

# FACTORS INFLUENCING OCCUPATIONAL HEALTH LITERACY OF WORKERS IN NEW FORMS OF EMPLOYMENT, GANSU PROVINCE, PR CHINA

Dongjing Ma<sup>1,2</sup>, Jinbin Wang<sup>2</sup>, Keqin Gao<sup>2</sup>, Qianya Wei<sup>2</sup>, Yicong Chen<sup>2</sup>  
and Yuanchao Zhang<sup>3</sup>

<sup>1</sup>The Collaborative Innovation Center for Prevention and Control by Chinese Medicine on Diseases Related Northwestern Environment and Nutrition, <sup>2</sup>School of Public Health, Gansu University of Chinese Medicine; <sup>3</sup>School of Finance, Lanzhou University of Finance and Economics, Lanzhou City, Gansu Province, PR China

**Abstract.** The study examined factors, which affected occupational health literacy and hampered improvement among workers in new employment models, focusing on Gansu Province, China. As the gig economy and flexible work arrangements, such as freelancing, part-time and remote work, expand, workers in these sectors face unique health risks. Yet, they often lack sufficient legal protection and health support, making them even more vulnerable to occupational hazards than those in the traditional work sector. This research assessed current levels of occupational health literacy, identified key influencing factors and suggested practical strategies for improvement. A survey was conducted of workers ( $n = 511$ ) from 14 cities in Gansu Province using a structured questionnaire and face-to-face interviews. The results showed that while these workers have moderate health literacy, significant differences were found based on age, education and employment type. Older workers and those with higher education tended to have better occupational health literacy, while gig and self-employed workers generally had lower literacy levels. Barriers to improving workplace health literacy include time constraints, limited access to relevant information and lack of training opportunities. The study highlighted the need for focused occupational health education programs, improved workplace conditions and more substantial institutional support to boost occupational health literacy. These findings should provide valuable data for the improvement of policies aimed at local governments, businesses and organizations interested in improving the health and well-being of workers, particularly in less developed regions like Gansu Province.

**Keywords:** improvement strategy, new form of employment, occupational health literacy

---

Correspondence: Yuanchao Zhang, School of Finance, Lanzhou University of Finance and Economics, 4 Weile Avenue, Lanzhou City, Gansu 730101, PR China  
Tel: +86 17362207641 E-mail: zhangyuanchao2024@126.com

## INTRODUCTION

Along with the transformation of the economy and the rapid development of information technology, new forms of employment have gradually emerged in China (Wu, 2021; Jin and Lyu, 2024; Tu and Wang, 2024). These “new forms of employment” refer to flexible work arrangements facilitated through online platforms, including freelancing, part-time jobs and remote work (Deganis *et al*, 2021; Anwar *et al*, 2023). These arrangements differ fundamentally from traditional employer-employee relationships, as they typically do not rely on fixed labor contracts and often lack comprehensive social security and welfare benefits (Sfetcu, 2024; Yelin *et al*, 2024). However, as the number of workers engaged in these flexible employment arrangements increases, occupational health challenges faced by these new forms

of employment have increasingly become a cause of concern.

Although workers in these new forms of employment enjoy the benefits of flexible hours and locations, they are simultaneously exposed to a broader and more complex array of occupational health risks (Benach *et al*, 2002; Dixon *et al*, 2019; Sargent *et al*, 2020). Inadequate legal protection and limited health support leave many of these workers vulnerable to potential safety hazards in their work environment. For example, prolonged use of electronic devices, insufficient rest and irregular working hours can contribute to the onset of occupational diseases (Park *et al*, 2019; Descatha *et al*, 2020; Li *et al*, 2020; Gaitens *et al*, 2021; Watanabe *et al*, 2022). In addition, the absence of a comprehensive social security system in China leaves many workers without adequate access to healthcare resources and financial support when facing

health challenges (López-Ruiz *et al*, 2015; Guan, 2017; Simpson *et al*, 2021). China's social security framework encompasses pension, unemployment and healthcare insurance; however, coverage remains limited, particularly for individuals engaged in informal and flexible employment (Qian and Wen, 2021; Liu *et al*, 2022; Cao *et al*, 2024). Many gig and part-time workers lack employer-sponsored health insurance and must rely on those provided by the government, such as the Urban and Rural Resident Basic Medical Insurance (URRBMI). While these programs aim to ensure broad healthcare access, they do not fully cover medical expenses, resulting in substantial out-of-pocket expenses for patients (Berkowitz *et al*, 2021). Consequently, workers in the new types of employment often experience financial problems when seeking medical care, underscoring the deficiencies in China's current healthcare security system.

Occupational health literacy refers to an individual's ability to recognize, prevent and address

health risks in the workplace. This includes awareness of health threats, the ability to implement more effective preventive measures and the capacity to manage occupational health issues (Ehmann *et al*, 2021; Friedrich *et al*, 2023). Research has demonstrated that enhancing occupational health literacy can significantly reduce the incidence of occupation-related diseases while also improving worker's physical and mental well-being, which in turn increases work efficiency and the quality of life (Güner and Ekmekci, 2019; Sevinc and Korkut, 2020; Suthakorn *et al*, 2020). For workers engaged in the new forms of employment, improvement of occupational health literacy is particularly crucial. These workers often face unstable work environments, uncertain income sources and a lack of traditional labor protections, all of which contribute to a diverse and complex array of health risks (Chen *et al*, 2020; Denisov, 2020). In China, occupational health training varies significantly across different industries and employment types.

While certain sectors, such as manufacturing and construction, require formal occupational health and safety training, workers in flexible employment types often lack access to formal training programs. Although some companies offer on-the-job training or informal health education, participation tends to be inconsistent and non-compulsory (Wong *et al*, 2017; Supples *et al*, 2024).

While some studies have begun in recent years to investigate the health issues faced by workers in flexible employment, existing research has primarily focused on the workforce in large cities or economically developed regions (Agnoletto, 2024; Cuervo *et al*, 2024; Erhel *et al*, 2024). Investigations into the occupational health literacy of workers in new employment types remain limited in central and western China. Gansu Province, representing a typical region in the western region of the country, faces unique local socioeconomic challenges and development constraints (Ma *et al*, 2019; Zhang *et al*, 2022; Wang and Cao, 2023; Cao

and Tao, 2024). With a population of approximately 25.3 million, Gansu ranks among China's less economically developed provinces, with a GDP in the lower national tier. The economy of Gansu Province depends mainly on agriculture, energy production and resource-based industries such as mining and petrochemicals, while modern service industries remain underdeveloped (Cao and Tao, 2024; Wang and Cao, 2023).

Workers engaged in the new forms of employment in Gansu Province face not only traditional occupational health risks, such as exposure to hazardous materials in mining and manufacturing, or ergonomic strains in logistics and delivery services but also challenges stemming from the Province's lower economic development situation and the relatively underdeveloped social security system (Dórea, 2021; Hulshof *et al*, 2021; Lovas *et al*, 2021). Gig workers, freelancers and other flexible employment workers in Gansu Province often lack access to employer-sponsored health insurance, formal occupational

health training and adequate workplace safety measures, which further exacerbates their vulnerability to occupational health risks (Bajwa *et al*, 2018; Ran and Zhao, 2023). Under current China's law, occupational health regulations generally do not extend to self-employed individuals and freelancers, leaving these workers responsible for managing their occupational health risks (Zhou, 2018). Given the increasing number of freelance and gig workers in China, occupational health literacy has become a critically important means for maintaining their workplace well-being.

The primary objective of the study was to investigate in Gansu Province the current state of occupational health literacy among workers in the new forms of employment. The study examined factors influencing health literacy and proposed practical strategies for its improvement. To this end, the study assessed various factors affecting workers' health literacy, such as age, gender, education level, type of work, and work

environment; and based on the findings, practical strategies will be developed for enhancing occupational health literacy. The results will provide both theoretical support and practical guidance for policymakers, businesses and relevant organizations in Gansu Province and other provinces in similar situations.

## MATERIALS AND METHODS

### Study design and participants

A cross-sectional study was conducted in several cities across Gansu Province, China (Fig 1) from 1 December 2024 to 30 January 2025. An occupational health literacy survey was conducted among workers in the new forms of employment across 14 cities within the Gansu Province. The questionnaire was developed via the WJX platform (<https://www.wjx.cn/>) and was disseminated to takeaway workers, couriers, internet anchors, and other relevant groups through popular social media platforms and offline research methods. Participants were encouraged to share the

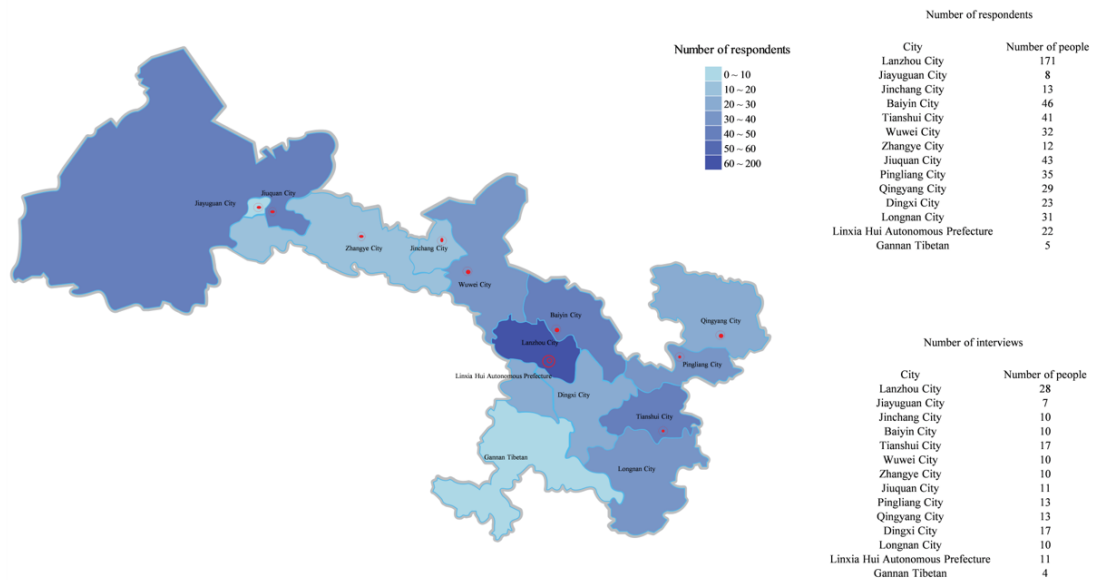


Fig 1 - Geographical distribution of participants in the study, Gansu Province, PR China

survey link to increase the overall survey population. To ensure data confidentiality and reliability, the questionnaire was designed to allow only one response per IP address. It consists of five sections: (i) basic characteristics of the survey subjects, (ii) understanding of occupational health knowledge, (iii) working environment and conditions, (iv) personal protection and health behavior cognition, and (v) corporate training and degree of participation. The workflow to

enroll participants is depicted in Fig 2.

### Data collection

**Questionnaire:** The study developed a structured questionnaire encompassing four primary categories, namely, training and participation, personal protection and health behavior, working environment and conditions, and occupational health knowledge. Given the distinct occupational health risks faced by workers in

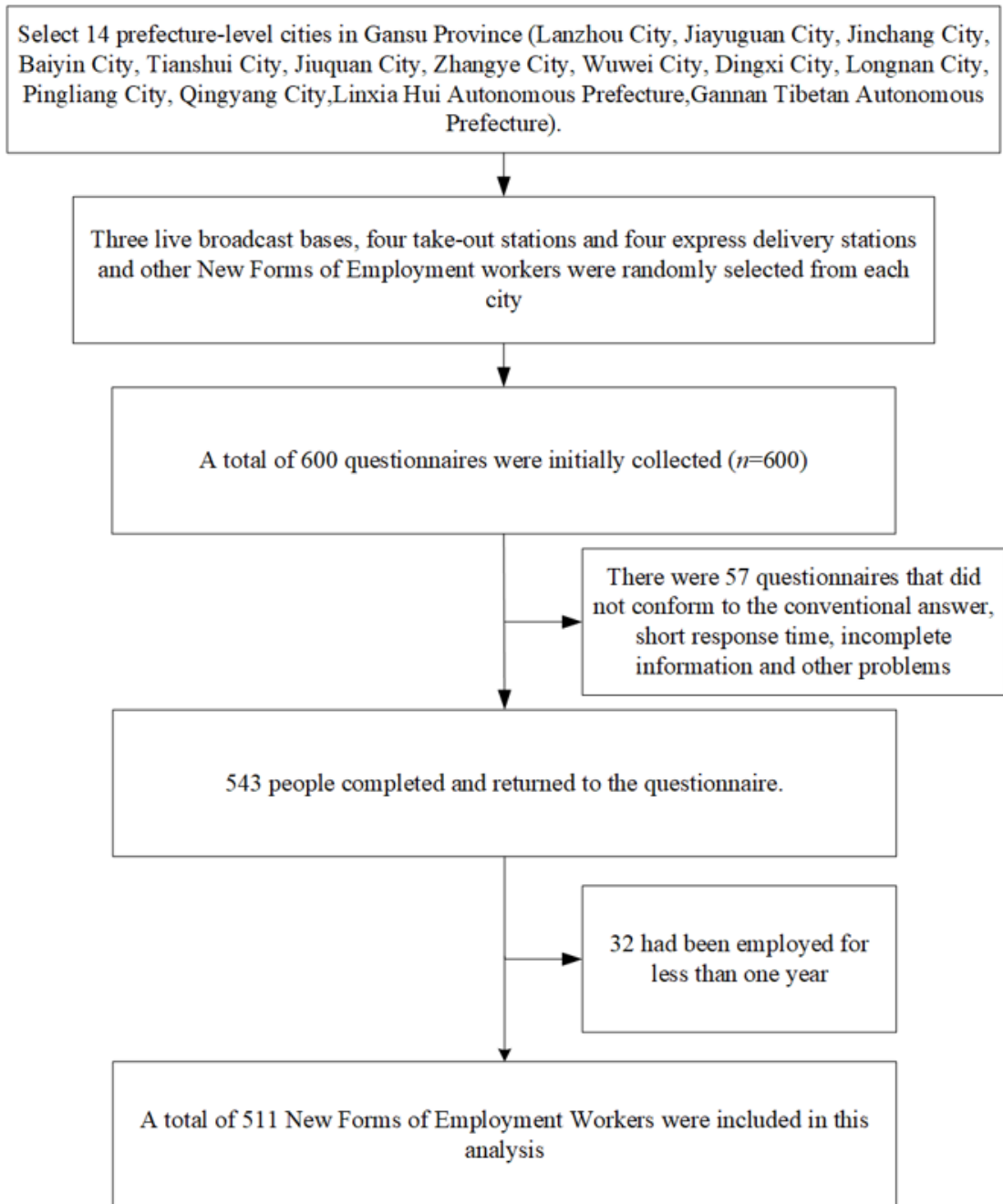


Fig 2 - Workflow of the process for selection of study participants

the new employment forms, *viz*, ergonomic strain from prolonged screen use, traffic-related accidents, exposure to extreme weather, and psychological stress due to job instability, the questionnaire was designed to assess awareness of workplace hazards, utilization of personal protective equipment (*eg*, masks, gloves and other protection items), adherence to healthy behavior (*eg*, regular health check-up, balanced diet, and exercise), and participation in occupational health training program.

The questionnaire was developed based on the established framework of occupational health literacy and adapted to the conditions of flexible employment. The design was primarily based on the National Key Population Occupational Health Literacy Monitoring Survey Questionnaire (National Health Commission, 2022). However, amendments were made to tailor the questionnaire to the specific occupational health challenges faced by gig workers, ensuring its relevance to the new forms of employment sector (Azizi

*et al*, 2019; Friedrich *et al*, 2023; Cannizzaro and Malta, 2024). To ensure content validity and reliability, the questionnaire was tested on a small number of workers ( $n = 100$ ) engaged in various forms of new employment. Revisions were made in response to their feedback prior to full-scale distribution. A five-point Likert scale (1 = strongly disagree, 5 = strongly agree) was utilized to measure responses. The final version of the questionnaire underwent expert review and was then distributed through both online and offline channels to ensure a diverse range of respondents.

**Face-to-face interview:** To further investigate factors influencing the occupational health literacy of workers in the new forms of employment, semi-structured face-to-face interviews were conducted with several of the respondents. The content of these interviews focused on several key aspects, namely, individual needs regarding occupational health, health risks present in the work environment, adoption of a healthy

lifestyle, and expectations for health support from the employing company or platform. Each interview lasted approximately 30-45 minutes.

### **Data analysis**

Descriptive statistical analysis was initially conducted to calculate the means, standard deviations, and ranges of occupational health literacy scores, offering a comprehensive assessment of health literacy among workers engaged in the new forms of employment. Subsequently, Pearson correlation analysis was employed to explore the relationships among key demographic variables, such as education level, employment type, age, and occupational health literacy. Finally, multiple regression analysis was conducted to identify significant predictors of occupational health literacy, emphasizing in particular on educational background and employment status.

A thematic analysis was applied for the semi-structured interviews. Interview recordings

were transcribed verbatim, and an inductive coding framework was employed to identify recurring themes concerning workers' perceptions of occupational health risks, access to healthcare resources, barriers to health literacy, and participation in training programs.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM, Armonk, NY) and Origin 2024 statistical software (OriginLab Corp, Northampton, MA).

### **Ethical considerations**

The study protocol was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the School of Public Health, Gansu University of Chinese Medicine (Approval No. GUCM20241024). Prior written informed consent was obtained from all participants in the study.

## **RESULTS**

### **Demographic characteristics**

The survey was conducted in

14 cities across Gansu Province, selecting 3 live broadcast bases, 4 take-out stations, and 4 express delivery stations from each. A total of 600 questionnaires were collected, with 57 excluded due to issues such as incomplete or invalid responses. After excluding 32 respondents with less than one year of employment, 511 valid questionnaires were included in the analysis.

Participants ( $n = 511$ ) who submitted completed questionnaires constituted a nearly equal number of females (47%) and males (53%), with over half being 19-35 years of age, holding at least a junior college degree and married (58, 53 and 54%, respectively) (Table 1). The majority of respondents (47%) were freelancers, followed by part-time workers (18%) and then remote workers (8%), indicating the diversity of occupations in the new forms of employment. Remote workers are individuals who perform their work entirely or primarily outside traditional office settings through digital platforms. This group encompasses

independent contractors and employees of companies with remote work policies, engaging in fields such as customer service, virtual assistance, IT support, and online education.

### **Occupational health literacy level**

The occupational health literacy of the respondents was evaluated based on four categories (training and participation, personal protection and health behavior, working environment and conditions, and occupational health knowledge) using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) (Table 2).

For training and participation, the average score was 4.00, indicating that the majority of workers demonstrated a high level of literacy in this category. However, the standard deviation (SD) of 0.82 underscored significant individual variations, ranging 1-5, suggesting that some workers may have low literacy in this category. The high participation rate among freelancers indicates that despite lacking formal employer-

Table 1

Demographic characteristics of participants (N = 511) in the study

Variable	Frequency <i>n</i> (%)
<b>Age</b>	
<18 years	14 (3)
19-25 years	127 (25)
26-35 years	171 (33)
36-45 years	120 (23)
46-55 years	54 (11)
>56 years	25 (5)
<b>Gender</b>	
Male	273 (53)
Female	238 (47)
<b>Education</b>	
Elementary school and below	52 (10)
Junior middle school	77 (15)
Senior secondary education	111 (22)
Three-year college education	160 (31)
Bachelor degree or above	111 (22)
<b>Marital status</b>	
Married	275 (54)
Unmarried	191 (37)
Divorced	30 (6)
Widowed	15 (3)
<b>Employment type</b>	
Freelance	241 (47)
Part-time worker	90 (18)
Telecommuter	41 (8)
Others	139 (27)

Table 2

Occupational health literacy levels of study participants (N = 511)

Category	Mean $\pm$ SD	P <sub>25</sub>	P <sub>75</sub>	Range
Training and participation	3.98 $\pm$ 0.82	3.75	4.00	1-5
Personal protection and healthy behavior	3.90 $\pm$ 0.89	3.75	3.75	1.25-5
Working environment and conditions	3.88 $\pm$ 0.93	3.75	3.75	1-5
Occupational health knowledge	3.76 $\pm$ 1.00	3.50	3.50	1-5

Note: Health literacy scores were calculated based on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

P<sub>25</sub>: 25<sup>th</sup> percentile; P<sub>75</sub>: 75<sup>th</sup> percentile

sponsored training, they recognize the importance of occupational health literacy and actively pursue available educational resources.

For personal protection and health behavior, the average score was 3.90, close to that obtained for training and participation, indicating that respondents generally demonstrated a moderate level of literacy concerning personal protection and health behavior. However, the SD of 0.89 and the lowest score of 1.25 revealed significant disparities in literacy levels among different workers.

For working environment and conditions, the average  $\pm$  SD score

was 3.88  $\pm$  0.93, comparable to scores for the abovementioned categories, but the slightly higher SD value indicated considerable individual variability for this category. Subpar working environment and conditions may negatively impact workers' occupational health literacy.

On knowledge of occupational health, the average score  $\pm$  SD was 3.76  $\pm$  1.00, the lowest mean score of the four assessed categories but with the highest SD value. This indicates that respondents have varying levels of understanding of occupational health. The lowest score was 1, suggesting that a

significant number of workers possessed a limited comprehension of occupational health concepts.

### **Relationships among demographic factors and occupational health literacy**

The Pearson correlation coefficient was used to analyze the relationships among demographic factors and the four categories of occupational health literacy (Table 3). The results are as follows.

**Age:** This factor is significantly positively correlated with training and participation ( $r = 0.098$ ,  $p$ -value = 0.027) and working environment and conditions ( $r=0.111$ ,  $p$ -value=0.012), suggesting that older workers tend to engage more actively in training programs and have a better understanding of workplace conditions. However, no significant correlations were found for the categories of personal protection and health behavior, and knowledge of occupational health.

**Sex:** The analysis showed that sex is not significantly correlated with any of the four categories of occupational health literacy,

indicating that both females and males did not differ in their understanding and interest in occupational health issues.

**Education:** Among the four categories, only a correlation (positive) was found between education level and working environment and conditions ( $r = 0.130$ ,  $p$ -value = 0.003), indicating that individuals with higher education are more likely to have a better understanding of their workplace environment and hence in their choice of the quality of employment.

**Marital status:** Marital status showed no significant correlation with any of the four categories of occupational health literacy.

**Employment type:** Employment type exhibited a significant positive correlation with all four categories of occupational health literacy, ranging from the highest correlation ( $r = 0.590$ ,  $p$ -value <0.001) with occupational health knowledge and lowest ( $r = 0.395$ ,  $p$ -value <0.001) with training and participation. These results indicated that

Table 3  
 Pearson correlation analysis of key factors influencing occupational health literacy of participants (N = 511)

Demographic characteristic	Relationship between demographic characteristic and the four categories of health literacy			
	Training and participation	Personal protection and healthy behavior	Working environment and conditions	Occupational health knowledge
Age	0.098 (0.027)	0.077 (0.081)	0.111 (0.012)	0.092 (0.038)
Gender	0.026 (0.553)	0.010 (0.816)	-0.027 (0.537)	-0.027 (0.541)
Education	0.069 (0.119)	0.063 (0.154)	0.130 (0.003)	0.015 (0.741)
Marital status	0.003 (0.943)	-0.011 (0.804)	-0.015 (0.732)	-0.028 (0.527)
Employment type	0.395 (<0.001)	0.546 (<0.001)	0.408 (<0.001)	0.590 (<0.001)

Note: Pearson correlation coefficients and their associated *p*-values represent strength and significance of the correlations among respondents.

different types of employment significantly influence occupational health literacy.

To further evaluate the factors influencing occupational health literacy a multivariate linear regression model was employed. A probability-probability (P-P) graph was then constructed to evaluate the normality of the regression residuals (Fig 3). The P-P graph revealed that the regression residuals for all four dependent variables, ie, the four categories, mostly aligned with a diagonal line, as evidenced by the dense clustering of data points along the diagonal with only a few outliers. This suggests that the residuals of the regression model largely follow a normal distribution.

### **Face-to-face interview**

The information collected from the face-to-face interviews, albeit involving a smaller number ( $n = 100$ ) of participants, could be summarized into two topics, obstacles and health support needs.

**Obstacles:** The participants identified three major obstacles

to improving occupational health literacy: i) lack of time and energy (43%), ii) limited access to information (38%), and iii) a disconnect between training content and actual work done (34%). Many freelancers and gig workers cited irregular schedules and heavy workloads, which limited their ability to participate in health training programs. Unlike traditional employees, they lacked employer-provided training and had to rely on self-learning or external resources. The health risks encountered in the work environment were musculoskeletal disorders resulting from prolonged sitting, eye strain due to excessive screen use and sleep disturbance caused by irregular working hours. Mental health challenges also were of significant concern, with many freelancers reporting stress and burnout stemming from job instability and financial insecurity. Furthermore, isolation and loneliness were prevalent among remote and independent workers, adversely affecting their well-being. Financial constraints

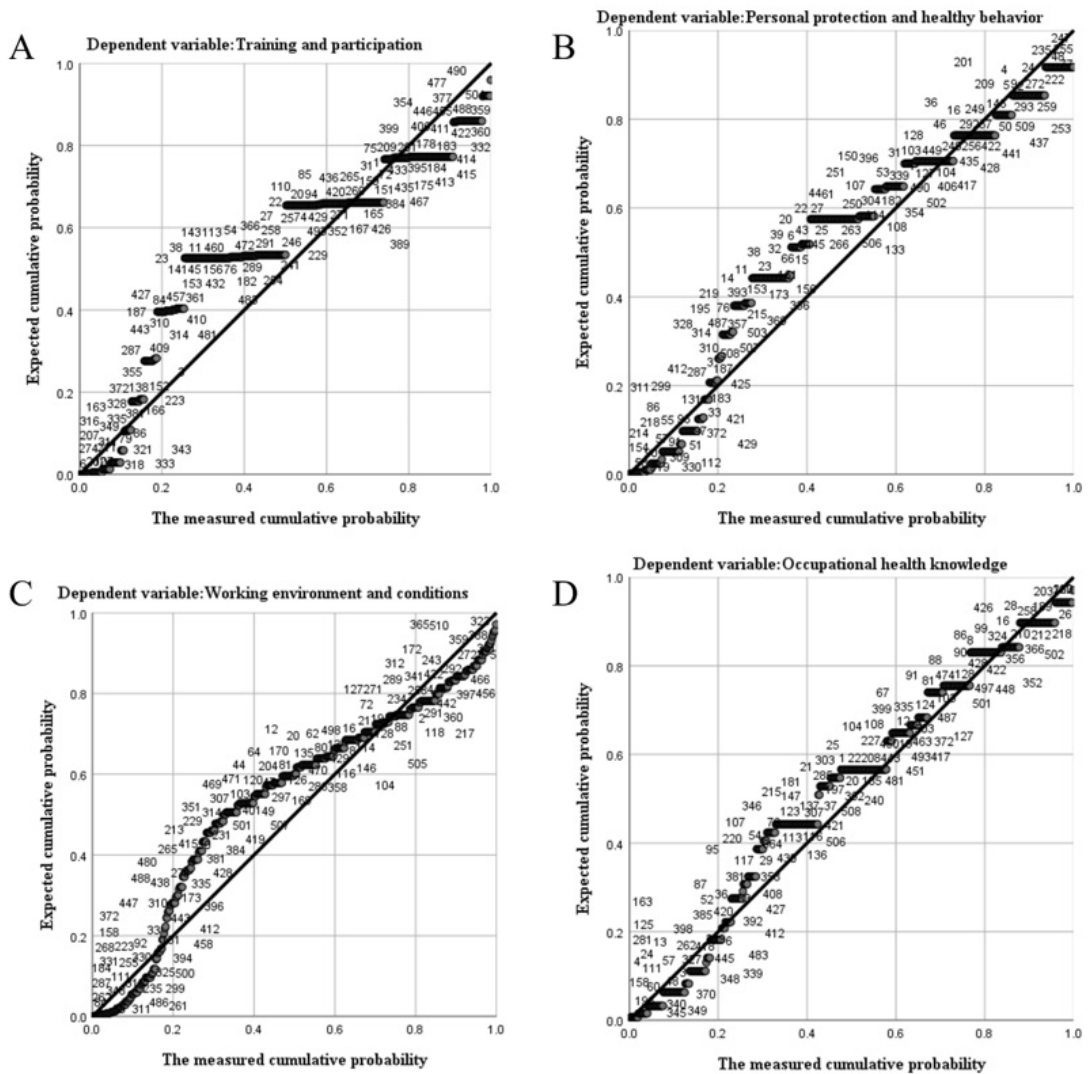


Fig 3 - Probability-probability graph for the four dependent variables  
 A: Training and participation; B: Personal protection and health behavior;  
 C: Working environment and conditions; D: Occupational health knowledge

further hindered occupational health literacy, as some workers avoided preventive care due to high costs. Many respondents emphasized the necessity for accessible training programs, such as free workshops, online courses and platform-sponsored health initiatives, to address the physical and mental health risks in flexible work environments.

**Health support needs:** The participants respondents expressed a strong desire for companies or platforms to enhance occupational health training (62%), to improve workplace environment and conditions (55%) and to lower cost of personal protective equipment (45%). In addition, health monitoring and physical examination services (45%) were also identified as key health support measures.

## DISCUSSION

The study investigated the occupational health literacy of workers engaged in the new forms of employment in Gansu Province, China to obtain information on the

challenges faced by this workforce in a region marked by economic underdevelopment and limited healthcare infrastructure. The study employed a questionnaire and face-to-face interviews to gather the relevant data.

A key insight from the study is the considerable discrepancy in occupational health literacy across various employment categories. While workers exhibited a relatively high participation rate in workplace health-related training, their understanding of specific health risks, workplace risk conditions and personal protective measures was low. This suggests that despite attending training programs, these initiatives may lack the depth or customization needed to meet the specific needs of the workers as previously noted (Burke *et al*, 2006; Ricci *et al*, 2016). The gap between knowledge and behavior highlights a broader challenge in translating theoretical understanding into practical everyday actions, a recurring issue observed in occupational health education (McCluskey and Lovarini, 2005;

Abuzeid *et al*, 2018; Kahlke *et al*, 2020).

Age was identified as one of the significant factors influencing occupational health literacy. Older workers demonstrated greater awareness and engagement with health-related training and preventive behavior, likely due to their accumulated experience and a deeper understanding of the risks associated with their work. This finding is in agreement with previous studies indicating that occupational health literacy tends to increase with age, possibly resulting from direct experience with occupational health issues during their time on the job (Pitt-Catsouphes *et al*, 2015; Choi *et al*, 2020). On the other hand, younger workers are more likely to be engaged in precarious and flexible employment reflecting their lower occupational health literacy. Thus, they are particularly vulnerable to occupational health risks, as they may not yet recognize the importance of preventive health measures or may lack access to relevant resources (Giraudo *et al*,

2016; Bender and Theodossiou, 2018; Dixon *et al*, 2019; O'Connor *et al*, 2020).

Educational attainment was another significant factor that influenced occupational health literacy. Individuals with higher levels of education exhibited a greater awareness of workplace conditions; however, this educational achievement did not translate into a better literacy of occupational health behavior or specific health knowledge. This suggests that while higher formal education provides individuals with the cognitive tools necessary to comprehend broader health concepts, it does not inherently lead to effective health practices, which requires additional targeted training and provision of work-related resources (Ross and Wu, 1995; Peters *et al*, 2010; Fernandes *et al*, 2024).

The findings regarding employment categories were particularly instructive. Nearly half of the respondents identified themselves as freelancers, who

typically engage in short-term, project-based, or contract work across various industries, including digital content creation, software development, graphic design, online tutoring, and consulting. They generally lack formal employer-employee relationships, which means they do not receive stable wages, employer-provided benefits, or occupational health protections. This situation may contribute to higher health risks and reduced access to occupational health resources. They also exhibit significantly lower levels of health literacy compared to individuals in more stable employment situations. This disparity highlights the unique challenges faced by workers engaged in the new forms of employment, who frequently lack employer support, legal protections and health benefits that are available to those in traditional types of employment. The absence of stable employment relationships, together with limited access to occupational health and safety programs, makes these workers especially vulnerable to work-related health risks.

While remote workers constituted only 8% of the respondents, they reported occupational health concerns associated with prolonged screen exposure, inadequate ergonomic workspace and challenges in maintaining work-life balance. These findings highlight the urgent need for government policies that extend health protection to workers engaged in emerging non-traditional forms of employment and ensure that health education programs are both accessible and tailored to the specific challenges encountered by workers in the new forms of employment as noted in previous studies conducted in Europe (MacEachen *et al*, 2022; Abd Samad *et al*, 2023; Ran and Zhao, 2023; Blázquez *et al*, 2024).

Several barriers to enhancing occupational health literacy have been identified, viz, time constraints, limited access to pertinent information and non-translational training programs. These challenges emphasize the necessity for more flexible and accessible health education initiatives, which take into

consideration the unique schedules and work conditions of individuals in emerging non-traditional types of employment. Overcoming these barriers will require a collaborative effort among employers, platform providers and policymakers to develop a work environment that prioritizes the health and safety of workers in the new forms of employment (Halonen *et al*, 2017; Dos S Ribeiro *et al*, 2019; Terry, 2023).

However, the study has several limitations. Firstly, the reliance on self-reported data introduces potential social bias, as participants may provide responses that reflect perceived societal expectations rather than their actual knowledge and behaviors. However, the probability-probability (P-P) analysis indicated that the data collected by self-report to the questionnaire met the normality criterion, reinforcing the theoretical basis of the study for subsequent policy recommendations and intervention strategies. Secondly, there is a lack of analysis regarding specific misconceptions about

occupational health risks. Effective interventions require an understanding of not only knowledge gaps but also prevalent misunderstandings that may contribute to unsafe practices. Future research should incorporate qualitative methods, such as in-depth interviews and focus groups, to explore these misperceptions and develop targeted, evidence-based interventions. Thirdly, the absence of standardized health and safety guidelines for flexible workers complicates efforts to improve occupational health literacy, leaving many without formal training or clear risk prevention strategies. And finally, the cross-sectional design limits causal inferences, necessitating longitudinal studies to follow changes over time and assess the impact of tailored health literacy programs. Future research should focus on developing accessible, context-specific educational interventions, particularly for gig workers, ensuring they receive adequate support despite the inherent challenges of non-traditional employment.

In conclusion, the study identified important gaps in occupational health literacy, particularly among younger and gig workers, thereby reinforcing the necessity for targeted health education programs. The findings indicated that despite high participation in health-related training, there exists a substantial discontinuity between theoretical knowledge and practical application. To address this problem, more customized and flexible training initiatives, along with stronger institutional support, are required to ensure that workers - especially those in emerging new forms of employment - are adequately equipped to safeguard their occupational health and safety. Ultimately, enhancing occupational health literacy is crucial not only for individual workers but also for improving overall workplace safety and productivity.

#### ACKNOWLEDGEMENTS

The authors thank all participants, volunteers and administrators. The research was supported by the Innovation and

Entrepreneurship Training Program for College Students of Gansu Province in 2024 (S202410735004X), the Youth Science and Technology Fund of Gansu Province in 2022 (2022B-119), the 2024 Annual Open Fund of the Collaborative Innovation Center of Traditional Chinese Medicine for Prevention and Control of Nutrition and Environmental Related Diseases in Northwest China (ZYXT-24-09), the Gansu Education College Students' Career Planning and Employment Guidance (GS[2024]GHBZX0101), and Lanzhou University of Finance and Economics 2024 Higher Education Research General Program (LJY202408).

#### CONFLICT OF INTEREST DISCLOSURE

The authors declare no conflict of interest.

#### DATA AVAILABILITY

Additional data of the study findings are available from the corresponding author upon reasonable request.

## REFERENCES

- Abd Samad K, Abd Rahman NH, Ismail S, Marmaya NH. Is the well-being of gig workers in Malaysia better? The reality of pain and gain. *Int Rev Appl Econ* 2023; 37(4): 518-31.
- Abuzeid RAM, Al Najjar A, Abdulqader N. Evaluating the Effect of Occupational Health Education on Workers Knowledge, 2018 [cited 2025 Feb 10]. Available from: URL: [https://www.gavinpublishers.com/assets/articles\\_pdf/1542878315article\\_pdf1505672284.pdf](https://www.gavinpublishers.com/assets/articles_pdf/1542878315article_pdf1505672284.pdf)
- Agnoletto M. Flexible working and well-being: evidence from the UK. *J Demogr Econ* 2024; 90: 589-625.
- Anwar MA, Schäfer S, Golušin S. Work futures: globalization, planetary markets, and uneven developments in the gig economy. *Globalizations* 2023; 21(4): 571-89.
- Azizi N, Karimy M, Abedini R, Armoon B, Montazeri A. Development and Validation of the Health Literacy Scale for Workers. *Int J Occup Environ Med* 2019; 10(1): 30-9.
- Bajwa U, Gastaldo D, Di Ruggiero E, Knorr L. The health of workers in the global gig economy. *Global Health* 2018; 14(1): 124.
- Benach J, Amable M, Muntaner C, Benavides FG. The consequences of flexible work for health: are we looking at the right place? *J Epidemiol Community Health* 2002; 56(6): 405-6.
- Bender KA, Theodossiou I. The unintended consequences of flexicurity: the health consequences of flexible employment. *Rev Income Wealth* 2018; 64(4): 777-99.
- Berkowitz SA, Gold R, Domino ME, Basu S. Health insurance coverage and self-employment. *Health Serv Res* 2021; 56(2): 247-55.
- Blázquez M, Herrarte A, Moro-Egido AI. Well-being effects of the digital platform economy: the case of temporary and self-employment. *Technol Econ Dev Eco* 2024; 30(6): 1618-51.
- Burke MJ, Sarpy SA, Smith-Crowe K, Chan-Serafin S, Salvador RO, Islam G. Relative effectiveness of worker safety and health training methods. *Am J Public Health* 2006; 96(2): 315-24.
- Cannizzaro E, Malta G. Occupational Health Literacy Scale development and validation in Italy: a pilot

- study. *Public Health* 2024; 236: 85-92.
- Cao P, Tao H. Sustainable development in Gansu Province: Theil index and cluster analysis. *Sustainability* 2024; 16: 4518.
- Cao Y, Zhao D, Huang Y. Research on labor and social security of Chinese new flexible employees under the background of new business. *Front Hum Soc Sci* 2024; 4(6): 306-15.
- Chen B, Liu T, Wang Y. Volatile fragility: new employment forms and disrupted employment protection in the new economy. *Int J Environ Res Public Health* 2020; 17(5): 1531.
- Choi MS, Dabelko-Schoeny H, Lee MY, Bungler AC. Does self-efficacy and team leader equity matter for older workers' mental health? *Gerontologist* 2020; 60(6): 996-1004.
- Cuervo I, Vignola EF, Ahonen EQ, Davis L, Bodin T, Baron SL. Hustle: experiences of making work 'work' for non-standard and precariously employed workers in New York City. *SSM Qual Res Health* 2024; 5: 100376.
- Deganis I, Tagashira M, Yang W. Digitally enabled new forms of work and policy implications for labour regulation frameworks and social protection systems, 2021 [cited 2025 Feb 10]. Available from: URL: <https://desapublications.un.org/file/18082/download>
- Denisov EI. New forms of employment and workers' health. *Russ J Occup Health Indust Ecol* 2020; 60(12): 936-50.
- Descatha A, Sembajwe G, Pega F, et al. The effect of exposure to long working hours on stroke: a systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. *Environ Int* 2020; 142: 105746.
- Dixon J, Banwell C, Strazdins L, Corr L, Burgess J. Flexible employment policies, temporal control and health promoting practices: a qualitative study in two Australian worksites. *PLoS One* 2019; 14(12): e0224542.
- Dórea JG. Neurodevelopment and exposure to neurotoxic metal(loid)s in environments polluted by mining, metal scrapping and smelters, and e-waste recycling in low and middle-income countries.

- Environ Res* 2021; 197: 111124.
- Dos S Ribeiro C, van de Burgwal LHM, Regeer BJ. Overcoming challenges for designing and implementing the One Health approach: a systematic review of the literature. *One Health* 2019; 7: 100085.
- Ehmann AT, Ög E, Rieger MA, Siegel A. Work-related health literacy: a scoping review to clarify the concept. *Int J Environ Res Public Health* 2021; 18(19): 9945.
- Erhel C, Guergoat-Larivière M, Mofakhami M. Diversity of flexible working time arrangements and workers' health: an analysis of a workers' panel and linked employer-employee data for France. *Soc Sci Med* 2024; 356: 117129.
- Fernandes P, Carvalho D, Alexandre A, et al. Health education as a strategy for improving quality of life, 2024 [cited 2025 Feb 10]. Available from: URL: <https://ojs.observatoriolatinoamericano.com/ojs/index.php/olel/article/view/3107/2198> [in Portuguese]
- Friedrich J, Münch A-K, Thiel A, Voelter-Mahlknecht S, Sudeck G. Occupational Health Literacy Scale (OHLS): development and validation of a domain-specific measuring instrument. *Health Promot Int* 2023; 38(1): daac182.
- Gaitens J, Condon M, Fernandes E, McDiarmid M. COVID-19 and essential workers: a narrative review of health outcomes and moral injury. *Int J Environ Res Public Health* 2021; 18(4): 1446.
- Giraud M, Bena A, Leombruni R, Costa G. Occupational injuries in times of labour market flexibility: the different stories of employment-secure and precarious workers. *BMC Public Health* 2016; 16: 150.
- Guan M. Should the poor have no medicines to cure? A study on the association between social class and social security among the rural migrant workers in urban China. *Int J Equity Health* 2017; 16(1): 193.
- Güner MD, Ekmekci PE. Health literacy level of casting factory workers and its relationship with occupational health and safety training. *Workplace Health Saf* 2019; 67(9): 452-60.
- Halonen JI, Atkins S, Hakulinen H, Pesonen S, Uitti J. Collaboration

- between employers and occupational health service providers: a systematic review of key characteristics. *BMC Public Health* 2017; 17(1): 22.
- Hulshof CTJ, Pega F, Neupane S, *et al.* The prevalence of occupational exposure to ergonomic risk factors: a systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. *Environ Int* 2021; 146: 106157.
- Jin X, Lyu K. The impact of digital economy on emerging employment trends: Insights from the China Family Panel Survey (CFPS). *Finance Res Lett* 2024; 64: 105418.
- Kahlke RM, McConnell MM, Wisener KM, Eva KW. The disconnect between knowing and doing in health professions education and practice. *Adv Health Sci Educ Theory Pract* 2020; 25(1): 227-40.
- Li J, Pega F, Ujita Y, *et al.* The effect of exposure to long working hours on ischaemic heart disease: a systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. *Environ Int* 2020; 142: 105739.
- Liu T, Liu Q, Jiang D. The influence of flexible employment on workers' wellbeing: Evidence from Chinese general social survey. *Front Psychol* 2022; 13: 771598.
- López-Ruiz M, Artazcoz L, Martínez JM, Rojas M, Benavides FG. Informal employment and health status in Central America. *BMC Public Health* 2015; 15: 698.
- Lovas S, Nagy K, Sándor J, Ádám B. Presumed exposure to chemical pollutants and experienced health impacts among warehouse workers at logistics companies: a cross-sectional survey. *Int J Env Res Public Health* 2021; 18(13): 7052.
- Ma L, Chen M, Fang F, Che X. Research on the spatiotemporal variation of rural-urban transformation and its driving mechanisms in underdeveloped regions: Gansu Province in western China as an example. *Sustain Cities Soc* 2019; 50: 101675.
- MacEachen E, de Rijk A, Dyreborg J, *et al.* Laws, policies, and collective agreements protecting low-wage and digital platform workers during the COVID-19 pandemic.

- New Solut* 2022; 32(3): 201-12.
- McCluskey A, Lovarini M. Providing education on evidence-based practice improved knowledge but did not change behaviour: a before and after study. *BMC Med Educ* 2005; 5(1): 40.
- National Health Commission. National Occupational Health Literacy Monitoring Survey: personal questionnaire for key populations, 2022 [cited 2024 Apr 06]. Available from: URL: [https://wjw.beijing.gov.cn/zwgk\\_20040/qt/202206/P020220614501552902314.pdf](https://wjw.beijing.gov.cn/zwgk_20040/qt/202206/P020220614501552902314.pdf) [in Chinese]
- O'Connor A, Peckham T, Seixas N. Considering work arrangement as an "Exposure" in occupational health research and practice. *Front Public Health* 2020; 8: 363.
- Park S, Lee JH, Lee W. The effects of workplace rest breaks on health problems related to long working hours and shift work among male apartment janitors in Korea. *Saf Health Work* 2019; 10(4): 512-7.
- Peters E, Baker DP, Dieckmann NF, Leon J, Collins J. Explaining the effect of education on health: a field study in Ghana. *Psychol Sci* 2010; 21(10): 1369-76.
- Pitt-Catsoupes M, James JB, Matz-Costa C. Workplace-based health and wellness programs: the intersection of aging, work, and health. *Gerontologist* 2015; 55(2): 262-70.
- Qian J, Wen Z. Extension of social insurance coverage to informal economy workers in China: an administrative and institutional perspective. *Int Soc Secur Rev* 2021; 74(1): 79-102.
- Ran X, Zhao Y. Behind the flexibility: insufficient occupational injury protection of gig workers in China. *Front Public Health* 2023; 11: 1117180.
- Ricci F, Chiesi A, Bisio C, Panari C, Pelosi A. Effectiveness of occupational health and safety training: a systematic review with meta-analysis. *J Workplace Learn* 2016; 28(6): 355-77.
- Ross CE, Wu CL. The links between education and health. *Am Sociol Rev* 1995; 60(5): 719-45.
- Sargent GM, McQuoid J, Dixon J, Banwell C, Strazdins L. Flexible work, temporal disruption and implications for health practices: an Australian qualitative study.

- Work Employ Soc* 2020; 35(2): 277-95.
- Sevinc N, Korkut B. Relationship of occupational health and safety training with health literacy among employees working in the various lines of business. *Univ Med* 2020; 39(3): 171-7.
- Sfetcu L. Addressing the challenges of gig work in the European Union: a review of the platform work directive. *Sci Ann Al I Cuza Univ Sociol Soc Work Series* 2024; 17(2): 55-67.
- Simpson J, Albani V, Bell Z, Bambra C, Brown H. Effects of social security policy reforms on mental health and inequalities: a systematic review of observational studies in high-income countries. *Soc Sci Med* 2021; 272: 113717.
- Supples MW, McIlwain JS, Snaveley AC, *et al.* Workplace health promotion programs available to emergency medical services clinicians in North Carolina. *Prehosp Emerg Care* 2024; 28(2): 335-41.
- Suthakorn W, Songkham W, Tantranont K, Srisuphan W, Sakarinkhul P, Dhatsuwan J. Scale development and validation to measure occupational health literacy among Thai informal workers. *Saf Health Work* 2020; 11(4): 526-32.
- Terry PE. The *Stare Decisis* Doctrine and *Total Worker Health*<sup>®</sup>: prior precedent and continuous improvement in health promotion. *Am J Health Promot* 2023; 37(3): 296-9.
- Tu W, Wang X. New forms of employment and labour protection in China, 2024 [cited 2025 Feb 10]. Available from: URL: [https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40asia/%40ro-bangkok/%40ilo-beijing/documents/publication/wcms\\_913322.pdf](https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40asia/%40ro-bangkok/%40ilo-beijing/documents/publication/wcms_913322.pdf)
- Wang Y, Cao X. The characteristics and countermeasures of coupled and coordinated development between technological innovation and ecological environment in China's Gansu province. *PLoS One* 2023; 18(10): e0290704.
- Watanabe T, Masuya J, Hashimoto S, *et al.* Long working hours indirectly affect psychosomatic stress responses via complete mediation by irregular mealtimes and shortened sleep duration:

- a cross-sectional study. *Int J Environ Res Public Health* 2022; 19(11): 6715.
- Wong WCW, Zhu S, Ong JJ, *et al.* Primary care workforce and continuous medical education in China: lessons to learn from a nationwide cross-sectional survey. *BMJ Open* 2017; 7(7): e015145.
- Wu C. The influence of digital economy on employment in China's labor market: mechanism, characteristics and strategies, 2021 [cited 2025 Feb 10]. Available from: URL: [https://digilib.uhk.cz/bitstream/handle/20.500.12603/567/WU\\_Chenzi.pdf?sequence=1&isAllowed=y](https://digilib.uhk.cz/bitstream/handle/20.500.12603/567/WU_Chenzi.pdf?sequence=1&isAllowed=y)
- Yelin E, Trupin L, Iley T, Rhee N, Lafrance A, Mac IV. The impact of alternative arrangements, contingent jobs, and work secured through an app on the well-being of working age adults: results from the California Work and Health Survey. *Am J Ind Med* 2024; 67(8): 753-63.
- Zhang F, Liu H, Gu W, Zhang J. Multidimensional poverty and types of impoverished counties in Gansu province of China. *Econ Polit Stud* 2022; 10(1): 105-25.
- Zhou Z. Understanding the administrative regulation on occupational health and trend in China. *J Occup Health* 2018; 60(2): 126-31.