevention and Control	–	–	–	–	–	–	−0.06 (0.03)	0.034	0.95 (0.90–1.00)
Safety and First Aid	–	–	–	–	–	–	0.08 (0.04)	0.051	1.08 (1.00–1.17)
Primary Medical Care	–	–	–	–	–	–	−0.02 (0.03)	0.543	0.98 (0.94–1.04)
Health Information	–	–	–	–	–	–	0.02 (0.03)	0.575	1.02 (0.96–1.07)

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Table 4 Linear Regression Analysis Identifies the Influencing Factors on the Number of Chronic Diseases Among the Participants

	Model 4		Model 5		Model 6	
	B (95% CI)	*P*	*B (95% CI)*	*P*	*B (95% CI)*	*P*
Overall Health literacy	−0.05 (−0.08 – −0.02)	< 0.001	–	–	–	–
Basic Knowledge and Attitudes	–	–	−0.01 (−0.02 – −0.01)	< 0.001	–	–
Healthy Behaviors and Lifestyles	–	–	−0.01 (−0.01–0.00)	0.021	–	–
Health-Related Skills	–	–	0.01 (0.00–0.01)	0.092	–	–
Scientific Views of Health	–	–	–	–	0.01 (0.00–0.02)	0.121
Infectious Disease Prevention and Control	–	–	–	–	−0.02 (−0.03 – −0.01)	< 0.001
Chronic Disease Prevention and Control	–	–	–	–	−0.01 (−0.02–0.00)	0.004
Safety and First Aid	–	–	–	–	0.01 (0.00–0.01)	0.144
Primary Medical Care	–	–	–	–	−0.02 (−0.03 – −0.01)	< 0.001
Health Information	–	–	–	–	0.01 (0.00–0.02)	0.164

Notes: All coefficients were estimated after adjusting for sex, age, education, marital status, job position, and monthly income. B Regression coefficient.
Abbreviation: CI, Confidence interval.

Higher health literacy was significantly associated with a lower likelihood of hypertension (B = 0.811, p < 0.001, 95% CI: 0.773–0.851). A significant inverse relationship was also found between health literacy and elevated uric acid levels, indicating that greater health literacy corresponds with a reduced prevalence of elevated uric acid (B = 0.888, p < 0.001, 95% CI: 0.840–0.938). Similarly, higher health literacy was linked to a lower prevalence of dyslipidemia (B = 0.896, p < 0.001, 95% CI: 0.848–0.947). However, no significant associations were observed between health literacy and the prevalence of fatty liver or *Helicobacter pylori* infection.

Associations Between Health Literacy and the Number of Chronic Diseases

The results from the linear regression analysis in Table 4 elucidate the associations between health literacy and the number of chronic diseases reported among employees in the petrochemical sector. This analysis accounts for potential confounders by adjusting all coefficients for sex, age, education, marital status, job position, and monthly income.

Model 4 assessed Overall Health Literacy and found a statistically significant negative association with the number of chronic diseases, as evidenced by a regression coefficient (B) of −0.05 (95% CI: −0.08 - −0.02, p < 0.001). This indicates that higher overall health literacy is associated with a decrease in the number of reported chronic diseases.

Model 5 showed that Basic Knowledge and Attitudes showed a significant negative association with the number of chronic diseases (B = −0.01, 95% CI: −0.02 - −0.01, p < 0.001), suggesting that greater foundational health knowledge and positive attitudes towards health correlate with fewer chronic conditions. Healthy Behaviors and Lifestyles also exhibited a significant but modest negative association (B = −0.01, 95% CI: −0.01–0.00, p = 0.021), while Health-Related Skills displayed a non-significant positive influence (B = 0.01, 95% CI: 0.00–0.01, p = 0.092).

Significant findings in Model 6 include a strong negative association between Infectious Disease literacy (B = −0.02, 95% CI: −0.03 - −0.01, p < 0.001) and Primary Medical Care (B = −0.02, 95% CI: −0.03 - −0.01, p < 0.001), both of which suggest that higher literacy in managing infectious diseases and primary care activities is linked to fewer chronic diseases. Chronic Disease literacy also showed a significant negative association (B = −0.01, 95% CI: −0.02–0.00, p = 0.004). This significant negative association suggests that higher levels of literacy specifically in managing chronic diseases are linked to a reduction in the number of chronic conditions reported by individuals.

Discussion

Enhancing occupational health in the petrochemical industry is crucial for reducing chronic diseases among employees, improving long-term health outcomes, and maintaining workforce productivity. This study examines the association of health literacy and chronic disease prevalence, yielding several principal findings that are delineated below.

The prevalence of chronic diseases observed in this study was 72.1%, which is substantially higher than the national average among Chinese residents aged 15 years and above (34.29%), and even exceeds the prevalence reported for the elderly population aged 65 years and above (62.33%).[8] This elevated prevalence is likely attributable to two primary factors. First, these diseases are

strongly correlated with occupational hazards. Previous studies have identified several occupational risk factors, including exposure to hazardous substances, extreme temperatures, heat radiation, poor lighting, confined spaces, repetitive tasks, extended and irregular working hours—particularly night shifts—and limited social support.[22,23] For instance, prolonged exposure to chemicals and dust has been linked to an increased risk of respiratory diseases and cancers.[24] Additionally, confined spaces frequently lack adequate ventilation, resulting in the buildup of airborne contaminants. This environment exacerbates respiratory conditions and promotes the development of chronic diseases.[25] Second, unhealthy lifestyle choices prevalent among these workers further exacerbate their health risks. These include high-fat diets, excessive alcohol consumption, and tobacco use.[26,27] Among the chronic conditions observed, fatty liver was the most common condition, followed by hypertension, *Helicobacter pylori* infection, high uric acid levels, and dyslipidemia. Demographically, males, older adults, lower-income individuals, and operators exhibit a higher prevalence of these conditions, aligning with prior research findings.[28]

While the overall qualification rate for health literacy was relatively high, two areas were notably deficient. In the domain-specific analysis, the "Health-Related Skills" domain exhibited the lowest qualification rate. Health-related skills encompass acquiring and understanding health information, recognizing hazard signs, measuring body temperature and pulse, and responding correctly in emergencies with appropriate first aid techniques. This indicates significant shortcomings in the practical application of health knowledge. One reason for this deficiency could be inadequate training and education programs focused on practical health skills within the industry. Additionally, the high-intensity work environment may limit opportunities for employees to engage in health literacy activities and apply what they have learned in real-world scenarios.[29] The dimension with the lowest qualification rates was Chronic Disease Prevention and Control, indicating a significant gap in health literacy related to chronic disease prevention among petrochemical industry employees. This deficiency may be attributed to the high-intensity work environment, irregular schedules, and exposure to hazardous substances, which likely cause employees to prioritize immediate safety risks over the long-term consequences of chronic diseases.

The association between overall health literacy and the prevalence of chronic diseases was not significant. This insignificance can be attributed to three main reasons. First, some individuals may only enhance their health literacy following a chronic disease diagnosis, resulting in health literacy levels comparable to those without such conditions at the time of the survey. This compensatory behavior may obscure direct associations with disease prevalence.[30] Second, health literacy does not invariably lead to healthier behaviors.[31] Although prior research has attempted to link health literacy with health behavior, findings have been inconsistent. While many studies indicate a positive relationship, others show negligible or negative correlations.[32,33] Additionally, occupational hazards in the petrochemical industry may overshadow the protective effects of health literacy, resulting in high disease rates despite adequate literacy levels.

These findings provide important insights into the limitations of the KAB model in explaining health behavior within this occupational context. Specifically, the observation that individuals with higher levels of health literacy still demonstrated a high prevalence of chronic diseases suggests that the pathway from knowledge to behavior may be disrupted or incomplete in high-risk work environments. This disconnect may be due to contextual barriers such as irregular working hours, high job stress, limited access to health services, or insufficient organizational support, which can hinder the translation of knowledge into effective health behaviors. In such settings, knowledge and positive health beliefs may not be enough to promote behavior change.

Although the association between overall health literacy and the prevalence of chronic diseases was not significant, significant associations were observed in specific domains and dimensions. In the domain-specific analysis, the study results indicate a positive correlation between Scientific Views of Health and chronic disease prevalence. This phenomenon may be attributed to two factors. Firstly, individuals with a higher level of scientific views of health are more likely to have a deeper understanding of health issues, making them more capable of recognizing and reporting their chronic conditions. Conversely, those lacking scientific views of health may not realize or report their chronic illnesses. Secondly, as this study employs cross-sectional data, it is challenging to establish causality between variables. Some individuals may develop a higher level of scientific views of health only after diagnosed with a chronic condition. In the dimension-specific analysis, Chronic Disease Prevention and Control was not only negatively correlated with the prevalence of chronic diseases but also significantly negatively associated with the number of chronic diseases. Individuals proficient in chronic disease prevention and control may face a lower prevalence of chronic diseases. This association likely stems from individuals' deeper knowledge and understanding of chronic disease prevention and control, which enables them to take effective preventative measures, such as improving lifestyle habits and undergoing regular health screenings. This

knowledge also helps them to manage conditions effectively in the early stages, thereby reducing the risk of worsening health and decreasing the number of chronic diseases.

These findings have several practical implications for workplace health programs in the petrochemical industry. Given the significant associations between literacy in Chronic Disease Prevention and Control and both the prevalence and number of chronic conditions, this dimension should be prioritized in workplace health interventions. Programs should be adapted to address the specific occupational challenges faced by petrochemical employees, including elevated psychological stress, irregular meal patterns due to shift work, and limited opportunities for routine health monitoring. Workplace interventions may include psychological counseling to alleviate work-related stress, nutrition guidance adapted to irregular shifts, and the integration of regular health monitoring programs into organizational routines.

Moreover, the findings of this study highlight the significant role of health literacy in influencing the prevalence of certain chronic diseases among petrochemical industry workers. The logistic regression analyses revealed that higher levels of health literacy are significantly associated with a reduced likelihood of hypertension, elevated uric acid, and dyslipidemia. This may be due to a stronger correlation between health literacy and the mechanisms underlying these specific conditions. For instance, hypertension, which was significantly associated with higher health literacy, is a condition that can be effectively managed and even prevented through informed lifestyle choices such as a balanced diet, regular physical activity, and adherence to medical advice. Individuals with higher health literacy are more likely to understand and implement these preventive measures, thereby reducing their risk of developing hypertension.[34]

The relationship between overall health literacy and the number of chronic diseases was found to be significant, aligning with previous research findings.[35] Moreover, significant associations were evident in two specific domains, Basic Knowledge and Attitudes, and Healthy Behaviors and Lifestyles, as well as in three dimensions: Chronic Disease Prevention and Control, Infectious Disease Prevention and Control, and Primary Medical Care. This could be because individuals with overall high health literacy, particularly in these domains and dimensions, possess proficiency in these domains and dimensions and are more inclined to seek disease-specific knowledge post-diagnosis, increase their health management awareness, and prioritize preventive healthcare.[36] This proactive approach significantly reduces the likelihood of comorbidities and heightens their understanding of the risks associated with additional chronic diseases. Therefore, enhancing the specific domains and dimensions of health literacy may potentially be beneficial in reducing the risk of subsequent chronic conditions.

This study has several limitations. First, employees' self-reported health literacy and chronic disease status may not accurately reflect their actual condition, as responses could be influenced by recall errors, limited medical knowledge, or personal perceptions. Future studies should incorporate clinical assessments or biomarker data to validate self-reported measures. Second, the cross-sectional nature of this study limits the extent to which causal relationships between health literacy and chronic disease outcomes can be inferred. Future research should adopt longitudinal designs that track employees over time to examine how changes in health literacy affect the incidence and progression of chronic diseases. Third, the voluntary nature of online participation may have introduced selection bias, potentially limiting the generalizability of the findings. Future studies should consider employing random sampling strategies to enhance representativeness and data accuracy. Fourth, the sample's exclusive focus on Chinese participants limits the generalizability of findings to countries with differing socioeconomic and occupational environments. Future research should aim to replicate this study in diverse geographic and socioeconomic contexts to examine the universality of the observed associations.

To enhance health literacy in the petrochemical industry, enterprises, and government agencies should collaborate by regularly conducting health education and promotion initiatives, with a primary focus on enhancing literacy in Chronic Disease Prevention and Control. These initiatives include comprehensive health workshops, accessible health resources, personalized health counseling, and a supportive work environment. Given the study results indicating that infectious disease prevention and control and primary medical care are closely related to chronic disease prevalence, emphasis should be placed on enhancing health literacy in these areas. For example, regular educational and training sessions specifically focused on infectious disease prevention and primary medical care can improve employees' understanding and application of this knowledge.

Conclusions

The findings indicate that while the overall qualification rate for health literacy was relatively high in this population, the prevalence of chronic diseases significantly exceeded the national average. Although overall health literacy was not

significantly associated with chronic disease prevalence, it was linked to the number of chronic diseases reported. Notably, the Chronic Disease Prevention and Control dimension of health literacy had the lowest qualification rate, yet it was the only one associated with both lower prevalence and fewer chronic diseases, underscoring its practical importance. Recommended interventions might include addressing work-related stress through psychological counseling, providing nutrition strategies tailored for shift workers, and regularly monitoring key health indicators.

Data Sharing Statement

The raw data supporting the conclusions of this article are available from the corresponding author upon reasonable request.

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Author Contributions

Conceptualization: Ying Wang, Shichao Zhao. Data curation: Ying Wang, Shichao Zhao, Yiming Su. Formal analysis: Huifen Ma, Yiming Su. Methodology: Yiming Su, Ying Wang, Shichao Zhao. Writing – original draft: Huifen Ma, Yiming Su. Writing – review & editing: Huifen Ma, Ying Wang, Shichao Zhao, Xiaolin Wei, Haiyan Qu. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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