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Examining the risk factors influencing safety outcomes for Chinese migrant construction workers in New Zealand

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Abstract

Purpose – With globalization, Chinese migrant construction workers (CMCWs) have become a key labour force in the construction industry. Despite their contributions, CMCWs face higher incident risks compared to native and other migrant workers. This study examines the significance and relationships among five critical factors—communication barriers, safety policies, quality of safety training, personal factors, and cultural differences—that impact safety outcomes for CMCWs. By addressing a critical research gap in migrant construction worker safety, it provides a PLS-SEM model for enhancing the health and safety of CMCWs.

Design/methodology/approach – Data collected from a questionnaire survey was analysed using a partial least squares structure equational modelling (PLS-SEM) tailored to CMCWs in New Zealand.

Findings – Findings indicate that safety policy ($p = 0.005$) and personal factors ($p = 0.042$) significantly influence safety outcomes for CMCWs.

Originality/value – Targeted safety management systems that enforce safety policies and strengthen safety awareness are essential for improving CMCW safety. This study provides an innovative view on language barriers, suggesting they do not primarily hinder communication but rather limit access to safety information, reduce the effectiveness of training, and impede the development of safety awareness. This framework enhances the understanding of occupational safety for CMCWs and offers a foundation for future research in safety management practices tailored to this demographic.

Keywords Health and safety, Chinese, Migrant, Construction workers

Paper type Research article

1. Introduction

1.1 Research background

Maintaining workers' health and safety has always been regarded as a major challenge, especially for the construction industry (Lingard, 2013). A substantial body of existing literature systematically examines the factors influencing the health and safety of construction workers, with the aim of enhancing their well-being and safety outcomes. For instance, factors affecting the

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safety performance of construction workers include "unfair" safety policies (Dutta, 2017), language barriers (Kim *et al*., 2020), and lack of safety training (Hussain *et al*., 2020). However, most of these studies have been conducted in international contexts, with limited research focusing on Chinese migrant construction workers (CMCWs). With the advancement of globalization, Chinese migrants have increasingly become a key labour resource in the international workforce (Ai, 2022). According to the International Labour Organization (ILO), the number of migrant workers worldwide has been rising annually and reached 169 million in 2019 (Rakotonarivo, 2021). China is fourth among the top 10 countries of origin for migrant workers (Pew Research Center, 2012), and there were approximately 1 million Chinese migrant workers at the end of 2019 (Chen, 2022), thus making them one of the main labour forces in the construction industry (Kilgallon and Xia, 2021). Migrant workers are disproportionately at risk of occupational injuries in the construction industry compared to native workers (Vignoli *et al*., 2021; Chávez and Altman, 2017). Among them, Chinese migrant workers—a significant subgroup—exhibit particularly high occupational injury mortality rates when compared to local workers and other migrant worker groups (Lee and Cho, 2019). One study reported that Chinese migrant workers accounted for 42,089 of the 71,593 occupational injury or disease compensation claims recorded in South Korea between 2007 and 2018 (Lee and Cho, 2019). In addition, Lei *et al*. (2018) insist that systemic deficiencies in safety management literacy among Chinese international contractors are a primary determinant of elevated occupational injury prevalence among Chinese migrant workers in transnational construction projects. This finding aligns with anecdotal accounts from New Zealand media (Chen, 2025a, b; Fisher and Tan, 2021), which document recurrent safety violations and workplace inequities experienced by Chinese migrant construction workers, underscoring their heightened vulnerability within the national construction industry. However, such reports remain fragmented, lacking methodological rigour or generalizability to quantify broader trends. Compounding this issue, New Zealand's governmental repositories (e.g. Statistics NZ, WorkSafe NZ) exhibit critical gaps in empirically robust metrics specific to this cohort, including workforce demographics, accident frequency, and injury severity indices. The absence of these foundational data not only impedes evidence-based policymaking but also signals an urgent need for targeted reforms to address systemic occupational health disparities and institutional oversight in safeguarding migrant workers populations, particularly those of Chinese origin. This situation indicates that there is limited information available on the occupational injury patterns of Chinese migrant construction workers in New Zealand, further emphasizing their vulnerability in overseas employment contexts.

This gap underscores the need for more in-depth research into the factors influencing the health and safety of Chinese migrant construction workers (CMCWs), with the aim of addressing this significant gap in the literature and contributing to the improvement of safety standards within the construction industry.

1.2 Research questions, aim, and objectives

Given the lack of comprehensive research on the factors influencing the safety of CMCWs, this study addresses the following research questions to fill this gap: What are the key risk factors affecting the health and safety of CMCWs? How can safety outcomes be effectively quantified? Which factors exert the most significant influence on safety outcomes? What are the intrinsic correlations between these influencing factors and safety outcomes? Based on these research questions, three research objectives were formulated to facilitate a comprehensive analysis and achieve the overall research goal, which are

(1) To identify the key influencing factors affecting the safety outcomes of CMCWs,

(2) To explore the significance of each influencing factor and inter-relationship with safety outcomes, and

(3) To systematically analyse the reasons for significance or non-significance of each factor.

This study extends the findings of a previous investigation. The earlier systematic literature review by Guan *et al*. (2024) identified key risk factors influencing the health and safety of migrant construction workers. Building upon these findings, this study aims to provide a systematic and in-depth analysis of the significance and intrinsic relationships between the risk factors and safety outcomes specifically for CMCWs, a critical subset of the migrant construction workforce.

2. Literature review

To achieve Research Objective 1, this study conducted a preliminary literature review to identify the five most critical factors influencing the health and safety of CMCWs, building upon the findings from my previous study, a systematic literature review by Guan *et al*. (2024). That prior review comprehensively examined health and safety risks affecting migrant construction workers over the past two decades. The most frequently cited risk factors in that literature include communication barriers, factors related to safety policies, the inferior quality of safety training, poor personal factors (such as lack of safety awareness and education), and cultural differences. The frequency of each factor is presented in Table 1.

This study builds upon the work of Guan *et al*. (2024) supplemented by a review of additional relevant literature to ensure the robustness and accuracy of the research variables. As depicted in Table 2, the five variables identified in this study are consistently correlated with the safety outcomes of migrant construction workers, as evidenced by the supporting literature. However, these supporting literature predominantly address migrant workers in a generalized context. Therefore, further investigation is required to determine whether these correlations remain applicable to the safety performance of Chinese migrant construction workers specifically.

Table 1. Top 5 risk factors mentioned in the literature review

Influencing factors	Frequency # Of paper (out of 60 identified articles), %
Communication barriers	33, (55%)
Factors related to safety policies	19, (31.7%)
Inferior quality of safety training	18, (30%)
Poor personal variables (lack of safety awareness, weak behaviours)	11, (18.3%)
Cultural differences	9, (15%)

Source(s): Guan *et al.* (2025)

Table 2. Supporting literature

Variables	Supporting literature
Safety policy (A)	Kwon *et al*. (2021), Lyu *et al*. (2018), Rotimi *et al*. (2021)
Safety training (B)	Hussain *et al*. (2020), Ibarra-Mejía *et al*. (2021), Vignoli *et al*. (2021)
Communication barriers (C)	Ibarra-Mejía *et al*. (2021), Lyu *et al*. (2020), Pink *et al*. (2010)
Cultural differences (D)	Al-Bayati *et al*. (2018), Hare *et al*. (2013), Kim *et al*. (2015)
Personal variables (E)	Ibarra-Mejía *et al*. (2021), Lyu *et al*. (2018), Welton *et al*. (2018)
Safety outcomes (O)	Lyu *et al*. (2018), Ghodrati *et al*. (2018), Newaz *et al*. (2023)

Source(s): Authors' own work

Therefore, this study focused on analysing the significance and the correlations between these 5 key influencing factors and safety outcomes among CMCWs in New Zealand. The explanation of each variable is shown below.

2.1 Factors related to safety policies

A safety policy refers to a written statement from an employer affirming the company's commitment to protecting the health and safety of its employees and the public (Sitesafe, 2022). However, migrant construction workers are disproportionately affected by inequitable safety policies, such as the confiscation of passports (Adhikary *et al*., 2018) and restrictions on their ability to change employers (Lee and Cho, 2019). These safety policy-related issues not only undermine the autonomy of migrant workers but also have significant implications for their safety outcomes (Adhikary *et al*., 2018). To facilitate discussion, this study consolidated the "factors related to safety policies" under the simpler term "safety policy", which was designated as variable A.

2.2 Inferior quality of safety training

Safety training is regarded as one of the primary factors affecting the safety outcomes of migrant construction workers (Peiró *et al*., 2020). Effective health and safety training aims to enhance knowledge and skills that have practical in mitigating the risk of injury on the job (Mango, 2022; Medved, 2021). While all construction workers are required to complete safety training before commencing work, there is a lack of uniform standards for training content, duration or learning outcomes (Peiró *et al*., 2020). The type, duration, and involvement of safety training significantly affect the injury and fatality rates among migrant construction workers (Hussain *et al*., 2020; Oswald *et al*., 2019; Peiró *et al*., 2020). To facilitate discussion, this study consolidated the "Inferior quality of safety training" under the simpler term "safety training", which was designated as variable B.

2.3 Communication barriers

Communication barriers can affect the health and safety of migrant construction workers (Bust *et al*., 2008; Hare *et al*., 2013; Icten, 2010). These barriers can be categorized into language challenges and ineffective communication methods (Rani, 2016). Linguistic difficulties and potential misunderstandings are among the primary challenges posed by communication barriers, which may increase the incident risk (Wasilkiewicz *et al*., 2016). To facilitate discussion, this study designated the "Communication barriers" as variable C.

2.4 Cultural differences

Cultural differences are widely recognized as critical non-linguistic determinants of safety outcomes among migrant workers, particularly in cross-national contexts (Ward *et al*., 2011). These differences encompass varying attitudes, behaviours, customs, and expressions unique to members of a particular ethnicity, race, or national backgrounds (Mighty Recruiter, 2022). In the context of safety management for migrant construction workers, cultural differences play a pivotal role in shaping workers' interpretation and understanding of local safety regulations, risk mitigation behaviours (Kim *et al*., 2015), and recognition of safety signage (Hare *et al*., 2013). For instance, comparative studies highlight that Chinese migrant workers often exhibit lower risk perception, a divergence rooted in culturally conditioned perceptions of authority and fatalism rather than linguistic misunderstandings (Al-Bayati *et al*., 2018). Consequently, this variable focuses on the adaptability of Chinese migrant workers to the health and safety management model under New Zealand culture, excluding language proficiency or communication challenges. To facilitate discussion, this study designated the "cultural differences" as variable D.

2.5 Poor personal variables (lack of safety awareness, weak behaviours)

Personal variables, including education level, safety awareness and safety behaviour, can influence the safety outcomes of migrant construction workers (Welton *et al.*, 2020). Low safety awareness, inadequate risk assessment skills, and poor psycho-social health status (discrimination or prejudice) represent personal variables that may impair the safety of migrant construction workers (Fernández-Esquer *et al.*, 2020; Meardi *et al.*, 2012; Oswald *et al.*, 2018; Chávez and Altman, 2017). To facilitate discussion, this study simplifies the "Poor personal Variables (lack of safety awareness, weak behaviours)" by consolidating it under the term "personal variables", which will be designated as variable E.

2.6 Safety outcomes

Safety outcomes encompass a range of metrics, including near misses, injuries, and fatalities, which serve as indicators of workplace safety (Christian *et al.*, 2009). More and more studies use self-reported injury data collected through questionnaires to assess safety outcomes (Siu *et al.*, 2004; Hon *et al.*, 2014; Huang *et al.*, 2006). Hence, this study not only relied on statistical data from documented accidents but utilized self-reported injury data to quantitative safety outcomes. Respondents were asked to self-report the number of near-miss and accident injuries they had experienced in the past 12 months. To facilitate discussion, this study designated the "Safety outcomes" as variable O.

3. Research hypotheses

According to the introduction section, there are correlations between safety outcomes and safety policy, safety training, communication barriers, cultural differences, and personal variables. Therefore, the following hypotheses are proposed:

H1. Safety policy (A) has a significant effect on safety outcomes (O) of Chinese migrant workers.

H2. Safety training (B) has a significant effect on safety outcomes (O) of Chinese migrant workers.

H3. Communication barriers (C) have a significant effect on safety outcomes (O) of Chinese migrant workers.

H4. Cultural differences (D) have a significant effect on safety outcomes (O) of Chinese migrant workers.

H5. Personal variables (E) have a significant effect on safety outcomes (O) of Chinese migrant workers.

4. Research methods

This study used a quantitative approach to explore the inherent relationship between five influencing factors and the safety outcomes of Chinese migrant construction workers. Qualitative research relies on measured data to assist researchers in observing phenomena or occurrences affecting the sample population (Burrell and Gross, 2017). The data collection method used in the study was a questionnaire survey and the data analysis method was partial least squares structure equational modelling (PLS-SEM).

4.1 Sample population

The sample population of this study consists of CMCWs, selected due to their significant representation in the overseas construction industry and the existing research gap in the literature concerning their safety influencing factors. As a key labour force in international construction, Chinese migrant workers face significant occupational risks, yet in-depth research on the factors influencing their health and safety remains limited (Liu and Lu, 2015). Additionally, the data for this study is primarily drawn from the New Zealand construction industry, where Chinese migrant workers represent the largest group of overseas labourers, particularly in the Auckland region (Guan *et al*., 2025). Between 2016 and 2018, this group represented 16% of all overseas migrant workers in New Zealand, constituting the largest proportion of any all-nationalities migrant construction ethnicity in this area (Sweet Analytics, 2023). Given their substantial presence, this population offers valuable insights into the safety challenges faced by migrant workers, contributing to a deeper understanding of safety management in both local and international construction contexts.

To ensure effective data collection for a specific sample population, it is essential to first summarize and generalize the definition of the population. The lack of universally accepted definitions will cause problems of interpretation (International Organization for Migration (IOM), 2019), which could impact the efficacy of data collection of CMCWs. Different literature sources offer varying definitions of Chinese migrant workers, often shaped by key characteristics such as demographic factors, occupational roles, and geographical location. For instance, early Chinese overseas workers in Southeast Asia were a temporary migrant group seeking financial opportunities with the intention of bringing their gains back to their home country (Chun, 1989). Rotimi *et al*. (2021) defined Chinese migrant workers as Chinese ethnic groups who hold temporary visas and work. Yin (2015) defined Chinese immigrants as those who have been in New Zealand for over 12 months. Liu and Lu (2015) defined new Chinese migrants as Chinese ethnic groups from the People's Republic of China and other countries like Malaysia or Indonesia. Based on this literature research, CMCWs in this research are defined as "*migrant workers who have Chinese Citizenship and have legal work in the construction industry outside of their country of origin*". The screening criteria for the sample population should include the following three aspects. The sample group should: (1) have a valid Chinese passport, (2) have a legal visa in New Zealand, and (3) have a current contract signed in the New Zealand construction industry.

4.2 Data collection method

An anonymous questionnaire survey was used to collect data. The questionnaire was distributed to Chinese migrant workers in construction associations across New Zealand such as Site Safe NZ, Master Builder Association, and New Zealand Chinese Building Industry Association (NZCBIA). The questionnaire survey was divided into two parts. The first part related to the demographic information of the respondents. The second part focussed on the influence factors on the safety outcomes of CMCWs. A Likert scale with a 5-point range from 1 (strongly disagree) to 5 (strongly agree) was used to gather all the data. All measurement indicators in this questionnaire were reviewed in both English and Chinese versions to ensure the feasibility of the variables. The research group initially developed an English-language questionnaire grounded in findings from relevant literature (shown in Table 2) and validated it through peer review in professionals in the New Zealand construction industry.

The English questionnaire was then translated into Chinese by the PhD student within the research group, and the translated version underwent peer review by associate professors in China to ensure accuracy and validity. Respondents finished the questionnaire online after receiving the quick response (QR) code of the questionnaire by email, WhatsApp, and WeChat, or researchers gave printed questionnaires to migrant construction workers through site visits. The research was assessed as low-risk as per the guidelines of Massey University Human Ethics Guidelines (the Ethics Notification Number is 400026149).

4.3 Data analysis method

As one of the most beneficial advanced statistical analysis techniques in the social sciences, SEM is a multivariate technique that integrates various aspects of factor analysis and regression (Xiong *et al.*, 2014). SEM is regarded as the second-generation technique to overcome the limitations of first-generation multivariate data analysis techniques that include cluster analysis and multiple regression (Tarka, 2022). SEM can be divided into two main approaches which are covariance-based SEM (CB-SEM) and partial least squares structure equational modelling (PLS-SEM). Compared to CB-SEM, PLS-SEM offers several advantages: 1) the application goal of CB-SEM is theoretical testing, whereas PLS-SEM is employed to confirm the key constructs within a study (Dash and Paul, 2021); 2) PLS-SEM does not require the variables to strictly follow a normal distribution (Hair *et al.*, 2011); 3) PLS-SEM can not only incorporate latent variables that are indirectly monitored by indicator variables but also can be beneficial in explaining the measurement errors in observed variables (Hair *et al.*, 2019); 4) The sample size required in PLS-SEM is smaller than that in CB-SEM. The minimum sample size requirements of PLS-SEM abide by the 10 times rule (Hair *et al.*, 2021), where the sample size ought to be equal to the larger of

(1) 10 times the largest number of formative indicators used to measure a single construct, or

(2) 10 times the largest number of structural paths directed at a particular construct in the structural model.

PLS-SEM provided a comprehensive model validation process aimed at demonstrating the feasibility and reliability of this method (Hair *et al.*, 2019). The detailed operational process was illustrated in Figure 1, where each validation step, including metrics for both measurement and structural models, was rigorously examined. This study used the original model as a template, conducting multiple rounds of reliability and validity testing in an iterative process based on the collected data. When specific indicators failed to meet the required standards, the model was modified and re-evaluated until all criteria were satisfied. Detailed results for each validation step are presented in Section 5.3 (Assessing the measurement model) and Section 5.4 (Assessing the structural model).

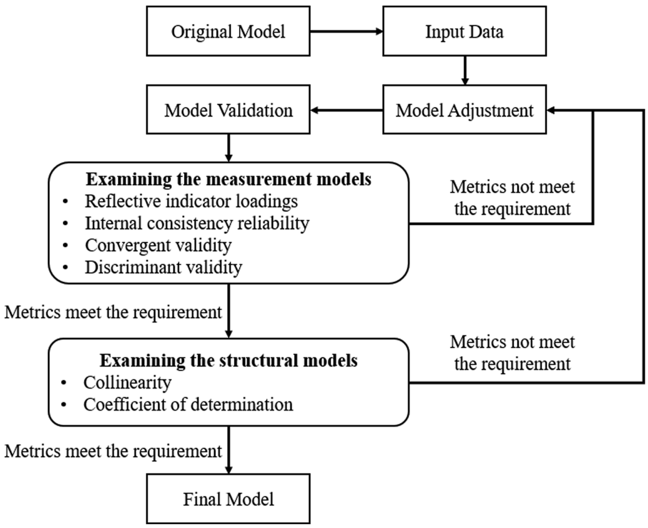

Figure 1. PLS-SEM model validation and adjustment process. Source: Authors' own work

5. Results

5.1 Demographic data

The data collection phase lasted 8 months to gather responses from CMCWs. The research team sent out questionnaire invitations widely across the New Zealand construction industry but only 156 respondents expressed their willingness to participate in the questionnaire survey at the end of the data collection phase. Based on the calculation formula for determining the minimum sample size outlined in Section 4.2 and the research model depicted in Figure 2, the acceptable sample size for this questionnaire survey is determined by the larger of the two following values:

(1) Ten times the largest number of formative indicators used to measure a single construct, yielding a minimum of 60 questionnaires ($10 \times 6 = 60$); or

(2) Ten times the largest number of structural paths directed toward a particular construct in the structural model, resulting in a minimum of 50 questionnaires ($10 \times 5 = 50$).

Therefore, the 156 questionnaires collected for this study exceed the minimum sample size requirement, ensuring the robustness of the research model and compliance with established methodological standards. Of the 156 questionnaires received, there are 120 complete and useable responses in this survey and the data results are shown in Table 3.

Based on Table 3, 78.3% of surveyed respondents were male. The majority of young respondents are 18–29 years old, accounting for 45.8% and 76.7% of respondents hold bachelor's or higher degrees. Moreover, the percentages of respondents who came to New

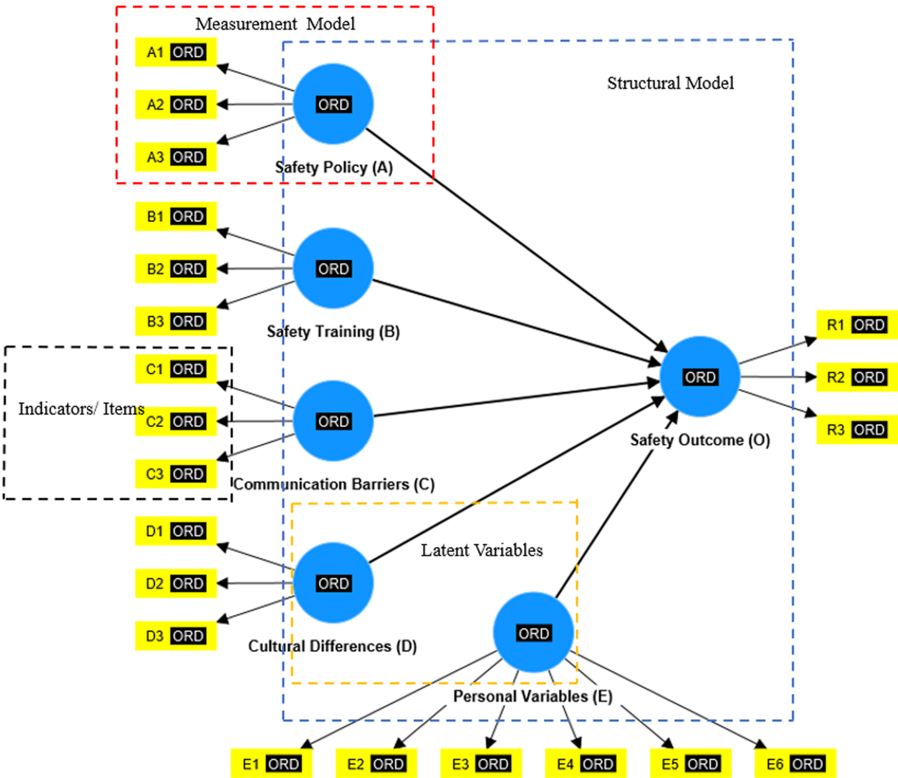

Figure 2. Original PLS-SEM model. Source: Authors' own work

Table 3. Demographic profile of the sample ($N = 120$)

Demographic factor	Categories	Frequencies	Percentages
Gender	Male	94	78.3%
	Female	24	20.0%
	Prefer not to say	2	1.7%
Age	18–29	55	45.8%
	30–39	39	32.5%
	40–49	20	16.7%
	Prefer not to say	6	5.0%
Education level	Primary or below	0	0.0%
	Secondary	7	5.8%
	Certificates and diplomas	21	17.5%
	Bachelor's degree or higher	92	76.7%
Time in New Zealand	≤5 years	48	40.0%
	6–10 years	56	46.7%
	≥11 years	16	13.3%
Time in construction company	≤5 years	110	91.7%
	6–10 years	7	5.8%
	≥11 years	3	2.5%

Source(s): Authors' own work

Zealand for less than 5 years, 6–10 years, and more than 10 years were 40.0%, 46.7%, and 13.3% respectively. The majority of respondents had less than or equal to 5 years of work experience accounting for 91.7%.

5.2 Model calibration

The preliminary PLS-SEM model developed in this study was presented in Figure 2. This model comprises three key components: latent variables, the measurement model, and the structural model and all components was analysed by a specific software SmartPLS 4.0.

SmartPLS is a milestone in latent variable analysis modelling, which helps researchers to apply complex data and methods (such as bootstrapping routines) in the simplest way (Ahmad and Afthanorhan, 2014). Following the process outlined in Figure 1, the original model was iteratively validated and adjusted using SmartPLS 4.0, resulting in a final PLS-SEM model that satisfied all validation requirements (as depicted in Figure 3). The questionnaire information and path coefficients corresponding to latent variables A to E are shown in Table 4.

5.3 Assessing measurement model

There are three approaches used to assess the adequacy of the model of the relationship between the latent variables and the constructs, namely individual item reliability analysis, convergent validity and discriminant validity. Individual item reliability, which is used to measure the individual latent variables, shows the correlation between latent variables and items. The acceptable load value should be greater than or equal to 0.7 (Hussain *et al.*, 2018). From Figure 3, all items have loading (a1 to a12) above 0.7. Therefore, all items demonstrated an acceptable level of individual item reliability once insignificant items were eliminated.

5.3.1 Convergent validity. Convergent validity is an important indicator to measure internal consistency. The convergent validity of the measured constructs can be determined by Cronbach's alpha/composite reliability scores (ρc), and average variance extracted (AVE). Cronbach's alpha is the coefficient of reliability (or consistency) used to evaluate the effect of a set of variables measuring a single one-dimensional latent structure (Cronbach, 1951). The acceptable value of Cronbach's Alpha and composite reliability is respectively more than 0.6

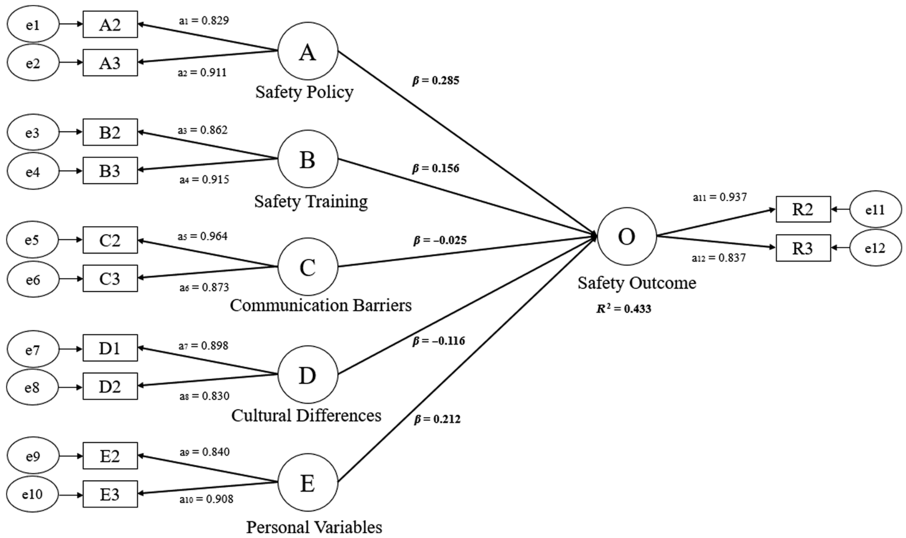

Figure 3. Final PLS-SEM model. Source: Authors' own work

Table 4. Details of independent latent variables and associated questionnaire items

Independent latent variables	Item code	Questions	Path coefficients (β)
Safety policy	A2	I think the health and safety policy is not effectively followed in my company	0.285
	A3	I cannot find the safety policy from the government website	
Safety training	B2	I can apply the knowledge of safety training to practical work	0.156
	B3	Safety training is helpful to my work in improving health and safety awareness and work skills	
Communication barriers	C2	I could not communicate personal or work-related issues with my co-workers or supervisors effectively and frequently	−0.025
	C3	I have difficulty communicating with others at the workplace and cannot effectively understand others' requirements	
Cultural differences	D1	I cannot integrate well with other workers because of cultural differences	−0.116
	D2	Some common behaviours in my hometown are regarded as unsafe behaviours in host country	
Personal variables	E2	Sometimes I must take risks to finish the job	0.212
	E3	I am easier to expose to near-miss incidents due to lacking safety awareness	

Source(s): Authors' own work

and 0.7 (Cronbach, 1951). Based on Table 5, all constructs showed good reliability. Moreover, the AVE is used to evaluate the convergent validity of the latent variables (Durdyev *et al.*, 2018). The AVE values of the latent variables should be higher than 0.5 (Fornell and Larcker, 1981) and all the AVE values in this study (shown in Table 5) satisfy this standard. Thus, the results illustrate that the measurement model has strong internal consistency and convergent validity.

Table 5. Reliability analysis of variables

Latent variable	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Communication barriers (C)	0.832	0.916	0.846
Cultural differences (D)	0.667	0.856	0.748
Personal variables (E)	0.697	0.866	0.765
Safety outcome (O)	0.745	0.882	0.790
Safety policy (A)	0.688	0.862	0.758
Safety training (B)	0.736	0.882	0.789

Source(s): Authors' own work

5.3.2 Discriminant validity. Discriminant validity refers to the degree of discrimination between a latent variable and others (Henseler *et al.*, 2015). Discriminant validity can be measured by two methods: (1) Analysis of cross-loadings and (2) Analysis of AVE (Henseler *et al.*, 2015). The highest Pearson Correlation coefficient is given in boldface in Table 6, and each latent variable has the highest value for its own load when compared to other latent variables. This means that each item has strong discriminant validity. Discriminant validity can also be proved by the analysis of AVE between latent variables (Henseler *et al.*, 2015). The Fornell-Larcker criterion of the analysis of AVE is that each latent variable's square root of the AVE ought to be the largest value (Fornell and Larcker, 1981). According to the boldface figures in Table 7, each latent variable shared more variance with its measures compared with the value between the latent variables and other latent variables. Therefore, both two tests showed that all latent variables are different.

The Heterotrait-Monotrait (HTMT) ratio of correlations criterion, introduced by Henseler *et al.* (2015), offers enhanced sensitivity in detecting discriminant validity concerns compared to traditional methods. As recommended by Henseler *et al.* (2015), HTMT values should below the conservative threshold of 0.85 indicate sufficient discriminant validity between constructs. Table 8 shows the HTMT result of all constructs and reveals that all HTMT values in this study fall within a range of 0.052–0.416, substantially below the 0.85 benchmark. These

Table 6. Cross-loading factor analysis of variables and associated questionnaire items

	Safety policy (A)	Safety training (B)	Communication barriers (C)	Cultural differences (D)	Personal variables (E)	Safety outcome (O)
A2	*0.829*	0.268	0.126	−0.125	−0.034	−0.184
A3	*0.911*	0.234	0.079	−0.092	−0.14	−0.249
B2	0.323	*0.862*	0.118	−0.147	−0.126	0.054
B3	0.196	*0.915*	0.125	−0.151	−0.063	0.068
C2	0.06	0.144	*0.964*	0.145	0.016	−0.056
C3	0.188	0.098	*0.873*	0.118	−0.002	−0.03
D1	−0.054	−0.116	0.171	*0.898*	0.279	−0.055
D2	−0.17	−0.183	0.07	*0.83*	0.137	−0.044
E2	−0.277	−0.106	−0.012	0.119	*0.84*	0.149
E3	0.046	−0.077	0.026	0.296	*0.908*	0.193
R2	−0.288	0.062	−0.058	−0.075	0.174	*0.937*
R3	−0.131	0.063	−0.025	−0.016	0.184	*0.837*

Source(s): Authors' own work

Table 7. Fornell-Larcker criterion for discriminant validity

	Communication barriers (C)	Cultural differences (D)	Personal variables (E)	Safety outcome (O)	Safety policy (A)	Safety training (B)
Communication barriers (C)	*0.92*					
Cultural differences (D)	0.146	*0.865*				
Personal variables (E)	0.01	0.249	*0.874*			
Safety outcome (O)	−0.05	−0.058	0.198	*0.889*		
Safety policy (A)	0.113	−0.121	−0.108	−0.253	*0.871*	
Safety training (B)	0.137	−0.167	−0.102	0.069	0.283	*0.888*

Source(s): Authors' own work

Table 8. HTMT for discriminant validity

	Safety policy (A)	Safety training (B)	Communication barriers (C)	Cultural differences (D)	Personal variables (E)	Safety outcome (O)
Safety policy (A)						
Safety training (B)	0.416					
Communication barriers (C)	0.182	0.166				
Cultural differences (D)	0.198	0.245	0.182			
Personal variables (E)	0.267	0.153	0.052	0.334		
Safety outcome (O)	0.320	0.094	0.055	0.076	0.274	

Source(s): Authors' own work

findings empirically confirm the discriminant validity of the measurement model, as no construct pair exhibits problematic overlap.

5.4 Assessing the structural model

The next step is to assess the structural model. The collinearity examination is a crucial test to ensure that the regression results do not deviate. The collinearity is determined by the VIF value and the ideal VIF value should be less than 3.0 (Belsley, 1993). The VIF value in this study is shown in Table 9 and all the values are acceptable.

The next step is to examine the validation of the structural model. Each path of the structural model in SEM corresponds to one hypothesis. The larger the path coefficient, the stronger substantial effect on the endogenous latent constructs (Hussain *et al.*, 2018). The result of each path coefficient, *t*-value, and *p*-value is shown in Table 10. Whether the hypothesis is significant depends on the *p*-value (Biau *et al.*, 2010). When the *p*-value is greater than 0.10, less than 0.05, or less than 0.01, the assumptions are "not significant", "significant" and "highly significant" respectively (Thiese *et al.*, 2016).

The results of the estimation of path coefficients and *T*-statistics demonstrate that:

(1) Communication barriers and cultural differences show a negative influence on safety outcomes in this sample population,

(2) Safety policy, safety training, and personal variables show a positive influence on safety outcomes in this sample population,

(3) Safety policies and personal variables are considered to be statistically significant in safety outcomes in this sample population,

Table 9. VIF value of inner model

Latent variable	VIF
A2	1.379
A3	1.379
B2	1.514
B3	1.514
C2	2.028
C3	2.028
D1	1.334
D2	1.334
E2	1.4
E3	1.4
R2	1.544
R3	1.544

Source(s): Authors' own work

Table 10. The assessment of structural model

	Path coefficients (β)	*T* statistics (|O/STDEV|)	*p*-values
From communication barriers (C) to safety outcome (O)	−0.025	0.225	0.822
From cultural differences (D) to safety outcome (O)	−0.116	0.996	0.319
From personal variables (E) to safety outcome (O)	0.212	2.035	*0.042*
From safety policy (A) to safety outcome (O)	0.285	2.812	*0.005*
From safety training (B) to safety outcome (O)	0.156	1.436	0.151

Source(s): Authors' own work

(4) Communication barriers, cultural differences, and safety training are not considered to be statistically significant on safety outcomes in this sample population.

Results (1) and (2) are derived from the path coefficients in Table 10, while results (3) and results (4) are based on the *p*-values within the same Table. It can be seen that only two paths (from E to O and from A to O) show significance. Based on the path coefficient of each independent variable, communication barriers ($\beta = -0.025$) and cultural differences ($\beta = -0.116$) had a negative impact on safety outcomes, but safety policies ($\beta = 0.285$), safety training ($\beta = 0.156$) and personal variables ($\beta = 0.212$) had a positive influence. This means that heightened communication barriers and significant cultural differences result in more adverse safety outcomes for CMCWs. Conversely, when safety policy, safety training, and personal variables are elevated, the safety outcomes of respondents also improve. Safety policies and personal variables had a significant impact on safety outcomes. Among the five independent variables, safety policy had the largest path coefficient, which means it had the strongest relationship with safety outcome.

6. Discussions

This study proposed three research objectives. The first objective identified five key factors impacting the safety outcomes of CMCWs. This objective was achieved by a previous literature review study in the introduction section. The second objective aims to construct a data model to assess the significance of these influencing factors on the safety outcomes of the sample population, while the third objective investigated the underlying causes of these factors. Based on the research objectives, five hypotheses were proposed. The analysis results demonstrated that hypotheses related to safety policy (H1) and personal variables (H5) were accepted, while the rest of the hypotheses (H2, H3, H4) were rejected.

Research results first showed that the safety policy is the main factor influencing the safety outcomes of CMCWs (H1). Limited access to, and understanding of, local safety policy knowledge significantly affects CMCWs by impeding their awareness of legal rights, development of safety practices skills, and adherence to safety compliance standards. For instance, 67.5% of respondents insisted that they cannot access the safety policy from website and 36% of them mentioned that they had to violate the safety policies to finish the construction work on time. Furthermore, the inability to effectively implement safety policies constitutes a primary factor contributing to the heightened risk of safety accidents among CMCWs. For example, while 59.2% of respondents illustrated that there was a complete safety policy in their companies, 54.2% of respondents thought the safety policies were not effectively implemented. This argument was also validated in another research. The impact of safety policies on migrant construction workers depends on whether the policies are effectively enforced (Hargreaves *et al*., 2019). Therefore, construction companies should strictly require site managers or safety managers to enhance the effectiveness of safety policy implementation by strengthening safety supervision.

Moreover, this study found that personal variables also impacted the safety outcome of CMCWs significantly (H5). For instance, some respondents argued that certain safety equipment, safety training, and safety behaviour requirements not only fail to reduce the risk of injuries but also affect work efficiency. 83% of respondents assert they possess strong construction skills acquired in China. However, these experienced workers may demonstrate poor safety awareness or underestimate the importance of safety training due to overconfidence in their abilities. This overconfidence can increase the risk of near misses, injuries, and fatalities among CMCWs. Additionally, the data model analysis reveals that safety training is not statistically significant in influencing safety outcomes. Hence, the hypothesis related to safety training (H2) was rejected and this argument was also validated in other literature as a common phenomenon among migrant construction workers, such as (Arcury *et al*., 2014).

Communication barriers (H3) and cultural differences (H4) are not considered to be statistically significant in the safety outcomes of CMCWs in this study. This result is contrary to previous research like (Guan *et al*., 2025; Hussain *et al*., 2020; Lyu *et al*., 2018). In this study, 77.5% of respondents demonstrated that they come from Chinese construction companies and 65% of respondents acknowledged that they worked with Chinese supervisors and colleagues on the construction sites. While 46.7% of respondents acknowledged that the language barrier is the main reason affecting the health and safety of migrant construction workers, only 25% of them indicated that language barriers impact communication and safety in their workplace. One explanation for this could be that most CMCWs predominantly worked for ethnically Chinese-run companies or companies with Chinese managers where language barriers and cultural differences were mitigated due to common language communication. Common language and culture can decrease safety hazards for migrant workers on construction sites (Roelofs *et al*., 2011). This finding indicated that research on the impact of language barriers on the safety outcomes of CMCWs should transcend the scope of communication barriers/cultural difference to encompass the specific challenges language barriers present in effectively disseminating safety information. It is imperative to examine how language barriers impede the promotion of safety policies, the implementation of safety training, and the provision of safety education.

7. Implications

This study is part of a broad range of research on the health and safety of migrant workers in the construction industry. This research makes a substantial contribution to bridging the research gap concerning the safety management of CMCWs. There are two implications in this study.

7.1 Contribution to knowledge

This study has made a significant contribution to the development of research and knowledge in the field of health and safety of migrant construction workers. This study first proposed a standardized definition for CMCWs. A standardized definition will significantly contribute to long-term theoretical and practical research progress in the research field (Gong and Ribiere, 2021). This study provides a context-specific analysis of the health and safety of Chinese migrant workers in the New Zealand construction industry. Due to the absence of standardized definitions, existing research lacks sufficient literature, research models, and accurate data on occupational injuries among CMCWs. This study also provides a robust structural framework (PLS-SEM model) for research in the field of health and safety concerning CMCWs. This model not only fills the research gap of the research field related to safety management of CMCWs but also offers a theoretical foundation for future research on general migrant workers in different countries. Moreover, this study proposed a novel argument that challenges conventional perceptions, suggesting that communication barriers, cultural differences, and safety training do not statistically influence the safety outcomes of CMCWs, due to their specific attributes (such as overconfidence and gregariousness). This finding will contribute to more comprehensive research direction on the health and safety of migrant construction workers and the broader theoretical discourse by demonstrating how safety outcomes are shaped by unique socio-cultural and regulatory contexts.

7.2 Contribution to practical guidance

This study contributes to enhancing practical strategies within the New Zealand construction industry to improve the health and safety of Chinese migrant construction workers, offering actionable solutions to address identified risks. Furthermore, the research model developed in this study can be used for comparative analysis in the construction industries of other countries, enabling the application of these findings to the health and safety of migrant construction workers from diverse nationalities.

8. Conclusion

8.1 Summary of research

This study explored the interrelationship between five key influencing factors and safety outcomes among CMCWs, yielding several innovative findings and arguments. CMCWs referring to the workers who have Chinese Citizenship and have legal work in the construction industry outside of their country of origin. In New Zealand, safety outcomes for CMCWs are significantly influenced by safety policies, characterized by a lack of comprehensive and equitable regulations, as well as personal factors, including insufficient safety awareness, limited education, and overconfidence. These findings suggest that the health and safety challenges faced by CMCWs are influenced by a combination of objective and subjective factors. Objectively, unfair policies and unspoken workplace rules that favour employers or local workers contribute significantly to the heightened risk of workplace accidents for CMCWs. These systemic inequalities create an environment where CMCWs are more susceptible to safety hazards. Subjectively, personal variables, including insufficient safety education and training, further exacerbating their vulnerability to occupational hazards. For instance, due to a lack of safety awareness and an overconfidence in their abilities, CMCWs may perceive safety training as having minimal influence on safety outcomes within the construction industry. This perception is reflected in the data model, which identifies no significant effect of safety training on the dependent variable. Another innovative perspective proposed in this study is that communication barriers and cultural differences do not significantly influence the safety outcomes of CMCWs in New Zealand. Most Chinese migrant workers prefer to choose construction groups with the same language and culture. This choice leads to an illusion that language barriers and cultural differences are insignificant to safety outcomes. The research findings indicate that the influence of language barriers on Chinese migrant construction workers extends beyond conventional communication challenges. These barriers significantly impede their ability to comprehend and internalize safety policies and training, thereby limiting their safety education and awareness. Consequently, language barriers indirectly affect their safety performance.

8.2 Limitation and future research

This study also has limitations. Research on the health and safety of CMCWs remains relatively limited in both depth and systematic analysis. This paper underscores a critical paucity of granular data pertaining to Chinese migrant construction workers within New Zealand's construction industry, particularly regarding workforce demographics, accident frequency, and injury prevalence. This data gap persists across both scholarly literature and governmental documentation, attributable to three interrelated factors: (1) the transient nature of Chinese migrant workers, which complicates accurate workforce enumeration; (2) lack of scholarly and institutional oversight of Chinese migrant worker health and safety as a distinct research priority; and (3) systemic underreporting of incidents by project managers, often driven by economic or reputational incentives. In addition, the R^2 value of the model is 0.433, indicating that the model accounts for 43.3% of the variance in the outcomes, which is acceptable but suggests room for improvement. Although the statistical adequacy of the current sample size and latent variable configuration in meeting the minimum thresholds for structural equation modeling (PLS-SEM), the study acknowledges limitations in the model's explanatory power and generalizability. While the extant framework satisfies foundational criteria for reliability and validity (e.g. composite reliability >0.7, AVE >0.5), future iterations would benefit from expanding both the sample size and the granularity of latent constructs. Augmenting the number of indicators per latent variable and sample size could enhance the model's robustness, mitigate overfitting risks, and strengthen the empirical validity of causal inferences. These refinements align with methodological guidance from Hair *et al*. (2021), who emphasize the necessity of sample and construct optimization in high-complexity PLS-SEM applications.

Thus, future research should aim to increase sample size and broaden geographic scope to develop more generalizable conclusions regarding the factors affecting safety outcomes for CMCWs across various regions. More latent variables should be expanded for incorporating validated multi-item scales for these five health and safety risk factors. Additionally, future studies should focus on the impact of language barriers on safety policy comprehension, the role of bilingual instruction in safety training, and a deeper analysis of improvements in workers' personal safety awareness and behaviours.

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