# Needs Assessment for Home Modification and Risk Factors for Home Unintentional Injuries in Post-total Knee Arthroplasty Patients

Saowalak Tongta, MSc,\* Patarawan Woratanarat, MD, PhD,\* Siwadol Wongsak, MD,\* Rossarin Phonakhae, BSc,\* Nartanong Arunwilai, RN,\* and Thira Woratanarat, MD, MMedSc†

**Objectives:** Home assessment and modification are crucial to prevent fall and fall-related injuries, especially in vulnerable subjects. This study assessed the need for home modifications and investigated risk factors associated with home injuries in post-total knee arthroplasty (TKA) patients.

**Methods:** This study was conducted at the university hospital from July 2022 to July 2023. The patients who had undergone TKA without perioperative complications were recruited. The demographics, clinical data, home environmental factors, needs for home modification, and factors related to home unintentional injury were collected at 2 weeks postoperatively. The analysis was done by using descriptive statistics, and logistic regression.

**Results:** A total of 140 patients were included. The occurrence of falls within 2 weeks after TKA was 33.57%. The location of falls was the home entrance (29.09%), living room (23.64%), and bathroom (18.18%). About 38.5% of the patients explicitly needed home modifications. Falls were associated with inefficient grab bars [adjusted odds ratio=3.26, 95% CI=1.37-7.81, P=0.008] and lighting (adjusted odds ratio=12.83, 95% CI=1.36-121.34, P=0.026).

**Conclusions:** Falls among post-TKA patients were frequently occurred. Preoperative home assessment and home modifications should be done in order to minimize risks of falls, particularly in common locations.

**Key Words:** falls, home assessment, home environment, injury prevention, knee osteoarthritis

(J Patient Saf 2025;21:143–149)

O steoarthritis (OA) is among the leading causes of disability in the elderly. Globally, 240 million people were affected, including 10% of men and 18% of women aged 60 and older.<sup>1,2</sup> Knee OA causes pain, dysfunction, impaired activities of daily living, and Health-Related Quality of Life (HRQOL).<sup>3,4</sup> Total knee arthroplasty (TKA) is the treatment for late-stage OA of the knee and one of the most commonly performed orthopedic surgeries worldwide.<sup>5</sup> The estimated annual number of knee replacement procedures in the United States is 3.48 million by the year 2030.<sup>6</sup> Although TKA is a highly successful surgery, the patients need physical, mental, and emotional adjustments after surgical procedures, especially during the hospital-to-home transition period. The prevalence of TKA patients who experienced at least one fall after surgery was 17.2% to 26.7% within 6 months, and up to 70% in 8 months.<sup>7,8</sup>

The home environment approximately accounted for a third of the injuries across all age groups. Odds of injury increased by 22% for each additional home hazard<sup>9</sup> In the United States, it was found that more fall hazards arose at home than anywhere else.<sup>10</sup> Research from Hong Kong pointed out that 45.2% of falls presented at home with 29% indoors, and mostly from walking (67.7%), slipping (35.5%), and tripping (35.5%).<sup>7</sup> A study in Thailand reported that 39% of the injuries happened at home, with 33% attributable to falls. The most common locations for these accidents were the home entrance (14%), followed by the bathroom (13%), and the stairs (6%).<sup>11</sup>

Thus, a safe home environment is essential for morbidity and mortality prevention as well as improving the quality of life for patients, families, and caregivers. Addressing home injury hazards leads to appropriate management and could effectively reduce household injuries.<sup>12,13</sup> A home risk assessment study identified that the lack of support along the stairs or in the bathrooms, inappropriate flooring material, inadequate home size, and the problems of resting furniture ergonomics can increase the risk of falls.<sup>14</sup>

A meta-analysis of 6 randomized controlled trials with 4208 participants showed that home safety assessments with subsequent modifications could decrease fall rates by 19% (relative rate =  $0.81 \ 95\%$  CI =  $0.68 \cdot 0.97$ ), particularly for individuals at higher risk of falling.<sup>15</sup> Moreover, the New Zealand Home Injury Prevention Intervention (HIPI) study found 26% fall reduction in average,<sup>16</sup> and 31% reduction among Māori households compared with those in unmodified homes.<sup>17</sup>

To encourage adoption and acceptability, home modifications should be tailored to the patient's needs and respond to specific requirements, demographics, affordability, and preferences of the patients and their caregivers. With regards to the limitations on their knee motion and walking abilities in post-TKA patients, these factors require specific interventions and fall prevention protocols, on top of those provided for the general elderly. This study aimed

J Patient Saf • Volume 21, Number 3, April 2025

www.journalpatientsafety.com | 143

From the \*Department of Orthopedics, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand; and †Department of Preventive and Social Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand.

The authors disclose no conflict of interest.

Correspondence: Thira Woratanarat, MD, MMedSc, Department of Preventive and Social Medicine, Faculty of Medicine, Chulalongkorn University, 1873 Rama IV Road, Pathumwan, Bangkok 10330, Thailand (e-mail: thira@chula.md).

Supplemental Digital Content is available for this article. Direct URL citations are provided in the HTML and PDF versions of this article on the journal's website, www.journalpatientsafety.com. Copyright © 2025 Wolters Kluwer Health, Inc. All rights reserved.

DOI: 10.1097/PTS.000000000001313

Copyright © 2024 Wolters Kluwer Health, Inc. All rights reserved.

to assess the need for home modifications and investigate the risk factors for unintentional injuries at home in post-TKA patients.

## **METHODS**

# Study Design

A cross-sectional study was conducted from July 2022 to July 2023 at a university hospital in Bangkok, Thailand. The ethical approval was obtained from the Institutional Review Board at Ramathibodi Hospital, Mahidol University (MURA2022/410).

#### **Participant Selection**

The inclusion criteria were adults who had undergone TKA and had a follow-up appointment  $\sim 2$  weeks after discharge. Patients with perioperative complications, including medical complications, superficial skin necrosis, wound infection, deep infection, and prosthetic instability or loosening were excluded. Those who had complications possibly contributed to higher risk of falling,<sup>18</sup> and might not represent the main study population of general post-TKA. Sample size was calculated based on alpha error at 0.05, beta error at 0.2, error margin at 5%, and an estimated incidence of the need for home modifications at 1%.<sup>19</sup> The total sample size required was 140. After getting the informed consent, the patients with or without their responsible relatives/caregivers were recruited into the study and interviewed.

# Data Collection

The data were collected using structured interview by an interviewer-administered questionnaire developed for this study (Supplemental Appendix, Supplemental Digital Content 1, http://links.lww.com/PAS/C5). Demographic characteristics and personal history were collected including sex, age, marital status, education level, congenital diseases, occupation, monthly family income, number of family members, use of assistive devices, duration of knee pain, and history of orthopedic surgery. We also assessed the patient's home environment such as the type of housing (single house, town house, shophouse serving residence and commercial business, apartment, and condominium), home size, duration of stay, home accessibility, home flooring, bathroom size, the presence of grab bars in the bathroom, mobility space, and lighting; and risk factors associated with injuries occurring in the homes of post-TKA patients. The outcomes of interest were unintentional home injury and the need for home modifications. All data were recorded by the researchers at  $\sim 2$  weeks after the operation.

# Statistical Analysis

STATA software version 15.0 (Stata Corp, College Station, TX) was used for data analysis. The demographic characteristics were presented as frequency, percentage, mean, and SD.  $\chi^2$  test for normally distributed data or the Fisher exact test for non-normal distribution was used to compare characteristics and the needs for home modification after total knee replacement surgery. To estimate the strength of the association between risk factors and home injuries, odds ratios (OR) were calculated along with a 95% CI. Factors with a *P*-value <0.1 from bivariate analysis were included in the multivariate model. Significant *P*-value was <0.05.

#### RESULTS

There were 150 patients scheduled and underwent TKA during the recruitment period. All of them were eligible, but 140 patients were willing to participate in the study. Most of the patients were female (88.6%). The average age was 68.6 years. In all, 120 (86.7%) were more than 60 years old and 84 (60.0%) were married. Most participants (67.14%) graduated at or below high school level, 80.0% were retirees/unemployed, 32.9% had monthly income < 20,000 Baht (US\$ 565), 71.4% lived with at least 3 family members, whereas the average family member was 3.7 persons per household. One-third of the patients used mobility devices at home, such as canes (23.6%), walkers (5.0%), and wheelchair (2.14%). The average pain duration before TKA was 6.47 years. Of 140 TKAs, 85% reported having underlying chronic diseases, and 47.9% had undergone previous surgery. The characteristics of these patients are presented in Table 1.

Two-thirds of the participants (67.9%) lived in single houses, followed by townhouses (17.9%), and shophouses (10.7%) (Table 2). The average home size was 190.74 m<sup>2</sup>. However, approximately half of them stayed in their homes <100 m<sup>2</sup>. Nearly 50% of the patients resided in their homes for more than 20 years. For home accessibility, 19.3% expressed their concerns regarding high threshold, narrow doorway, and lack of ramp for those using wheelchair. In all, 71.4% of the participants reported living in multilevel flooring. Grab bars were installed in only 34.3% of participants' homes. Although most of the participants assessed that their homes had overall adequate lighting, they still pointed out some deficient lighting areas such as home entrance/stairs, bathroom, living room, and garage. Home injuries within 2 weeks after TKA were reported in 47 patients (33.6%) with an average of 1.72  $\pm$  0.95 times. Of those who reported home injuries, 11 patients experienced multiple falls, and the rest of them fell only once. A total of 65 causes of injuries were identified. However, only 55 places were detailed due to 6 patients could not remember the fall location. Causes of injuries were slipping on a wet surface (22 patients, 33.9%), tripping on uneven flooring (13 patients, 20%), collisions with furniture (13 patients, 20%), falling in a dark area (9 patients, 13.8%), injuries from sharp objects (6 patients, 9.2%), and falling from stairs (2 patients, 3.1%). The injuries occurred at the home entrance (16 patients, 29.1%), living room (13 patients, 23.6%), bathroom (10 patients, 18.2%), kitchen (4 patients, 7.3%), stairs (1 patient, 1.8%), and others (5 patients, 9.1%).

About 38.57% of the patients expressed their need for home modifications. Perception of higher injury risks from their underlying health conditions was associated with intervention needs (66.67%), followed by aiming to improve living spaces (25.93%) and to enhance their privacy (7.41%). Home entrances and wheelchair ramps (36.78%), kitchens (14.94%), and bathrooms (14.94%) were the most in need of modifications (Table 3).

The post-TKA patients who had underlying chronic diseases, and those who encountered home injuries expressed greater needs for home modifications (P = 0.046 and < 0.01, respectively), Table 4.

Baseline characteristics, chronic disease, device use, previous injury, home accessibility, home flooring, bathroom size, and mobility space did not significantly relate to unintentional home injuries after TKA (Table 3). However, the absence of grab bars in the bathroom (crude OR = 3.05,

144 | www.journalpatientsafety.com

		Needs for hon		
Variables	All (N = 140)	Yes, N (%)	No, N (%)	Р
Sex				
Female	124 (88.57)	47 (87.04)	77 (89.53)	0.651
Male	16 (11.43)	7 (12.96)	9 (10.47)	
Age (y)				
41-60	20 (14.29)	4 (7.41)	16 (18.60)	0.126
61-80	115 (82.14)	47 (87.04)	68 (79.07)	
> 80	5 (3.57)	3 (5.56)	2 (2.33)	
Marital status				
Single/divorced/widowed	56 (40.00)	20 (37.04)	36 (41.86)	0.571
Married	84 (60.00)	34 (62.96)	50 (58.14)	
Education level				
No education	7 (5.00)	6 (11.11)	1 (1.16)	0.091
Elementary school	59 (42.14)	21 (38.89)	38 (44.19)	
High school	28 (20.00)	12 (22.22)	16 (18.60)	
Vocational education	7 (5.00)	3 (5.56)	4 (4.65)	
Bachelor's degree	31 (22.14)	11 (20.37)	20 (23.26)	
Postgraduate	8 (5.71)	1 (1.85)	7 (8.14)	
Underlying chronic disease				
No	21 (15.00)	4 (7.41)	17 (19.77)	0.046
Yes	119 (85.00)	50 (92.59)	69 (80.23)	
Occupation				
Personal business	9 (6.43)	4 (7.41)	5 (5.81)	0.184
Government officials	8 (5.71)	3 (5.56)	5 (5.81)	
Farmers	5 (3.57)	4 (7.41)	1 (1.16)	
Retired/unemployed	112 (80.00)	43 (79.63)	69 (80.23)	
Merchant	5 (3.57)	0 (0)	5 (5.81)	
Other	1 (0.71)	0 (0)	1 (1.16)	
Household income				
<20,000 baht	46 (32.86)	16 (29.63)	30 (34.88)	0.206
20,000-39,999 baht	41 (29.29)	19 (35.19)	22 (25.58)	
40,000-59,999 baht	36 (25.71)	10 (18.52)	26 (30.23)	
$\geq 60,000$ baht	17 (12.14)	9 (16.67)	8 (9.30)	
Family members				
1-2 members	40 (28.57)	15 (27.78)	25 (29.07)	0.495
3-4 members	61 (43.57)	21 (38.89)	40 (46.51)	
>4 members	39 (27.86)	18 (33.33)	21 (24.42)	
Device use				
None	97 (69.29)	32 (59.26)	65 (75.58)	0.198
Cane	33 (23.57)	16 (29.63)	17 (19.77)	
Walker	7 (5.00)	4 (7.41)	3 (3.49)	
Wheelchair	3 (2.14)	2 (3.70)	1 (1.16)	
Side				
Both	97 (69.29)	38 (70.37)	59 (68.60)	0.969
Right	21 (15.00)	8 (14.81)	13 (15.12)	
Left	22 (15.71)	8 (14.81)	14 (16.28)	
Previous surgery				
No	73 (52.14)	27 (50)	46 (53.49)	0.688
Yes	67 (47.86)	27 (50)	40 (56.51)	
Home injury				
No	93 (66.43)	19 (35.19)	74 (86.05)	< 0.001
Yes	47 (33 57)	35 (64.81)	12 (13 95)	

230 95% CI = 1.32-7.03, P = 0.009) and insufficient lighting (crude OR = 10.95, 231 95% CI = 1.24-96.68, P = 0.031) were significantly correlated with home injuries as shown in Table 3.

From multivariate analysis, the absence of grab bars in the bathroom was significantly associated with home injuries (adjusted OR = 3.26, 95% CI = 1.37-7.81, P = 0.008). In addition, inadequate lighting within the home was also significantly correlated with home hazards (adjusted OR = 12.83, 95% CI = 1.36-121.34, P = 0.026) (Table 4).

# DISCUSSION

Home environmental safety is important for fall prevention, particularly among vulnerable groups, including elderly and postoperative TKA patients. Our study indicates that 34% of post-TKA patients experienced unintentional falls. Approximately 40% of participants advocated for home modifications due to chronic diseases and previous home injuries. Common places for intervention needs include the home entrance and bathroom. Significant risk factors for home hazards include inefficient grab bars (3 times higher risk) and lighting (13 times higher risk).

Copyright © 2025 Wolters Kluwer Health, Inc. All rights reserved.

www.journalpatientsafety.com | 145

Variables         AII (N = 140)         Yes, N (%)         No, N (%)         P           Sec			Home injuries after TKA		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Variables	All $(N = 140)$	Yes. N (%)	No. N (%)	р
$\begin{array}{cccc} \hline \begin{tabular}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Sev				
Male         16 (11.43)         6 (12.77)         10 (10.75)           41.40         20 (14.29)         5 (10.64)         15 (16.13)         0.328           61.80         15 (82.14)         39 (82.98)         76 (81.72)         >80           Arrial status         5         37 (35.7)         3 (63.65)         2 (21.5)           Single/domeed/worked         56 (40.00)         22 (45.19)         34 (36.56)         0.242           Elementary school         59 (42.14)         17 (36.17)         42 (45.16)         0.043           Elementary school         28 (20.00)         9 (19.15)         19 (20.43)         0.043           Vocational education         7 (5.00)         6 (12.15)         6 (6.45)         0.043           Bachelor's degree         31 (22.14)         12 (25.53)         19 (0.43)         0.040           Postgraduat         8 (5.71)         2 (4.35)         0.040         0.040         0.040           Comparison         119 (85.00)         7 (14.89)         14 (15.04)         14 (15.04)         14 (15.04)           Personal basiness         9 (6.43)         5 (5.38)         4 (85.51)         0.243         5 (3.09)         16 (0.00)         0.000         0.000         0.0000         0.0000         0.0000 <td>Female</td> <td>124 (88.57)</td> <td>41 (87.23)</td> <td>83 (89.25)</td> <td>0.724</td>	Female	124 (88.57)	41 (87.23)	83 (89.25)	0.724
Age (g)         (1.64)         (1.64)         (1.64)         (1.64)         (1.64)         (1.61,13)         (0.328)           41.40         20 (14.29)         5 (10.64)         76 (8.172)         (3.638)         (2.15)           Marital status         5         36 (3.638)         2 (2.15)         (3.638)         (2.15)           Marital status         7 (5.00)         22 (46.81)         34 (36.56)         0.242           Decision level         7         (1.08)         0.052         (3.617)         42 (45.16)         0.052           Elementary school         29 (42.14)         17 (3.617)         42 (45.16)         0.052         (3.631)         (3.623)         (3.643)         0.052         (3.631)         0.052         (3.631)         0.052         (3.631)         0.052         (3.631)         0.056         0.980         (3.631)         0.1631)         0.056         0.980         (5.633)         0.100,01         0.081         0.980         (5.633)         0.100,01         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         0.080         <	Male	16 (11.43)	6 (12.77)	10 (10.75)	0.721
$\begin{array}{cccc} 14.50 & 20 (4.29) & 5 (10.64) & 15 (1.13) & 0.28 \\ 61.80 & 15 (82.14) & 39 (82.98) & 76 (81.72) \\ > 80 & 5 (3.57) & 3 (6.38) & 2 (2.15) \\ \hline \\ Married strus & \\ SingledVorced/vidowed & 56 (40.00) & 22 (46.81) & 44 (36.56) & 0.242 \\ Married & 84 (60.00) & 22 (46.81) & 44 (36.56) & 0.242 \\ Married & 84 (60.00) & 12 (3.15) & 41 (65.16) & 0.052 \\ Elementary shool & 59 (42.14) & 17 (21.15) & 41 (65.16) & 0.052 \\ Hementary shool & 59 (42.14) & 17 (21.15) & 41 (65.16) & 0.052 \\ Vectoriand cleation & 7 (5.00) & 12 (2.15) & 6 (6.45) & 0.043 & 0.052 \\ Weational cleation & 7 (5.00) & 7 (4.89) & 14 (15.05) & 0.980 \\ Vectoriand cleation & 7 (5.00) & 7 (4.89) & 14 (15.05) & 0.980 \\ Vectoriand cleation & 9 (6.31) & 2 (4.26) & 6 (6.45) & 0.043 & 0.052 \\ Vestoriand cleation & 9 (6.31) & 3 (3.23) & 5 (10.64) & 0.243 \\ Weational cleation & 9 (6.31) & 3 (3.23) & 5 (10.64) & 0.243 \\ Weational cleation & 9 (6.31) & 3 (3.23) & 5 (10.64) & 0.243 \\ Vestoriand cleation & 9 (6.31) & 3 (3.23) & 5 (10.64) & 0.243 \\ Vestoriand cleation & 9 (6.37) & 3 (3.23) & 5 (10.64) & 0.243 \\ Farmers & 5 (3.57) & 3 (3.23) & 5 (10.64) & 0.243 \\ Retired/namployed & 11 (2.8000) & 76 (81.72) & 35 (76.60) & 0.060 \\ Other & 1 (0.71) & 1 (1.08) & 0 (0.00) & 0.061 \\ Cloudo 59.999 buh1 & 46 (32.86) & 9 (19.15) & 77 (39.78) & 0.056 \\ 20.000-39.999 buh1 & 41 (29.29) & 16 (4.404) & 22 (26.88) & 0.056 \\ 20.000-39.999 buh1 & 36 (25.71) & 13 (27.66) & 23 (24.73) & 0.056 \\ 20.000-39.999 buh1 & 36 (25.71) & 13 (27.66) & 66 (70.97) & 0.486 \\ Caan & 33 (23.57) & 14 (29.79) & 0.2 (27.96) & 0.057 \\ Verice tac & 97 (69.29) & 31 (65.96) & 66 (70.97) & 0.486 \\ Caan & 33 (23.57) & 14 (29.79) & 10 (21.04) & 0.059 \\ Nuckchair & 3 (2.14) & 12 (15.00) & 6 (12.77) & 15 (16.13) & 0.059 \\ Nader & 7 (50.0) & 1 (2.13) & 2 (6.45) & 0.069 \\ Verice tac & 97 (69.29) & 31 (65.96) & 66 (70.97) & 0.486 \\ Caan & 33 (23.57) & 14 (29.79) & 19 (20.43) & 0.059 \\ Nader & 7 (50.0) & 1 (2.15) & 2 (4.55) & 0.010, 0.00 & 0.01 \\ Net vise & 0 & 0.000 & 1 (1.08) & 0.000 & 0.000 & 0.000 \\ Verice tac$	Age (y)				
61-80       115 (62.14)       39 (82.98)       76 (8.72)         >80       5 (3.57)       3 (6.38)       2 (2.15)         Marital status	41-60	20 (14.29)	5 (10.64)	15 (16.13)	0.328
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	61-80	115 (82.14)	39 (82.98)	76 (81.72)	
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	> 80	5 (3.57)	3 (6.38)	2 (2.15)	
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	Marital status				
married end of the set of the s	Single/divorced/widowed	56 (40.00)	22 (46.81)	34 (36.56)	0.242
$\begin{aligned} \begin{array}{llllllllllllllllllllllllllllllllllll$	Married Education level	84 (60.00)	25 (53.19)	39 (03.44)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	No education	7 (5 00)	6 (12 77)	1 (1.08)	0.052
High school         28 (20,00)         9 (19,15)         19 (20,43)           Vocational elucation         7 (5,00)         1 (2,13)         6 (6.45)           Bachelor's degree         31 (22,14)         12 (25,53)         19 (20,43)           Postgraduate         8 (5,71)         2 (4,26)         6 (6.45)           Underlying chronic disease         9 (6,43)         5 (5,38)         4 (8,51)         0.243           Government officials         8 (5,71)         3 (3,23)         2 (4,26)         6 (6.46)           Government officials         8 (5,71)         3 (3,23)         2 (4,26)         7 (5,60)           Farmers         5 (3,57)         5 (3,38)         0 (0,00)         0 (0,00)           Houshold income	Elementary school	59 (42, 14)	17(3617)	42 (45 16)	0.052
$\begin{array}{cccc} Vacchinal education & 7 (5.00) & 1 (2.13) & c (7.45) \\ Bachelor's degree & 31 (22.14) & 12 (25.33) & 19 (20.43) \\ Postgraduate & 8 (5.71) & 2 (4.26) & 6 (6.45) \\ \hline Moderlying chronic disease & 1 \\ No & 21 (15.00) & 7 (14.89) & 14 (15.05) & 0.980 \\ Yes & 119 (85.00) & 40 (85.11) & 79 (84.95) \\ \hline Personal busines & 9 (6.43) & 5 (5.38) & 4 (8.51) & 0.243 \\ Government officials & 8 (5.71) & 3 (3.23) & 5 (10.64) \\ Farmers & 5 (3.57) & 3 (3.23) & 2 (4.26) \\ Retired/unemployed & 112 (80.00) & 76 (81.72) & 30 (76.60) \\ \hline Merchant & 5 (3.57) & 5 (5.38) & 0 (0.00) \\ \hline Other & 1 (0.71) & 1 (1.08) & 0 (0.00) \\ \hline Houshold income & - \\ < 0.000 > 3999 baht & 46 (32.86) & 9 (19.15) & 7 (39.78) & 0.056 \\ 20.000 > 3999 baht & 36 (25.71) & 13 (27.66) & 23 (24.73) \\ = 20.000 > 3999 baht & 36 (25.71) & 13 (27.66) & 22 (24.73) \\ = 20.000 > 3999 baht & 36 (25.71) & 13 (27.66) & 22 (24.73) \\ = 20.000 > 30 baht & 17 (12.14) & 9 (19.15) & 8 (8.60) \\ \hline Family members & - \\ 1.2 members & 40 (28.57) & 14 (29.79) & 26 (27.96) & 0.973 \\ 3 4 members & 61 (43.57) & 20 (42.55) & 41 (44.09) \\ = 24 members & 61 (43.57) & 13 (27.66) & 22 (27.80) \\ \hline Device tue & - \\ \hline None & 7 (69.29) & 31 (65.96) & 66 (70.97) & 0.486 \\ Cane & 33 (22.57) & 14 (29.79) & 9 (20.43) & 0.876 \\ Cane & 33 (22.57) & 14 (29.79) & 19 (20.43) & 0.876 \\ Cane & 33 (22.57) & 14 (29.79) & 19 (20.43) & 0.876 \\ Cane & 33 (22.57) & 14 (29.79) & 19 (20.43) & 0.876 \\ Cane & 7 (50.0) & 12 (13.15) & 6 (64.5) & 0.637 \\ Walker & 7 (50.0) & 12 (21.5) & 51 (61.3) & 0.637 \\ Mater & 7 (50.0) & 13 (27.61) & 22 (45.81) & 31 (45.96) & 0.639 \\ Yes & 7 (35.77) & 33 (70.21) & 6 (66.67) & 0.498 \\ Torv hous & 15 (10.71) & 6 (12.77) & 15 (16.13) & 0.671 \\ No & 7 (29.99 m)^2 & 22 (15.71) & 7 (14.88) & 51 (54.84) & 0.369 \\ Yes & 7 (25.44) & 22 (63.81) & 30 (43.94) & 0.950 \\ 100.199 m^2 & 20 (42.857) & 13 (27.66) & 27 (29.03) & 0.870 \\ Yes & 7 (25.77) & 13 (16.33) & 51 (64.51) & 11 (11.83) \\ Shophouse & 15 (0.71) & 16 (12.77) & 15 (16.13) & 0.671 \\ No & Condominim & 4 (2.26) & 0 (0.00) & 4 (4.$	High school	28 (20.00)	9 (19.15)	19 (20.43)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Vocational education	7 (5.00)	1 (2.13)	6 (6.45)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Bachelor's degree	31 (22.14)	12 (25.53)	19 (20.43)	
Underlying chronic disease No $Yes$ (19 (85.00) 40 (85.11) 79 (84.95) (9.80) Yes (10.64) 79 (84.95) (9.24) Personal business 9 (6.43) 5 (5.38) 4 (8.51) 0.243 Government officials 8 (5.71) 3 (5.23) 5 (10.64) Farmers 5 (3.57) 3 (5.23) 2 (4.26) Marchant 05 (3.57) 5 (5.38) 0 (0.00) Marchant 5 (3.57) 5 (5.38) 0 (0.00) Household income 1 (0.71) 1 (1.08) 0 (0.00) Household income 2 (20.00) Dath 4 (6 (32.86) 9 (19.15) 37 (39.78) 0.056 20.000-39.999 baht 4 (29.29) 16 (34.04) 25 (25.68) 40.000-59.999 baht 3 (6 (25.71) 13 (27.66) 23 (24.73) > 60.000 baht 1 (7 (12.14) 9 (19.15) 8 (8.60) Family members 4 (28.57) 14 (29.79) 26 (27.96) 0.973 3-4 members 2 (20.00) baht 2 (24.73) 26 (27.96) 0.973 3-4 members 4 0 (28.57) 14 (29.79) 26 (27.96) 0.973 3-4 members 3 (27.86) 13 (27.66) 26 (27.96) Device us 7 (5.00) 1 (2.13) 2 (26.79) Device us 7 (5.00) 1 (2.13) 2 (26.79) None 97 (69.29) 31 (65.96) 66 (70.97) 0.486 Cane 33 (22.37) 14 (29.77) 19 (20.43) Walker 7 (5.00) 1 (2.13) 2 (2.15) Side Much 97 (69.29) 35 (74.47) 62 (66.67) 0.637 Right 21 (15.00) 6 (12.77) 16 (17.20) Previous surgery 7 (20.00) 21 (2.13) 2 (2.15) No 7 (3 (52.14) 22 (45.11) 6 (2.77) 16 (17.20) Previous surgery 7 (20.00) 23 (57.14 (29.17) 16 (17.20) Previous surgery 7 (20.17) 16 (17.20) No 7 (3 (52.14) 25 (53.19) 42 (45.16) 0.369 Yes 67 (47.86) 22 (46.81) 39 (41.94) 0.950 Yes 7 (40.83) 11 (11.83) Apartment 1 (0.71) 0 (0.00) 1 (1.08) Condominium 4 (2.86) 0 (0.00) 4 (4.30) Previous surgery 7 (20.12) (20.20) (20.43) Marker 7 (3.57) 13 (7.06) (27.20) (20.29) No 7 (20.2) 20.29 m <sup>2</sup> (2.157.1) 7 (14.89) 15 (15.13) Shophouse 15 (10.71) 4 (8.51) 11 (11.83) Apartment 1 (0.71) 0 (0.00) 1 (1.08) Condominium 4 (2.86) 0 (0.00) 4 (4.30) Duration of stay (y) 0-10 (4 3 (3.071) 18 (8.64.31) 13 (27.60) 27 (29.03) 20.20-29 m <sup>2</sup> (2.20,57.11 0,70,48) (50.64) 12.30 m <sup>3</sup> (1.14,29 (50.64) 12 (12.90) Duration of stay (y) 0-10 (4 3 (3.071) 13 (7.68,72) 7 (6.17.20) Previous possibily Convenient home entrance 13 (3.071) 13 (7.68,72) 7 (6.17.20) Da	Postgraduate	8 (5.71)	2 (4.26)	6 (6.45)	
No         21 (15.00) $7 (14.89)$ 14 (15.05)         0.980           Yes         19 (85.00)         40 (85.11)         70 (84.95)         0.243           Occupation         9         6(.43)         5 (5.38)         4 (8.51)         0.243           Government officials         8 (5.71)         3 (3.23)         2 (4.26)         0.243           Retired/unemployed         11 (2.80.00)         76 (81.72)         36 (76.60)         0.000           Other         1 (0.71)         1 (1.08)         0 (0.00)         0           Household income $< 20,000.39,99$ baht         46 (32.86)         9 (19.15)         37 (39.78)         0.056           20,000.39,99 baht         46 (32.86)         9 (19.15)         8 (8.60) $< 10.71$ 1 (1.08) $< 0.000$ Family members $< 10.71$ 1 (2.14)         9 (19.15)         8 (8.60) $< 12.86$ Cause of the mebers $40 (28.57)$ 14 (29.79)         26 (27.96) $0.973$ 3-4 members $39 (27.86)$ 13 (27.66)         26 (27.96) $0.973$ 3-4 members $39 (27.86)$ 13 (27.66)         26 (27.96) $0.6643$ $0.243$	Underlying chronic disease		- (1 ( 00)		
Tis         19 (6.3.00) $40 (63.11)$ $70 (64.39)$ Occupation         9 (6.4)         5 (5.3)         4 (8.51)         0.243           Personal business         9 (6.4)         3 (3.23)         5 (10.64)         0.243           Government officials         8 (5.71)         3 (3.23)         2 (4.26)         0.000           Metric/lumemployed         112 (80.00)         76 (81.72)         36 (76.60)         0.000           Metric/lumemployed         10 (71)         1 (108)         0 (0.00)         0.000           Household income         -	No Vez	21 (15.00)	7 (14.89)	14 (15.05)	0.980
Operation         9 (6,43)         5 (5,38)         4 (8,51)         0.243           Government officials         8 (5,71)         3 (3,23)         2 (4,26)           Retired/unemployed         112 (80,00)         76 (81,72)         36 (76,60)           Merchant         5 (3,57)         5 (5,38)         0 (0,00)           Other         1 (0,71)         1 (108)         0 (0,00)           Other         1 (0,71)         1 (108)         0 (0,00)           Household income         -	Occupation	119 (83.00)	40 (83.11)	79 (84.93)	
Government officials         8 (5.71)         3 (3.23)         5 (10.64)           Farmers         5 (3.57)         3 (3.23)         2 (4.26)           Retired/unemployed         112 (80.00)         76 (81.72)         36 (76.60)           Merchant         5 (3.57)         5 (5.38)         0 (0.00)           Other         1 (0.71)         1 (1.08)         0 (0.00)           Household income         -         -         -           < 20,000 baht	Personal business	9 (6.43)	5 (5.38)	4 (8.51)	0.243
Farmers       5 (3.57)       3 (3.23)       2 (4.26)         Retired/unemployd       12 (80.00)       76 (81.72)       36 (76.60)         Merchant       5 (3.57)       5 (5.38)       0 (0.00)         Household income       1       1 (1.08)       0 (0.00)         Household income	Government officials	8 (5.71)	3 (3.23)	5 (10.64)	
Retired/unemployed         112 (80.00)         76 (81.72)         36 (76.60)           Merchant         5 (3.57)         5 (5.38)         0 (0.00)           Other         1 (0.71)         1 (1.08)         0 (0.00)           Household income         20.000 baht         46 (32.86)         9 (19.15)         37 (39.78)         0.056           20.000-39.999 baht         41 (29.29)         16 (34.04)         25 (26.88)         04000-59.999 baht         36 (27.17)         8 (8.00)           Family members         1-2 members         40 (28.57)         14 (29.79)         26 (27.96)         0.973           3-4 members         61 (43.57)         20 (42.55)         41 (44.09)         2         34 (66.45)         0.0486           Cane         39 (27.86)         13 (27.66)         26 (27.96)         0.973           3-4 members         97 (69.29)         31 (65.96)         66 (70.97)         0.486           Cane         33 (23.57)         14 (29.79)         19 (20.43)         Walker           Walker         7 (50.0)         1 (2.13)         6 (6.67)         0.637           Kight         21 (15.00)         6 (12.77)         15 (16.13)         16           Left         22 (15.71)         6 (12.77)         15 (6.67)	Farmers	5 (3.57)	3 (3.23)	2 (4.26)	
Merchant         5 (3.57)         5 (5.38)         0 (0.00)           Other         1 (0.71)         1 (1.08)         0 (0.00)           Household income         -         -           <20,000 baht	Retired/unemployed	112 (80.00)	76 (81.72)	36 (76.60)	
Other         1 (0.71)         1 (1.08)         0 (0.00)           Household income $<$ 20,000 3py baht         46 (32.86)         9 (19.15)         37 (39.78)         0.056           20,000-39.999 baht         36 (25.71)         13 (27.66)         23 (24.73)         88.60)           Family members         12         members         8 (8.60)         9 (19.15)         8 (8.60)           Family members         12         members         61 (43.57)         20 (42.55)         41 (44.09)         > 4           3-4 members         39 (27.86)         13 (27.66)         26 (27.96)         0.973           3-4 members         39 (27.86)         13 (27.66)         26 (27.96)         0.973           3-4 members         39 (27.86)         13 (27.66)         26 (27.96)         0.973           Sector         7 (50.00)         1 (2.13)         6 (6.45)         0.486           Cane         33 (23.57)         14 (29.79)         19 (20.43)         0.645           Walker         7 (50.00)         1 (2.13)         6 (6.67)         0.637           Side         7         50.00         6 (12.77)         15 (16.13)         10 (17.20)           Previous surgery         7         52 (53.19) <td< td=""><td>Merchant</td><td>5 (3.57)</td><td>5 (5.38)</td><td>0 (0.00)</td><td></td></td<>	Merchant	5 (3.57)	5 (5.38)	0 (0.00)	
HOUSENDIA HICOME         < 20,000 baht	Other	1 (0.71)	1 (1.08)	0 (0.00)	
$\begin{array}{ccccccc} < 2,0,000 \ Path & 40 \ (22,26) & f \ (34,04) & 25 \ (25,88) & 0.056 \\ 40,000-59,999 \ bah & 36 \ (25,71) & 13 \ (27,66) & 23 \ (24,73) & \\ > 60,000 \ bah & 17 \ (12,14) & 9 \ (19,15) & 8 \ (8,60) & \\ Family members & & & & & & & & & & & & & & & & & & &$	Household income	46 (22.86)	0 (10 15)	27 (20 78)	0.056
$\begin{array}{ccccccc} 20,000-39,279 \ Latt (1,2,2) & 10 (24,05) & 2.0 (20,08) \\ 20,000-39,279 \ Latt (1,2,14) & 9 (19,15) & 8 (8,60) \\ \hline \\ Fanily members & 17 (12,14) & 9 (19,15) & 8 (8,60) \\ \hline \\ Fanily members & 40 (28,57) & 14 (29,79) & 26 (27,96) & 0.973 \\ 3.4 \ members & 61 (43,57) & 20 (42,55) & 41 (44,09) \\ > 4 \ members & 39 (27,86) & 13 (27,66) & 25 (27,96) \\ \hline \\ Device use & & & & & \\ \hline \\ None & 97 (69,29) & 31 (65,96) & 66 (70,97) & 0.486 \\ Cane & 33 (23,57) & 14 (29,79) & 19 (20,43) \\ \hline \\ Walker & 7 (5,00) & 1 (2,13) & 6 (6,45) \\ \hline \\ Wheelchair & 3 (2,14) & 1 (2,13) & 2 (2,15) \\ \hline \\ Side & & & & & \\ Both & 97 (69,29) & 35 (74,47) & 62 (66,67) & 0.637 \\ \hline \\ Right & 21 (15,00) & 6 (12,77) & 15 (16,13) \\ \hline \\ Left & 22 (15,71) & 6 (12,77) & 15 (16,13) \\ \hline \\ Type of housing & & & & \\ \hline \\ Type of housing & & & & \\ \hline \\ Type of housing & & & & \\ Single house & 15 (10,71) & 4 (8,51) & 11 (11,83) \\ \hline \\ Apartment & 1 (0,71) & 0 (0,00) & 1 (1,08) \\ \hline \\ Condominium & 4 (2,86) & 0 (0,00) & 4 (4,30) \\ \hline \\ Horne size & & & & \\ \hline \\ 0.99 \ n^2 & 0 (2,857) & 13 (27,66) & 27 (29,03) \\ 200-299 \ n^2 & 2 (215,71) & 7 (14,89) & 15 (16,13) \\ \geq 300 \ n^2 & 17 (12,14) & 5 (10,64) & 12 (12,90) \\ \hline \\ Duration of stay (y) & & & & \\ \hline \\ 0-10 & 43 (30,71) & 18 (38,30) & 25 (26,88) & 0.360 \\ 11-20 & 26 (18,57) & 10 (21,28) & 16 (17,20) \\ 21-30 & 20 (14,29) & 6 (12,77) & 14 (15,05) \\ > 30 & & 5 (13,643) & 13 (27,66) & 37 (29,03) \\ \hline \\ Don to for stay (y) & & & & \\ \hline \\ Orven house & 0 & 20 (14,29) & 6 (12,77) & 14 (15,05) \\ > 30 & & 5 (13,643) & 13 (27,66) & 38 (40,86) \\ \hline \\ Horne size & & & & & & \\ \hline \\ Orven house & 0 & 20 (14,29) & 6 (12,77) & 14 (15,05) \\ > 30 & & 5 (13,643) & 13 (27,66) & 38 (40,86) \\ \hline \\ Horne size & & & & & & \\ \hline \\ Convenient home access & 27 (19,29) & 10 (12,8) & 17 (18,28) & . \\ \hline \end{array}$	< 20,000 bant 20,000, 20,000 babt	40 (52.80)	9 (19.15)	37 (39.78)	0.036
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	40,000-59,999 balt	41(29.29) 36(2571)	13 (27.66)	23 (20.88)	
Family members       1.0       1.0       1.0       0.000         1-2 members       40 (28.57)       14 (29.79)       26 (27.96)       0.973         3-4 members       61 (43.57)       20 (42.55)       41 (44.09)       20         > 4 members       39 (27.86)       13 (27.66)       26 (27.96)       26         Device use	$> 60\ 000\ baht$	17 (12.14)	9 (19 15)	8 (8 60)	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Family members	17 (12.11)	y (19.13)	0 (0.00)	
$\begin{array}{c cccccc} 34 \mbers & 61 \mbers & 39 \mbers & 31 \mbers & 32 \mbers & 31 \mbers & 32 \mbers & 31 \mbers & 32 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 33 \mbers & 33 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 32 \mbers & 33 \mbers & 32 \mbers & 33 \$	1-2 members	40 (28.57)	14 (29.79)	26 (27.96)	0.973
>4 members 39 (27.86) 13 (27.66) 26 (27.96) Device use $$$ 769.29$ 31 (65.96) 66 (70.97) 0.486$ Cane 33 (23.57) 14 (29.79) 19 (20.43) Walker 7 (5.00) 1 (2.13) 6 (64.5) Wheelchair 3 (2.14) 1 (2.13) 2 (2.15) Side $$$ 2.14$ 1 (2.13) 2 (2.5)$ Both 97 (69.29) 35 (74.77) 62 (66.67) 0.637 Right 21 (15.00) 6 (12.77) 15 (16.13) Left 22 (15.71) 6 (12.77) 16 (17.20) Previous surgery $$ 73 (52.14) 25 (53.19) 42 (45.16) 0.369$ Yes 67 (47.86) 22 (46.81) 51 (54.84) Type of housing $$ 70 (9.28) 35 (70.21) 62 (66.67) 0.498$ Town house 93 (66.43) 10 (21.28) 15 (16.13) Shophouse 15 (10.71) 4 (8.51) 11 (11.83) Apartment 1 (0.71) 0 (0.00) 1 (1.08) Condominium 4 (2.86) 0 (0.00) 4 (4.30) Home size $$ 09 m^2$ 17 (12.14) 5 (10.64) 12 (12.90) 15 (16.13) ≥ 300 m^2 17 (12.14) 5 (10.64) 12 (12.90) Duration of stay (y) $$ 00.25 (13.97) 13 (27.66) 25 (26.88) 0.360 (11.20) 11 (12.90) 15 (16.13) ≥ 300 m^2 17 (12.14) 5 (10.64) 12 (12.90) 15 (16.13) ≥ 300 m^2 17 (12.14) 5 (10.64) 12 (12.90) 11 ($	3-4 members	61 (43.57)	20 (42.55)	41 (44.09)	
Device use None 97 (69.29) 31 (65.96) 66 (70.97) 0.486 Cane 33 (23.57) 14 (29.79) 19 (20.43) Walker 7 (5.00) 1 (2.13) 6 (6.45) Wheelchair 3 (2.14) 1 (2.13) 2 (2.15) Side Both 97 (69.29) 35 (74.47) 62 (66.67) 0.637 Right 21 (15.00) 6 (12.77) 15 (16.13) Left 22 (15.71) 6 (12.77) 16 (17.20) Previous surgery No 73 (52.14) 25 (53.19) 42 (45.16) 0.369 Yes 67 (47.86) 22 (46.81) 51 (54.84) Type of housing Single house 93 (66.43) 10 (21.28) 15 (16.13) Shophouse 15 (10.71) 4 (8.51) 11 (11.83) Apartment 1 0.71) 0 (0.00) 1 (1.08) Condominium 4 (2.86) 0 (0.00) 4 (4.30) Home size 0-99 m <sup>2</sup> 61 (43.57) 22 (46.81) 39 (41.94) 0.950 100-199 m <sup>2</sup> 40 (28.57) 13 (27.66) 27 (29.03) 200-299 m <sup>2</sup> 17 (12.14) 5 (10.64) 12 (12.90) Duration of stay (y) 0-10 43 (30.71) 18 (83.80) 25 (26.88) 0.360 11-20 26 (18.57) 10 (21.28) 16 (17.20) Duration of stay (y) 0-10 43 (30.71) 18 (8.830) 25 (26.88) 0.360 11-20 26 (18.57) 10 (21.28) 16 (17.20) Duration of stay (y) 0-10 43 (30.71) 18 (38.30) 25 (26.88) 0.360 11-20 26 (18.57) 10 (21.28) 16 (17.20) Duration of stay (y) 0-10 43 (30.71) 18 (38.30) 25 (26.88) 0.360 11-20 26 (18.57) 10 (21.28) 16 (17.20) 21-30 20 (14.29) 6 (12.77) 14 (15.05) ≥ 30 m <sup>2</sup> 13 (36.43) 13 (27.66) 38 (40.86) Home accessibility Convenient home entrance 113 (80.71) 37 (78.72) 76 (81.72) 0.671 Inconvenient home access 27 (19.29) 10 (21.28) 17 (18.28)	>4 members	39 (27.86)	13 (27.66)	26 (27.96)	
None97 (69.29)31 (65.96)66 (70.97)0.486Cane33 (23.57)14 (29.79)19 (20.43)Walker7 (5.00)1 (2.13)6 (6.45)Whelechair3 (2.14)1 (2.13)2 (2.15)Side2 (2.15)Side3 (2.14)1 (2.13)2 (2.15)Side3 (2.14)1 (2.13)6 (12.77)15 (16.13)12 (15.00)6 (12.77)15 (16.13)12 (15.00)12 (2.17)Previous surgery22 (15.71)6 (12.77)16 (17.20)16 (17.20)12 (15.00)12 (15.00)12 (15.00)12 (15.00)12 (15.00)Previous surgery773 (52.14)25 (53.19)42 (45.16)0.36936 (45.84)15 (16.13)36 (17.97)12 (45.84)Type of housing10 (21.28)15 (16.13)13 (11.83)4 (2.86)0 (0.00)1 (1.83)4 (2.86)0 (0.00)1 (1.08)10 (11.83)14 (2.86)0 (0.00)1 (1.08)10 (11.93)12 (2.90)10 (10.99)12 (12.90)10 (10.99)12 (12.90)10 (10.99)12 (12.90)10 (10.99)12 (12.90)12 (12.90)12 (12.90)12 (12.90)12 (12.90)12 (12.90)12 (12.90)13 (27.66)38 (40.86)13 (27.66)38 (40.86)14 (15.05)3 303 (3 (0.71)18 (38.30)25 (26.88)0.36011-2026 (18.57)10 (21.28)16 (17.20)12 (12.90)12 (12.90)12 (12.90)13 (27.66)38 (40.86)14 (15.05)3 3013 (27.66)38 (40.86)14 (15.05)3 30 <td>Device use</td> <td></td> <td></td> <td></td> <td></td>	Device use				
Cane33 (23.57)14 (29.79)19 (20.43)Walker7 (5.00)1 (2.13)6 (6.45)Wheelchair3 (2.14)1 (2.13)2 (2.15)Side	None	97 (69.29)	31 (65.96)	66 (70.97)	0.486
Waker $7$ (5.00)         1 (2.13)         6 (6.45)           Wheelchair         3 (2.14)         1 (2.13)         2 (2.15)           Side	Cane	33 (23.57)	14 (29.79)	19 (20.43)	
Whetehalf $3 (2.14)$ $1 (2.13)$ $2 (2.13)$ Side $2 (15,0)$ $3 (2.14)$ $1 (2.13)$ $2 (2.13)$ Both97 (69.29) $35 (74.47)$ $62 (66.67)$ $0.637$ Right21 (15.00) $6 (12.77)$ $15 (16.13)$ Left22 (15.71) $6 (12.77)$ $16 (17.20)$ Previous surgery $0 (12.77)$ $12 (45.16)$ $0.369$ Yes $67 (47.86)$ $22 (46.81)$ $51 (54.84)$ Type of housing $0 (21.28)$ $15 (16.13)$ $0 (21.28)$ Single house $47 (33.57)$ $33 (70.21)$ $62 (66.67)$ $0.498$ Town house $93 (66.43)$ $10 (21.28)$ $15 (16.13)$ Apartment $1 (0.71)$ $0 (0.00)$ $1 (1.08)$ Condominium $4 (2.86)$ $0 (0.00)$ $4 (4.30)$ Home size $0 (28.57)$ $13 (27.66)$ $27 (29.03)$ $200-299 m^2$ $22 (15.71)$ $7 (14.89)$ $15 (16.13)$ $\geq 300 m^2$ $10 (21.28)$ $16 (17.20)$ Duration of stay (y) $0 (21.28)$ $16 (17.20)$ $21-30$ $20 (14.29)$ $6 (12.77)$ $14 (15.05)$ $> 30$ $51 (36.43)$ $13 (27.66)$ $38 (40.86)$ Home accessibility $0 (21.28)$ $17 (18.28)$ $0.671$ Low remeint home entrance $113 (80.71)$ $37 (78.72)$ $76 (81.72)$ $0.671$	Walker	7 (5.00)	1(2.13)	6 (6.45)	
Both       97 (69.29)       35 (74.47)       62 (66.67)       0.637         Right       21 (15.00)       6 (12.77)       15 (16.13)       0.637         Left       22 (15.71)       6 (12.77)       15 (16.13)       0.637         Previous surgery       0       73 (52.14)       25 (53.19)       42 (45.16)       0.369         Yes       67 (47.86)       22 (46.81)       51 (54.84)       0.498         Type of housing       33 (70.21)       62 (66.67)       0.498         Town house       93 (66.43)       10 (21.28)       15 (16.13)         Apartment       1 (0.71)       4 (8.51)       11 (11.83)         Apartment       1 (0.71)       0 (0.00)       4 (4.30)         Home size       90 (0.00)       4 (4.30)       0.950         Our page m <sup>2</sup> 61 (43.57)       22 (46.81)       39 (41.94)       0.950         200-299 m <sup>2</sup> 22 (15.71)       7 (14.89)       15 (16.13)       2300 m <sup>2</sup> 200-299 m <sup>2</sup> 20 (15.71)       7 (14.89)       15 (16.13)       24 (12.90)         Duration of stay (y)       0       10 (21.28)       16 (17.20)       25 (26.88)       0.360         11-20       26 (18.57)       10 (21.28)       16 (17.20) </td <td>Side</td> <td>3 (2.14)</td> <td>1 (2.13)</td> <td>2 (2.13)</td> <td></td>	Side	3 (2.14)	1 (2.13)	2 (2.13)	
DotalD (0.22)D (0.22)D (0.23)D (0.23)D (0.23)D (0.23)Right21 (15.00)6 (12.77)15 (16.13)Left22 (15.71)6 (12.77)16 (17.20)Previous surgery73 (52.14)25 (53.19)42 (45.16)0.369Yes67 (47.86)22 (46.81)51 (54.84)Type of housing733 (70.21)62 (66.67)0.498Town house93 (66.43)10 (21.28)15 (16.13)Shophouse15 (10.71)4 (8.51)11 (11.83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size0.99 m²61 (43.57)22 (46.81)39 (41.94)0.950100-199 m²20 (22 (15.71))7 (14.89)15 (16.13)2 300 m²10 (12.28)15 (16.13)≥ 300 m²17 (12.14)5 (10.64)12 (12.90)10 (12.90)10 (12.90)10 (12.90)Duration of stay (y)021 (30, 30 (11 (15.05))38 (40.86)11 (15.05)30 (12.29)6 (12.77)14 (15.05)> 3051 (36.43)13 (27.66)38 (40.86)11 (15.05)38 (40.86)11 (13.80.71)37 (78.72)76 (81.72)0.671Inconvenient home entrance113 (80.71)37 (78.72)76 (81.72)0.67110 (21.28)17 (18.28)	Both	97 (69 29)	35 (74 47)	62 (66 67)	0.637
Left12 (15.71)6 (12.77)16 (17.20)Previous surgery $N_0$ 73 (52.14)25 (53.19)42 (45.16)0.369Yes67 (47.86)22 (46.81)51 (54.84)51Type of housing $S_{11}$ $S_{11}$ $S_{11}$ $S_{11}$ $S_{11}$ Single house47 (33.57)33 (70.21)62 (66.67)0.498Town house93 (66.43)10 (21.28)15 (16.13)Shophouse15 (10.71)4 (8.51)11 (11.83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size $0.99 m^2$ 61 (43.57)22 (46.81)39 (41.94)0.99 m²22 (15.71)7 (14.89)15 (16.13) $\geq 300 m^2$ 17 (12.14)5 (10.64)12 (12.90)Duration of stay (y) $0$ $0$ $14 (15.05)$ $> 30$ 51 (36.43)13 (27.66)38 (40.86)Home accessibility $C$ $C$ $S_1 (36.71)$ $S_1 (78.72)$ $76 (81.72)$ $0.671$ Inconvenient home entrance113 (80.71)37 (78.72)76 (81.72) $0.671$	Right	21(1500)	6(12.77)	15(1613)	0.057
Previous surgery       No       73 (52.14)       25 (53.19)       42 (45.16)       0.369         Yes       67 (47.86)       22 (46.81)       51 (54.84)       51         Type of housing       50 (66.43)       10 (21.28)       15 (16.13)       51 (11.183)         Town house       93 (66.43)       10 (21.28)       15 (16.13)       51 (11.183)         Apartment       1 (0.71)       4 (8.51)       11 (11.83)         Condominium       4 (2.86)       0 (0.00)       4 (4.30)         Home size       0.99 m²       61 (43.57)       22 (46.81)       39 (41.94)       0.950         100-199 m²       40 (28.57)       13 (27.66)       27 (29.03)       200.299 m²       22 (15.71)       7 (14.89)       15 (16.13)         ≥ 300 m²       17 (12.14)       5 (10.64)       12 (12.90)       0       11-20       26 (18.57)       10 (21.28)       16 (17.20)       21-30       20 (14.29)       6 (12.77)       14 (15.05)       > 30       51 (36.43)       13 (27.66)       38 (40.86)       11-20       26 (18.57)       10 (21.28)       16 (17.20)       21-30       20 (14.29)       6 (12.77)       14 (15.05)       > 30       51 (36.43)       13 (27.66)       38 (40.86)       11-20       26 (18.57)       10 (21.28) <t< td=""><td>Left</td><td>22(15.71)</td><td>6 (12.77)</td><td>16 (17.20)</td><td></td></t<>	Left	22(15.71)	6 (12.77)	16 (17.20)	
No73 (52.14)25 (53.19)42 (45.16)0.369Yes67 (47.86)22 (46.81)51 (54.84)Type of housingSingle house47 (33.57)33 (70.21)62 (66.67)0.498Town house93 (66.43)10 (21.28)15 (16.13)Shophouse15 (10.71)4 (8.51)11 (11.83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size0.99 m²61 (43.57)22 (46.81)39 (41.94)0.950100-199 m²40 (28.57)13 (27.66)27 (29.03)0.950200-299 m²22 (15.71)7 (14.89)15 (16.13)≥ 300 m²17 (12.14)5 (10.64)12 (12.90)Duration of stay (y)026 (18.57)10 (21.28)16 (17.20)21.3020 (14.29)6 (12.77)14 (15.05)3033 (40.86)Home accessibility51 (36.43)13 (27.66)38 (40.86)0.671Inconvenient home entrance113 (80.71)37 (78.72)76 (81.72)0.671	Previous surgery				
Yes67 (47.86)22 (46.81)51 (54.84)Type of housing $33 (70.21)$ 62 (66.67)0.498Single house93 (66.43)10 (21.28)15 (16.13)Town house93 (66.43)10 (21.28)11 (11.83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size $0.99 \text{ m}^2$ 61 (43.57)22 (46.81)39 (41.94)0.99 m²61 (43.57)22 (46.81)39 (41.94)0.950200-299 m²22 (15.71)7 (14.89)15 (16.13) $\geq 300 \text{ m}^2$ 17 (12.14)5 (10.64)12 (12.90)Duration of stay (y) $0.11-20$ 26 (18.57)10 (21.28)16 (17.20)21-3020 (14.29)6 (12.77)14 (15.05)3038 (40.86)Home accessibility $0.13 (80.71)$ 37 (78.72)76 (81.72)0.671Inconvenient home access27 (19.29)10 (21.28)17 (18.28)0.671	No	73 (52.14)	25 (53.19)	42 (45.16)	0.369
Type of housing Single house47 (33.57)33 (70.21)62 (66.67)0.498Town house93 (66.43)10 (21.28)15 (16.13)Shophouse15 (10.71)4 (8.51)11 (11.83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size $0.99 \text{ m}^2$ 61 (43.57)22 (46.81)39 (41.94)0.950100-199 m²40 (28.57)13 (27.66)27 (29.03)0.950200-299 m²22 (15.71)7 (14.89)15 (16.13)0.950≥ 300 m²17 (12.14)5 (10.64)12 (12.90)0.670Duration of stay (y) $0.10$ 43 (30.71)18 (38.30)25 (26.88)0.36011-2026 (18.57)10 (21.28)16 (17.20)21.3020 (14.29)6 (12.77)14 (15.05)> 3051 (36.43)13 (27.66)38 (40.86)10.67110 (21.28)16 (17.20)Convenient home entrance113 (80.71)37 (78.72)76 (81.72)0.671Inconvenient home access27 (19.29)10 (21.28)17 (18.28)	Yes	67 (47.86)	22 (46.81)	51 (54.84)	
Single house47 (33.57)33 (70.21)62 (66.67)0.498Town house93 (66.43)10 (21.28)15 (16.13)Apartment1 (0.71)4 (8.51)11 (11.83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size $0.99 \text{ m}^2$ 61 (43.57)22 (46.81)39 (41.94)0.950100-199 m²40 (28.57)13 (27.66)27 (29.03)0.950200-299 m²22 (15.71)7 (14.89)15 (16.13)0.950 $\geq 300 \text{ m}^2$ 17 (12.14)5 (10.64)12 (12.90)Duration of stay (y) $0.10 (21.28)$ 16 (17.20)0.36011-2026 (18.57)10 (21.28)16 (17.20)21-3020 (14.29)6 (12.77)14 (15.05)38 (40.86)Home accessibility $0.13 (27.66)$ 38 (40.86)0.671Inconvenient home entrance113 (80.71)37 (78.72)76 (81.72)0.671	Type of housing				
Town house93 (66.43)10 (21.28)15 (16.13)Shophouse15 (10.71)4 (8.51)11 (11.83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size $0.99 \text{ m}^2$ 61 (43.57)22 (46.81)39 (41.94)0.950100-199 m²40 (28.57)13 (27.66)27 (29.03)0.950200-299 m²22 (15.71)7 (14.89)15 (16.13) $\geq 300 \text{ m}^2$ 17 (12.14)5 (10.64)12 (12.90)Duration of stay (y) $0.10$ 43 (30.71)18 (38.30)25 (26.88)0.36011-2026 (18.57)10 (21.28)16 (17.20)21-3020 (14.29)6 (12.77)14 (15.05)30> 3051 (36.43)13 (27.66)38 (40.86)Home accessibility $0.921$ $0.671$ $0.671$ Inconvenient home entrance113 (80.71)37 (78.72)76 (81.72)0.671Inconvenient home access27 (19.29)10 (21.28)17 (18.28)	Single house	47 (33.57)	33 (70.21)	62 (66.67)	0.498
Shophouse15 (10, 11)4 (8,51)11 (11,83)Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size $0.99 \text{ m}^2$ 61 (43.57)22 (46.81)39 (41.94)0.950100-199 m²40 (28.57)13 (27.66)27 (29.03) $0.950$ 200-299 m²22 (15.71)7 (14.89)15 (16.13) $\geq 300 \text{ m}^2$ 17 (12.14)5 (10.64)12 (12.90)Duration of stay (y) $0.10$ 43 (30.71)18 (38.30)25 (26.88)0.36011-2026 (18.57)10 (21.28)16 (17.20)21-3020 (14.29)6 (12.77)14 (15.05) $330$ > 3051 (36.43)13 (27.66)38 (40.86)Home accessibility $0.77 (78.72)$ 76 (81.72)0.671Inconvenient home entrance113 (80.71)37 (78.72)76 (81.72)0.671	Town house	93 (66.43)	10 (21.28)	15 (16.13)	
Apartment1 (0.71)0 (0.00)1 (1.08)Condominium4 (2.86)0 (0.00)4 (4.30)Home size $0.99 \text{ m}^2$ 61 (43.57)22 (46.81)39 (41.94)0.950100-199 m²40 (28.57)13 (27.66)27 (29.03)200-299 m²22 (15.71)7 (14.89)15 (16.13) $\geq 300 \text{ m}^2$ 17 (12.14)5 (10.64)12 (12.90)Duration of stay (y)0-1043 (30.71)18 (38.30)25 (26.88)0.36011-2026 (18.57)10 (21.28)16 (17.20)21-3020 (14.29)6 (12.77)14 (15.05)30> 3051 (36.43)13 (27.66)38 (40.86)Home accessibility $C$ $T$ $T$ $T$ Convenient home entrance113 (80.71)37 (78.72)76 (81.72)0.671Inconvenient home access27 (19.29)10 (21 28)17 (18 28)	Shophouse	15 (10.71)	4 (8.51)	11(11.83)	
Home size $4 (2.30)$ $6 (0.00)$ $4 (4.30)$ $0.99 \text{ m}^2$ $61 (43.57)$ $22 (46.81)$ $39 (41.94)$ $0.950$ $100-199 \text{ m}^2$ $40 (28.57)$ $13 (27.66)$ $27 (29.03)$ $200-299 \text{ m}^2$ $22 (15.71)$ $7 (14.89)$ $15 (16.13)$ $\geq 300 \text{ m}^2$ $17 (12.14)$ $5 (10.64)$ $12 (12.90)$ Duration of stay (y) $0.10$ $43 (30.71)$ $18 (38.30)$ $25 (26.88)$ $0.360$ $11-20$ $26 (18.57)$ $10 (21.28)$ $16 (17.20)$ $21-30$ $20 (14.29)$ $6 (12.77)$ $14 (15.05)$ > 30 $51 (36.43)$ $13 (27.66)$ $38 (40.86)$ Home accessibility $C$ $113 (80.71)$ $37 (78.72)$ $76 (81.72)$ $0.671$ Inconvenient home entrance $113 (80.71)$ $37 (78.72)$ $76 (81.72)$ $0.671$	Condominium	1(0.71)	0(0.00)	1(1.08)	
$\begin{array}{c cccccc} & & & & & & & & & & & & & & & & $	Home size	4 (2.80)	0 (0.00)	4 (4.50)	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$0.99 \text{ m}^2$	61 (43 57)	22 (46 81)	39 (41 94)	0.950
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$100-199 \text{ m}^2$	40 (28.57)	13 (27.66)	27 (29.03)	
$ \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	200-299 m <sup>2</sup>	22 (15.71)	7 (14.89)	15 (16.13)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\geq 300 \text{ m}^2$	17 (12.14)	5 (10.64)	12 (12.90)	
	Duration of stay (y)				
$\begin{array}{ccccccc} 11-20 & 26 & (18.57) & 10 & (21.28) & 16 & (17.20) \\ 21-30 & 20 & (14.29) & 6 & (12.77) & 14 & (15.05) \\ > 30 & 51 & (36.43) & 13 & (27.66) & 38 & (40.86) \\ \\ \text{Home accessibility} & & & & & \\ \text{Convenient home entrance} & 113 & (80.71) & 37 & (78.72) & 76 & (81.72) & 0.671 \\ \\ \text{Inconvenient home access} & 27 & (19.29) & 10 & (21.28) & 17 & (18.28) \\ \end{array}$	0-10	43 (30.71)	18 (38.30)	25 (26.88)	0.360
$\begin{array}{ccccc} 21-30 & 20 & (14.29) & 6 & (12.77) & 14 & (15.05) \\ > 30 & 51 & (36.43) & 13 & (27.66) & 38 & (40.86) \\ \end{array}$ Home accessibility Convenient home entrance 113 (80.71) 37 (78.72) 76 (81.72) 0.671 Inconvenient home access 27 (19.29) 10 (21.28) 17 (18.28)	11-20	26 (18.57)	10 (21.28)	16 (17.20)	
> 50     51 (56.43)     13 (27.66)     38 (40.86)       Home accessibility     76 (81.72)     0.671       Inconvenient home access     27 (19.29)     10 (21 28)     17 (18 28)	21-30	20 (14.29)	6 (12.77)	14 (15.05)	
Frome accessionity113 (80.71)37 (78.72)76 (81.72)0.671Inconvenient home access27 (19.29)10 (21 28)17 (18 28)	> 30	51 (36.43)	13 (27.66)	38 (40.86)	
Convenient nome entrance115 (00.71) $57 (76.72)$ $70 (61.72)$ $0.071$ Inconvenient home access27 (19.29)10 (21 28)17 (18 28)	Convenient home entrance	112 (20 71)	27 (77 97)	76 (81 77)	0.671
	Inconvenient home access	27 (19 29)	10 (21 28)	17 (18 28)	0.071

Copyright © 2025 Wolters Kluwer Health, Inc. All rights reserved.

## TABLE 2. (continued)

		Home injuries after TKA		
Variables	All (N = 140)	Yes, N (%)	No, N (%)	Р
Home flooring				
Single-level flooring	40 (28.57)	13 (27.66)	27 (29.03)	0.865
Multi-level flooring	100 (71.43)	34 (72.34)	66 (70.97)	
Bathroom size				
Adequate size	128 (91.43)	41 (87.23)	87 (93.55)	0.208
Narrow size	12 (8.57)	6 (12.77)	6 (6.45)	
Grab bar	× ,			
Yes	48 (34.29)	9 (19.15)	39 (41.94)	0.007*
No	92 (65.71)	38 (80.85)	54 (58.06)	
Mobility space				
Adequate space with grab bars	24 (17.14)	6 (12.77)	18 (19.35)	0.764
Adequate space without grab bars	111 (79.29)	39 (82.98)	72 (77.42)	
Insufficient space	3 (2.14)	1 (2.13)	2 (2.15)	
Uneven ground surfaces	2 (1.43)	1 (2.13)	1 (1.08)	
Lighting in the home	× ,			
Adequate	134 (95.71)	42 (89.36)	92 (98.92)	0.008*
Inadequate	6 (4.29)	5 (10.64)	1 (1.08)	

Shophouse = a shop that opens onto the street and is used as the owner's home. \*P-value < 0.05

Characteristics of patients in this study with high proportions of elderly (85.7%) and females (88.57%) reflect that the chance for knee replacement surgery tends to increase with age,<sup>20</sup> and demonstrate the gender disparity often seen in the patients with knee OA. Moreover, the high prevalence of chronic diseases (85%), being retired or unemployed (80%), prolonged pain duration (average 6.5 y), and the history of prior surgeries emphasize complex health challenges and the determinants of social determinants encountered by the patients.

The incidence of falls among patients after TKA (34%) in this study aligns with previous research findings, that is, 20% to 43% of all post-TKA unintentional falls,<sup>7,8,21</sup> and 20% to 55% of fall-related injuries in the elderly.<sup>22</sup> Several factors may contribute to this high fall rate, including knee pain, limited knee mobility,23 an increased number of comorbidities, higher medication use, and depression.<sup>8</sup> A previous systematic review and meta-analysis summarized that limited knee motion increased the risk of post-TKA falling (pooled OR = 2.08, 95% CI = 1.20-3.60 with a low level of evidences.18 When focusing on falling mechanisms and location, the previous study indicated that slipping, tripping, and collisions commonly took place at the home entrance, living room, and bathroom. Most of falls happened during regular activities on a ground level, and nearly half of them encountered risky behaviors.<sup>24</sup> Post-TKA patients in this study reported falling caused by slipping on a wet surface (34%), tripping due to uneven flooring (20%), and collisions with furniture (20%). Injuries arose at home entrance (29%), living room (24%), and bathroom (18%). These findings represent common antecedents of unintentional injuries in both general elders and post-TKA patients.

This study contemplated post-TKA patients and/or family demand for their living area renovation and might ask for external support. Nearly 40% of them expressed their needs for home modifications with regard to health conditions, living space improvement, and privacy issues. The most frequently needed modifications were for the home entrance/wheelchair ramp (37%), bathroom (15%), and kitchen (15%). Handrail installation and lighting enhancement may be relatively quick and practically easy to apply. On the other hand, constructing home entrance, ramp, or reinforcing bathroom/kitchen walls definitely required time, resources, and manpower.<sup>25,26</sup>

There are several pertinent factors associated with the need for home modifications and fall prevention, including host, environment, and contextual factors. Host factors related to needs for home modification included the presence of chronic diseases (OR = 3.08, 95% CI = 0.92-13.25, P = 0.046), and previous home injuries (OR = 3.35, 95%) CI = 1.36-8.41, P < 0.001). Other factors such as age, educational level, income, previous surgery, and assistive device use did not significantly correlate with needs for home modification. A previous study from China demonstrated a 30% need for home modification,<sup>27</sup> particularly anti-slip/vinyl floor, and handrail installation. The needs were associated with chronic disease (an incident rate ratio = 1.16, 95% CI = 1.09-1.25) as well as primary school educational level, and lower income context. However, the relationship between the history of falls and home modification needs has not been explored. Hypothetically, previous falls may increase perceptual home hazards and directly induce the requirement for home modification.

From our data, significant environmental home hazards among post-TKA patients were inefficient grab bars (adjusted OR = 3.26, 95% CI = 1.37-7.81) and lighting (adjusted OR = 12.83, 95% CI = 1.36-121.34). Grab bars and sufficient home lighting were associated with fall reduction by 20% and 52%, respectively. These findings were comparable to previous evidences. Overall home modifications could reduce fallrelated injuries up to 26% to 31% per year.<sup>16,17</sup> Using grab bars for bathtub transfer enhanced trunk balance and significantly provided a higher likelihood (75.8%) of fall prevention.<sup>28</sup> Upgraded lighting encouraged visual acuity and reduced falls by 43% when compared with the controls (4.82 vs. 8.44 falls per 1000 resident-days, P = 0.004).<sup>29</sup>

Other identifiable risks of falls are related to physical and sociodemographic factors. The studies by Masarwa et al<sup>8</sup> and Shao et al<sup>21</sup> determined higher comorbidity, a history of prior falls, and limitations in activities of daily

Patient Saf •	Vo	lume 21,	Number	3, April	2025
---------------	----	----------	--------	----------	------

Variables	Crude OR (95% CI)	Р	
Sex			
Female	Reference		
Male	1.22 (0.41-3.57)	0.724	
Age (y)			
41-60	Reference		
61-80	1.54 (0.52-4.55)	0.435	
> 80	4.5 (0.58-35.15)	0.152	
Underlying chronic disease			
No	Reference		
Yes	1.01 (0.38-2.71)	0.980	
Device use			
None	Reference		
Cane	1.57 (0.70-3.53)	0.277	
Walker	0.35 (0.04-3.08)	0.347	
Wheelchair	1.06 (0.09-12.19)	0.960	
Previous surgery			
No	Reference		
Yes	1.38 (0.68-2.79)	0.370	
Home accessibility			
Convenient	Reference		
Inconvenient	1.21 (0.5-2.9)	0.672	
Home flooring			
Single level	Reference		
Multi-level	1.07 (0.49-2.33)	0.865	
Bathroom size			
Adequate	Reference		
Narrow	2.12 (0.64-6.98)	0.216	
Grab bar in bathroom	(		
Yes	Reference		
No	3.05 (1.32-7.03)	0.009*	
Mobility space		0.000	
Adequate space with grab bars	Reference		
Adequate space without grab	1.63 (0.60-4.43)	0.343	
hars		0.0.0	
Insufficient space	1 5 (0 11-19 64)	0 757	
Uneven ground surfaces	3 (0 16-55 72)	0.461	
Home lighting	5 (0.10 55.12)	0.101	
Adequate	Reference		
Inadequate	10.95 (1.24-96.68)	0.031*	

living as the risk factors for falls after TKA. Nevertheless, our study did not find chronic disease, device use, and previous injury contributed to post-TKA unintentional falls. The explanation might be better health conditions among younger age (mean age 68.6 y) when compared with the previous report (average age 82.4-86.7 y).<sup>21</sup>

Variable	Crude OR (95%CI)	Adjusted OR (95%CI)	Р	
Grab bar in ba	throom			
Yes	Reference	Reference		
No	3.05 (1.32-7.03)	3.26 (1.37-7.81)	0.008*	
Home lighting	· · · · ·			
Adequate	Reference	Reference		
Inadequate	10.95 (1.24-96.68)	12.83 (1.36-121.34)	0.026*	

TABLE 3. Bivariate Analysis of Factors Associated With Home

Taking all related factors into account for preventative purposes, holistic, multidisciplinary, and interprofessional stepby-step approaches for TKA patients should be considered from the preoperative period to postoperative periods in order to reduce falls. First, the assessment of the patient's demographics, socioeconomic factors, and underlying conditions, as well as hazard perception during daily living, should be done. Second, multidisciplinary and/or interprofessional teams should assess home hazards, or the home hazard assessment tools can be used by either the patient and/or family members. In the case of identified risks of falls at home, there should be a managed system to provide advice and support for the patients and family members to modify their homes for a safe environment. Finally, in the postoperative period, the monitoring and evaluation plan should be done to ensure the patient's performance, rehabilitation process, clinical outcomes, and practical home safety conditions.

From our experience in Thailand, even those in need of improving lighting or installing grab bars, the patients and their family still reluctant to manage by themselves. To effectively improve home safety in real life, it is not enough for the health system to provide only health education, but we should also consider integrating additional services such as the provision of do-it-yourself (DIY) guidelines, information about the instruments and where to buy, and the lists of the contractor, electricians, and other technicians. In light of expected deliverables, previous studies pointed out that focusing on home modifications could reduce the incidence of fall-related injuries by up to 26% to 31% per year.<sup>16,17</sup> Based on our data, inadequate lighting and grab bars were related to unintentional falls among post-TKA patients with population-attributable risk (PAR) 6.6%, and 57.4%, respectively. Preoperative home assessment and home modifications should be encouraged in order to minimize the risks of falls, particularly in common locations. To optimize clinical outcomes, patients' quality of life, and needs for home modifications, the health services system should be integrated with multidisciplinary and interprofessional support.

# Strengths and Limitations

This study provides insightful data on the occurrence of falls within 2 weeks of TKA in patients in Thailand, their needs for home modifications, and the risk of unintentional injuries at home, including host, sociodemographics, and home environment. The strengths of this study are adequate sample size, using structured interviews with the questionnaire to ensure precise estimation, and avoid measurement bias. However, several limitations are the inability to determine the causal relationship between home hazards and unintentional injuries with regards to the cross-sectional study design; potential underestimation of fall rate due to the limit of 2-week postoperative follow-up; information bias from majority elderly patients, verification bias according to the self-reported home environment without on-site assessment. To obtain more robust data, further randomized controlled trials or prospective studies by a multidisciplinary team using a home survey should be conducted to explore the most effective home modification strategies for patients.

#### CONCLUSION

Approximately 39% of post-TKA patients expressed their need for home modification. Insufficient grab bars and lighting are primary factors related to unintentional home injuries during the first 2 weeks after TKA. Further RCTs

148 | www.journalpatientsafety.com

Copyright © 2025 Wolters Kluwer Health, Inc. All rights reserved.

are required to explore the causes and effects of home modifications on home injury.

# REFERENCES

- 1. Hawker GA. Osteoarthritis is a serious disease. *Clin Exp Rheumatol.* 2019;37 Suppl 120:3–6.
- Neogi T. The epidemiology and impact of pain in osteoarthritis. Osteoarthritis Cartilage. 2013;21:1145–1153.
- 3. Fukutani N, Iijima H, Aoyama T, et al. Knee pain during activities of daily living and its relationship with physical activity in patients with early and severe knee osteoarthritis. *Clin Rheumatol.* 2016;35:2307–2316.
- Farr Ii J, Miller LE, Block JE. Quality of life in patients with knee osteoarthritis: a commentary on nonsurgical and surgical treatments. *Open Orthop J*. 2013;7:619–623.
- Steinhaus ME, Christ AB, Cross MB. Total knee arthroplasty for knee osteoarthritis: support for a foregone conclusion? HSS J. 2017;13:207–210.
- Feng JE, Novikov D, Anoushiravani AA, et al. Total knee arthroplasty: improving outcomes with a multidisciplinary approach. J Multidiscip Healthc. 2018;11:63–73.
- Chan ACM, Jehu DA, Pang MYC. Falls after total knee arthroplasty: frequency, circumstances, and associated factors —a prospective cohort study. *Phys Ther.* 2018;98:767–778.
- Masarwa R, Yonai Y, Paz I, et al. Falls among older patients with total knee arthroplasty. *Int J Surg Open*. 2022;45:100510.
- 9. Keall MD, Baker M, Howden-Chapman P, et al. Association between the number of home injury hazards and home injury. *Accid Anal Prev.* 2008;40:887–893.
- Bergen G, Chen LH, Warner M, et al. Injury in the United States: 2007 Chartbook. Hyattsville, MD: National Center for Health Statistics 2008.
- Kortawat U, Silapasuwan P, Sujirarut D, et al. Perception of older adults about the safety and convenience of living at home. *J Public Health Nurs.* 2019;32:77–96.
- 12. Turner S, Arthur G, Lyons RA, et al. Modification of the home environment for the reduction of injuries. *Cochrane Database Syst Rev.* 2011;2011:Cd003600.
- Huisman ERCM, Morales E, van Hoof J, et al. Healing environment: a review of the impact of physical environmental factors on users. *Built Environ*. 2012;58:70–80.
- Joshi R, Joseph A, Mihandoust S, et al. Understanding key home and community environment challenges encountered by older adults undergoing total knee or hip arthroplasty. *Gerontologist*. 2021;61:1071–1084.
- 15. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev.* 2012;2012:Cd007146.

- Keall MD, Pierse N, Howden-Chapman P, et al. Home modifications to reduce injuries from falls in the Home Injury Prevention Intervention (HIPI) study: a cluster-randomised controlled trial. *Lancet*. 2015;385:231–238.
- Keall MD, Tupara H, Pierse N, et al. Home modifications to prevent home fall injuries in houses with Māori occupants (MHIPI): a randomised controlled trial. *Lancet Public Health*. 2021;6:e631–e640.
- Lo CWT, Tsang WWN, Yan CH, et al. Risk factors for falls in patients with total hip arthroplasty and total knee arthroplasty: a systematic review and meta-analysis. *Osteoarthritis Cartilage*. 2019;27:979–993.
- Day L, Fildes B, Gordon I, et al. Randomised factorial trial of falls prevention among older people living in their own homes. *BMJ*. 2002;325:128.
- Patel AP, Gronbeck C, Chambers M, et al. Gender and total joint arthroplasty: variable outcomes by procedure type. *Arthroplast Today*. 2020;6:517–520.
- Shao L, Shi Y, Xie XY, et al. Incidence and risk factors of falls among older people in nursing homes: systematic review and meta-analysis. J Am Med Dir Assoc. 2023;24: 1708–1717.
- Lord SR, Menz HB, Sherrington C. Home environment risk factors for falls in older people and the efficacy of home modifications. *Age Ageing*. 2006;35(Suppl 2):ii55–ii59.
- Soison A, Riratanapong S, Chouwajaroen N, et al. Prevalence of fall in patients with total knee arthroplasty living in the community. J Med Assoc Thai. 2014;97:1338–1343.
- Newton RA. Prevention of falls at home: home hazard and safety assessment and management. *Ann Longterm Care*. 2006; 14:28–33.
- Jumrusjarongpol A, Wiriya N, Thaihiam M. A study of housing modifications for low-income people with disabilities in Ayutthaya and Nonthaburi. *NAJUA: Arch Design Built Environ.* 2020;35:C3–C16.
- Wellecke C, D'Cruz K, Winkler D, et al. Accessible design features and home modifications to improve physical housing accessibility: a mixed-methods survey of occupational therapists. *Disabil Health J.* 2022;15:101281.
- Li J, Wu B, Wang J. Creating a supportive environment for older adults in China —exploring factors associated with the need for home modifications based on a cross-sectional survey in Central China. *BMC Geriatrics*. 2023;23:795.
- Levine IC, Montgomery RE, Novak AC. Grab bar use influences fall hazard during bathtub exit. *Hum Factors*. 2023; 65:1821–1829.
- Grant LK, St Hilaire MA, Heller JP, et al. Impact of upgraded lighting on falls in care home residents. J Am Med Dir Assoc. 2022;23:1698–704.e2.

Copyright © 2025 Wolters Kluwer Health, Inc. All rights reserved.

www.journalpatientsafety.com | 149