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Featured Article

The effect of physical and social isolation due to the COVID-19 pandemic on the incidence of hip fractures among senior citizens

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ABSTRACT

This study aimed to explore the effects of the lockdown due to the coronavirus disease 2019 pandemic on the incidence and characteristics of hip fracture in older adults. Data from the three-month lockdown period and the corresponding period in the previous year were obtained from the computerized medical records of a large acute-care hospital. No significant differences were observed in the absolute and relative numbers of hip fractures. There were no significant differences in terms of socio-demographic and clinical characteristics, which are considered risk factors for falls. Similarly, there was no difference in the length of time between admission and surgery and the mean length of hospital stay. Compared to the previous year, there was a significantly higher incidence of hip fractures in older adults living alone during the lockdown. Health policy should provide social support and monitoring of healthcare, particularly to older adults living alone.

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Introduction

The coronavirus disease 2019 (COVID-19) pandemic has placed older adults at the forefront of public interest worldwide because of their higher vulnerability to the virus.¹ Accordingly, health policy gradually advanced from instructing older adults to maintain social distancing by reducing outdoor activities to participation in full lockdowns for extended periods of time during which the entire population was obliged to stay home. This resulted in prolonged periods of physical and social isolation.^{2,3}

Being restricted to the home environment and minimizing outdoor activities may have promoted a more sedentary lifestyle. Sedentary behavior is associated with muscle weakness, decreased balance, and reduced aerobic capacity in older adults,⁴ which increase the risk of falls and consequently of hip fractures.⁵ As a result of restricted mobility in public spaces, increased loneliness was reported by older adults,^{6–8} with a higher incidence reported among those living alone.^{7,8} A review of previous studies indicated that the level of loneliness and its negative consequences on mental state following the COVID-19 lockdown depend on the duration and frequency of isolation periods.⁷ Anxiety is the most frequently reported psychological distress among older adults during the COVID-19 pandemic.⁹ Risk factors for increased anxiety among older adults include advanced age, living alone, being unmarried, and having a lower level of education.⁸ A survey of changes in medication among older adults during

the COVID-19 pandemic revealed increased consumption of antidepressants and anti-anxiety drugs.¹⁰ Anxiolytic drugs (antidepressants and anti-anxiety medications) are reported to increase the risk of fall,^{11,12} and this may have affected the incidence of falls during the COVID-19 pandemic. Indeed, consumption of such drugs has been shown to increase the risk of hip fractures.¹³ Fall-related hip fractures in older adults are devastating events with significant consequences on the morbidity and disability of the individual and the healthcare system at large.^{2,14} Accordingly, it is important to explore whether the imposed physical and social isolation during the COVID-19 lockdown increased the incidence of fall-related hip fractures among older adults.

Several reviews have demonstrated that the COVID-19 pandemic resulted in a decrease in the total referral load to orthopedic wards, regardless of patient age. Additionally, the lockdown imposed during this period resulted in a shift in the types of injuries presented, with notably fewer injuries related to motor vehicle accidents and sporting activities banned during this period.^{5,15,16} However, systematic reviews by Blum¹⁵ and Lim⁵ did not specifically examine the impact of COVID-19 on the incidence of hip fractures among older adults. In contrast, in a systematic review by Jain et al.,¹⁶ several studies considered hip fractures.^{2,17–19}

The results of studies evaluating the effect of the pandemic on the incidence of hip fractures in older adults are not consistent, with some studies reporting no change between the preceding period and the time of lockdown due to the pandemic,^{17,20} some reporting an increase in the incidence of hip fractures,^{19–21} and other studies reporting a decrease in the incidence of hip fractures.^{22–24} These

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contrasting results may be related to the study country and/or methodology. Additionally, the proportionately higher mortality rate in older adults with COVID-19 in certain countries (e.g., Italy) may have masked the incidence of hip fractures in this age group during the pandemic.²³ Finally, the method of calculation of the effects of the pandemic on the incidence of hip fractures varied between studies. Some studies compared the absolute number of hip fractures before and during the pandemic,^{20,22,23} while others analyzed the proportion of hip fractures in relation to other injuries requiring admission to orthopedic wards, which may not directly reflect the incidence of hip fractures, but rather illustrates a change in the number of other types of injuries.^{17,20,21} To address these conflicting results, the purpose of this study was to compare (1) the incidence of hip fractures among older adults admitted to a large general hospital in Northern Israel during the first lockdown period of the COVID-19 pandemic with the corresponding period in 2019; (2) the characteristics of patients with hip fractures between these two periods (e.g., age, sex, place of residence, medicine consumption); and (3) the characteristics of fracture management in terms of time to operation, surgeon seniority, and hospital stay.

We hypothesized that the increase in the risk factors of fall during the lockdown period would result in an increase in the absolute and relative incidence of fall-related hip fractures in older adults compared to the pre-pandemic period. We did not expect age or gender to be related to the increased incidence of hip fractures, but expected that living conditions will affect this incidence. Further, we did not expect changes in fracture management during the COVID-19 pandemic.

Methods

Design

This was a retrospective study based on the review of computerized medical records using a specialized software. This study was approved by the hospital's Helsinki Board.

Sample and settings

Data were collected from a major 1000-bed general hospital in Northern Israel, which includes two orthopedic wards with a total of 70 beds.

Inclusion criteria: Patients aged ≥ 65 years admitted to one of the two orthopedic wards following intertrochanteric, subtrochanteric, or subcapital hip fractures due to a fall during the first three months of the lockdown period due to COVID-19 (March 19, 2020, to June 18, 2020) or during the corresponding period in 2019.

Measurement

The following data were extracted: 1. Demographic data: age, sex, marital status, number of children, body mass index (BMI), and dwelling information; 2. Clinical characteristics: number of medications consumed, consumption of anti-anxiety and antidepressant medications (benzodiazepines and selective serotonin reuptake inhibitors), consumption of medications for hypertension, alcohol consumption, and smoking; 3. Characteristics of fracture management: time to operation, duration of hospital stay, and surgeon's seniority.

Statistical analysis

Descriptive statistics of continuous variables are reported as the mean and standard deviation (SD), and those of categorical variables are reported as numbers and percentages. The normality of the distribution of the quantitative parameters was tested using the Shapiro–Wilk test. Two-sample t-tests and Mann–Whitney tests were

used to compare data between the two-time frames for parametric and non-parametric data, respectively. Categorical parameters were compared using Fisher's exact test or Pearson chi-square tests. Statistical significance was set at $P < 0.05$. SPSS version 27 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses.

The effect of lockdown on the number of hip fractures was calculated as a proportion of the number of hospitalized patients in the orthopedic wards during each time period. To determine whether COVID-19 affected the absolute number of hip fractures, the incidence of hip fractures in each period in relation to the sum of hip fractures in both periods was calculated.

Results

During the lockdown period, the hospital operated in an emergency mode, with specialized intensive care units and internal medicine wards admitting large numbers of patients with COVID-19, which reduced the elective activity throughout the hospital.

The number of hip fractures and patient characteristics during the two time periods are presented in Table 1. No patient with hip fracture was COVID-positive. With regard to patients admitted to the orthopedic ward, 49 out of 673 (7.2%) and 58 of 753 (7.7%) had hip fractures during the lockdown period and the corresponding period of the previous year, respectively, and the difference was not statistically significant. In addition, calculation of the incidence of hip fractures in each period in relation to the sum of hip fractures in both periods (107) indicated no significant difference in the number of hip fractures occurring in each period.

No significant differences were noted between the two time periods in terms of the following sociodemographic characteristics: age,

Table 1
Characteristics of patients with hip fracture.

Variable	2019	2020	p-value
Age (years) (mean \pm SD)	82.1 \pm 7.9	82.5 \pm 8.00	0.84
Sex, n (%)	43 (74%)	34 (69%)	0.66
Female	15 (26%)	15 (31%)	
Male			
Marital status, n (%)	32 (58.2%)	25 (50%)	0.63
Widowed	20 (36.4%)	19 (38%)	
Married	1 (1.8%)	2 (4%)	
Single	2 (3.6%)	4 (8%)	
Divorced			
Number of children (mean \pm SD)	4.0 \pm 2.9	3.0 \pm 1.8	0.18
Body mass index (kg/m ²) (mean \pm SD)	26.6 \pm 4.3	25.0 \pm 4.9	0.15
Place of residence, n (%)	43 (74%)	40 (82%)	0.48
Home	15 (26%)	9 (18%)	
Assisted living facility			
Living condition, n (%)	6 (10%)	14 (28%)	0.02
Living alone	52 (90%)	35 (72%)	
Living with caregiver/family			
Number of medications consumed (mean \pm SD)	6.6 \pm 3.8	6.0 \pm 3.5	0.40
Consumption of anti-anxiety and antidepressant medications, n (%)	15 (25.9%)	18 (36.0%)	0.25
Yes	43 (74.1%)	32 (64.0%)	
No			
Consumption of antihypertensive medication, n (%)	48 (82.8%)	40 (78.4%)	0.57
Yes	10 (17.2%)	11 (21.6%)	
No			
Alcohol consumption, n (%)	2 (3.6%)	2 (6.7%)	0.61
Yes	53 (96.4%)	28 (93.3%)	
No			
Smoking, n (%)	0 (0%)	3 (8.1%)	0.08
Yes	48 (100.0%)	34 (91.9%)	
No			

SD = standard deviation.

Table 2
Characteristics of fracture management.

Variable	2019, n=58	2020, n=49	p-value
Mean time to operation (days) (mean±SD)	1.3 ±0.9	1.1±0.6	0.10
Mean hospital stay (days) (mean±SD)	8.3±4.7	8.7±8.0	0.63
surgeons' seniority, n (%)	28 (48%)	34 (69%)	0.032
Senior surgeon	30 (52%)	15 (31%)	
Resident			

SD= standard deviation.

sex, marital status, number of children, and BMI. In addition, no significant differences were noted between the two time periods in the following clinical characteristics: number of medications consumed, consumption of anti-anxiety and antidepressant medications (benzodiazepines and selective serotonin reuptake inhibitors), consumption of medications for hypertension, alcohol consumption, and smoking.

While no significant difference was noted regarding patients' place of residence, a significantly larger proportion of the patients admitted during the lockdown period lived alone (28%) compared to that in the corresponding period in 2019 (10%).

Information regarding fracture management is presented in Table 2. No significant differences between the two groups were noted in the time between arrival at the hospital's emergency room and the day of surgery, or in the mean length of hospital stay. A significant difference was found in the experience of the operating surgeons, as during the COVID-19 period, more patients were operated by senior surgeons (69%) than in the preceding year (48%).

Discussion

The COVID-19 pandemic has brought many changes to our daily lives. It has raised many health and ethical concerns and has influenced everyday social interactions. It also influenced hospital routines, which had to adapt to the situation caused by the outbreak.²⁵ The aim of the current study was to explore the effect of the COVID-19 pandemic on the incidence of hip fractures, patient characteristics, and fracture management among older adults in Israel.

The findings indicate no significant increase in the relative and absolute incidence of hip fractures during the lockdown period compared to the previous year. The analyses of both the absolute and relative numbers of hip fractures are consistent with some of the reports of previous studies,^{17,20,26} which showed that the COVID-19 pandemic did not significantly affect the incidence of hip fractures. However, it is difficult to compare our findings with those of previous studies that demonstrated opposite results due to different study methodologies (such as patient age, period of data collection, and methods of calculation of the incidence of hip fracture). It has been suggested that the incidence of hip fractures may be related to the geographic and ethnic background of older adults due to factors such as exposure to the sun (vitamin D), genetic factors, dietary habits, or bone mineral density.^{27,28} Therefore, we compared the current results with those of other studies conducted in Israel. However, the comparison yielded no results, as the other studies in Israel were conducted during different periods of the COVID-19 pandemic when the levels of social isolation and movement restrictions were different.^{29–32} These studies presented a pattern similar to that observed in global studies; most studies showed a decrease in the absolute number of hip fractures,^{29,30,32} and one study showed an increase.³¹ As noted in studies from all over the world, this inconsistent pattern is probably the result of the high variability between studies in terms of data collection duration and period.

The reason for no increase in the incidence of hip fracture during the COVID-19 period, as we had hypothesized, may be that being home bound led older adults to adopt a more careful behavior

avoiding indoor activities that could cause falls. The lack of difference in the incidence of hip fracture may also be attributed to the fact that there was no difference between the periods in terms of the generally cited risk factors for fall.^{33–36} Considering the recurrent waves of the COVID-19 pandemic, it is possible that we may observe an increased risk of falls in the future, which was not evident during the first three months of social and mobility restriction.

The present study demonstrated no significant differences between the two time periods in terms of patient age and sex distribution, marital status, and number of children, which is similar to the findings of previous studies.^{17,20,31,32,37}

Previous studies have indicated that a larger percentage of fractures in general,^{5,19} particularly hip fractures, occurred at home during the COVID-19 period.³² This is because the lockdown limited outdoor activities. In the current study, information regarding fall locations was not available in most medical records. In light of the literature^{5,19,32} and the lockdown conditions, we assume that most of the fractures in our sample occurred in or near the place of residence of the older adults. However, data collected in the present study included the place of residence (home/assisted living facility) and living conditions (alone/not alone). The results indicate no significant differences in residence location between the two periods (before and during the pandemic). However, a significantly higher percentage of older adults who fell during the COVID-19 pandemic lived alone (28%), compared to only 10% in the preceding year (p=0.02). Thus, the results indicate that the lockdown period may have increased the vulnerability of older adults, which is supported by studies indicating that social isolation and loneliness experienced by older people, particularly among those who live alone, increase the risk of falls.^{38,39} Solitary living, even under normal circumstances, has been proven to increase the risk of fall and have a negative effect on the recovery of functional independence, rate of institutionalization, and mortality.^{40–43} However, the lockdown intensified the excessive risk of living alone, probably due to extreme behavioral, psychological, and/or physical changes in daily routines. For example, during the lockdown period, older adults were forced to perform demanding daily activities for which they usually receive external assistance.

As most low-energy injuries and hip fractures during the lockdown period occurred in the home environment, Zhu et al.¹⁹ stressed the need to adopt injury prevention strategies in the home environment. These include avoiding hazardous situations (e.g., lack of sufficient light or wet floor) and adopting cautious behavior by wearing antiskid shoes, showering in a sitting position, transferring slowly with assistance of external support (handrail or armchair) after prolonged sitting or lying.

The present results highlight the need to establish structured healthcare services for older adults living at home, particularly when alone, designed to address prolonged periods of crisis (such as pandemics or rainstorms) and creating networks of digital online communication with medical staff and supportive social communities, as well as instituting technological means for healthcare monitoring. This may include systems detecting and alerting regarding movements that might lead to a fall and home-based fall-prevention exercise programs^{44–46} to minimize the negative effects of isolation on older adults living alone.^{47,48}

A decrease in elective activity in the hospital (as experienced during the pandemic) may result in more available operating rooms and shorten the mean time to operation. However, this was not the case in the present study. In this study, we observed an interesting difference in the seniority of the surgeon performing hip fracture fixation. In 2019, during "normal" hospital routine, approximately half of the hip fractures were operated on by senior surgeons and half by residents, while during the COVID-19 lockdown in 2020, 69% of hip fractures were operated on by senior surgeons. This was due to the decrease in elective activity and increased availability of senior

surgeons in the evenings. Further studies are required to determine whether this shift influences long-term surgical outcomes, as previous studies have suggested better outcomes with more experienced surgeons.^{49,50}

Although rehabilitation facilities had to cope with the COVID-19 outbreaks, and referral to such facilities was limited during the pandemic period, the length of hospital stay seemed to remain the same. However, we have no data regarding where patients were sent after their acute hospital stay or how this affected their rehabilitation. Thus, the primary limitation of this study was that the hospital data did not include patient follow-up. Furthermore, although data were collected from one of the largest acute-care hospitals in Israel, the total number of cases reviewed was limited.

Conclusion

We showed that a short period of social isolation due to the COVID-19 pandemic did not have a direct effect on the absolute number of fall-related hip fractures in older adults compared to an identical period during the previous year (2019). A higher incidence of hip fractures occurred during the social isolation period among older adults who lived alone. Based on the current results, we suggest that health policy should include social support and health monitoring, particularly for older adults who live alone. Future studies should include larger populations, longer follow-up periods, and evaluate the effects of longer periods of lockdowns, particularly in more vulnerable older adults.

Ethical review committee statement

The study was approved by the Helsinki Board at the Rambam Health Care Campus, Haifa, Israel.

Declaration of Competing Interest

Each author certifies that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

References

- Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun.* 2020;109: 102433.
- Liu J, Mi B, Hu L, et al. Preventive strategy for the clinical treatment of hip fractures in the elderly during the COVID-19 outbreak: Wuhan's experience. *Aging (Albany NY).* 2020;12(9):7619.
- Gardner W, States D, Bagley N. The coronavirus and the risks to the elderly in long-term care. *J Aging Soc Policy.* 2020;32(4-5):310–315.
- Garcia Meneguci CA, Meneguci J, Sasaki JE, Tribess S, Júnior JSV. Physical activity, sedentary behavior and functionality in older adults: a cross-sectional path analysis. *PLoS One.* 2021;16(1):e0246275.
- Lim MA, Ridia KGM, Pranata R. Epidemiological pattern of orthopaedic fracture during the COVID-19 pandemic: a systematic review and meta-analysis. *J Clin Orthop Trauma.* 2020.
- Kasar KS, Karaman E. Life in lockdown: social isolation, loneliness and quality of life in the elderly during the COVID-19 pandemic: a scoping review. *Geriatr Nurs.* 2021.
- Stolz E, Mayerl H, Freidl W. The impact of COVID-19 restriction measures on loneliness among older adults in Austria. *Eur J Public Health.* 2021;31(1):44–49.
- Guner TA, Erdogan Z, Demir I. The effect of loneliness on death anxiety in the elderly during the COVID-19 pandemic. *OMEGA J Death Dying.* 2021. 00302228211010587;302228211010587.
- Wang C, Pan R, Wan X, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health.* 2020;17(5):1729.
- Brown JD, Vouri SM, Manini TM. Survey-reported medication changes among older adults during the SARS-CoV-2 (COVID-19) pandemic. *Res Social Adm Pharm.* 2021;17(8):1478–1482.
- Sterke CS, Verhagen AP, Van Beeck EF, van der Cammen TJ. The influence of drug use on fall incidents among nursing home residents: a systematic review. *Int Psychogeriatr.* 2008;20(5):890–910.
- Whitney J, Close JC, Jackson SH, Lord SR. Understanding risk of falls in people with cognitive impairment living in residential care. *J Am Med Dir Assoc.* 2012;13(6):535–540.
- Bakken MS, Engeland A, Engesæter LB, Ranhoff AH, Hunskaar S, Ruths S. Risk of hip fracture among older people using anxiolytic and hypnotic drugs: a nationwide prospective cohort study. *Eur J Clin Pharmacol.* 2014;70(7):873–880.
- Hall AJ, Clement ND, MacLulich AM, White TO, Duckworth AD. IMPACT-Scot 2 report on COVID-19 in hip fracture patients. *Bone Joint J.* 2021;1–10.
- Blum P, Putzer D, Liebensteiner MC, Dammerer D. Impact of the Covid-19 pandemic on orthopaedic and trauma surgery—a systematic review of the current literature. *In Vivo.* 2021;35(3):1337–1343.
- Jain VK, Lal H, Patralekh MK, Vaishya R. Fracture management during COVID-19 pandemic: a systematic review. *J Clin Orthop Trauma.* 2020;11:S431–S441.
- Nuñez JH, Sallent A, Lakhani K, et al. Impact of the COVID-19 pandemic on an emergency traumatology service: experience at a tertiary trauma centre in Spain. *Injury.* 2020;51(7):1414–1418.
- Shariyate MJ, Kachooei AR. Association of new coronavirus disease with fragility hip and lower limb fractures in elderly patients. *Arch Bone Jt Surg.* 2020;8(suppl1):297.
- Zhu Y, Chen W, Xin X, et al. Epidemiologic characteristics of traumatic fractures in elderly patients during the outbreak of coronavirus disease 2019 in China. *Int Orthop.* 2020;44(8):1565–1570.
- Lv H, Zhang Q, Yin Y, et al. Epidemiologic characteristics of traumatic fractures during the outbreak of coronavirus disease 2019 (COVID-19) in China: a retrospective and comparative multi-center study. *Injury.* 2020;51(8):1698–1704.
- Septon B, Mahapatra P, Shenouda M, et al. The effect of COVID-19 on a Major Trauma Network. An analysis of mechanism of injury pattern, referral load and operative case-mix. *Injury.* 2021;52(3):395–401.
- Malik-Tabassum K, Crooks M, Robertson A, To C, Maling L, Selmon G. Management of hip fractures during the COVID-19 pandemic at a high-volume hip fracture unit in the United Kingdom. *J Orthop.* 2020;20:332–337.
- Maniscalco P, Poggiali E, Quattrini F, et al. Proximal femur fractures in COVID-19 emergency: the experience of two Orthopedics and Traumatology Departments in the first eight weeks of the Italian epidemic. *Acta Biomed.* 2020;91(2):89.
- Moscadini S, Stramazzo L, Miceli A, et al. Did the COVID-19 pandemic change hip fracture incidence in elderly? *Euro Mediterranean Biomed J.* 2021;16(11):48–51.
- Mathai NJ, Venkatesan AS, Key T, Wilson C, Mohanty K. COVID-19 and orthopaedic surgery: evolving strategies and early experience. *Bone Jt Open.* 2020;1(5):160–166.
- Johansen A, Inman DS. *A view of COVID-19 from the perspective of the National Hip Fracture Database.* London: British Editorial Society of Bone & Joint Surgery; 2021.
- Dhanwal D, Cooper C, Dennison E. Geographic variation in osteoporotic hip fracture incidence: the growing importance of Asian influences in coming decades. *J Osteoporos.* 2010;2010: 757102.
- Noel SE, Santos MP, Wright NC. Racial and ethnic disparities in bone health and outcomes in the United States. *J Bone Miner Res.* 2021.
- Prossio I, Oren N, Livshits G, Lakstein D. Incidence and mortality rate of hip fractures in different age groups during the first wave of the COVID-19 pandemic. *Isr Med Assoc J.* 2021;23(8):475–478.
- Amzallag N, Factor S, Shichman I, Ben-Tov T, Khoury A. Hip fractures during the COVID-19 pandemic: demographics, treatment pathway, and outcomes. *Isr Med Assoc J.* 2021;23(8):484–489.
- Shemesh S, Bebin A, Niego N, Frenkel Rutenberg T. The impact of the COVID-19 2020 pandemic on hospital length of stay following fragility hip fracture surgery. *Isr Med Assoc J.* 2021;23(8):469–474.
- Steinfeld Y, Ben Natan M, Yonai Y, Berkovich Y. Hip fracture following a fall among older adults during the COVID-19 pandemic. *Isr Med Assoc J.* 2021;23(8):479–483.
- Bemand TJ, Thomas S, Finucane P. The extent of polypharmacy and use of “fall risk increasing drugs” in the oldest old admitted to a regional New South Wales hospital. *Australas J Ageing.* 2021.
- Cho BY, Seo DC, Lin HC, Lohrmann DK, Chomistek AK. BMI and central obesity with falls among community-dwelling older adults. *Am J Prev Med.* 2018;54(4):e59–e66.
- Tan GJ, Tan MP, Luben RN, Wareham NJ, Khaw KT, Myint PK. The relationship between alcohol intake and falls hospitalization: results from the EPIC-Norfolk. *Geriatr Gerontol Int.* 2021;21(8):657–663.
- Thorin MH, Wihlborg A, Akesson K, Gerdhem P. Smoking, smoking cessation, and fracture risk in elderly women followed for 10 years. *Osteoporos Int.* 2016;27(1):249–255.
- Serra-Torres M, Barreda R, Weaver D, Torres-Reveron A. Delayed presentation of patients with hip fractures during the COVID-19 “stay-at-home” order in the south-most region of the United States. *Adv Orthop.* 2021.
- Gale CR, Westbury L, Cooper C. Social isolation and loneliness as risk factors for the progression of frailty: the English Longitudinal Study of Ageing. *Age Ageing.* 2018;47(3):392–397.
- Newall NE, Menec VH. Loneliness and social isolation of older adults: why it is important to examine these social aspects together. *J Soc Personal Relat.* 2019;36(3):925–939.
- Dahl C, Holvik K, Meyer HE, et al. Increased mortality in hip fracture patients living alone: a NOREPOS study. *J Bone Miner Res.* 2021;36(3):480–488.

41. Maharlouei N, Jafarzadeh F, Rezaianzadeh A, et al. Survival analysis of patients with hip fracture, Shiraz, Iran. *Arch Osteoporos*. 2020;15(1):33.
42. Wahlsten LR, Smedegaard L, Brorson S, Gislason G, Palm H. Living settings and cognitive impairment are stronger predictors of nursing home admission after hip fracture surgery than physical comorbidities A nationwide Danish cohort study. *Injury*. 2020;51(10):2289–2294.
43. Talbot LA, Musiol RJ, Witham EK, Metter EJ. Falls in young, middle-aged and older community dwelling adults: perceived cause, environmental factors and injury. *BMC Public Health*. 2005;5(1):1–9.
44. Horng G-J, Chen K-H. The smart fall detection mechanism for healthcare under free-living conditions. *Wirel Personal Commun*. 2021;118(1):715–753.
45. Mostajeran F, Steinicke F, Ariza Nunez OJ, Gatsios D, Fotiadis D. Augmented reality for older adults: exploring acceptability of virtual coaches for home-based balance training in an aging population. In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 2020.
46. Taylor ME, Close JC, Lord SR, et al. Pilot feasibility study of a home-based fall prevention exercise program (StandingTall) delivered through a tablet computer (iPad) in older people with dementia. *Australas J Ageing*. 2020;39(3):e278–e287.
47. Juang LH, Wu MN. Fall down detection under smart home system. *J Med Syst*. 2015;39(10):1–12.
48. Liu J, Zhao Q, Wang J, Zhang J, Jiang J, Wang H. Effects of continuous nursing based on WeChat platform on the functional recovery and quality of life in elderly patients after total hip arthroplasty. *Am J Transl Res*. 2021;13(5):5623.
49. Authen AL, Dybvik E, Furnes O, Gjertsen JE. Surgeon's experience level and risk of reoperation after hip fracture surgery: an observational study on 30,945 patients in the Norwegian Hip Fracture Register 2011–2015. *Acta Orthop*. 2018;89(5):496–502.
50. Palm H, Jacobsen S, Krashennnikoff M, et al. Influence of surgeon's experience and supervision on re-operation rate after hip fracture surgery. *Injury*. 2007;38(7):775–779.