Lecture Notes in Mechanical Engineering

Mohd Hasnun Arif Hassan
Mohd Nadzeri Omar
Nasrul Hadi Johari
Yongmin Zhong *Editors*

Proceedings of the 2nd Human Engineering Symposium

HUMENS 2023, Pekan, Pahang, Malaysia

Springer

Lecture Notes in Mechanical Engineering

Lecture Notes in Mechanical Engineering (LNME) publishes the latest developments in Mechanical Engineering—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNME. Volumes published in LNME embrace all aspects, subfields and new challenges of mechanical engineering.

To submit a proposal or request further information, please contact the Springer Editor of your location:

Europe, USA, Africa: Leontina Di Cecco at Leontina.dicecco@springer.com
China: Ella Zhang at ella.zhang@springer.com
India: Priya Vyas at priya.vyas@springer.com
Rest of Asia, Australia, New Zealand: Swati Meherishi at swati.meherishi@springer.com
Topics in the series include:

- Engineering Design
- Machinery and Machine Elements
- Mechanical Structures and Stress Analysis
- Automotive Engineering
- Engine Technology
- Aerospace Technology and Astronautics
- Nanotechnology and Microengineering
- Control, Robotics, Mechatronics
- MEMS
- Theoretical and Applied Mechanics
- Dynamical Systems, Control
- Fluid Mechanics
- Engineering Thermodynamics, Heat and Mass Transfer
- Manufacturing Engineering and Smart Manufacturing
- Precision Engineering, Instrumentation, Measurement
- Materials Engineering
- Tribology and Surface Technology

Indexed by SCOPUS, EI Compendex, and INSPEC.

All books published in the series are evaluated by Web of Science for the Conference Proceedings Citation Index (CPCI).

To submit a proposal for a monograph, please check our Springer Tracts in Mechanical Engineering at https://link.springer.com/bookseries/11693.

Mohd Hasnun Arif Hassan · Mohd Nadzeri Omar ·
Nasrul Hadi Johari · Yongmin Zhong
Editors

Proceedings of the 2nd Human Engineering Symposium

HUMENS 2023, Pekan, Pahang, Malaysia

Springer

Editors
Mohd Hasnun Arif Hassan
Faculty of Mechanical and Automotive Engineering Technology
Universiti Malaysia Pahang Al-Sultan Abdullah
Pekan, Pahang, Malaysia

Mohd Nadzeri Omar
Faculty of Mechanical and Automotive Engineering Technology
Universiti Malaysia Pahang Al-Sultan Abdullah
Pekan, Pahang, Malaysia

Nasrul Hadi Johari
Faculty of Mechanical and Automotive Engineering Technology
Universiti Malaysia Pahang Al-Sultan Abdullah
Pekan, Pahang, Malaysia

Yongmin Zhong
School of Engineering
RMIT University
Melbourne, VIC, Australia

ISSN 2195-4356 ISSN 2195-4364 (electronic)
Lecture Notes in Mechanical Engineering
ISBN 978-981-99-6889-3 ISBN 978-981-99-6890-9 (eBook)
https://doi.org/10.1007/978-981-99-6890-9

Preface

Technological advancements have significantly benefited humans. Technology has led to the development of ergonomic tools and equipment that improve human comfort, reduce strain, and enhance overall productivity. From adjustable office chairs to ergonomic keyboards, these innovations promote proper posture and reduce the risk of musculoskeletal disorders. When it comes to road safety, technology has played a pivotal role in saving lives and preventing accidents. Advanced driver assistance systems (ADAS) equipped with sensors, cameras, and artificial intelligence algorithms help detect potential hazards, warn drivers, and even intervene if necessary. In the realm of sports technology, advancements have revolutionized training methodologies and performance analysis. Athletes now have access to wearable devices that monitor their biometric data, providing insights into their physical condition, performance metrics, and injury prevention. Further, technological advancements have led to sophisticated tools and methods for studying the human body's mechanics and movement. High-speed cameras, force sensors, and motion-tracking systems enable researchers to gain deeper insights into human locomotion, joint mechanics, and muscle activation patterns. These findings help design better prosthetics, rehabilitation programs, and ergonomic solutions tailored to individual needs.

The "Unlocking Human Potential: The Future of Human Engineering" symposium seeks to delve into the cutting-edge field of human engineering, exploring the possibilities of augmenting and optimizing human capabilities through advancements in science, technology, and design. This symposium brings together experts from various disciplines to discuss and showcase innovative approaches, methodologies, and ethical considerations in the realm of human engineering. From neuroenhancement to prosthetics, cognitive augmentation to genetic engineering, this symposium aims to stimulate insightful discussions and inspire the creation of a future where human potential knows no bounds.

Pekan, Malaysia — Mohd Hasnun Arif Hassan

Contents

About the Editors

Dr. Mohd Hasnun Arif Hassan earned his first degree in Mechanical Engineering from the Technische Hochschule Bingen, Germany, in 2010. During the final year of his undergraduate study, he was offered a scholarship by Universiti Malaysia Pahang (UMP) to pursue a Master's degree in Mechanical Engineering at the University of Malaya in Kuala Lumpur, which he graduated with distinction in 2012. After that, he embarked on his Ph.D. journey at UMP where he studied about the head injury sustained by soccer players due to heading manoeuvre. He completed his Ph.D. study in 2016 and then continued to serve UMP as a senior lecturer. His research interests include finite element modelling of the interaction between human and sports equipment, instrumentation of sports equipment, and injury prevention particularly with regards to sports and traffic accidents. His work aims to apply engineering principles in sports not only to enhance the performance of an athlete but also to prevent injuries.

Dr. Mohd Nadzeri Omar received the B.Eng. (Hons) and Ph.D. degrees from RMIT University, Melbourne, Australia, in 2013 and 2017, respectively. He is a senior lecturer with the Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang. He is also attached to the Human Engineering Research Group which focuses on research, development, and innovations in human-centered technology and products. His research interests include soft tissue modelling, sports technology, biomechanical engineering, and mechatronics.

Dr. Nasrul Hadi Johari obtained his Ph.D. in Biofluid Mechanics from Imperial College London, United Kingdom. He is currently a senior lecturer at the Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang. Dr. Johari's research activities include computational modeling of blood flow, tissue mechanics, and mass transport in the cardiovascular system, with applications ranging from evaluating the hemodynamic performance of medical devices to predict the outcome of endovascular interventional procedures. He is also interested in computational and experimental modeling of the interaction between human

and sports equipment particularly in improving training aid systems and injury prevention.

Dr. Yongmin Zhong is currently an Associate Professor with the School of Aerospace, Mechanical and Manufacturing Engineering, at RMIT University, Australia. His research interests include computational engineering, haptics, soft tissue modeling, surgical simulation, aerospace navigation and control, intelligent systems, and robotics.

Developing a Survey Tool to Measure Human Factors Constructs for Personal Hearing Protector (PHP) Use Among Industrial Workers—First Phase

Nur Syafiqah Fauzan, Mirta Widia, and Ezrin Hani Sukadarin

Abstract The survey tool (questionnaire) is one of the most widely used tools to collect data. This paper aims to develop a survey tool of human factors and personal hearing protector (PHP) use among industrial workers. The survey tool is developed based on the combination of the Health Promotion Model (HPM) and Health Belief Model (HBM). Development of the eight main constructs in the survey included narrative literature and qualitative review by the two expert panels of researchers in the related field. Overall, this tool produced good comments from the experts. Some of the items were removed due to poor match in terms of content. This current research is crucial to investigate the factors and PHP usage among targeted industrial workers. This study can serve as the primary instrument for determining the human factors and personal hearing protectors used for industrial workers in various sectors. This survey tool can contribute to an improved understanding of the human factors that may influence the consistent use of PHP in an excessive noise work area.

Keywords Survey tool · Factors · Personal hearing protector · Industrial workers

N. S. Fauzan · M. Widia (✉)
Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, Lebuh Persiaran Tun Khalil Yaakob, 26300 Kuantan, Pahang, Malaysia
e-mail: mirta@umpsa.edu.my

M. Widia
Centre for Advanced Industrial Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, 26600 Pekan, Pahang, Malaysia

E. H. Sukadarin
Department of Chemical Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussien Onn Malaysia (UTHM), Johor, Malaysia

M. H. A. Hassan et al. (eds.), *Proceedings of the 2nd Human Engineering Symposium*, Lecture Notes in Mechanical Engineering,
https://doi.org/10.1007/978-981-99-6890-9_24

1 Introduction

The World Health Organization (WHO) estimated that around 466 million people have hearing loss globally [1]. Besides, Occupational Noise Related Hearing disorders were reported as the highest among other occupational poisoning and disease cases from 2016 until 2019 [2]. The manufacturing sector reported the highest percentage of confirmed occupational poisoning and disease cases in 2019 [3]. A study by Rasasoran et al. [4] shows that a high prevalence of hearing loss was reported among workers in the noise-exposed palm oil industries. On the other hand, the automotive industry in China reported about 62.53% of them exceeded 85 dB(A) of the personal noise level. Most of the excessive noise comes from various automotive industry jobs, such as surface treatment, metal cutting, stamping, grinding, welding, forging, assembly and plastic moulding [5]. Besides the manufacturing industries, other industries, such as the construction industry, were found to have personal noise exposure level issue among both machine and non-machine workers [6].

Therefore, understanding factors that facilitate or hinder specific safety behaviours' performance is crucial [7]. A study by Reddy et al. [8] found that both personal and environmental factors for intrapersonal, interpersonal, organisational, community and policy influenced the use of hearing protectors. A study by Acharya [9] found that using personal protective equipment (PPE) among workers was significantly associated with the gender of the respondents and encouragement to use PPE. Several factors lead to using hearing protectors among workers, such as exposure level, individual risk perceptions, a company's safety climate [10] and social modelling [11]. Nath et al. [12] reported that the significant challenge of issuing personal protective equipment is comfort, and it can be adequate if PPE is worn correctly. Thus, determining factors that play an important role in the usage of PPE is the first step before planning and implementing an intervention to increase PPE use [13].

Thus, this paper aims to present the process of developing a survey tool for measuring human factors and PHP use among industrial workers. The dimensional construct of human factors influencing PHP use among industrial workers was determined. Then, the finalised items within the study construct via qualitative assessment were determined.

2 Materials and Methods

2.1 Survey Tool Development

The survey tool was developed in several stages. First, a survey tool is developed based on the guiding validated framework from the combination of the Health Belief Model (HBM) [14] and the Health Promotion Model (HPM) [15].

Second, a narrative literature review was carried out to identify relevant questions closely related to the main objective of the survey tool development. The questions were adapted and modified from the previous studies. The researchers developed the items of each construct from past research by combining two selected frameworks: The Health Belief Model and the Health Promotion Model.

The two (2) appointed experts reviewed the constructs used in the survey tools. Another previous study used two expert panels to review the instrument before it could be used by the end users [16]. According to Presser et al. [17], the review method assesses any worries associated with the questionnaire in advance of annoying ideas or unsuitable wording of questions. Each expert commented on the modified items and indicated their decision to remove, keep, or modify them [18].

2.2 Conceptual Framework on the Human Factors and Personal Hearing Protector (PHP) Use Among Industrial Workers

The framework had eight constructs. A theoretical framework on the relationship between human factors and PHP usage among industrial workers was used to develop the survey tool. The independent constructs are the interpersonal influences, perceived susceptibility, perceived severity, perceived benefit, perceived barriers, perceived self-efficacy and cues to action. The dependent construct is the use of PHP (see Fig. 1).

3 Results and Discussion

The developed survey tool consisted of two parts. The first part focuses on sociodemographics. The second part comprised eight study constructs: interpersonal influence, perceived susceptibility, perceived severity, perceived benefit, perceived barrier, perceived self-efficacy, cues to action and use of PHP.

The survey tool applied a 5-point Likert scale. All seven (7) constructs were used scale from 1 (strongly disagree) to 5 (strongly agree). This scale is ranged from 1 (strongly disagree) to 5 (strongly agree), which indicates the respondent's agreement with each item [20]. Besides, the last construct for Personal Hearing Protector use was to use a scale from 1 as 'Never' to a scale of 5 as 'Always'. The Likert scale is one of the most basic and widely used psychometric tools in sociology, psychology, information systems, politics, economics and other fields [21]. 5-point rating scales are less confusing and may boost the response rate.

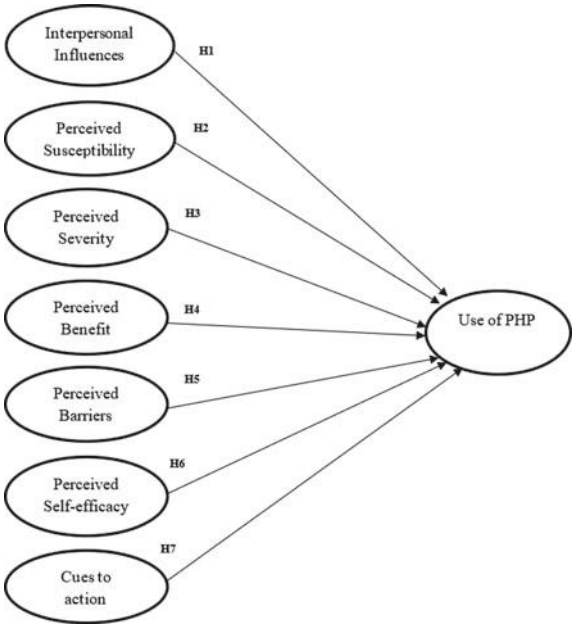

Fig. 1 Conceptual framework. Adapted from Health Belief Model and Health Promotion Model [14, 15, 19]

3.1 Sociodemographic

The questions for sociodemographic section consists of eighteen (18) questions (gender, age, nationality, marital status, educational level, working experience, type of personal hearing protector, working type, worker's experience with the ear problem and illnesses, family history of hearing disorder/loss, worker's audiometric test and hearing re-examination experience, worker's satisfaction on current PHP and the worker's position). Table 1 shows the first phase of sociodemographic information is finalised after the qualitative review by the appointed two (2) experts. Overall, items inside this section remain. However, certain items need improvements due to incorrect or overlapping items, and wrong chosen words.

3.2 Analyses of Human Factors Constructs for PHP Use

In the beginning, the total items for this tool are 97 items which cover all the study construct. During the qualitative assessment process, certain items considered perfect matches were maintained as it is, while the items considered moderate matches were maintained after refining some of the sentences. Besides, the items that were considered poor matches by the experts were removed. Items that were consistently deemed unnecessary were removed, and the modified items were altered [18]. After

Table 1 Finalise the first phase of Sociodemographic information

	Sociodemographic	Items
S1	Gender	Male
		Female
S2	Age	≤24 year
		25–34 years
		35–44 years
		≥ 45 years
S3	Nationality	Malaysian
		Non-Malaysian
S4	Marital status	Single
		Married
		Others (widowed, divorced)
S5	Educational level	Primary
		Secondary
		Certificate
		Diploma
		Bachelor degree
		Master
		Ph.D.
S6	Working experience	≤1 year
		2–5 years
		6–10 years
		≥11 years
S7	Type of personal hearing protector (PHP)	Earplug
		Ear muff
		Combination
S8	Working type	Regularly
		Shift
S9	Do you experience ringing in the ears or sound heard differently in each ear?	Yes
		No
S10	Have you suffered any illness that has affected your hearing (e.g., infection, tinnitus, discharge, etc.)?	Yes
		No
S11	Have you ever had an ear operation or any other major operation that affected your hearing?	Yes
		No
S12	Any family history of hearing loss/disorder?	Yes
		No
S13	Have you had an audiometric test before?	Yes

(continued)

Table 1 (continued)

	Sociodemographic	Items
		No
S14	Have you suffered any illness listed here?	Yes
		No
S15	If **YES**, please tick (/) **ONE** or more illnesses listed here	Vision impairment
		Alzheimer's disease
		Diabetes mellitus
		Cancer
		Vertigo
		Dizziness
		Psychosocial health
		Cardiovascular disease
		Stroke
S16	Experience of hearing re-examination	Yes
		No
S17	Are you satisfied with your current personal hearing protector?	Yes
		No
		Not applicable
S18	Position	Manager
		Engineers
		Executive
		Supervisor
		Technician
		Operator
		General worker

the qualitative assessment, the total items retained for this current study are 79 (see Table 2).

Table 3 shows the finalised first phase of Human Factors Construct for PHP use after considering all the comments by the appointed experts. According to this table, the construct for interpersonal influence has a total of eight (8) items, perceived susceptibility has seven (7) items, perceived severity has eight (8) items, perceived benefit has eight (8) items, perceived barrier eighteen (18) items, perceived self-efficacy have fifteen (15) items, cues to action have ten (10) items and use of personal hearing protector (PHP) have five (5) items.

Table 2 Changes the number of items in the study construct after qualitative content validation

No.	Human factors (construct)	Items (prior expert review)	Source	Items retained for the current study	Source
		No of items		No of items	
1	Interpersonal influence (II)	10	[13, 22, 23]	8	[13, 22, 23]
2	Perceived susceptibility (PS)	9	[23, 24]	7	[23, 24]
3	Perceived severity (PV)	10	[23–25]	8	[23–25]
4	Perceived benefit (PB)	14	[22–30]	8	[23, 28, 31]
5	Perceived barrier (PR)	20	[13, 22, 23, 25–28]	18	[13, 22, 23, 28, 31]
6	Perceived self-efficacy (PSE)	17	[13, 22, 23, 26, 28, 32]	15	[13, 22, 23, 28, 31, 32]
7	Cues to action (CA)	12	[23, 29]	10	[23, 29]
8	Use of personal hearing protector (PHP)	5	[33, 34]	5	[33, 34]
Total of items		97		79	

4 Conclusion

The first phase of survey tools for measuring the human factors constructs for PHP use among industrial workers was successfully developed via qualitative content validation by the two (2) experts. However, other studies conducted content validity using a quantitative approach [35]. This study manages to develop eight human factor constructs consisting of 79 items, including interpersonal influence, perceived susceptibility, perceived severity, perceived benefit, perceived barrier, perceived self-efficacy, cues to action and use of personal hearing protector (PHP). The sociodemographic parts are successfully developed, consisting of eighteen (18) items.

However, there are some highlights to be noted every time the content validation is planned; (1) the survey tool/questionnaire has to be translated and used in a dual language in English and Malay before it will be given to the targeted group, (2) provide a guide to the respondents on how to fill the survey questionnaire form and (3) involvement of experienced industrial practitioner such as safety officer as

Table 3 Finalise first phase research construct of Human Factors for PHP use

Question		Response options
(1) Interpersonal Influence		
II1	My team leader often uses a personal hearing protector when exposed to a noisy workplace	1. Strongly Disagree 2. Disagree 3. Neither Agree not Disagree 4. Agree 5. Strongly Agree
II2	My co-workers often use personal hearing protectors when exposed to a noisy workplace	
II3	My co-workers expect me to wear a personal hearing protector when I am in a noisy work environment	
II4	My family members encourage me to use a personal hearing protector when I am in a noisy work environment	
II5	My supervisor expects me to wear a personal hearing protector when I am in a noisy work environment regularly	
II6	Everyone in this company expects me to wear a personal hearing protector regularly	
II7	My co-worker expects me to wear a personal hearing protector every day	
II8	My company management encourages me to wear a personal hearing protector every day	
(2) Perceived Susceptibility		
PS1	I believe my chances of developing a hearing loss problem are high	1. Strongly Disagree 2. Disagree 3. Neither Agree nor Disagree 4. Agree 5. Strongly Agree
PS2	I worry about getting a hearing loss problem	
PS3	I know people in this career field who got a hearing loss problem	
PS4	Small exposures to noise hazards won't me to a hearing loss problem	
PS5	Everybody can get hearing loss problems, including office workers	
PS6	I am at risk of a hearing loss problem	
PS7	I can have a hearing loss problem even without experiencing any signs or symptoms	
(3) Perceived Severity		
PV1	The thought of getting a hearing loss problem deeply concerns me	1. Strongly Disagree 2. Disagree 3. Neither Agree not Disagree 4. Agree 5. Strongly Agree
PV2	If I developed a hearing loss problem, my career would be in jeopardy	
PV3	Problems I would experience from the hearing loss problem would last a long time	
PV4	A hearing loss problem will lead to permanent changes in my health	
PV5	My financial security would be endangered if I developed a hearing loss problem	

(continued)

Table 3 (continued)

Question		Response options
PV6	I am afraid to even think about getting a hearing loss problem	
PV7	There are no drugs to manage hearing loss problems	
PV8	Hearing loss complications would endanger my problem	
(4) Perceived Benefit		
PB1	Feeling safe while wearing a personal hearing protector	1. Strongly Disagree 2. Disagree 3. Neither Agree nor Disagree 4. Agree 5. Strongly Agree
PB2	Feeling useful while wearing a personal hearing protector	
PB3	Wearing a personal hearing protector will prevent future hearing problems for me	
PB4	A personal hearing protector prevents exposure to the noise hazards I am around on the job	
PB5	I benefit from wearing a personal hearing protector	
PB6	I think wearing a personal hearing protector every time I am in loud environments is important	
PB7	I am convinced I can prevent hearing loss by wearing hearing protectors whenever I am in loud environments	
PB8	If I wear a personal hearing protector, I can protect my hearing	
(5) Perceived Barrier		
PR1	Wearing a personal hearing protector is uncomfortable	1. Strongly Disagree 2. Disagree 3. Neither Agree not Disagree 4. Agree 5. Strongly Agree
PR2	I think using a personal hearing protector will slow my speed	
PR3	A personal hearing protector limits my ability to hear what I want to hear	
PR4	I think it will be hard to hear warning signals (like backup beeps) if I am wearing hearing protectors	
PR5	I don't feel like wearing a personal hearing protector at the workplace	
PR6	I think earmuffs make my head sweat too much	
PR7	Personal hearing protectors are uncomfortable to wear	
PR8	A personal hearing protector limits my ability to communicate with others	
PR9	Wearing a personal hearing protector is annoying	
PR10	The size of the personal hearing protector is not fit for me, so I don't wear it	
PR11	I don't like to wear anything on my ears while performing a job task	
PR12	I think a personal hearing protector puts too much pressure on my ears	

(continued)

Table 3 (continued)

Question		Response options
PR13	A personal hearing protector interferes with my ability to do my job	
PR14	A personal hearing protector is not always available to me	
PR15	My co-workers would make fun of me for wearing a personal hearing protector	
PR16	I would need to develop a new habit of wearing a personal hearing protector, and that is difficult	
PR17	A personal hearing protector is expensive	
PR18	There are disadvantages to wearing a personal hearing protector	
(6) Perceived Self-efficacy		
PSE1	If using a personal hearing protector was comfortable, I would definitely use it	1. Strongly Disagree 2. Disagree 3. Neither Agree not Disagree 4. Agree 5. Strongly Agree
PSE2	If a personal hearing protector was easy to obtain, I would definitely use it	
PSE3	I know when I should use a hearing protector	
PSE4	I can wear a personal hearing protector regularly in a noisy workplace	
PSE5	I wear a personal hearing protector regularly, even though my colleagues around me are not in the habit of wearing a personal hearing protector	
PSE6	When my personal hearing protector is not functioning, I will inform my supervisor to get a new one for me	
PSE7	I can inspect or check for any defects in the personal hearing protector before wearing it	
PSE8	I am sure how to tell when a personal hearing protector needs to be replaced	
PSE9	I can wear a personal hearing protector properly	
PSE10	I can wear a personal hearing protector even if I have to wear other personal protective equipment (PPE)	
PSE11	I am confident the usage of a personal hearing protector can reduce the noise exposure to me	
PSE12	I am confident that I will remember to use a personal hearing protector when I am exposed to noise hazards	
PSE13	I am confident I can obtain the proper personal hearing protector when I am exposed to noisy hazards at work	
PSE14	I am confident that my job performance will not be adversely impacted by wearing a personal hearing protector	
PSE15	I am confident that after wearing the proper PHP throughout my career will help prevent me from getting a hearing loss issue	
(7) Cues to Action		

(continued)

Table 3 (continued)

Question		Response options
CA1	A reminder from my supervisor every day would be important to wear of personal hearing protector	1. Strongly Disagree 2. Disagree 3. Neither Agree not Disagree 4. Agree 5. Strongly Agree
CA2	Inspection from my supervisor would improve my wear of personal hearing protectors	
CA3	The fact that OSHA fines me or my employer for not wearing a personal hearing protector is important	
CA4	Posters in my workplace would serve as important reminders to wear personal hearing protectors	
CA5	The threat of disciplinary action is an important factor in ensuring I wear a personal hearing protector	
CA6	Having a personal hearing protector at the location of the hazard is critical to ensure that I wear it	
CA7	If I see others wearing personal hearing protectors in my area, then it reminds me to use them	
CA8	Regular and frequent education on the importance of personal hearing protectors improves how often I wear them	
CA9	My supervisor sets the example of wearing a personal hearing protector when being exposed to hazards	
CA10	Training provided by my supervisor about PHP and the importance of personal hearing protectors was helpful	
Use of Personal Hearing Protector (PHP)		
UP1	How often do you wear personal hearing protectors during the past week when in high-noise areas?	1. Never 2. Rarely 3. Sometimes 4. Very Often 5. Always
UP2	How often do you wear personal hearing protectors during the past month when in high-noise areas?	
UP3	How often do you wear personal hearing protectors during the past three months when in high-noise areas?	
UP4	How often are you aware of the compliance of wearing a personal hearing protector when working in an excessive noise area?	
UP5	How often do you make sure that your personal hearing protector is well-fitted?	

an appointed expert panel in reviewing the content of the questionnaire. Before distributing the finalised survey tool (questionnaire), a briefing must be conducted on the targeted respondents to ensure workers' understanding in answering the questions. The consent form must be given to the respondent to ensure the participants understand and know the study's purpose before carrying out the sampling process.

Therefore, this survey tool can contribute toward an improved understanding of the human factors that may influence the consistent use of PHP among workers working in an excessively noisy work area.

Acknowledgements The authors would like to thank the Universiti Malaysia Pahang, Malaysia, for providing financial support under Internal Research grant RDU190388.

References

1. WHO (2018) Addressing the rising prevalence of hearing loss, no 02
2. DOSH (2019) Annual report 2019. Department of Occupational Safety and Health, Putrajaya
3. DOSH (2019) Occupational poisoning and disease statistics 2019, Putrajaya
4. Rasasoran KA, Atil A, Jeffree MS, Saupin S, Lukman KA (2021) Hearing loss and associated factors among noise-exposed workers in palm oil mills. Risk Manag Healthc Policy 14:3653–3658. https://doi.org/10.2147/RMHP.S319858
5. Chen Y et al (2019) Prevalence and determinants of noise-induced hearing loss among workers in the automotive industry in China: a pilot study. J Occup Health 61(5):387–397. https://doi.org/10.1002/1348-9585.12066
6. Fauzan NS, Mirta W, Kee HY (2019) Psychological impact of noise exposure among machine and non- machine operators in construction industry. In: IOP conference series: materials science and engineering, vol 702, no 012055, pp 1–7. https://doi.org/10.1088/1757-899X/702/1/012055
7. Morgan JI, Curcuruto M, Steer M, Bazzoli A (2020) Implementing the theoretical domains framework in occupational safety: development of the safety behaviour change questionnaire, no December. https://doi.org/10.1016/j.ssci.2020.105135
8. Reddy RK, Welch D, Thorne P, Ameratunga S (2012) Hearing protection use in manufacturing workers: a qualitative study. Noise Heal 14(59):202–209. https://doi.org/10.4103/1463-1741.99896
9. Acharya S (2014) Journal of public health open access utilization pattern of personal protective equipment. Heal Prospect J Public Heal 13(Ii):24–28
10. Arezes PM, Miguel AS (2005) Hearing protection use in industry: the role of risk perception. Saf Sci 43(4):253–267. https://doi.org/10.1016/j.ssci.2005.07.002
11. Ronis DL, Hong O, Lusk SL (2006) Comparison of the original and revised structures of the health promotion model in predicting construction workers' use of hearing protection, pp 3–17. https://doi.org/10.1002/nur
12. Nath ND, Behzadan AH, Paal SG (2020) Automation in construction deep learning for site safety: real-time detection of personal protective equipment. Autom Constr 112(July 2019):103085. https://doi.org/10.1016/j.autcon.2020.103085
13. Lu L, Shi L, Han L, Ling L (2015) Individual and organisational factors associated with the use of personal protective equipment by Chinese migrant workers exposed to organic solvents. Saf Sci 76:168–174. https://doi.org/10.1016/j.ssci.2014.11.025
14. Rosenstock IM (1974) The health belief model and preventive health behavior. Health Educ Monogr 2(4):354–386. https://doi.org/10.1177/109019817400200405
15. Pender NJ (1987) Health promotion in nursing practice, 2nd ed. Appleton & Lange, Norwalk, CT
16. Makhilan NI, Fauzan NS, Shariffudin N, Mohd Zin A (2021) Development of safety assessment system for food premises. Int J Ind Manag 11(1):274–286. https://doi.org/10.15282/ijim.11.1.2021.6117
17. Presser S et al (2004) Methods for testing and evaluating survey questions university of Maryland university of Michigan U.S. census bureau office for national statistics university of Michigan 68(1):109–130
18. Bai Y, Li J, Bai Y, Ma W, Yang X, Ma F (2018) Development and validation of a questionnaire to evaluate the factors influencing training transfer among nursing professionals. BMC Health Serv Res 18(1):1–9. https://doi.org/10.1186/s12913-018-2910-7