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HIRARC-Based Assessment of Fall-Related Workplace Accident Trends with Practical Risk Control Recommendations in Public Institutions

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Abstract

Workplace accidents remain a significant occupational safety concern, with fall-related accidents being among the most common causes of workplace injuries. In public educational institutions, hazards such as slippery surfaces, damaged infrastructure, uneven walkways, and unstable equipment may increase the risk of falls among institutions staff. This study aims to identify fall-related hazards, assess associated risk levels, and propose suitable control measures using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) methodology. The study employed a descriptive research design involving the analysis of workplace accident records from 2020 to 2025, site inspections, hazard identification, and risk assessment procedures. The findings revealed that chair-related falls, drainage collapse incidents, slippery surfaces, and falls from height were the primary contributors to workplace accidents. Risk assessment results indicated that several identified hazards were classified as medium-risk and required immediate control measures. Based on the findings, practical recommendations were proposed following the Hierarchy of Controls to reduce workplace hazards. The study demonstrates that the application of HIRARC provides a systematic approach for hazard prioritisation and contributes to improving workplace safety performance in public educational institutions.

1. Introduction

Workplace safety remains an important aspect of occupational safety and health management, particularly in public institutions where staff are exposed to various workplace hazards during daily operations (Hakim, Irwin, Abdillah, & Masykuri, 2024). Among occupational accidents, fall-related incidents continue to be one of the most common causes of injuries and lost workdays (Lu, 2021). Hazards such as slippery surfaces, damaged drainage systems, poor lighting, unstable furniture, and unsafe work practices contribute significantly to fall-related accidents (Hakim, Irwin, Abdillah, & Masykuri, 2024). Despite existing safety measures, fall-related workplace accidents continue to occur in public institutions. This research studied accident reports reported under NADOPOD between 2020 and 2025 and identified a trend of fall-related incidents among employees. Chair-related falls recorded the largest number, followed by falls caused by drainage and slippery or uneven surfaces. Although falls from heights and toilets were less common, their potential consequences were still significant. This trend indicates the issue is related to specifics reoccurring conditions that can be recognized and managed

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and highlight the need for a systematic assessment of workplace hazards and associated risks (Zermane, Zermane, & Mohd Tohir, 2024). The HIRARC methodology provides a structured approach for identifying hazards, evaluating risks, and recommending practical control measures. Therefore, this study applies the HIRARC approach to analyse fall-related workplace accident trends and propose practical risk control recommendations to improve workplace safety performance within a public institution.

2. Literature Review

Many studies have been conducted on workplace safety and the importance of hazard identification and risk assessment in reducing occupational accidents, particularly fall-related incidents in institutional environments (Hakim, Irwin, Abdillah, & Masykuri, 2024). Previous research has shown that fall-related accidents are strongly associated with environmental and infrastructural factors such as slippery surfaces, poor drainage systems, uneven walkways, inadequate lighting, and unsafe furniture conditions (Lu, 2021). Studies have also highlighted that behavioural factors and poor maintenance practices contribute significantly to recurring accident trends, especially in workplaces where systematic hazard monitoring is limited. The application of the Hazard Identification, Risk Assessment and Risk Control (HIRARC) methodology has been widely recognised as an effective approach in identifying workplace hazards (Zermane, Zermane, & Mohd Tohir, 2024), evaluating associated risks based on likelihood and severity, and implementing control measures using the Hierarchy of Controls. This structured approach enables organisations to prioritise high-risk hazards and implement preventive strategies that reduce accident occurrences. In addition, past studies in university and institutional have emphasised that continuous safety inspections, proper maintenance systems, and safety awareness among staff are essential in preventing fall-related accidents and improving overall occupational safety performance.[

2.1 Importance of HIRARC

The HIRARC (Hazard Identification, Risk Assessment and Risk Control) approach is important in occupational safety and health as it provides a systematic method for identifying workplace hazards, assessing the level of risk based on likelihood and severity, and implementing effective control measures. It helps organizations prioritize high-risk hazards and reduce the occurrence of workplace accidents by applying the Hierarchy of Controls. In addition, HIRARC supports continuous improvement in safety management by ensuring hazards are properly identified, evaluated, and controlled in a structure

2.2 Fall-Related Workplace Accidents

Accidents related falls occurs when employees lose their balance because of hazardous workplace conditions or unsafe workplace behaviours. Slippery floors, uneven walking surfaces, broken drainage covers, dim lighting, inappropriate ladder use, and unstable furniture are common causes. According to prior studies, these risks have a major role in workplace accidents and lost productivity. Therefore, to reduce fall-related occurrences, preventative measures and continuous monitoring are required.

2.3 Hazard Identification, Risk Assessment and Risk Control (HIRARC)

HIRARC is a systematic technique for identifying occupational hazards, assessing related risks, and implementing suitable management methods. The method ensures that appropriate preventative measures have been put into action while allowing organizations to prioritize hazards according to their likelihood and severity.

The Department of Occupational Safety and Health (DOSH) commonly acknowledges HIRARC as an effective tool for occupational risk management.

3. Methodology

This study used the HIRARC methodology to assess fall-related work-related incidents and identify potential hazards at a public institution. To identify recurrent fall-related hazards and accident patterns, NADOPOD accident reports from 2020 to 2025 were analysed. With the objective to identify hazardous conditions and help in the risk assessment process, site inspections and workplace observations were also carried out.

3.1 Study Design and Method

This study used a qualitative descriptive methodology. Workplace observations, site inspections, HIRARC evaluations, and accident record analysis were used to gather data. The study focused on fall-related accidents

that occurred among university employees. To identify hazards, evaluate risk levels, and suggest suitable control measures, the DOSH (2008) recommended HIRARC procedure was applied.

3.2 Data Collection Process

The study started by gathering fall-related accident data from NADOPOD between 2020 and 2025.Data collection was conducted in three main stages: accident record analysis, workplace inspection and observation, and HIRARC assessment. First, fall-related workplace accident records reported under NADOPOD from 2020 to 2025 were collected and reviewed to identify recurring accident patterns and categories. The recorded cases were classified according to the reported type of fall, including falls from chairs, drainage-related falls, falls from heights, falls on slippery or uneven surfaces, and restroom-related falls.

Second, workplace inspections and direct observations were conducted at relevant areas within the public institution to identify existing conditions that could contribute to fall-related accidents. The inspection focused on floor conditions, drainage systems, carpets, workstation arrangements, electrical cables, portable ladders, stairwell lighting, and other physical conditions associated with the identified accident trends. The observations were used to verify whether similar hazardous conditions were present at the workplace.

Finally, the information obtained from the accident records and workplace inspections was used to identify hazards for the HIRARC assessment. Each identified hazard was assessed based on its likelihood of occurrence and severity of potential consequences using the HIRARC risk assessment approach. The resulting risk level was then used to determine appropriate control measures according to the Hierarchy of Controls.

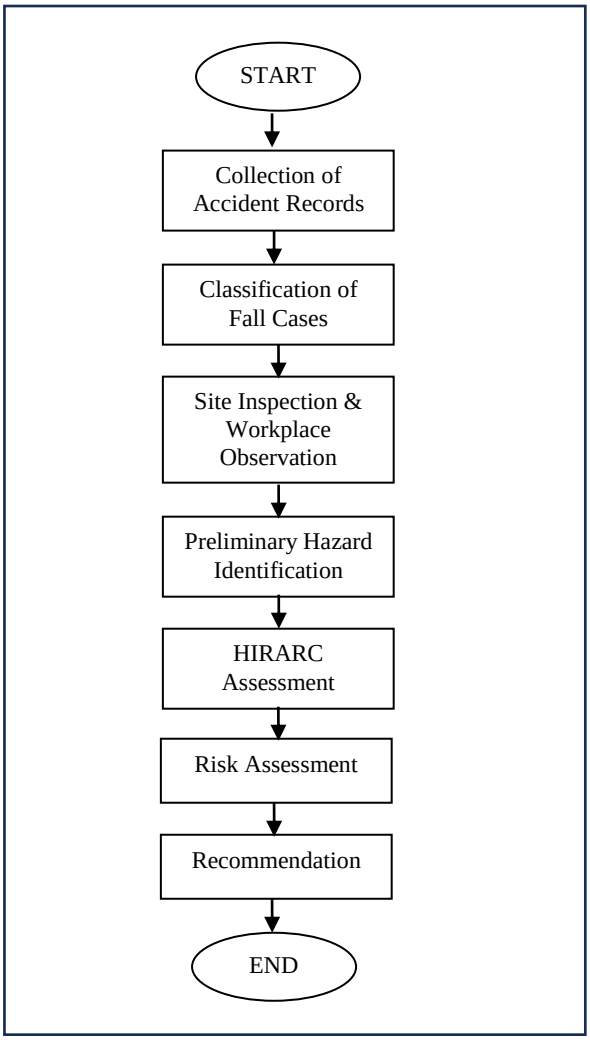


Figure 1. Flowchart of Study

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3.3 Data Analysis

Descriptive analysis methods were used to analyse the gathered data. To identify recurrent patterns and trends, accident records were categorized by accident type. Using the HIRARC risk matrix, risk levels were calculated by assessing each identified hazard's likelihood and severity. The hierarchy of controls was then applied to recommend practical control measure to reduce the reoccurring fall-related accident trends.

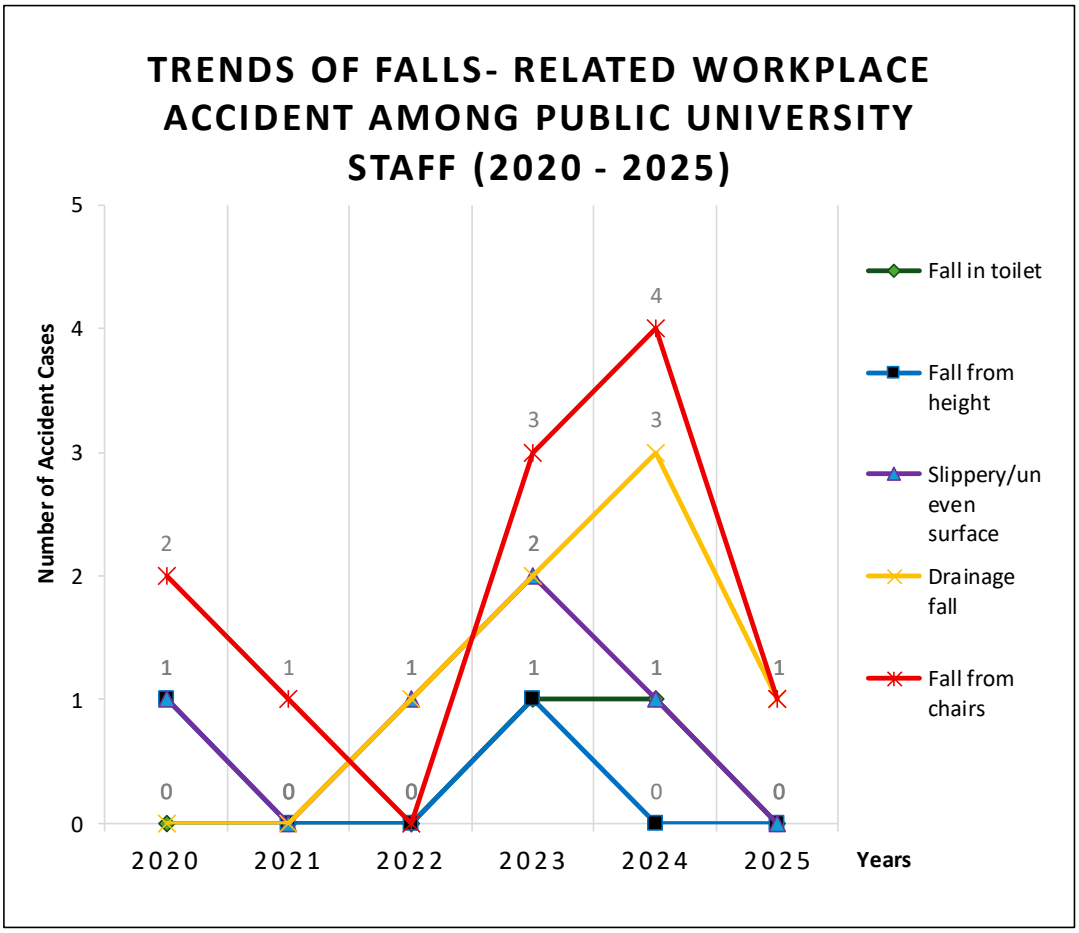


Figure 2. Trends of Fall-Related Workplace Accidents (2020–2025)

4. Findings and Recommendations

4.1 Trend Analysis of Fall-Related Workplace Accidents

Five primary categories of fall-related workplace accidents were identified from the accident records between 2020 and 2025: falls from chairs, drainage falls, falls from height, slippery or uneven surface falls, and falls related to restrooms. Among these categories, chair-related falls recorded the highest number of cases, followed by drainage falls and slippery or uneven surface falls. The relatively frequent occurrence of these categories suggests that fall-related accidents were associated not only with high-risk activities but also with routine workplace conditions, furniture use, and the condition of workplace facilities.

Chair-related falls were recorded in every year except 2022 and increased from two cases in 2020 to four cases in 2024. This recurring pattern may indicate that inappropriate use of chairs, unsuitable furniture, or unsafe workstation practices remained present within the workplace. The finding highlights the importance of addressing routine activities that may be perceived as low risk but can repeatedly contribute to accidents. Similarly, drainage-related falls increased from one case in 2022 to three cases in 2024, indicating that infrastructure and maintenance conditions may contribute to recurring fall hazards. Previous research has also identified environmental and workplace conditions as important contributors to occupational accident occurrence, supporting the need for continuous hazard identification and monitoring (Hakim, Irwin, Abdillah, & Masykuri, 2024).The number of fall-related accidents increased between 2023 and 2024 before decreasing in

2025. The decrease may indicate an improvement in workplace conditions, maintenance practices, or safety awareness; however, the available accident records alone cannot establish that corrective measures directly caused the reduction. Therefore, continued monitoring is necessary to determine whether the reduction represents a sustained improvement or a temporary variation in accident occurrence. Trend analysis is useful in this context because it enables recurring accident categories to be identified and provides a basis for prioritising subsequent risk assessment and control measures (Nai'em, Darwis, & Maksun, 2021).

Table 1. Trend of Fall-Related Workplace Accidents (2020–2025)

Types of Fall	2020	2021	2022	2023	2024	2025
Fall in toilet	0	0	0	1	1	0
Fall from height	1	0	0	1	0	0
Slippery/uneven surface	1	0	1	2	1	0
Drainage fall	0	0	1	2	3	1
Fall from chairs	2	1	0	3	4	1

4.2 Pareto Analysis of Fall-Related Accident Categories

The Pareto analysis showed that approximately 80% of the recorded fall-related accidents were concentrated in three categories: falls from chairs, drainage falls, and falls involving slippery or uneven surfaces. This concentration indicates that a relatively small number of recurring hazard categories contributed to a large proportion of the recorded accidents. Therefore, focusing preventive efforts on these categories may provide greater safety benefits than applying the same level of attention to all fall-related hazards.

The dominance of chair-related falls suggests that furniture selection, workstation practices, and employee behaviour should receive greater attention during workplace safety inspections. Meanwhile, the occurrence of drainage and slippery or uneven surface falls indicates that building maintenance and housekeeping are important components of fall prevention. These findings are consistent with previous research indicating that workplace conditions, maintenance practices, and environmental hazards can contribute to recurring occupational accidents (Hakim, Irwin, Abdillah, & Masykuri, 2024).

The Pareto findings therefore provide a practical basis for prioritising control measures. Rather than focusing only on the number of accidents, the institution should address the underlying workplace conditions associated with the most frequent categories. This approach is consistent with the purpose of HIRARC, which is to systematically identify hazards, assess their associated risks, and prioritise appropriate risk control measures (Zermane, Zermane, & Mohd Tohir, 2024).

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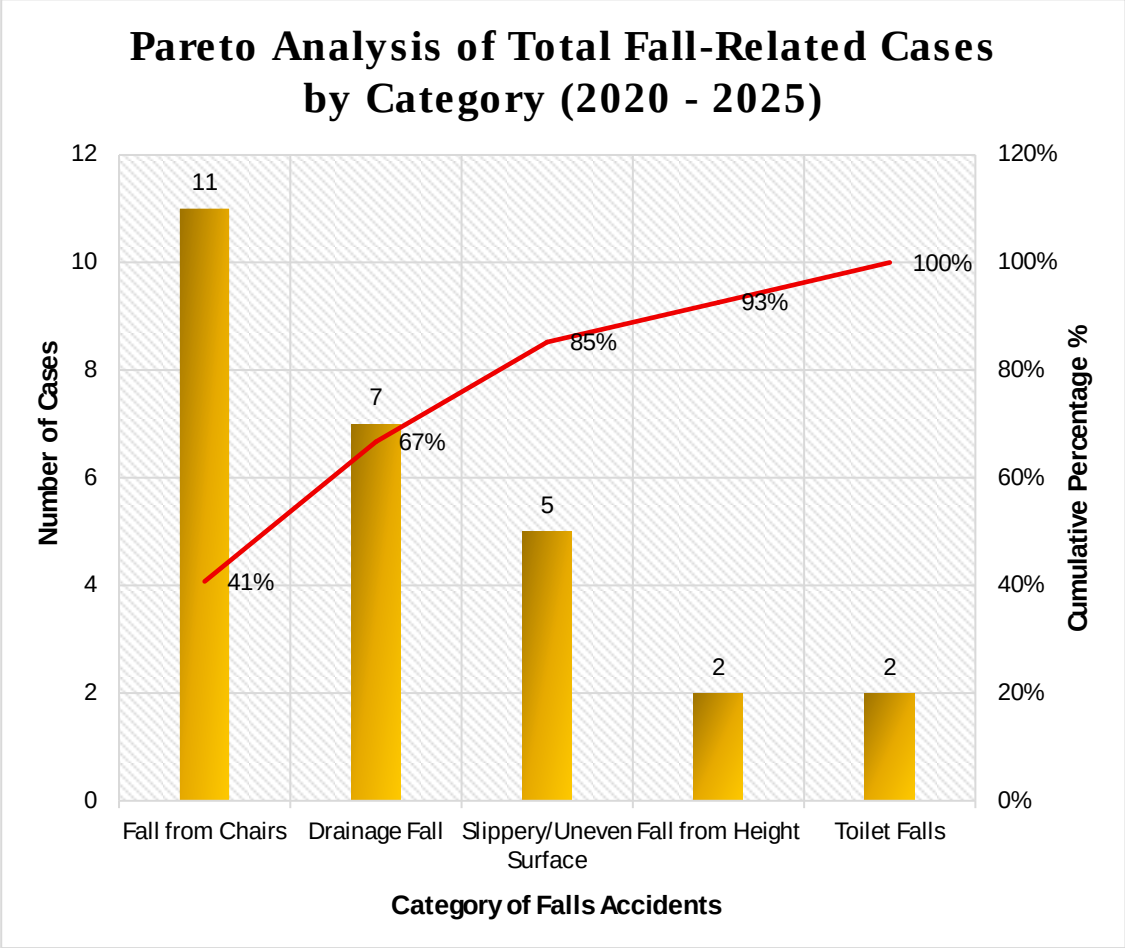


Figure.3 Pareto Analysis of Total Fall Related Cases by Category (2020 -2025)

4.3 HIRARC Assessment Findings

The HIRARC assessment identified seven fall-related hazards based on workplace observations, site inspections, and the analysis of accident records. The identified hazards included wet and slippery toilet floors, slippery entrance carpets, poorly maintained drainage, poorly positioned electrical adapters, the use of portable ladders for retrieving files, exposed cables in meeting rooms, and inadequate lighting on staircases. Each hazard was assessed based on its likelihood and severity, while existing controls and additional control measures were identified according to the hierarchy of controls. The assessment showed that all seven identified hazards were initially classified as medium risk. The highest initial risk scores were observed for working at height using portable ladders, exposed cables in meeting rooms, and poor lighting on staircases, each with a risk score of 12. Following the recommended control measures, five hazards were reduced to low risk, while the ladder-related and staircase lighting hazards remained at medium risk and therefore require continued monitoring and further improvement. These findings demonstrate the importance of addressing both existing workplace conditions and task-related hazards through appropriate control measures.The HIRARC assessment results are presented in Table 2.

Table 2. Hazard Identification, Risk Assessment and Risk Control (HIRARC) for Fall-Related Hazards

Work Activity	Identified Hazard	Consequences	Existing Controls	Recommended Control Measures
Cleaning and mopping toilet floors	Wet and slippery floor	Slips, trips and minor injuries	Routine cleaning; safety footwear	Use anti-slip mats, fast-drying cleaning methods and warning signs during cleaning.
Entering the building through entrance pathways	Slippery entrance carpet	Slips, falls, sprains and fractures	Entrance carpet	Replace with anti-slip carpet and provide warning signs during wet weather.
Conducting internal audit inspections	Poorly maintained drainage	Slips, falls, bruises and fractures	Periodic inspection	Install suitable drain covers and conduct regular drainage maintenance.
Plugging/unplugging electrical adapters under workstations	Poorly positioned electrical adapters	Loss of balance, slips and falls	General safety awareness	Relocate electrical sockets to accessible positions and use suitable extension cables.
Retrieving files from high storage shelves	Unsafe use of portable ladder	Falls, fractures and head injuries	Portable ladder	Use a stable anti-slip ladder with handrails and provide ladder safety training.
Walking in meeting rooms during presentations	Exposed electrical cables	Trips, falls and injuries	Extension cables	Secure cables using suitable cable management and keep walkways clear.
Carrying documents using staircases	Poor staircase lighting	Trips, falls, sprains and fractures	Standard lighting	Improve staircase lighting and install anti-slip stair nosing.

4.4 Recommendations

The control measures recommended in the thesis were based on the hierarchy of controls and focused on practical actions that could be implemented in the workplace. The study suggested anti-slip mats, warning signs, and better cleaning techniques for slippery and wet toilet surfaces. It was recommended to replace or fix any slippery entrance carpeting. Inspection and maintenance of drain covers have been recommended for drainage-related hazards. The study recommended more effective wiring management and safer electrical adapter placement for exposed cables and inadequate workstation architecture. The study recommended safer work practices, training, and appropriate ladder inspection for activities involving ladders. Improved lighting and maintenance inspections were recommended for inadequate stairwell lighting. These actions are appropriate because they reduce the likelihood of recurring incidents while solving the root causes of the hazards identified during inspection. All hazards were lowered from medium risk to low risk following the implementation of the controls in the analysis. This indicates that recommended measures were practical as well as effective in improving worker safety.

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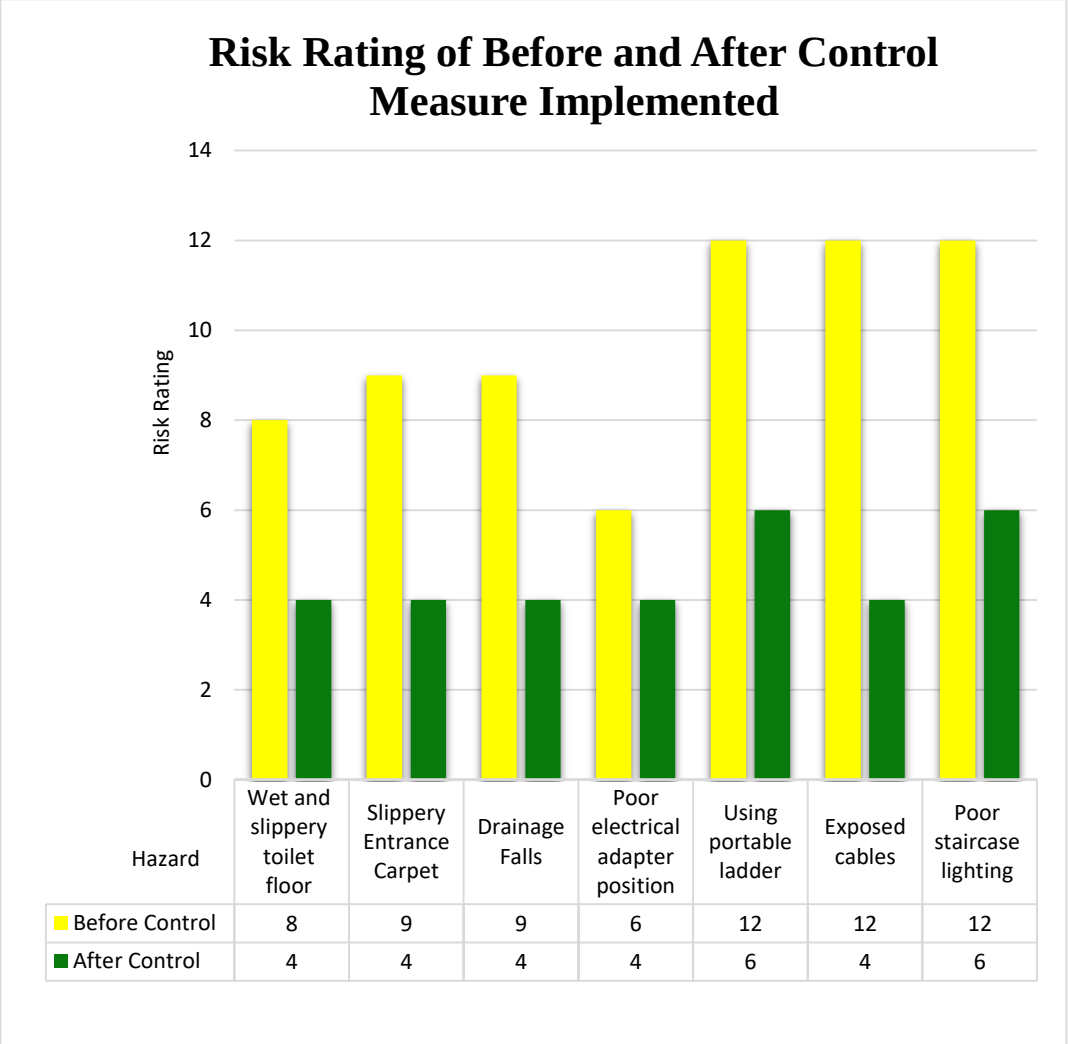


Figure.4 Risk Rating Before and After Recommended Control Measure

5. Conclusion

This study demonstrates that reoccurring hazards that may be identified and managed with HIRARC were the root cause of fall-related workplace accidents in the public institution. Chair falls, drainage falls, and slippery or uneven surface falls were the primary causes of the overall number of occurrences, according to the accident trend analysis. Seven occupational hazards were identified by the HIRARC assessment, and each may be minimized by appropriate management measures. The results demonstrate that when hazard identification, workplace inspection, and risk control are carried out methodically, fall incidents can be minimized. The study's practical recommendations can help improve public institutions' maintenance procedures, workplace hygiene, safety awareness, and overall occupational safety performance.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: study conception and design: Nirmala Nair A/P Rashavan Nair, Dr. Akhir Bin Ahmad; data collection: Nirmala Nair A/P Rashavan Nair; analysis and interpretation of results: Nirmala Nair A/P Rashavan Nair, Dr. Akhir Bin Ahmad; draft manuscript preparation: Nirmala Nair A/P Rashavan Nair. All authors reviewed the results and approved the final version of the manuscript.

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