

Chapter 2

Factors Leading to Slip-and-Fall Incidents

Abstract There are several factors that prompt the slip-and-fall incidents and this study focuses on seven factors. Epidemiology approach was used to determine the factors of slip-and-fall incidents, and questionnaire was selected as an instrument for data collection. Exploratory Factor Analysis (EFA) was performed to evaluate how the respondents perceived the slip-and-fall factors while Cronbach's alpha was used to assess the internal consistency for each domain in the survey. Subsequently, the factors were ranked in accordance with the total variance recorded.

2.1 Seven Factors of Slip-and-Fall

In this study, the seven factors consisted of (i) footwear factor, (ii) contaminant factor, (iii) flooring factor, (iv) cleaning factor, (v) environment factor, (vi) individual factor, and (vii) perception of risk factor. Statistical analysis was important to validate how the respondent perceived the slip-and-fall factors in this study.

In the analysis, Exploratory Factor Analysis (EFA) was chosen along with Principle Components Analysis (PCA) and Varimax rotation method where Kaiser-Meyer-Olkin's (KMO) verification of sampling adequacy was performed. The eigenvalue of higher than 1.0 was set and loading item greater than 0.4 was considered. In the beginning, the EFA was conducted on 30 items of slip-and-fall factors. Then, items with low reliability and factor loading were removed. Finally, only 25 items were considered for the analysis. Based on KMO test results, the pattern of correlation was considered as accepted (0.701, mediocre). Then, the factor loading values were obtained (ranging from 0.345 to 0.930). The Bartlett's test of sphericity recorded statistical significance with $\chi^2(435) = 1325$, $p < 0.0001$, indicating that the correlation between the items was sufficient for PCA. This kind of information is also supported by previous study [1]. It was found that the seven factors solution in the analysis occupied 59.809% of the total variance.

2.2 Leading Factors by Rank

Cronbach's alpha was utilised to verify the interrelatedness of items [2]. There liability analysis used it to find the internal consistency for each domain of the survey. Cronbach's alpha discovered that the values were ranging from 0.673 to 0.894 in the analysis. Hence, the seven factors of slip-and-fall incidents were considered reliable and obtained high internal consistency. This consideration was made based on previous study [1].

To describe a set of 'p' random variables (factors), factor analysis was used where interpretation of coefficient in a factor model (loading) can be determined. The factor loading in this analysis was found in a value ranging from 0.345 to 0.93.

Based on workers' perception of the seven factors, the analysis showed that the perception of risk was the main factor of slip-and-fall (12.605%), followed by environment factor (10.161%), individual factor (9.471%), cleaning factor (9.039%), contaminant factor (7.333%), footwear factor (6.025%), and flooring factor (5.176%). Based on the total variance obtained, those tested factors were ranked as follows: (1) perception of risk factor; (2) environment factor; (3) individual factor; (4) cleaning factor; (5) contaminant factor; (6) footwear factor; and (7) flooring factor. Table 2.1 presents factors that are established based on the percentage of variance.

In this study, perception of risk factor was identified as a significant factor of slip-and-fall incidents. Various researchers in previous studies considered the perception of risk to avoid slip-and-fall hazard before it occurs [3–7]. Based on the findings, the experienced workers tend to ignore their own safety at the workplace. In this case, being too confident is among the causes of accidents to happen.

As stated in the previous study, personality plays a big role in the way people react to instructions, either by ignoring or complying with them [8]. Previous researchers stated that when some people are unable to perceive risks well (poor perception of risks), they will not maintain their body balance and cannot adjust their gait pattern [5, 9, 10]. As found in this study, new workers are also prone to getting slip-and-fall incidents because they are not familiar with their own working environment. They lack the experience and understanding of their health and safety responsibilities. This finding is supported by earlier studies that highlighted the lack of experience [11] and the lack of understanding on health and safety [12]. In this condition, it is important for the management to take preventive measures. According to previous study, poor perception of risk by the workers and failure to provide health and safety training to the workers make the accidents unavoidable [12]. Thus, some researchers suggested a good safety management by managing the perception of risk that may provide a better organisational safety culture [13, 14].

Environment is the second factor that contributes to the slip-and-fall incidents in the manufacturing industry. In this study, respondents agreed that poor lighting, noisy environment, unpleasant condition, unsuitable temperature, and glare are the criteria of this factor. In a working area, glare or insufficient lighting may hamper the workers from seeing clearly [8, 15, 16]. Unsuitable temperature during working

Table 2.1 Summary of factor and reliability analyses on slip-and-fall factors

	Factors and items	Factor loading	% of variance	Cronbach's alpha, α
	<i>Footwear factor</i>			
1.	Wearing shoes with non-skid soles may avoid slip-and-fall incidents	0.817	6.025	0.743
2.	Wearing unsuitable shoes at the workplace must be avoided	0.864		
3.	Old shoes that are already worn out may cause a person to slip	0.751		
	<i>Contaminant factor</i>			
4.	Spillages or items of contamination attended at all times give hazard	0.821	7.333	0.673
5.	All spills must be wiped up promptly	0.854		
6.	Grease and oil accumulations cannot be ignored	0.717		
7.	Most spillages occur as a result of faulty machineries	0.475		
	<i>Flooring factor</i>			
8.	Suitable flooring must be used at the work areas	0.708	5.176	0.692
9.	Applications of polishes and coatings can change surface properties	0.569		
10.	Slippery floor may cause a person to slip	0.721		
	<i>Cleaning factor</i>			
11.	Wet floor warning or caution sign must be displayed	0.778	9.039	0.764
12.	Spillages cannot be attended at all times	0.696		
13.	Wet floor must be fenced off until dry	0.830		
14.	Working area must be in tidy	0.729		
	<i>Environment factor</i>			
15.	Poor lighting contributes to the slip-and-fall incidents	0.747	10.161	0.771
16.	Noisy and unpleasant conditions may cause distractions	0.849		
17.	Unsuitable temperature during working hours can reduce alertness	0.827		
18.	Glare may cause difficulty for a person to see	0.526		
	<i>Individual factor</i>			
19.	Tiredness is one of the factors that initiates accidents	0.93	9.471	0.74
20.	Stress or pressure may interfere a person during working hours	0.927		
21.	Avoid carrying loads that block your vision	0.345		
22.	A person who has any health or medical problems may easily be involved in accidents	0.604		

(continued)

Table 2.1 (continued)

	Factors and items	Factor loading	% of variance	Cronbach's alpha, α
	<i>Perception of risk factor</i>			
23.	Too confident is one of the causes of slip-and-fall incident to occur	0.863	12.605	0.894
24.	Experienced workers often ignore their safety at the workplace	0.919		
25.	Unfamiliarity with own working condition and environment may cause you to be involved in slip-and-fall incidents	0.912		

[8] and noisy environment [8, 16, 17] interrupt workers' awareness in regard to any hazards in a non-ergonomic condition. Humidity is another contributing factor in the environment. Under a humid environment, the floors may be slippery [8]. All of these findings are supported by previous studies [15–17].

Next, the third factor is the individual factor. In this study, the respondents agreed that tiredness, poor stress management, improper working method, and poor health condition have made them prone to slipping and falling. These findings are consistent with previous study that discovered improper working methods such as carrying load can block one's own vision [18]. Poor health condition [4, 19, 20] and lost footing balance [12] were also found to be the criteria in slip-and-fall incidents. In addition, several earlier studies have confirmed that other criteria of individual personality such as age [19, 20, 22], experience [20], gender [22], and body mass [20, 23] are important in order to prevent slip-and-fall incidents. These criteria were considered as the background details in the studies. For example, two workers may have the same weight but different health conditions, or they may adopt different working methods to suit their individual personality. In conclusion, individual factor plays a big role in adopting practical strategies to avoid slip-and-fall incidents.

Cleanliness is the fourth factor of slip-and-fall incidents. The respondents of this study opined that wet floor must be fenced off and allocated with a warning sign, indicating that effective solutions for this factor are rather simple and inexpensive, and can ignite other benefits of preventing slip-and-fall incidents. This statement is supported by previous study [24]. Spillage cannot be attended at all times hence a working area must always be tidy. In this case, [24] agreed on the importance of removing spillage while other researcher emphasised the tidiness aspect of a working area [21]. These studies particularly measured the relationship between causes and injury severity. Inadequate cleaning is the cause of most injury cases that are severe and consequently require intensive treatment [21].

The fifth factor in this study is contaminant. A contaminant can be represented by various types of liquid such as detergent [17, 25], water [25], and oil [17, 18, 25]. In this study, the respondents agreed that any contamination can cause hazard hence it must be cleaned immediately. These findings corroborate the findings of previous study [6]. The respondents also agreed that grease and oil accumulation cannot be

ignored because most of the spillages in manufacturing industry is a result of faulty machinery. In previous study, oil contaminant received the lowest COF value hence it should be avoided [6]. In addition, it was found that most spillages occur as a result of faulty machineries [26] that do not have adequate maintenance [21]. These contaminants are dangerous as they can initiate slip-and-fall incidents [16, 17, 25, 28, 29].

A person can slip on an oil contaminant due to the lowest value of friction being measured compared to water [25]. Hence, the accumulation of grease and oil cannot be ignored by workers in the manufacturing industry. Moreover, contamination control needs to be applied because almost all slip-and-fall incidents occur due to contamination [30]. Respondents' perception in this case is consistent with the findings in the previous studies [17, 25, 27–29].

Footwear is the sixth factor in any slip-and-fall incidents. In this study, it was found that non-skid soles may avoid slip-and-fall incidents and it was recommended that unsuitable shoes must be avoided [24, 28, 31]. This is because different types of job, floor surface, floor condition, and sole material have different purposes and functions [24]. Hazards or accidents are unavoidable if workers wear shoes that are unsuitable with their working condition and environment. In this study, worn-out shoes were also perceived as a cause of slipping, as mentioned in previous study [24]. Therefore, each person should be alert with the condition of their shoes. Previous researchers also considered sole material in preventing slipperiness [25, 26, 28]. The criteria in this factor are supported by earlier studies [24–26, 28, 31].

Finally, flooring is the seventh factor contributing to the slip-and-fall incidents. Most respondents agreed that slippery floor may cause them to slip and fall. This argument is consistent with [25]. In addition, suitable flooring in terms of floor selection must be considered at the workplace [24]. Different types of floor are needed for different working environments to ensure the safety of workers and prevent them from involving in any accidents. The applications of polish and coating can change the surface properties, where the floor finishes may help reduce the floor's slippery condition [32]. Hence, it is important to understand whether a surface can be modified to improve slip resistance. All of the findings were related to the friction and roughness of the floor, which is a factor that will affect the potential of slip-and-fall incidents. Earlier studies confirmed the various issues related to floor friction [25, 28, 33] and floor roughness [6, 32, 34, 35]. Thus, a flooring factor can be considered to study the effect of slipperiness in the slip-and-fall areas.

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and Fall Incidents

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2017, XIII, 41 p. 20 illus., 19 illus. in color., Softcover

ISBN: 978-981-10-3285-1