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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

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საქართველოს სამედიცინო სიახლენი

**GEORGIAN MEDICAL NEWS**

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**GMN: Georgian Medical News** is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

**GMN: Медицинские новости Грузии -** ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

**GMN: Georgian Medical News –** საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

**WEBSITE**

www.geomednews.com

## К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

**При нарушении указанных правил статьи не рассматриваются**.

## REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.**

## ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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*Содержание:*

# FACTORS AFFECTING MORTALITY IN PATIENTS WITH HIP FRACTURES AND SHAH HIP FRACTURE MORTALITY SCORE: A RISK QUANTIFICATION TOOL

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## Abstract.

**Objective:** Hip fractures are serious injuries of elderly associated with 6.2% mortality in first 30-days and 22% mortality in first year. We aim to identify the key risk factors affecting mortality and to produce a score to predict 30 and 365-day mortality risk in patients with hip fracture.

**Methods:** 689 hip fractures managed at our hospital between 2016 and 2019 were analysed. Mortality at 30 and 365-days was obtained for factors like age, gender, American Society of Anaesthesiologists physical status classification (ASA grade), residence, pre-fracture ambulatory status, Abbreviated Mental Test Score (AMTS), fracture classification, treatment method, time to surgery and anaesthesia used. This data was analysed using univariate and then multivariate regression analysis and a 7-point (5 Factor) score was devised to predict mortality in the first month and first year following hip fracture.

**Results:** 6.7% and 25.3% of the 689 patients died within 30 and 365-days of suffering a hip fracture. Older age, Male sex, ASA Class IV/V, Non-operative management, and housebound/ bedbound status, were all found to be associated with increased mortality at 30 and 365-days post-fracture.

**Conclusions:** This study identified Age, Sex, ambulation, ASA grade and non-operative management as key factors influencing 30 and 365-day mortality. Patients with the non-operative management and ASA grade 4/5 had the worst mortality risk. We devised a scoring system to predicts the 30-day and 365-day mortality which shows an almost linear relationship between the score and mortality rates.

**Key words.** Hip fracture, Mortality rate, score, ASA, Age.

## Introduction.

Hip fractures are considered one of the most serious injuries elderly individuals and are associated with a 6.2% mortality in first 30 days [1] and 22% mortality rate during the first year globally [2]. But the patients belonging to different physiological groups have the different risk of mortality following a hip fracture.

Although literature shows increasing risk of mortality with age in patients with hip fractures, and different papers studying different age groups do show increasing mortality with age, there is still a deficiency of papers studying the mortality associated with various age groups in patients with hip fractures [3-7]. Nottingham Hip Fracture Score (NHFS) is a validated pre-operative risk-prediction tool used to estimate 30-day mortality in patients with hip fractures. But our aim is to re-evaluate all the risk factors, to find out which risk factors are more strongly associated with mortality in hip fractures and try to develop a better risk prediction tool that can not only evaluate 30-day mortality but also 365-day mortality [8].

In this paper we are trying to evaluate statistical evidence to find whether factors like age, sex, American Society of Anesthesiologists physical status classification (ASA grade), place of residence, ambulatory status, dementia, type of anaesthesia, time to surgery, fracture type and surgery type had any impact on mortality. We also aim at producing a scoring system that would help us predict the 30-day mortality and 365-day mortality in patients who suffered hip fractures.

## Materials and Methods.

During a four-year period (1st January 2016 and 31st December 2019) a total of 689 hip fractures were managed by our hospital. This included intertrochanteric (IT), Neck of Femur (NOF) and subtrochanteric (ST) fractures. Patient data was collected retrospectively and 30-day and 365-day mortality was calculated for each of the following factors and their classes: ASA Class, age, sex, place of residence, pre-fracture ambulatory status, Abbreviated Mental Test Score (AMTS), fracture classification, treatment type, time to surgery and anaesthesia used.

30-day and 365-day mortality rates in all these groups and classes were compared with known average values of 6.2% and 22% rates respectively to formulate The Shah Hip Fracture Mortality Score to predict 30 and 365-day mortality following a hip fracture. For each of the factors studied, the classes with mortality rate lower than the average of 6.2% and 22% were put in one group and given 0 points in our score, and those with mortality rate higher than the average were put in the second group and were given 1 or 2 points.

**Statistics:** First univariate analysis of was performed for both groups of each factor for 30 and 365-day mortality. Statistically significant factors were then analysed via multivariate analysis for identification of independent risk factors. We analysed the data using backward stepwise Wald method with Multivariate Binary Logistic Regression analysis.

For 30-day mortality Model Development & Validation, because there were so few events (46 deaths), internal validating was used to keep the statistical power at 100% by using the full cohort as the sample for testing.

For 365-Day Mortality Model Development & Validation, the total cohort of (n=689) was randomly divided into two sets - the Derivation Cohort (70%) which is utilized to develop the model and the independent Validation Cohort (30%) which is utilized to validate the performance of the score.

## Results.

Of the 689 patients included in the study, majority of the patients belonged to age group of 80–89 (47%) and the mean age was 83 years. 68% of patients were female. About 50% of patients younger than 70 were female, but the proportion of females increased with each passing decade: 60% of patients in their 70s, 70% of patients in their 80s and 80% of patients in their 90s were female.

The 30 and 365-day mortality of 6.7% and 25.3% respectively was seen. Thirty-four patients (4.9%) were managed non-operatively. Of these thirteen (38.2%) and twenty-two (64.7%) died within 30 and 365-days respectively. Prior to sustaining the fracture, the majority (85%) lived in their own home. 35% were considered housebound. Pre-operatively 85% of patients had an ASA Class II and III and only 5 patients had an ASA of I. Furthermore, 58% of patients had an AMTS between 8 and 10. For those who underwent operative management, time to surgery was up to 28 hours in 50% of patients. About 50% of patients received a General Anaesthetic (GA +/- spinal) and 50% received spinal block only. Mortality was determined for these factors as is given in Table 1.

We found that Age, Sex, residence type, ambulatory status, AMTS, time to surgery, ASA grade, non-operative management had statistically significant impact on mortality. Anaesthesia type, fracture type or classification and type of surgery had no statistically significant effect on 30 or 365-day mortality rate. Age greater than 80, male sex, nursing/care home residence, house bound/bed bound ambulatory status, AMTS of 0-7 and time to surgery more than 36 hours were all associated with higher than Average (i.e. higher than 6.2/22%) mortality rate. While age less than 80, females, independent residence, community ambulation, AMTS 8-10 and early surgery were associated with less than Average mortality.

With regards to age there was a linear progressive increase in

***Table 1.*** *Factors and their associated 30 and 365-day mortality with univariate analysis.*

| **Factor and Class** | **n** | **30-day mortality** | ***Odds Ratio (95% CI)*** | ***p-value*** | **365-day mortality** | ***Odds Ratio (95% CI)*** | ***p-value*** |
|---|---|---|---|---|---|---|---|
| **Age** | | | | | | | |
| 60-69 | 75 | 1.30% | | | 12% | | |
| 70-79 | 151 | 4.60% | | | 17.20% | | |
| 80-89 | 322 | 8.10% | | | 28.70% | | |
| 90-99 | 135 | 8.90% | | | 37% | | |
| 100-106 | 6 | 0% | | | 50% | | |
| ***Less than 80*** | 226 | 3.5% (8) | *1(Reference)* | - | 15.5% (35) | *1(Reference)* | - |
| ***80 and more*** | 463 | 8.2% (32) | *2.44 (1.12 – 5.31)* | *0.025* | 30.0% (139) | *2.34 (1.55 – 3.53)* | *<0.001* |
| **Sex** | | | | | | | |
| Male | 220 | 9.50% | *1(Reference)* | - | 32.20% | *1 (Reference)* | - |
| Female | 469 | 5.30% | *1.87 (1.03 – 3.43)* | *0.041* | 22.00% | *1.69 (1.18 – 2.42)* | *0.004* |
| **ASA Classification** | | | | | | | |
| 1 | 5 | 0.00% | | | 0.00% | | |
| 2 | 162 | 1.90% | | | 11.10% | | |
| 3 | 417 | 4.80% | | | 24.20% | | |
| 4 | 99 | 19.20% | | | 50.50% | | |
| 5 | 6 | 66.70% | | | 83.30% | | |
| ***1-3*** | 584 | 3.9% (23) | *1 (Reference)* | - | 20.4% (119) | *1 (Reference)* | - |
| ***4-5*** | 105 | 21.1% (23) | *6.84 (3.67 – 12.75)* | *<0.001* | 52.4% (55) | *4.30 (2.79 – 6.63)* | *<0.001* |
| **Management** | | | | | | | |
| Non-Operative | 34 | 38.20% | *1 (Reference)* | - | 64.70% | *1 (Reference)* | - |
| Operative | 655 | 5% | *11.67 (5.37 – 25.33)* | *<0.001* | 23.20% | *6.07 (2.93 – 12.54)* | *<0.001* |
| **Time to Surgery (hrs)** | | | | | | | |
| 0 – 36 | 385 | 3.40% | *1 (Reference)* | - | 21.00% | *1 (Reference)* | - |
| >36 | 270 | 7.40% | *2.29 (1.12 – 4.69)* | *0.023* | 26.30% | *1.34 (0.93 – 1.93)* | *0.117* |
| **Place of Residence** | | | | | | | |
| Own home | 586 | 5.60% | *1 (Reference)* | - | 23.40% | *1 (Reference)* | - |
| Nursing/Care Home | 103 | 12.60% | *2.42 (1.23 – 4.78)* | *0.011* | 35.90% | *1.84 (1.18 – 2.87)* | *0.007* |
| **Pre-Fracture Ambulatory Status** | | | | | | | |
| Independent | 257 | | | | 18.20% | | |
| One mobility aid | 129 | | | | 16.30% | | |
| Two mobility aids or frame | 55 | | | | 18.20% | | |
| Housebound | 237 | | | | 37.10% | | |
| Bedbound | 11 | | | | 72.70% | | |
| ***Mobile*** | 441 | | *1 (Reference)* | - | 17.7% (78) | *1 (Reference)* | - |
| ***House/bedbound*** | 248 | 248 | *2.99 (1.62 – 5.53)* | *<0.001* | 38.7% (96) | *2.94 (2.06 – 4.19)* | *<0.001* |
| **AMTS** | | | | | | | |
| 0 – 7 | 286 | 9.40% | *1 (Reference)* | - | 34.30% | *1 (Reference)* | - |
| 8 – 10 | 403 | 4.70% | *2.11 (1.15 – 3.87)* | *0.016* | 18.90% | *2.24 (1.58 – 3.18)* | *<0.001* |

***Table 2.*** *Multivariate Logistic Regression Analysis for 30-day mortality.*

| Independent Risk Factor | β (Coefficient) | P-value | Adjusted Odds Ratio | 95% C.I. | Assigned Score |
|---|---|---|---|---|---|
| Non-Operative Management* | - | - | - | - | **2** |
| ASA Grade 4/5 | 1.242 | 0.002 | 3.46 | 1.58 – 7.59 | **2** |
| Age > 80 years | 0.764 | 0.110 | 2.15 | 0.84 – 5.49 | **1** |
| Male Sex | 0.760 | 0.043 | 2.14 | 1.02 – 4.47 | **1** |
| Bed/Housebound mobility | 0.747 | 0.053 | 2.11 | 0.99 – 4.50 | **1** |

**Weight assigned based on univariate strength and clinical judgment.*

***Table 3.*** *Multivariate Logistic Regression Analysis for 365-day mortality.*

| Independent Risk Factor | β Coefficient | P-value | Adjusted Odds Ratio | 95% C.I. | Assigned Score |
|---|---|---|---|---|---|
| Non-Operative Management | - | - | - | - | **2** |
| ASA Grade 4/5 | 1.031 | 0.002 | 2.80 | 1.47 – 5.36 | **2** |
| Age > 80 years | 1.006 | 0.001 | 2.73 | 1.52 – 4.92 | **1** |
| Male Sex | 1.012 | < 0.001 | 2.75 | 1.67 – 4.54 | **1** |
| Immobility | 1.044 | < 0.001 | 2.84 | 1.75 – 4.61 | **1** |

***Table 4.*** *Predicted 30 and 365-day mortality for Shah Score.*

| Shah score | Number of pts | 30-day Mortality | % | 365-day Mortality | % |
|---|---|---|---|---|---|
| 0 | 100 | 1 | *1* | 6 | *6* |
| 1 | 250 | 4 | *2* | 35 | *14* |
| 2 | 199 | 12 | *6* | 60 | *30* |
| 3 | 57 | 7 | *12* | 24 | *42* |
| 4 | 46 | 8 | *17* | 23 | *50* |
| 5 | 21 | 6 | *29* | 13 | *62* |
| 6 | 11 | 4 | *36* | 8 | *73* |
| 7 | 5 | 4 | *80* | 5 | *100* |

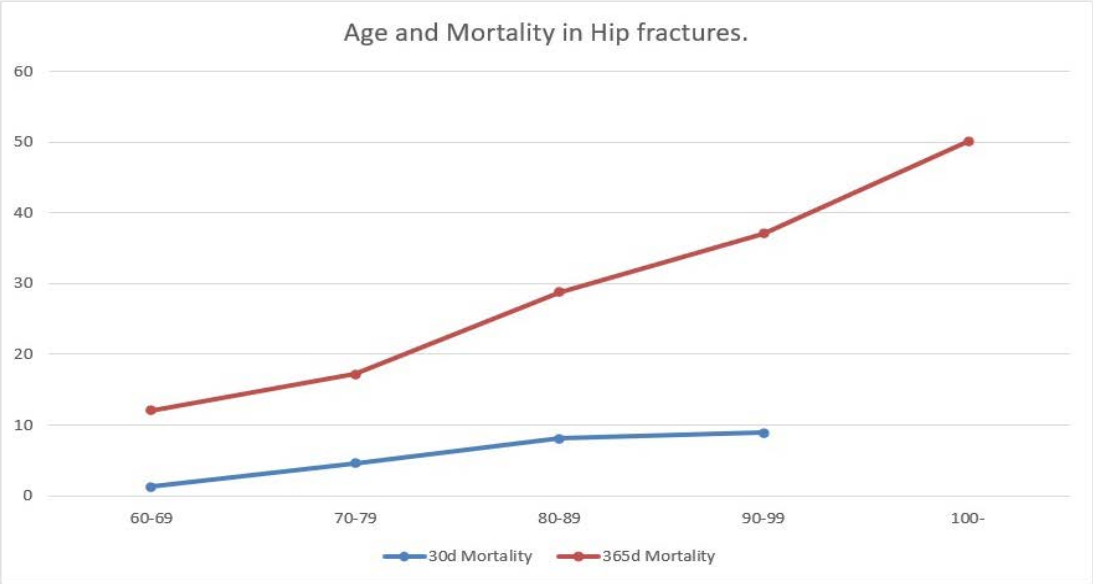


***Figure 1.*** *Effect of age on 30-day and 365-day mortality in patients with hip fractures.*

mortality with each decade (Figure 1) The 365-day mortality is approximately 10% in those younger than 70 years. And the 365-day mortality increases by about 10% in each of the following decades. 365-day mortality risk can also be roughly calculated as "Age - 55" (Figure 1).

Time to surgery receives lot of attention in National Hip Fracture Database and Best Practice Tariff in the UK for improving outcomes in patients with neck of femur fracture. We found that delay greater than 36 hours influenced 30-day mortality on univariate analysis, however its effect on 365-day mortality was not found as prominent as expected and was not statistically significant with p = 0.117. Also, on multivariate analysis, we did not find any statistically significant corelation between time to surgery and mortality rates.

ASA had a significant effect on mortality with 365-day mortality almost doubling with each increase in ASA grade.

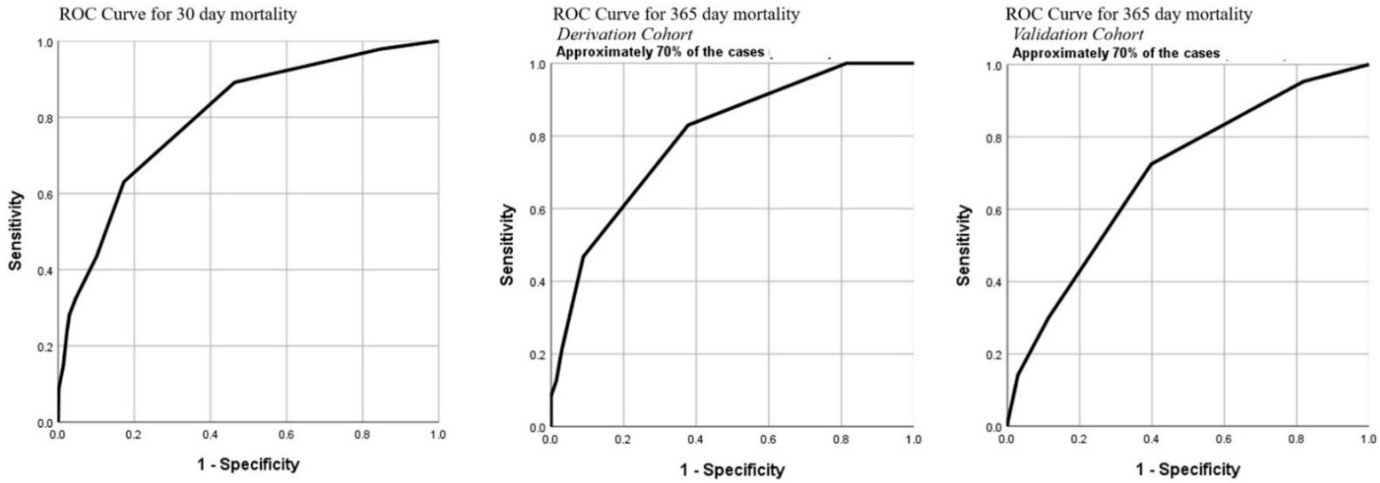


***Figure 2.*** *ROC Curves for 30- and 365-day mortality scores.*

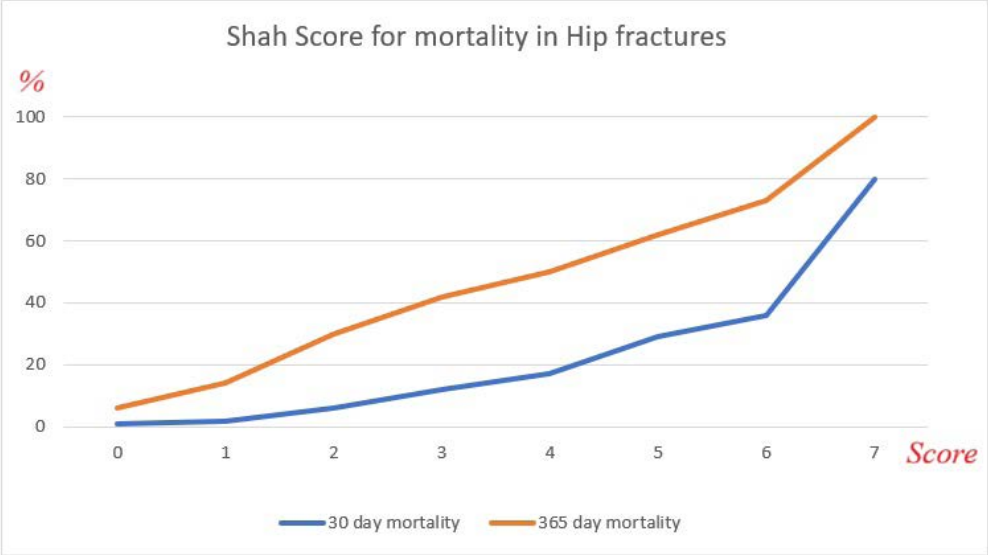


***Figure 3.*** *Predicted 30 and 365-day mortality rate (%) for Shah Score (0-7).*

ASA grade of 4-5 was associated with a great effect on mortality (52.4%).

Non-operative patients however had the worst outcome in terms of mortality (64.7%).

ASA grade 5 and Bedbound status had alarming mortality rates of 83.3 and 72.7, but these were statistically not significant when compared to mortality in ASA grade 4 and House bound patients.

Anaesthesia type, fracture type or fixation method had no statistically significant effect on mortality.

**30-Day Mortality Model Development:**

The final statistical model established four independent predictors: ASA Grade 4 or 5; Male gender; Immobile status; Age > 80 years. Non-operative management was entered into the final prediction score by way of manual inclusion due to the exceptionally high impact (Univariate OR = 11.67) and limitations of the regression technique used for data analysis. Based on the regression coefficients (β), a weighted score was constructed with a maximum possible score of 7.

**365-Day Mortality Model Development:**

A Multivariate Binary Logistic Regression analysis (Backward Stepwise Likelihood Ratio) using the Derivation Cohort led to the identification of four factors that statistically significantly independently predicted one-year mortality: immobility, high ASA grade (4 or 5), male sex and advanced age (> 80).

Non-Operative Management was excluded from the regression procedure solely due to its technical separation, as evidenced by a very high event rate among patients classified in the non-operative category. As a result, Non-Operative Management received a 2-point weighting in the final scoring scheme, manually applied following univariate analysis that yielded an Odds Ratio (OR) of 6.07 in addition to the fact that it is considered a clinically important mortality predictor. A simplified weighted score was constructed based on the β Coefficient and odds ratio on univariate analysis. The maximum possible score is 7.

**30 and 365-Day Mortality score Validation:**

The new 30-day score demonstrated excellent discriminative ability and good calibration:

- Discrimination (AUC): 0.800 (95% CI: 0.734 – 0.867), P < 0.001.
- Calibration: The Hosmer-Lemeshow goodness-of-fit test indicated a good model fit (Chi-square = 8.68, df = 6, P = 0.192).

The 365-day score had excellent discriminative ability:

- Derivation Cohort: AUC = 0.697 (95% CI: 0.644 – 0.749).
- Validation Cohort: AUC = 0.797 (95% CI: 0.725 – 0.869), P < 0.001.
- Calibration: The Hosmer-Lemeshow goodness-of-fit test showed a strong agreement between predicted and observed probabilities (Chi-square = 3.97, df = 6, P = 0.681), suggesting the model is well-calibrated.

The score with the number of patients in each score group and their 30- and 365-day mortality rates have been shown in table 4. We can see a progressive increase in mortality rates with increasing Shah score.

## Discussion.

Using the collected data, we analysed the statistically significant factors associated with increase mortality at both 30 and 365-days following a hip fracture. Older age, male gender, ASA Class 4/5, non-operative management, pre-fracture housebound/bedbound status were all identified as being associated with increased mortality at both 30 and 365-days post-fracture. The factors which demonstrated the highest mortality risk were high ASA classification and non-operative management.

Our study demonstrated a linear increase in mortality with increasing age, with those in the over 80 group possessing higher than average one-year mortality. The knowledge that increasing age results in higher hip fracture mortality has been known for over 40 years [9]. One recent meta-analysis, however, looked at six studies assessing the mortality in 51,938 patients and found that age continues to be a statistically significant indicator for mortality at 6–12 months post-hip fracture surgery, with the risk of death being 68% less in people age under 85 years [10]. However, they also correctly suggest that age should be considered in relation to other factors most notably co-morbidities and physical capability [10].

We also demonstrated a small but significant increase in mortality in males. Men were more likely to die following a hip fracture despite being a younger population than female patients. It has previously been reported that men who sustain hip fractures have a higher associated mortality than women when matched for age [11-14]. Consistent findings were seen in our study with a higher percentage mortality in the male group at both 30 and 365-days. However, other studies cast doubt over gender as an isolated factor causing higher mortality and suggest that other confounding factors such as higher ASA and higher age at time of fracture contribute to this difference and that this should be considered when interpreting gender [9,10,15]. Data from the Scottish Hip Fracture Audit in 2008 found that when compared with women, men do indeed have significant differences in case-mix variables, which are likely to influence outcome. However, when they adjusted for these differences, gender was seen to still have a significant effect on mortality [16]. In addition, they also found that men not only have higher early post-operative mortality but are also less likely to return to independent living or mobility [16].

Our study clearly demonstrates that patients who have a higher ASA score have a higher mortality. An ASA score of 4 or greater inferring a 365-day mortality risk of >50% and a score of 5 inferring a 30-day mortality risk of 67%. White et al in the 1980's found the ASA grading system to be the most accurate predictor of post-operative mortality after a fracture of the hip [17]. This has since been confirmed by several studies which have previously been evaluated and summarised [18]. One recent study retrospectively reviewed 327 nonagenarians who underwent hip fracture surgery over a 12-year period. They also found significant associations between the ASA grade and the rates of postoperative complications and 1-year mortality [19]. One large District General Hospital in the UK studied mortality in the immediate post-operative period up to 48 hours in 9,393 patients from 1986 to 2015 [20]. They found that over 90% of those that died within the first 48 hours had an ASA greater than 3 highlighting the importance of perioperative optimisation in those with high ASA scores. As such, pre-operative ASA appears to be an accurate barometer of not only long-term but also short-term mortality in hip fracture patients.

In examining the effect of pre-fracture ambulatory status, we found almost no increase in mortality between individuals who are independent, those who mobilise with one aid or two aids. However, previous studies have seen that those who ambulate with a device do have higher mortality and it has been hypothesised that this may be due to the patient's inability to immediately bear weight post-operatively or may be a surrogate for frailty [21]. We did, however, see mortality double in those who are housebound. Previous study concerning those who are housebound is limited. It is well documented that those who have delay in getting out of bed have associated poor function and increased mortality post-operatively [22]. Vochteloo et al also showed that more than half of hip fracture patients do not go on to regain full mobility in the first post-operative year and that those who already have a lower pre-fracture mobility have a higher risk of becoming immobile [23]. Therefore, if the patient already had very limited mobility prior to the fracture, they will very likely return to either a poor functional state or a state of immobility which is known to increase mortality. We also saw a significant one-year mortality of 72.7% in those who were already immobile. That being said, our study is limited as we only saw 11 patients with hip fractures who were completely immobile which only equated to 1.6% of the cases, of which 5 were managed non-operatively. Significant immobility has previously been seen as an indicator for conservative management; however, one study conducted a prospective review of 3,515 patients with hip fractures of whom 152 were immobile prior to the fracture [24]. 94% were operatively managed and after one year 51% of patients were still alive. Of the survivors, 54 had none or minimal pain in the hip and 58 had the same residential status as before the fracture. They concluded that immobility in patients with hip fracture is uncommon and is not a valid reason for withholding surgical treatment.

Many studies have focussed on those who live in institutions vs those who do not, however, we know that several individuals may be living in their own home and instead receive nursing care there rather than in for example a nursing home. Our study found increased mortality rate in patients living in nursing or care homes on univariate analysis, however on multivariate regression analysis we did not find this to be significant.

One key understanding regarding mortality risk in those who suffer a hip fracture is to appreciate that each factor is providing only a small piece of the puzzle. One single factor alone does not confer any precise level of mortality for a patient but rather their combination of factors. As such, when predicting mortality in those who suffer hip fractures it is more useful to provide a personalised score which combines known risk factors. Several risk prediction models including The Nottingham Hip Fracture Score have aimed to do exactly this [8]. The Shah Hip Fracture Score has built on the work previously done and identified some key characteristics missing from other prediction models including Operated vs Non-Operated and mobility status. We have identified age, sex, ambulatory status, ASA grade and non-operative management as the key factors resulting in high 30 and 365-day mortality in our local population which aligns well to the data seen in previous studies. We found non-operative management and ASA grade 4 and 5 had the worst mortality.

We found age has a linear effect on mortality which can roughly be calculated as "365-day Mortality ≈ Age – 55".

We devised a scoring system which shows almost a linear relationship between Shah score and 365-day mortality rates. We can 'roughly' say that for Shah Score 0-7, 30-day mortality rate can be approximated to 1, 2, 6, 10, 20, 30, 40 and 80% while the 365-day mortality rate can be approximated to 5, 15, 30, 40, 50, 60, 70, 100%. About 50% of the patients had a Shah score of 0-1 and a further 30% had a score of 2.

We have also identified that fracture classification, treatment method and anaesthesia type used had no significant bearing on the observed mortality on univariate regression analysis while time to surgery, residence type and AMTS score have no bearing on mortality rates on multivariate analysis.

## Highlights.

• The key factors influencing mortality rate in patients with hip fractures are Age, Sex, ambulatory status, ASA grade and non-operative management. Non-operative management and ASA grade 4 and 5 have the worst effect on mortality.

• AMTS, residence type, Fracture classification, treatment method, and anaesthesia type have no significant bearing on the observed mortality. And the effect of time to surgery remains unclear and needs further study in future.

• Age has a linear effect on mortality which can roughly be calculated as "365-day Mortality ≈ Age - 55".

• The Shah score provides a practical tool for predicting both 30- and 365-day mortality following hip fracture.

## Future research.

Future research must further evaluate the effect of Frailty score and biochemical markers on 30- and 365-day mortality. Time to surgery should be evaluated as an independent factor in patients delayed due to logistic issues rather than for medical optimisation.

## Declaration.

There is no funding, there are no financial interests or other conflicts of interest and no copy-right issues. The work is original research not under consideration anywhere else.

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