Time from injury to hip-fracture surgery in low-income and middle-income regions: a secondary analysis of data from the International Orthopaedic Multicentre Study in Fracture Care (INORMUS)

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Summary

Background Globally, fall-related injuries are a substantial problem, and 80% of fatal falls occur in low-income and middle-income countries. We aimed to measure time from injury to hip-fracture surgery in people aged 50 years or older living in low-income and middle-income regions, as well as to measure the proportion of patients with surgical stabilisation of their hip fracture within 72 h of admission to hospital and to identify risk factors associated with surgical delay.

Methods For this secondary analysis, we analysed data collected from Africa, Latin America, China, India, and Asia (excluding China and India) for the International Orthopaedic Multicentre Study in Fracture Care (INORMUS) between March 29, 2014, and June 15, 2022. Patients from INORMUS were included in this analysis if they were aged 50 years or older and had an isolated, primary hip fracture sustained from a ground-level fall. Staff at participating hospitals identified patients with musculoskeletal injury and referred them for assessment of eligibility. We report time from injury to surgery as three distinct time periods: time from injury to hospital admission, time from admission to surgery, and a total time from injury to surgery. Date and time of injury were self-reported by patients at the time of study recruitment. If time to hospital admission after injury exceeded 24 h, patients reported the primary reason for delayed admission. Reasons for surgery, no surgery, and surgical delay were reported by the treating team. For patients undergoing surgery, multivariable regression analyses were used to identify risk factors for surgical delay.

Findings 4486 adults aged 50 years or older with an isolated, primary hip fracture were enrolled in INORMUS from 55 hospitals in 24 countries. Countries were grouped into five regions: Africa (418 [9·3%] of 4486), Latin America (558 [12·4%]), China (1680 [37·4%]), India (1059 [23·6%]) and Asia (excluding China and India; 771 [17·2%]). Of 4486 patients, 3805 (84·8%) received surgery. The rate of surgery was similar in all regions except in Africa, where only 193 (46·3%) of 418 patients had surgery. Overall, 2791 (62·2%) of 4486 patients were admitted to hospital within 24 h of injury. However, 1019 (22·7%) of 4486 patients had delayed hospital admission of 72 h or more from injury. The two most common reasons for delayed admission of more than 24 h were transfer from another hospital (522 [36·2%] of 1441) and delayed care-seeking because patients thought the injury would heal on its own (480 [33·3%]). Once admitted to hospital, 1451 (38·1%) of 3805 patients who received surgery did so within 72 h (median 4·0 days [IQR 1·7–6·0]). Regional variation was seen in the proportion of patients receiving surgery within 72 h of hospital admission (92 [17·9%] of 514 in Latin America, 53 [27·5%] of 193 in Africa, 454 [30·9%] of 1471 in China, 318 [44·4%] of 716 in Asia [excluding China and India], and 534 [58·6%] of 911 in India). Of all 3805 patients who received operative treatment, 2353 (61·8%) waited 72 h or more from hospital admission. From time of injury, the proportion of patients who were surgically stabilised within 72 h was 889 (23·4%) of 3805 (50 [9·7%] of 517 in Latin America, 31 [16·1%] of 193 in Africa, 277 [18·8%] of 1471 in China, 189 [26·4%] of 716 in Asia [excluding China and India], and 342 [37·5%] of 911 in India).

Interpretation Access to surgery within 72 h of hospital admission was poor, with factors that affected time to surgery varying by region. Data are necessary to understand existing pathways of hip-fracture care to inform the local development of quality-improvement initiatives.

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Research in context

Evidence before this study

We searched Ovid Embase from database inception to March 20, 2024, using the terms "hip fracture" and ("adult" or "aged" or "elderly" or "geriatric") and ("total quality management" or "gap analysis") and "time to surgery" without language restrictions, which yielded 33 results. Due to ageing populations in low-income and middle-income countries (LMICs), the management of patients with hip fracture from ground-level falls has been recognised as a research priority. However, studies specific to hip fracture sustained by older people in LMICs are sparse. One review identified only three hip-fracture registries, with variation evident in the collected data. One single-country study reported a time to surgery from hospital admission of at least 5·0 days (IQR 2·5–13·6). In examining associated literature already known to the authors, a further three observational studies were identified that showed improved patient outcomes resulting from reduced time to surgery after implementation of orthogeriatric care.

Added value of this study

To our knowledge, our study is the first analysis exploring time to surgery after hip fracture from low-income and middle-income countries in Africa, Asia, and Latin America via systematically collected data from a large observational study to document patient pathways from injury to surgery. We differentiated total time to surgery by using two distinct start points (ie, injury and hospital admission) and, by doing so, have highlighted that delays from injury to hospital admission and from admission to surgery were both potential contributors to surgical delay after hip fracture. Addressing the causes of delayed admission to hospital and delayed surgery will require different solutions, depending on the reason for delay.

Implications of all the available evidence

Our analysis showed that the causes of delayed surgery for patients with isolated, primary hip fractures sustained from ground-level falls varied across low-income and middle-income regions and, therefore, locally developed and targeted solutions are required in these regions. Although hip-fracture registries are uncommon, data collection of locally agreed variables is required for the identification and prioritisation of quality-improvement initiatives. We recommend that local stakeholders collaborate to customise existing hip-fracture registry datasets for local contexts by including variables to measure prehospital delay and pre-operative delay. We also encourage clinicians to address the causes of prehospital delays that they might be able to influence, for example by participating in the development of locally applicable transfer protocols.

Introduction

Globally, fall-related injuries are a substantial problem, with more than 600 000 fatal falls annually.[1] 80% of these fatal falls occur in low-income and middle-income countries (LMICs).[1] These countries, classified by the World Bank via gross national income per capita,[2] contain 75% of the global population, and are predicted to have an increasing burden of fall-related fracture as a consequence of population growth and ageing.[3] Of all fall-related fractures, a fracture of the proximal femur (ie, a hip fracture) has the greatest effect on patients and health-care systems as it diminishes mobility, functional independence, and quality of life[4] and almost always requires early surgical treatment to provide the best opportunity for recovery, survival, and avoidance of complications.[5,6]

Health-care system approaches to improving the quality of hip-fracture care in high-income countries (HICs) are consistent and use evidence-based guidelines to inform quality standards and their associated indicators. Audits and feedback are used to assess the provision of health care by hospitals and clinicians against existing quality standards and their indicators.[7] Quality standards address various aspects of clinical care including diagnosis, antibiotic use, thromboprophylaxis, surgical decision making, postoperative recovery, and re-fracture prevention[8] and guide data collection as a mechanism for consistent measurement of the care pathway to identify opportunities for improvement of clinical care. Data collection and reporting of the current provision of care are necessary to evaluate the quality of care worldwide.[9,10]

Multidisciplinary care, including co-management by both surgeons and physicians, early surgery, and early mobilisation, are quality indicators that have been used in countries seeking to improve the quality of hip-fracture care.[11] However, the most commonly used indicator to assess hip-fracture care worldwide is time to surgery within a specified time, typically 24 h, 36 h, or 48 h.[11] In LMICs, these targets might be unrealistic. Dela and colleagues[12] found that the median time from hospital admission to surgery was 88 h (IQR 40–174) for older patients admitted to hospitals with low-trauma hip fracture in three regions of South Africa, and Tabu and colleagues[13] showed a range in median time from hospital admission to surgery of 60–192 h in patients with hip fractures in five countries in Asia. Environmental factors, such as injury location, type of hospital, and day or time of hospital admission, have been found to predict time to surgery,[12] although whether these factors are similar in different regions is unknown, suggesting a need to further explore hip-fracture care pathways in LMICs.[14,15]

We aimed to conduct a secondary analysis of time to hip-fracture surgery from both injury and hospital admission in people aged 50 years or older with an isolated, primary hip fracture sustained from a ground-level fall living in LMICs using a subset of data from the International Orthopaedic Multicentre Study in Fracture Care (INORMUS).[16,17] We also aimed to measure the proportion of patients with surgical treatment of hip fractures within 72 h of admission to hospital and to identify risk factors associated with surgical delay (ie, surgery >72 h after admission).

Methods

Study design

INORMUS is a prospective, observational cohort study of adults with musculoskeletal trauma in Africa, Asia, and Latin America.[16] The aims of INORMUS are to measure the incidence of major complications from musculoskeletal injuries within 30 days of admission to hospital and to establish the patient, system, and treatment factors associated with complications after hospital admission.

For this secondary analysis, we used data collected for INORMUS between March 29, 2014, and June 15, 2022. We grouped patient data into the regions of Africa, Latin America, China, India, and Asia (excluding China and India) for reporting.

This analysis was reviewed and approved by the Hamilton Integrated Research Ethics Board. The INORMUS protocol was approved by the McMaster University Research Ethics Board and the research ethics committee of each participating hospital; the methods have been published previously (NCT02150980).[17,18]

Patients

INORMUS inclusion criteria were patients aged 18 years or older who were admitted to a recruiting hospital for treatment of an orthopaedic injury (ie, fracture or dislocation) of the spine or appendicular skeleton (ie, upper and lower extremities, shoulder girdle, or pelvic girdle) that occurred within 3 months of admission. INORMUS exclusion criteria were patients unwilling to comply with the follow-up schedule or who did not consent to participation.

For this secondary analysis, patients from INORMUS were included if they were aged 50 years or older and had an isolated, primary hip fracture sustained from a ground-level fall. Hip fractures included fractures of the femoral head or neck, intertrochanteric fractures, or subtrochanteric fractures within a 5 cm subtrochanteric zone. A ground-level fall was defined as a fall from standing or where the person's feet were estimated to be 1 m or less from the ground.

All patients provided written informed consent to be included in INORMUS. The consent form for INORMUS included all analyses exploring quality of fracture care.

Procedures

Staff at participating hospitals identified patients with musculoskeletal injury and referred them to research personnel for assessment of eligibility and consent and for collection of data on sociodemographic factors, injury characteristics, details of hospital admission, and injury treatment. Sex data were self-reported via the two options of male or female. Data were initially recorded on a paper case-report form before entry into an electronic database. These two tasks could be done by different staff.

Date and time of injury were self-reported by patients at the time of study recruitment and were used to calculate time from injury to hospital admission and total time from injury to surgery, in days. If time to hospital admission after injury exceeded 24 h, patients selected the primary reason for delayed admission from nine predetermined options and one option that simply read "Other". Reasons for surgery, no surgery, and surgical delay, including any medical conditions of the patient at admission, were reported by the treating team on the basis of patient assessment. These reasons were also selected from predetermined options. For potentially sensitive questions, such as income, patients were also given the option to state that they preferred not to disclose.

Assessing the outcomes of definitive treatment was beyond the scope of this analysis. A 30-day follow-up was done in the clinic, if possible, to reduce potential source bias.

Statistical analysis

We analysed data describing hip-fracture management from injury to surgery. By region, we summarised sociodemographic characteristics of patients as frequencies and percentages (ie, self-reported age, sex, education, location of residence, occupation, income, health insurance, and comorbidities), as well as injury variables (ie, height of fall, place of injury, date, and time), prehospital management variables (ie, mode of transport to hospital, pre-admission treatment, and reasons for hospital admission delay), and variables relevant to definitive fracture treatment after admission (ie, date, time, and type of treatment, and antibiotic use). We used a relative classification of income within regions from quartiles of the ordinal income data recorded. Patients who were missing data for a variable were removed from any analyses of that variable via listwise deletion.

For patients who received surgery, we used Kaplan–Meier estimates of time from injury to hospital admission and time from hospital admission to surgery to visualise the distribution of these variables, stratified by region. For patients undergoing surgery, multivariable regression analyses of a generalised linear model with log-link function and Poisson distribution with robust errors[19] were used to identify risk factors for surgical delay as a binomial outcome with a fixed-time threshold of 72 h after hospital admission. We estimated relative risk (95% CI) for individual risk factors, then adjusted for age group and sex by including them in the regression model. SAS version 9.4 and R version 4.22 were used for analyses.

No sensitivity or post-hoc analyses were done.

Role of the funding source

The funders of INORMUS had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Between March 29, 2014, and June 15, 2022, 4486 adults aged 50 years or older with an isolated, primary hip fracture from a fall of less than 1 m (n=563) or from

	Africa (n=418)	Asia (excluding China and India; n=771)	China (n=1680)	India (n=1059)	Latin America (n=558)	All (n=4486)
Sex						
Female	235 (56·2%)	552 (71·6%)	1139 (67·8%)	612 (57·8%)	453 (81·2%)	2991 (66·7%)
Male	183 (43·8%)	219 (28·4%)	541 (32·2%)	447 (42·2%)	105 (18·8%)	1495 (33·3%)
Age, years*	71·7 (11·52)	75·0 (10·31)	75·9 (10·08)	71·2 (10·44)	81·0 (9·58)	74·9 (10·72)
Age group, years*						
50–59	69 (16·5%)	66 (8·6%)	135 (8·0%)	136 (12·8%)	14 (2·5%)	420 (9·4%)
60–69	123 (29·4%)	149 (19·3%)	292 (17·4%)	312 (29·5%)	57 (10·2%)	933 (20·8%)
70–79	107 (25·6%)	261 (33·9%)	508 (30·2%)	349 (33·0%)	152 (27·2%)	1377 (30·7%)
80–89	87 (20·8%)	239 (31·0%)	654 (38·9%)	209 (19·7%)	222 (39·8%)	1411 (31·5%)
≥90	32 (7·7%)	55 (7·1%)	91 (5·4%)	53 (5·0%)	113 (20·3%)	344 (7·7%)
Location of patient residence						
Rural	243 (58·1%)	244 (31·6%)	384 (22·9%)	510 (48·2%)	45 (8·1%)	1426 (31·8%)
Urban	175 (41·9%)	527 (68·4%)	1296 (77·1%)	549 (51·8%)	513 (91·9%)	3060 (68·2%)
Education						
Primary school or less	310 (74·2%)	447 (58·0%)	836 (49·8%)	640 (60·4%)	290 (52·0%)	2523 (56·2%)
Secondary or high school	78 (18·7%)	206 (26·7%)	664 (39·5%)	324 (30·6%)	216 (38·7%)	1488 (33·2%)
More than secondary or high school	30 (7·2%)	118 (15·3%)	180 (10·7%)	95 (9·0%)	52 (9·3%)	475 (10·6%)
Occupation						
Employed (ie, agriculture, self-employed, industry, government, or business)	182 (43·5%)	138 (17·9%)	342 (20·4%)	269 (25·4%)	46 (8·2%)	977 (21·8%)
Homemaker	47 (11·2%)	167 (21·7%)	89 (5·3%)	395 (37·3%)	326 (58·4%)	1024 (22·8%)
Retired	36 (8·6%)	150 (19·5%)	302 (18·0%)	63 (5·9%)	105 (18·8%)	656 (14·6%)
Unemployed	148 (35·4%)	313 (40·6%)	941 (56·0%)	322 (30·4%)	78 (14·0%)	1802 (40·2%)
Other (eg, student)	5 (1·2%)	<5	6 (0·4%)	10 (0·9%)	<5	27 (0·6%)
Household income						
US$2000 or less	121 (28·9%)	193 (25·0%)	279 (16·6%)	566 (53·4%)	123 (22·0%)	1282 (28·6%)
US$2001–50 000	38 (9·1%)	372 (48·2%)	968 (57·6%)	114 (10·8%)	252 (45·2%)	1744 (38·9%)
More than US$50 000	0	31 (4·0%)	36 (2·1%)	<5	7 (1·3%)	77 (1·7%)
Unknown income	259 (62·0%)	175 (22·7%)	397 (23·6%)	376 (35·5%)	176 (31·5%)	1383 (30·8%)
Health insurance						
Private	<5	32 (4·2%)	56 (3·3%)	98 (9·3%)	53 (9·5%)	243 (5·4%)
Government	83 (19·9%)	505 (65·5%)	1467 (87·3%)	124 (11·7%)	440 (78·9%)	2619 (58·4%)
None	331 (79·2%)	234 (30·4%)	157 (9·3%)	837 (79·0%)	65 (11·6%)	1624 (36·2%)
Self-reported comorbid conditions						
None	196 (46·9%)	168 (21·8%)	319 (19·0%)	402 (38·0%)	148 (26·5%)	1233 (27·5%)
One	160 (38·3%)	205 (26·6%)	504 (30·0%)	385 (36·4%)	225 (40·3%)	1479 (33·0%)
Two or more	62 (14·8%)	398 (51·6%)	857 (51·0%)	272 (25·7%)	185 (33·2%)	1774 (39·5%)
Types of self-reported comorbid conditions						
Cardiovascular	131 (31·3%)	459 (59·5%)	1003 (59·7%)	484 (45·7%)	328 (58·8%)	2405 (53·6%)
Diabetes	47 (11·2%)	204 (26·5%)	351 (20·9%)	260 (24·6%)	109 (19·5%)	971 (21·6%)
Osteoporosis	40 (9·6%)	157 (20·4%)	528 (31·4%)	9 (0·8%)	56 (10·0%)	790 (17·6%)
Respiratory	10 (2·4%)	56 (7·3%)	75 (4·5%)	40 (3·8%)	21 (3·8%)	202 (4·5%)
Infectious or parasitic	27 (6·5%)	34 (4·4%)	84 (5·0%)	19 (1·8%)	7 (1·3%)	171 (3·8%)
Anaemia or other blood disease	<5	25 (3·2%)	80 (4·8%)	36 (3·4%)	13 (2·3%)	158 (3·5%)
Other	22 (5·3%)	188 (24·4%)	148 (8·8%)	117 (11·0%)	69 (12·4%)	544 (12·1%)

Data are n (%) or mean (SD). If a result was fewer than five patients, data are reported as <5, for confidentiality. *One patient in Asia (excluding China and India) was missing data for age.

Table 1: **Sociodemographic characteristics of patients with isolated, primary hip fracture, by region**

	Africa	Asia (excluding China and India)	China	India	Latin America	All
Mechanism						
Standing-height fall	345/418 (82·5%)	680/771 (88·2%)	1568/1680 (93·3%)	800/1059 (75·5%)	530/558 (95·0%)	3923/4486 (87·4%)
Feet less than 1 m from the ground	73/418 (17·5%)	91/771 (11·8%)	112/1680 (6·7%)	259/1059 (24·5%)	28/558 (5·0%)	563/4486 (12·6%)
Place of injury						
Home	334/418 (79·9%)	712/771 (92·3%)	1202/1680 (71·5%)	960/1059 (90·7%)	511/558 (91·6%)	3719/4486 (82·9%)
Road or street	58/418 (13·9%)	37/771 (4·8%)	378/1680 (22·5%)	66/1059 (6·2%)	41/558 (7·3%)	580/4486 (12·9%)
Industrial site	8/418 (1·9%)	<5/771	15/1680 (0·9%)	11/1059 (1·0%)	<5/558	39/4486 (0·9%)
Farm	15/418 (3·6%)	<5/771	8/1680 (0·5%)	9/1059 (0·8%)	<5/558	37/4486 (0·8%)
Recreation area	<5/418	9/771 (1·2%)	47/1680 (2·8%)	5/1059 (0·5%)	<5/558	64/4486 (1·4%)
Other	<5/418	5/771 (0·6%)	30/1680 (1·8%)	8/1059 (0·8%)	<5/558	47/4486 (1·0%)
Transport to hospital by*						
Ambulance	76/418 (18·2%)	371/771 (48·1%)	729/1680 (43·4%)	197/1059 (18·6%)	327/558 (58·6%)	1700/4486 (37·9%)
Private vehicle	175/418 (41·9%)	339/771 (44·0%)	868/1680 (51·7%)	825/1059 (77·9%)	226/558 (40·5%)	2433/4486 (54·2%)
On foot	0	<5/771	<5/1680	0	0	<5/4486
Air transport	0	<5/771	0	<5/1059	0	<5/4486
Other (eg, public transport, motorcycle, or rickshaw)	166/418 (39·7%)	53/771 (6·9%)	82/1680 (4·9%)	35/1059 (3·3%)	5/558 (0·9%)	341/4486 (7·6%)
Admitted to hospital from†						
Accident or injury site	86/418 (20·6%)	90/771 (11·7%)	440/1680 (26·2%)	178/1059 (16·8%)	83/558 (14·9%)	877/4486 (19·5%)
Local medical doctor	5/418 (1·2%)	15/771 (1·9%)	18/1680 (1·1%)	30/1059 (2·8%)	11/558 (2·0%)	79/4486 (1·8%)
Home	158/418 (37·8%)	408/771 (52·9%)	901/1680 (53·6%)	613/1059 (57·9%)	377/558 (67·6%)	2457/4486 (54·8%)
Other hospital	156/418 (37·3%)	255/771 (33·1%)	320/1680 (19·0%)	197/1059 (18·6%)	83/558 (14·9%)	1011/4486 (22·5%)
Nursing home	<5/418	0	<5/1680	9/1059 (0·8%)	<5/558	13/4486 (0·3%)
Other	12/418 (2·9%)	<5/771	0	32/1059 (3·0%)	<5/558	48/4486 (1·1%)
Location of treatment before hospital admission						
No treatment provided	298/418 (71·3%)	434/771 (56·3%)	1484/1680 (88·3%)	813/1059 (76·8%)	479/558 (85·8%)	3508/4486 (78·2%)
Treatment at another hospital	96/418 (23·0%)	233/771 (30·2%)	179/1680 (10·7%)	208/1059 (19·6%)	72/558 (12·9%)	788/4486 (17·6%)
Treatment elsewhere (eg, traditional healer or non-hospital)	25/418 (6·0%)	105/771 (13·6%)	17/1680 (1·0%)	40/1059 (3·8%)	7/558 (1·3%)	194/4486 (4·3%)
Surgical treatment after admission‡						
Surgery received	193/418 (46·2%)	716/771 (92·9%)	1471/1680 (87·6%)	911/1059 (86·0%)	514/558 (92·1%)	3805/4486 (84·8%)
Surgery not required	184/418 (44·0%)	30/771 (3·9%)	39/1680 (2·3%)	96/1059 (9·1%)	21/558 (3·8%)	370/4486 (8·2%)
Surgery not received	39/418 (9·3%)	25/771 (3·2%)	170/1680 (10·1%)	52/1059 (4·9%)	23/558 (4·1%)	309/4486 (6·9%)
Reason surgery not received						
Patient fear	0	<5/25	35/170 (20·6%)	11/52 (21·2%)	0	50/309 (16·2%)
Patient could not afford surgery	6/39 (15·4%)	7/25 (28·0%)	11/170 (6·5%)	5/52 (9·6%)	<5/23	31/309 (10·0%)
Lack of hospital resources	11/39 (28·2%)	<5/25	<5/170	<5/52	5/23 (21·7%)	21/309 (6·8%)
Implant availability	0	0	0	0	<5/23	<5/309
Lack of technical expertise	<5/39	0	<5/170	0	0	<5/309
Patient condition§	19/39 (48·7%)	11/25 (44·0%)	83/170 (48·8%)	20/52 (38·5%)	12/23 (52·2%)	145/309 (46·9%)
Patient or family refused	0	0	10/170 (5·9%)	11/52 (21·2%)	<5/23	23/309 (7·4%)
Treated elsewhere or transferred	<5/39	0	8/170 (4·7%)	<5/52	<5/23	11/309 (3·6%)
Unknown	<5/39	<5/25	20/170 (11·8%)	<5/52	0	25/309 (8·1%)
Internal-fixation method of patients who received surgery¶						
Arthroplasty	52/193 (26·9%)	338/716 (47·2%)	673/1471 (45·8%)	278/910 (30·5%)	182/514 (35·4%)	1523/3804 (40·0%)
Plate and screws	39/193 (20·2%)	221/716 (30·9%)	37/1471 (2·5%)	159/910 (17·5%)	138/514 (26·8%)	594/3804 (15·6%)
Screws only	26/193 (13·5%)	29/716 (4·1%)	134/1471 (9·1%)	37/910 (4·1%)	9/514 (1·8%)	235/3804 (6·2%)
Intramedullary nail	69/193 (35·8%)	123/716 (17·2%)	627/1471 (42·6%)	374/910 (41·1%)	161/514 (31·3%)	1354/3804 (35·6%)
Other (eg, amputation, wires, cerclage, or fusion)	12/193 (6·2%)	17/716 (2·4%)	32/1471 (2·2%)	82/910 (9·0%)	27/514 (5·3%)	170/3804 (4·5%)

(Table 2 continues on next page)

	Africa	Asia (excluding China and India)	China	India	Latin America	All
(Continued from previous page)						
Location of first antibiotic dose for patients who received surgery						
Injury scene	0	<5/716	0	0	0	<5/3805
Emergency room or initial hospitalisation	11/193 (5·7%)	58/716 (8·1%)	218/1471 (14·8%)	252/911 (27·7%)	28/514 (5·4%)	567/3805 (14·9%)
Before surgery	95/193 (49·2%)	541/716 (75·6%)	996/1471 (67·7%)	476/911 (52·3%)	446/514 (86·8%)	2554/3805 (67·1%)
Operative	11/193 (5·7%)	6/716 (0·8%)	91/1471 (6·2%)	<5/911	13/514 (2·5%)	124/3805 (3·3%)
Postoperative	0	64/716 (8·9%)	17/1471 (1·2%)	17/911 (1·9%)	<5/514	99/3805 (2·6%)
Not recorded	76/193 (39·4%)	45/716 (6·3%)	149/1471 (10·1%)	163/911 (17·9%)	26/514 (5·1%)	459/3805 (12·1%)

Data are n/N (%). If a result was fewer than five patients, data are reported as <5, for confidentiality. *Four patients in Asia (excluding China and India), one in Africa, and one in India were missing data for transport to hospital. †One participant in Asia (excluding China and India) was missing data for admitted to hospital from. ‡Two participants in Africa were missing operative treatment data. §Treating team decided that the patient was medically unfit for surgery. ¶More than one type of treatment could be reported, so the total number of people reporting individual treatments was greater than the denominator of people who received surgery. One patient from India who received surgery was missing data on internal-fixation method.

Table 2: **Characteristics of injury and injury management of patients with isolated, primary hip fracture, by region**

	Africa	Asia (excluding China and India)	China	India	Latin America	All
Time from injury to hospital admission*						
<24 h	248/418 (59·3%)	398/771 (51·6%)	1161/1680 (69·1%)	599/1059 (56·6%)	385/558 (69·0%)	2791/4486 (62·2%)
24 h to <72 h	66/418 (15·8%)	118/771 (15·3%)	248/1680 (14·8%)	176/1059 (16·6%)	67/558 (12·0%)	675/4486 (15·0%)
≥72 h	104/418 (24·9%)	255/771 (33·1%)	270/1680 (16·1%)	284/1059 (26·8%)	106/558 (19·0%)	1019/4486 (22·7%)
Reason for admission delay >24 h†						
Delay in the emergency department	0	8/327 (2·4%)	<5/424	13/420 (3·1%)	9/133 (6·8%)	31/1441 (2·2%)
Initially treated by a traditional healer	16/137 (11·7%)	17/327 (5·2%)	8/424 (1·9%)	34/420 (8·1%)	8/133 (6·0%)	83/1441 (5·8%)
Distance to hospital	<5/137	7/327 (2·1%)	<5/424	21/420 (5·0%)	6/133 (4·5%)	37/1441 (2·6%)
Thought the injury would heal on its own	26/137 (19·0%)	105/327 (32·1%)	210/424 (49·5%)	108/420 (25·7%)	31/133 (23·3%)	480/1441 (33·3%)
Did not want to come to hospital	12/137 (8·8%)	24/327 (7·3%)	41/424 (9·7%)	38/420 (9·0%)	13/133 (9·8%)	128/1441 (8·9%)
Could not organise transportation	7/137 (5·1%)	13/327 (4·0%)	<5/424	12/420 (2·9%)	5/133 (3·8%)	38/1441 (2·6%)
Concern about cost	7/137 (5·1%)	10/327 (3·1%)	0	64/420 (15·2%)	26/133 (19·5%)	107/1441 (7·4%)
Transfer from other hospital	67/137 (48·9%)	138/327 (42·2%)	158/424 (37·3%)	125/420 (29·8%)	34/133 (25·6%)	522/1441 (36·2%)
Fear of hospitals	<5/137	5/327 (1·5%)	<5/424	5/420 (1·2%)	<5/133	15/1441 (1·0%)
Time from hospital admission to surgery						
Surgery completed in <48 h	34/193 (17·6%)	257/716 (35·9%)	212/1471 (14·4%)	376/911 (41·3%)	55/514 (10·7%)	934/3805 (24·5%)
Surgery completed in 48 h to <72 h	19/193 (9·8%)	61/716 (8·5%)	242/1471 (16·5%)	158/911 (17·3%)	37/514 (7·2%)	517/3805 (13·6%)
Surgery completed in ≥72 h	140/193 (72·5%)	398/716 (55·6%)	1016/1471 (69·1%)	377/911 (41·4%)	422/514 (82·1%)	2353/3805 (61·8%)
Time from injury to surgery						
Surgery completed in <48 h	18/193 (9·3%)	124/716 (17·3%)	102/1471 (6·9%)	211/911 (23·2%)	19/514 (3·7%)	474/3805 (12·5%)
Surgery completed in 48 h to <72 h	13/193 (6·7%)	65/716 (9·1%)	175/1471 (11·9%)	131/911 (14·4%)	31/514 (6·0%)	415/3805 (10·9%)
Surgery completed in ≥72 h	162/193 (83·9%)	527/716 (73·6%)	1192/1471 (81·0%)	569/911 (62·5%)	464/514 (90·3%)	2914/3805 (76·6%)
Reason for delayed surgery†						
Patient was a family caregiver	0	0	0	7/156 (4·5%)	0	7/636 (1·1%)
Patient fear	0	13/206 (6·3%)	<5/7	<5/156	<5/197	20/636 (3·1%)
Could not afford surgery	15/70 (21·4%)	23/206 (11·2%)	0	49/156 (31·4%)	25/197 (12·7%)	112/636 (17·6%)
Patient condition‡	<5/70	82/206 (39·8%)	<5/7	77/156 (49·4%)	25/197 (12·7%)	190/636 (29·9%)
Lack of hospital resources	22/70 (31·4%)	36/206 (17·5%)	0	<5/156	31/197 (15·7%)	91/636 (14·3%)
Implant availability	6/70 (8·6%)	<5/206	0	<5/156	114/197 (57·9%)	123/636 (19·3%)
Lack of technical expertise	0	<5/206	0	<5/156	0	<5/636
Unknown or other	23/70 (32·9%)	50/206 (24·3%)	<5/7	15/156 (9·6%)	<5/197	91/636 (14·3%)

Data are n/N (%). If a result was fewer than five patients, data are reported as <5, for confidentiality. *One patient in China was missing data for time from injury to hospital admission. †Reasons for delay were provided at the discretion of the treating team. The denominator does not reflect the number of patients who were delayed in hospital admission for >24 h or who received surgery >72 h after hospital admission. ‡Treating team decided that the patient was medically unfit for surgery.

Table 3: **Time to operative treatment and reasons for delay, by region**

standing height (n=3923) were enrolled in INORMUS from 55 hospitals in 24 countries (appendix p 4). For reporting purposes, countries were grouped into the three regions of Africa (418 [9·3%] of 4486), Asia (3510 [78·2%]), and Latin America (558 [12·4%]). For this analysis, Asia was divided into China (1680 [37·4%] of 4486), India (1059 [23·6%]) and Asia (excluding China and India; 771 [17·2%]). Of the 4486 patients included in the analyses, 2991 (66·7%) were female and 1495 (33·3%) were male (table 1). The mean age of female patients was 75·7 years (SD 10·43) and 244 (8·2%) of 2991 were aged 90 years or older. The mean age of male patients was 73·3 years (11·10) and 100 (6·7%) of 1495 were aged 90 years or older. Primary reported occupations were unemployed (1197 [40·0%] of 2991 female patients and 605 [40·5%] of 1495 male patients), homemakers (974 [32·6%] female patients and 50 [3·3%] male patients), employed (445 [14·9%] female patients and 532 [35·6%] male patients), and retired from work (365 [12·2%] female patients and 291 [19·5%] male patients). 1003 (33·5%) of 2991 female patients and 621 (41·5%) of 1495 male patients reported having no health insurance, and 2239 (74·9%) female patients and 1014 (67·8%) male patients reported at least one comorbid condition, of which cardiovascular conditions and diabetes were the most common (table 1).

Home was the most common place of injury, and more than half of all patients were transported to hospital in a private vehicle (table 2). A third of patients in Africa and Asia (excluding China and India) were transferred from another hospital but, overall, home was the most common place from which patients were admitted to hospital. In Asia (excluding China and India), 338 (43·8%) patients received treatment before hospital admission. However, most patients did not receive treatment before admission to hospital (table 2).

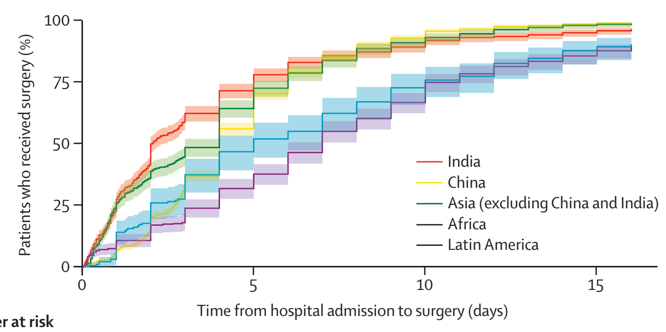
Of 4486 patients, 3805 (84·8%) received surgery. The rate of surgery was similar in all regions except in Africa, where only 193 (46·2%) of 418 patients had surgery (table 2). When surgery was recommended, 309 (6·9%) of 4486 patients did not receive surgery, with the primary reason being patient condition. For patients who received surgery, arthroplasty and intramedullary nailing were the most common methods of treatment (table 2).

We report time from injury to surgery as three distinct time periods (ie, time from injury to hospital admission, time from admission to surgery, and a total time from injury to surgery; table 3). Overall, almost two-thirds of patients were admitted to hospital within 24 h of injury. However, 1019 (22·7%) of 4486 patients had delayed hospital admission of 72 h or more from injury. The two most common reasons for delayed admission of more than 24 h were transfer from another hospital and delayed care-seeking because patients thought the injury would heal on its own (table 3). Once admitted to hospital, 1451 (38·1%) of 3805 patients who received surgery did so within 72 h (median 4·0 days [IQR 1·7–6·0]). Regional variation was seen in the proportion of patients receiving surgery within 72 h of hospital admission (92 [17·9%] of 514 in Latin America, 53 [27·5%] of 193 in Africa, 454 [30·9%] of 1471 in China, 318 [44·4%] of 716 in Asia [excluding China and India], and 534 [58·6%] of 911 in India; figure). Of all 3805 patients who received operative treatment, 2353 (61·8%) waited 72 h or more from hospital admission (table 3). From time of injury, the proportion of patients who were surgically stabilised within 72 h was 889 (23·4%) of 3805 (50 [9·7%] of 517 in Latin America, 31 [16·1%] of 193 in Africa, 277 [18·8%] of 1471 in China, 189 [26·4%] of 716 in Asia [excluding China and India], and 342 [37·5%] of 911 in India).

Private health insurance was a risk factor for delayed surgery in Africa and government health insurance was a risk factor for delayed surgery in Asia (excluding China and India) and Latin America (table 4). Patients in Asia (excluding China and India) and India who reported being self-employed and who reported any income above the first quartile had a reduced risk of delayed operative treatment (table 4). Receiving treatment before admission to the operating hospital reduced the risk of surgical delay for patients in Asia (excluding China and India) and Latin America (appendix pp 5–7).

Discussion

In this secondary analysis of data from INORMUS, most patients received surgical treatment for an isolated, primary hip fracture sustained from a ground-level fall. However, most patients had delayed surgical treatment, as only 38% of patients received surgery within 72 h of hospital admission and 23% received surgery within 72 h of injury. Regional variation in access to surgery was evident. Risk factors for surgical delay of 72 h or more after hospital admission also varied by region, suggesting nuanced initiatives are needed to address local factors influencing timely hip-fracture surgery.



Number at risk				
India	911	261	100	47
China	1470	648	108	27
Asia (excluding China and India)	716	257	66	16
Africa	193	103	53	24
Latin America	514	351	172	75

***Figure:* Time from admission to operative treatment for patients who had surgery for hip fracture, by region**
Shading represents 95% CIs. Data are until day 16.

	Africa (n=193)	Asia (excluding China and India; n=716)	China (n=1471)	India (n=911)	Latin America (n=514)	All (n=3805)
Age group, years						
50–59	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
60–69	1·16 (0·86–1·57)	1·05 (0·79–1·40)	1·13 (0·95–1·33)	1·28 (0·97–1·68)	1·31 (0·82–2·09)	1·17 (1·04–1·32)
70–79	1·19 (0·88–1·61)	1·07 (0·82–1·39)	1·20 (1·02–1·40)	1·16 (0·88–1·52)	1·31 (0·83–2·07)	1·22 (1·09–1·36)
80–89	1·01 (0·73–1·40)	1·07 (0·82–1·40)	1·23 (1·06–1·44)	1·11 (0·82–1·49)	1·23 (0·78–1·95)	1·29 (1·15–1·44)
≥90	1·33 (0·90–1·98)	0·85 (0·56–1·27)	1·21 (0·98–1·49)	0·72 (0·42–1·24)	1·27 (0·80–2·01)	1·25 (1·09–1·43)
Sex						
Male	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Female	0·91 (0·76–1·08)	1·09 (0·94–1·28)	0·97 (0·90–1·04)	1·04 (0·89–1·21)	1·06 (0·94–1·19)	1·06 (1·00–1·12)
Education						
Primary school or less	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Secondary or high school	0·76 (0·58–1·00)	1·23 (1·07–1·42)	1·02 (0·95–1·10)	0·85 (0·71–1·02)	0·94 (0·86–1·03)	1·04 (0·98–1·09)
More than secondary or high school	0·82 (0·59–1·14)	0·82 (0·65–1·03)	1·07 (0·96–1·20)	0·78 (0·57–1·06)	0·98 (0·85–1·12)	0·96 (0·88–1·05)
Occupation						
Retired or unemployed	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Agriculture	0·95 (0·77–1·17)	1·09 (0·86–1·38)	0·97 (0·86–1·09)	1·20 (0·96–1·49)	0·91 (0·63–1·32)	0·99 (0·91–1·08)
Self-employed	0·88 (0·62–1·25)	0·57 (0·38–0·84)	0·90 (0·71–1·15)	0·65 (0·44–0·94)	1·05 (0·86–1·28)	0·74 (0·64–0·86)
Homemaker	0·94 (0·71–1·26)	0·69 (0·57–0·84)	0·75 (0·60–0·93)	0·97 (0·79–1·18)	1·04 (0·94–1·16)	0·87 (0·82–0·93)
Other	0·72 (0·45–1·15)	0·96 (0·71–1·30)	1·04 (0·90–1·20)	1·40 (0·93–2·11)	0·80 (0·51–1·25)	1·06 (0·94–1·19)
Income quartile in region						
First	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Second	0·88 (0·63–1·22)	0·45 (0·34–0·59)	0·87 (0·78–0·98)	0·69 (0·51–0·94)	0·94 (0·80–1·11)	0·77 (0·70–0·84)
Third	0·93 (0·61–1·40)	0·71 (0·63–0·80)	0·92 (0·84–1·00)	0·70 (0·57–0·85)	0·98 (0·87–1·10)	0·85 (0·80–0·90)
Fourth	0·64 (0·37–1·13)	0·14 (0·09–0·21)	0·82 (0·67–1·01)	0·62 (0·46–0·82)	0·92 (0·79–1·08)	0·49 (0·43–0·56)
Unknown	0·82 (0·69–0·98)	0·74 (0·65–0·84)	0·79 (0·71–0·89)	0·61 (0·50–0·75)	0·92 (0·81–1·04)	0·76 (0·71–0·81)
Location of patient residence						
Urban	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Rural	0·90 (0·75–1·07)	0·87 (0·75–1·01)	0·92 (0·84–1·01)	1·07 (0·92–1·25)	1·11 (1·00–1·24)	0·86 (0·81–0·92)
Health insurance						
None	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Private	1·29 (1·08–1·53)	1·08 (0·54–2·16)	1·07 (0·85–1·34)	0·90 (0·68–1·19)	0·97 (0·63–1·48)	1·02 (0·86–1·19)
Government	1·14 (0·93–1·38)	3·34 (2·60–4·29)	1·04 (0·91–1·18)	1·16 (0·94–1·44)	2·02 (1·52–2·68)	1·66 (1·55–1·77)

(Table 4 continues on next page)

We explored time to surgery from injury and from hospital admission using a fixed-time threshold of 72 h as this threshold has been used as an achievable target for time to surgery in Thailand[20] and targets should be perceived as challenging but achievable.[21] Due to the low proportion of patients receiving surgery within 72 h of hospital admission, existing quality indicators specifying low targets for time to surgery (eg, 24 h, 36 h, or 48 h) might not currently be applicable to LMICs as these targets might not balance the motivation provided by a difficult target with the realistic ability to achieve that target. Not attaining a poorly set time-to-surgery target might discourage clinicians and organisational providers from attempting to address any cause of delay.[21] Specific to hip-fracture quality indicators, time-to-surgery indicators have been changed over time in HICs, which could be a feasible approach in LMICs.[22] Although we used 72 h as a threshold in recognition of potential health-care system capabilities in LMICs, surgery within 48 h of hospital admission has been shown to reduce the risk of mortality[23] and can reduce fracture pain, length of hospital stay, and avoidable complications.[24] Surgery within 6 h of hospital admission can further reduce complications and length of hospital stay,[6] but this threshold has not been implemented as a standard in any country, which might suggest that it is not realistically sustainable. To inform the development of clinically relevant targets for providers of surgical hip-fracture treatment in LMICs, we encourage them to continuously collect and use data for review of clinical care.[25]

We chose to use time to surgery as it is the most commonly used quality indicator evaluating hip-fracture care.[11] Reduced time to surgery might reflect the general organisation of care and availability of other variables that have major influences on outcomes, such as trauma transport and geriatric medicine services. We found that,

	Africa (n=193)	Asia (excluding China and India; n=716)	China (n=1471)	India (n=911)	Latin America (n=514)	All (n=3805)
(Continued from previous page)						
Self-reported comorbid conditions						
None	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
One	1·12 (0·93–1·36)	0·85 (0·75–0·97)	1·09 (0·97–1·23)	1·22 (1·02–1·46)	0·88 (0·80–0·97)	1·05 (0·98–1·12)
Two or more	0·98 (0·75–1·29)	0·48 (0·42–0·56)	1·28 (1·15–1·42)	1·16 (0·94–1·43)	0·97 (0·89–1·06)	1·04 (0·98–1·11)
Height of fall						
Standing-height fall	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Feet less than 1 m from the ground	0·84 (0·64–1·10)	0·88 (0·70–1·11)	1·00 (0·87–1·16)	1·20 (1·01–1·41)	1·06 (0·89–1·27)	0·88 (0·81–0·97)
Place of injury						
Home	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Road or street	0·94 (0·73–1·21)	1·26 (1·00–1·58)	0·84 (0·76–0·93)	1·05 (0·77–1·42)	1·14 (1·03–1·25)	1·02 (0·95–1·10)
Other	0·94 (0·64–1·37)	1·05 (0·73–1·53)	0·97 (0·84–1·12)	0·82 (0·48–1·42)	1·22 (1·14–1·31)	1·06 (0·94–1·20)
Admitted to hospital from						
Home	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Accident or injury site	0·95 (0·72–1·24)	1·46 (1·24–1·72)	0·95 (0·88–1·03)	0·66 (0·52–0·85)	1·07 (0·96–1·19)	1·00 (0·94–1·07)
Other hospital	1·00 (0·82–1·23)	1·13 (0·97–1·30)	0·88 (0·79–0·97)	0·90 (0·73–1·10)	1·18 (1·10–1·28)	0·99 (0·93–1·05)
Other	0·86 (0·57–1·30)	0·57 (0·27–1·20)	0·83 (0·55–1·24)	0·65 (0·41–1·02)	0·94 (0·67–1·31)	0·73 (0·58–0·90)
Transported to hospital by						
Ambulance	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Private vehicle	1·06 (0·84–1·33)	0·77 (0·67–0·90)	1·02 (0·95–1·09)	1·48 (1·15–1·89)	0·97 (0·89–1·06)	0·91 (0·86–0·96)
Other (eg, public transport, motorcycle, or rickshaw)	0·93 (0·72–1·20)	1·40 (1·21–1·63)	1·02 (0·86–1·21)	2·30 (1·61–3·27)	0·80 (0·36–1·78)	1·13 (1·03–1·24)
Previous treatment						
No	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Yes	1·13 (0·95–1·34)	0·85 (0·74–0·98)	0·89 (0·79–1·01)	1·09 (0·91–1·30)	0·76 (0·64–0·90)	0·88 (0·82–0·94)
Admission delayed by >24 h						
No	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)	0 (ref)
Yes	1·09 (0·91–1·31)	0·99 (0·87–1·13)	1·03 (0·96–1·11)	1·17 (1·00–1·36)	0·85 (0·77–0·95)	0·98 (0·93–1·03)

Data are relative risk (95% CI). Some categories had no counts or very small counts and so were pooled into the “Other” category.

***Table 4:* Risk factors for operative treatment ≥72 h after hospital admission for patients with isolated, primary hip fracture who received surgery, adjusted for age and sex, by region**

once admitted to hospital, patient condition was a cause of delay in all assessed regions. This finding is a reminder of the importance of both medical and surgical care for patients to prepare them for surgery. A 2023 study found variable medical input and absent specialist geriatric care in the majority of 98 hospitals in Malaysia, Thailand, the Philippines, Sri Lanka, and Nepal.[13] Short-term solutions for increasing geriatric assessment of patients could include routine inclusion of other physician specialists, such as anaesthetists or cardiologists, into the pre-operative management of patients, although these team-based approaches to service delivery might require a review of existing payment models. There could be an opportunity to explore the use of payments associated with achievement of bundled quality measures, including time to surgery, as a pay-for-performance approach has been shown to increase achievement of hip-fracture quality measures.[26]

Regional differences in the proportion of patients receiving operative treatment were small, except for Africa, where less than half of admitted patients were treated operatively. In this region, 44% of patients who did not receive surgery were deemed to not require surgery. However, this finding differs substantially from the other included regions, where no more than 9% of patients were deemed to not require surgery. The reasons for this difference are unclear. Surgery might not have been clinically appropriate for the specific fracture type, although this finding would be unusual in the context of hip fracture in older adults. Non-operative management, other than in the context of a stable fracture, is more likely to result in higher rates of complications, deformity, and mortality at 30 days, 6 months, and 1 year than operative management.[5] Berry and colleagues[27] reported that, compared with non-surgical management, surgical repair of a hip fracture in nursing home residents with advanced dementia was associated with lower mortality over 2 years and less documented pain and fewer pressure ulcers at 6 months after surgery. Alternatively, the low rates of surgery in Africa could reflect complex decision making regarding resource allocation, as the two most common reasons for not receiving surgery in this region were lack of hospital resources and treatment affordability. The low supply of essential utilities (eg, power and water), availability of workforce, and surgical capacity have previously been recognised as barriers to the provision of surgical care in Africa.[28]

Risk factors for surgical delay varied by region. In Asia (excluding China and India) and Latin America, previous treatment decreased the risk of delayed surgery after admission to the operating hospital. In these regions, patients who had previous treatments could have plausibly been prepared for surgery before admission to the operating hospital or might not have been admitted until surgery was confirmed. As hospital transfer was the most common reason for delayed admission overall, the efficiency of existing patient-transfer processes in hospitals in the studied regions could be affected by resource limitations, communication barriers between hospitals, or patient factors (eg, financial constraints).[29] Furthermore, we found that private health insurance in Africa and government health insurance in Asia (excluding China and India) and Latin America were risk factors for surgical delay. Compared to not having insurance, having insurance could result in patients undergoing more tests, thereby delaying surgery. Alternatively, insurance might have been insufficient to cover all the costs of operative treatment and the effects of out-of-pocket costs could have therefore influenced clinician recommendations or patient decisions. In Asia (excluding China and India) and India being self-employed reduced the risk of delayed surgery. These patients could be prioritised for surgery to facilitate the recovery of functional mobility and return to work.

We found variation between regions in the socio-demographic characteristics of patients. The proportion of female patients admitted to hospital with hip fractures was unexpectedly low in Africa and India. Data on hip-fracture incidence in both regions are sparse and we can therefore only speculate on the possible reasons for the lower rate of hospital admission in female patients.[30] For example, different incidences of hip fracture, unidentified admission biases for male patients, or selection biases (eg, more male patients agreeing to participate in INORMUS than female patients). Although sex was not a risk factor for delayed surgery, further exploration of time to surgery and outcomes stratified by sex is an opportunity for future investigations. Overall, 40% of patients reported being unemployed, which could suggest that they were seeking an economic role within their family or community at the time of injury. This finding highlights the importance of timely surgery to ensure that individuals can return to a desired economic role. We suggest that, in LMICs, the evaluation of outcomes after treatment for hip fracture should consider employment status and return to employment as a measure of the success of the treatment provided, as these outcomes could be important in indicating meaningful recovery.

The strengths of this analysis are the use of prospective data, description of sociodemographic characteristics of patients with hip fracture in LMICs, and quantification of timely surgery from both injury and hospital admission. However, there are several limitations. First, we chose to present data by region rather than by individual site or country, which ignores country-specific factors that might influence the provision of hip-fracture care and does not acknowledge within-country variation in the sociodemographic characteristics of patients. Second, the data are observational and only patients admitted to hospital were included in INORMUS. Some people with hip fracture presenting to hospital might not have been admitted, and some people might not have presented to hospital at all. Therefore, our findings overestimate the proportion of people with hip fractures who were treated surgically and, as there was no record of the number of patients who presented to hospital but were not admitted, underestimate non-operative treatments in all regions. Third, participating hospitals might not be representative of their region. All included hospitals had clinical research infrastructure, which could indicate better care than other hospitals in the region, thereby limiting the generalisability of our findings. Fourth, time calculations from injury were based on self-reported injury date and time, which could have been affected by recall errors. However, with such a major injury, individuals or relatives were probably able to accurately recall the timing of the injury event. Fifth, we did not collect data on the number of hospitals to which patients presented before admission to the operating hospital, which limits insight into transfer delay and is an area for further investigation. Finally, data on the combination of fracture type and treatment were not available. Therefore, we were unable to report on the appropriateness of treatment for the specific fracture type, and decisions to treat fractures non-operatively might have been clinically appropriate.

Our analysis has shown that the majority of older people living in LMICs do not receive timely operative treatment for fall-related hip fracture. For this important aspect of hip-fracture care, data collection is essential for the development and implementation of quality improvement initiatives as data can identify gaps between the current situation and what is recommended. Data can then inform contextually appropriate solutions. As a starting point, both clinicians and organisational providers should collect data on time from injury and hospital admission to surgery for every person presenting to hospital, whether they are admitted or not, to objectively assess burden and the provision of current care. These data can then be used to inform local policy and practice and can provide a basis to advocate for additional resources where needed.

Contributors

EA, KR, and RI conceptualised and designed this analysis. EA drafted the manuscript. KR and CSL accessed, verified, and analysed the data. CSL and SS curated the data. All authors contributed to study design and data acquisition, provided feedback on the manuscript, had full access to all the data in the study, and had final responsibility for the decision to submit for publication.

Declaration of interests

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Data sharing

Data pertaining to individual patients will not be made available due to privacy rules. Related documents will not be made available either.

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