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Prediction of Postoperative Outcomes Following Hip Fracture Surgery: Independent Validation and Recalibration of the Nottingham Hip Fracture Score

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Abstract

Objectives

Independent validation of risk scores after hip fracture is uncommon, particularly for evaluation of outcomes other than death. We aimed to assess the Nottingham Hip Fracture Score (NHFS) for prediction of mortality, physical function, length of stay and postoperative complications.

Design

Analysis of routinely collected prospective data partly collected by follow-up interviews.

Setting and Participants

Consecutive hip fracture patients were identified from the Northumbria hip fracture database between 2014-2018. Patients were excluded if they were not surgically managed or if scores for predictive variables were missing.

Methods

C-statistics were calculated to test the discriminant ability of the NHFS, Abbreviated Mental Test Score (AMTS), and ASA grade for in-hospital, 30- and 120-day mortality, functional independence at discharge, 30-days and 120-days, length of stay, and postoperative complications.

Results

We analysed data from 3208 individuals, mean age 82.6 (SD 8.6). 2192 (70.9%) were female. 194 (6.3%) died during the first 30-days, 1686 (54.5%) were discharged to their own home, 211 (6.8%) had no mobility at 120-days, 141 (4.6%) experienced a postoperative complication.

The median length of stay was 18 days (IQR 8-28). For mortality, c-statistics for the NHFS ranged from 0.68-0.69, similar to ASA and AMTS. For postoperative mobility, the c-statistics for the NHFS ranged from 0.74-0.83, similar to AMTS (0.61-0.82) and better than the ASA grade (0.68-0.71). Length of stay was significantly correlated with each score ($p<0.001$ by Jonckheere-Terpstra test); NHFS and AMTS showed inverted U-shaped relationships with length of stay. For postoperative complications, c-statistics for NHFS (0.54-0.59) were similar to ASA grade (0.53-0.61) and AMTS (0.50-0.58).

Conclusions and Implications

The NHFS performed consistently well in predicting functional outcomes, moderately in predicting mortality, but less well in predicting length of stay and complications. There remains room for improvement by adding further predictors such as measures of physical performance in future analyses.

Introduction

Hip fractures are the most common serious injury in older people, the most common reason for older people to need emergency surgery, and the most common cause of death following an accident. In 2017, there were over 65000 hip fractures in the UK.[1] More people are surviving to old age, with accompanying frailty and multi-morbidity; frailty is a syndrome of impaired homeostasis and vulnerability to minor stressors. 14% of those aged 60 and over are living with frailty in England.[2] In England, hip fracture prevalence peaked for males in the early-2000s and for females in the mid-1990s;[3] however, evolving demographics means that patients have increasingly complex medical, social and rehabilitation needs.[4] The ability to predict mortality after hip fracture surgery is vital for informing prognostic conversations and adjusting for casemix when benchmarking service performance. The ability to predict other outcomes such as length of stay, postoperative mobility and complications are also important to patients and healthcare services.

The Nottingham Hip Fracture Score (NHFS) was developed in 2008 to predict mortality at 30-days following hip fracture.[5] The equation used to derive variable weights has been recalibrated twice, in 2012 and 2015, to accommodate a gradual reduction in overall 30-day mortality after hip fracture.[6,7] The NHFS uses a simple scoring system, which includes age, gender, haemoglobin on admission, malignancy, preoperative residential status (own home or institution), Abbreviated Mental Test Score (AMTS) and comorbidities. Comorbidities are defined on admission history or from patient notes and include cardiovascular, cerebrovascular, respiratory and renal diseases. All the variables are objective measures and are routinely checked or known at admission, reducing observer and omission bias, and facilitating easy calculation. It is scored from 0 to 10 and is used to predict the risk of 30-day mortality across its range.

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The ability of the NHFS to predict 30-day mortality has been validated independently and internationally.[8-10] There have been several validations of the NHFS in predicting mortality in the UK, with some revealing limitations when applied to differing demographics or subsets of the cohort. As the equation consistently overestimates mortality and is more heavily weighted towards pre-existing disease rather than patient function, it may benefit from recalibration.[6,7] Far less research has focussed on the NHFS in predicting other important outcomes, including length of stay and complications. Few studies have sought to test the NHFS in predicting functional outcomes[11] and one-year mortality,[12] and there is no published independent validation in predicting these outcomes. The ability of the NHFS to predict postoperative complications has been neglected by the literature.

As the NHFS was purpose-built to predict 30-day mortality, it remains unclear whether the tool reliably predicts a broader range of outcomes of importance to patients, surgical teams and healthcare organisations. Therefore, this study aims to provide independent validation and recalibration of the NHFS with regards to mortality, and compare its predictive ability for functional outcomes, residential status, length of stay and postoperative complications against ASA grade and AMTS. These scores were chosen as they are assessed routinely and could provide simple, more reliable prediction of hip fracture outcomes.

Methods

Analysis population

Data were prospectively gathered on consecutive hip fracture patients attending Northumbria Healthcare NHS Foundation Trust between 1 October 2009 and 1 January 2019. All in-patient data were directly entered into a local database by specialist nurses and subsequently uploaded to the National Hip Fracture Database (NHFD).[13] NHFS and AMTS

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were calculated at admission by emergency medicine and orthopaedic speciality doctors. American Society of Anaesthesiologists (ASA) grade was evaluated by the anaesthetic team in the immediate pre-operative period. The NHFS was calculated for patients from 1 April 2014 onwards. Post-discharge outcomes were assessed through follow-up phone interviews conducted by specialised NHFD nurses directly with patients, relatives or institutions to which the patients were discharged. Data on medical complications were obtained from routine clinical records collected prospectively on all in-patients at the trust. The study was managed in accordance with Caldicott principles.[14] As the analysis did not require any new patient contact or data collection, the study did not require evaluation by an ethics committee. Datasets were linked using the patient's trust ID number and anonymised within the trust before export for analysis. Individuals were excluded from analysis if their data could not be linked, if data on NHFS, AMTS or ASA grade were incomplete or missing, or if the patient was managed non-operatively.

The AMTS comprises 10 questions and is used to assess cognitive impairment and composes part of the NHFS. An AMTS of ≥8 is deemed normal.[15] We assessed the ability of the AMTS alone to predict outcomes as a simple alternative to the NHFS. The AMTS is widely used, simple to collect, and requires no additional medical history or biochemical results, making it suitable for use in resource-poor settings. The AMTS has been demonstrated as an independent predictor of length of hospital stay following hip fracture[16] and eventual return-to-home.[11] The AMTS can identify patients suffering from delirium,[17] which is a frequent complication in hip fracture associated with longer hospital stays, increased rates of other complications and mortality.[18]

We also compared the NHFS to ASA grade, which scores patients: I (healthy), II (mild systemic disease), III (severe systemic disease), IV (severe systemic disease which is a constant threat

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to life), V (moribund person who is not expected to survive without the operation) and VI (brain-dead). It is a subjective global measure of the burden of comorbidities assessed on the day of surgery by the anaesthetic team, which is routinely measured on all surgical patients and therefore provides a practical alternative to the NHFS. It is associated with length of stay following hip fracture surgery, severity of complications and total hospitalisation costs.[16,19,20]

Selection of postoperative outcomes

The NHFS was designed to predict 30-day mortality.[5] Other outcomes are also important, including length of stay, postoperative mobility and complications; however, there is no consensus on which tool to use to predict such outcomes. The outcomes we assessed included mortality, mobility, residential status, length of stay and complications.

We assessed all-cause mortality at three intervals: in-hospital, within 30-days post-surgery and within 120-days post-surgery. These variables were selected to provide a clear comparison against the existing NHFS literature, whilst allowing for calibration of the NHFS for our dataset. For physical function we analysed residential status after discharge and mobility. Residential status was analysed by the number of patients at home or sheltered housing within 30-days and within 120-days post-surgery: an assessment of social independence following discharge.

Postoperative mobility was analysed by the number of patients reportedly mobile outdoors without aids at 30-days and 120-days post-surgery, mobile outdoors with or without aids at 30-days and 120-days post-surgery, or with no mobility at 30-days and 120-days post-surgery. 'No mobility' was defined as being wheelchair or bed-bound. Length of stay was derived from hospital admission and discharge data; where patients were transferred to rehabilitation wards/units after surgery, the date of discharge from the rehabilitation unit was used instead.

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These units are part of a Northumbria Healthcare Trust hub and spoke system. Until May 2015, patients were operated on at multiple sites, as of June 2015, patients were operated on at the hub site and spend approximately 2-3 days there post-operatively prior to being transferred to a spoke site. All centres from which we collected data including date of discharge are directly part of Northumbria trust. Length of stay data was calculated from date of admission at the hub site (Northumbria Specialist Emergency Care Hospital) to date of discharge from any Northumbria Trust spoke site (e.g. Alnwick, Berwick, Hexham, Wansbeck or North Tyneside General Hospital). To assess the rate of postoperative complications, we used the following records from the database: deep vein thrombosis (DVT) or pulmonary embolism (PE) within 60-days post-surgery, urinary tract infection (UTI) or pneumonia within 30-days post-surgery, stroke or myocardial infarction (MI) within 30-days post-surgery and any post-operative complication (excluding DVT and PE) within 30-days post-surgery. Postoperative complications and mobility variables were selected due to their availability within the dataset and their utility in assessing a broad range of outcomes.

Statistical Analysis

Data were analysed using SPSS v25 (IBM, New York, USA). A two-sided p value of <0.05 was taken as significant for all analyses. Descriptive data were generated for baseline characteristics of the study dataset.

Analysis of discriminant ability of predictive variables

Receiver-operator characteristic (ROC)-curves and c-statistics with 95% confidence intervals were generated to compare the performance of the NHFS, AMTS and ASA grade in predicting mortality, residential status, mobility and postoperative complications. We defined c-

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statistics as good (>0.70), moderate (0.60-0.70) and poor (<0.60). The relationship between predictor variables and length of stay was assessed using the Jonckheere-Terpstra test. Boxplots were generated to demonstrate the relationship between length of stay and the predictor variables.

Recalibration

To recalibrate the original NHFS equation to best fit the observed 30-day mortality for our cohort, binary logistic analysis was performed on the same patients involved in the discriminant analysis. A binary variable was produced for 30-day mortality following hip fracture surgery (deceased=0; living=1), which was used as the dependent variable and the NHFS as the independent variables. The values generated by the regression analysis were inserted into an equation in the format of "Risk (%) = $\frac{100}{1+e^{C+X(NHFS)}}$", where "C" is a constant and "X" is a coefficient of the NHFS. This equation is modelled on the format of the original equation produced in 2008[5] and its subsequent revisions,[6,7] which are all designed to predict 30-day mortality. A 95% confidence interval was calculated using odds ratios produced by the regression analysis.

Results

NHFS values were available for 3208 patients. Due to missing NHFS (n=30), AMTS values (n=8) and non-operative management (n=78), further patients were excluded (*see Figure 1*). Baseline details (n=3092) are shown in Table 1, and the prevalence of each outcome is shown in Table 2. Supplementary Table 1 shows the prevalence of each outcome by NHFS score, demonstrating the expected gradients of mortality, postoperative function and complications.

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Mortality

5 patients were missing in-patient mortality data. At 30-days post-surgery, 194 (6.3%) patients had died, with a mean age of 86.1 years (SD 8.0); 107 (55.2%) were women. At 120-days (n=1503) post-surgery, 278 (18.5%) were dead. There were 243 (7.9%) deaths in-hospital, with a mean age of 86.0 years (SD 8.1); 142 were women (58.4%). The NHFS had moderate discriminative ability for mortality at 30-days, 120-days and in-hospital, with c-statistics of 0.690 (0.652-0.727), 0.676 (0.641-0.710) and 0.684 (0.650-0.718) respectively. ASA grade had similar discriminative ability for 30-day and in-hospital mortality, but performed better in predicting 120-day mortality, with a c-statistic of 0.702 (0.669-0.735). AMTS had the poorest discriminative ability for mortality, with c-statistics ranging from 0.614 (0.579-0.648) to 0.627 (0.591-0.662), shown in Table 3.

Residential status

At 30-days post-surgery, 1330 (43.1%) had returned to their own home or sheltered housing. At 120-days post-surgery, 777 (51.7%) had returned to their own home or sheltered housing. The NHFS had good discriminative ability for return-to-home / sheltered housing both at 30- and 120-days, with c-statistics of 0.769 (0.752-0.785) and 0.793 (0.770-0.816) respectively; ASA grade was moderate/good, 0.688 (0.669-0.707) and 0.713 (0.688-0.739), however AMTS outperformed the NHFS and ASA at both 30-days, 0.793 (0.778-0.809), and 120-days, 0.823 (0.802-0.845), shown in Table 3.

Postoperative mobility

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At 120-days post-surgery, 211 (6.8%) patients had no mobility. NHFS had moderate to good discriminative ability for mobility, with c-statistics ranging from 0.672 (0.617-0.728) (in predicting 'no mobility at 120-days') to 0.834 (0.722-0.946) (in predicting 'mobile outdoors without aids at 30-days'). Similar results were seen for both ASA grade and AMTS, with c-statistics between 0.654 (0.595-0.713) to 0.876 (0.807-0.945) and 0.609 (0.443-0.774) to 0.788 (0.745-0.831) respectively, shown in Table 3.

Length of Stay

The median length of stay was 18 days (IQR 8-28). Significant differences in length of stay at different scores was discovered for NHFS, AMTS and ASA grade, but both NHFS and AMTS showed inverted U-shaped relationships between score and length of stay. The relationship between the predictor variables and median length of stay is demonstrated in Figure 2.

Postoperative complications

141 (4.6%) patients experienced a postoperative complication. For DVT/PE, c-statistics were comparable for NHFS (0.536 (0.452-0.620)) and ASA grade (0.529 (0.457-0.602)), which were superior to AMTS (0.502 (0.422-0.583)). For UTI, NHFS (0.589 (0.550-0.628)) and AMTS (0.577 (0.538-0.616)) were comparable and were superior to ASA grade (0.536 (0.498-0.574)). For pneumonia, ASA grade (0.614 (0.543-0.684)), NHFS (0.585 (0.510-0.661)) and AMTS (0.562 (0.496-0.627)) were comparable. NHFS (0.571 (0.498-0.644)) scored similarly to ASA grade (0.614 (0.540-0.688)) and AMTS (0.519 (0.452-0.586)) in predicting Stroke/MI. An aggregate variable for all complications (excluding DVT and PE) within 30-days was created, with c-statistics demonstrated in Table 3.

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Recalibration

Binary logistic regression was used to recalibrate the NHFS equation for 30-day mortality. The recalibrated equation used a constant of -5.020 and a coefficient of 0.434. This formed the equation "Risk (%) = $\frac{100}{1 + e^{(0.434*NHFS)-5.02}}$ ". The relationship between observed and predicted values for the 2015 NHFS and the recalibrated equation, and a comparison between the predicted mortality rates for each point of the NHFS, are shown in Supplementary Figures 1, 2 and 3.

Discussion

Using prospectively gathered data, we have independently validated the NHFS as a predictor of postoperative outcomes in hip fracture surgery. The NHFS performed consistently well in discriminating in-hospital mortality, and mortality, residential status and mobility at 30- and 120-days post-surgery. A significant association was evident between NHFS and length of stay, but the score performed poorly in predicting postoperative complications. The NHFS showed good agreement between observed and predicted 30-day mortality in our sample, with little change on recalibration. We observed that length of stay was lowest at both extremes of the NHFS, a phenomenon also seen with the AMTS. This is likely because patients with the highest NHFS (and lowest AMTS) are more often admitted from residential care; consequently, a lower degree of functional recovery is required before discharge, expediting the process compared to those with intermediate scores.

The ability of the NHFS to predict 30-day mortality has been the focus of most prior studies. This has been validated in both UK and international cohorts, where 30-day mortality is

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significantly increased in high-risk patients (NHFS >4).[9,12] Only one study has examined the NHFS in predicting return-to-home, finding that increasing NHFS negatively correlates with eventual return-to-home.[11] This is also the only study to evaluate the NHFS in predicting length of stay, showing that increasing NHFS negatively correlates with the proportion of patients returning to home at 7-, 14- and 21-days.[11] No previous studies have examined the ability of the NHFS to predict mobility and postoperative complications.

The original cohort of patients in which the NHFS was designed had a mean age 2.8 years (3.4%) younger, 5.5% fewer males and 1.6% higher 30-day mortality than this cohort.[5] Whilst increasing age and male sex are risk factors for postoperative mortality,[21,22] the improved survival rate observed in our population may be attributed to the introduction of the BPT (Best Practice Tariff) in 2010.[23] The BPT uses monetary incentives to ensure standards are met and provide the best quality of care. BPT criteria include time to surgery (<36 hours) and assessment by a geriatrician within 72 hours. Mortality has been consistently decreasing since the adoption of the BPT, with 30-day mortality decreasing from 6.9% to 6.1% between 2017 and 2018.[13] These changes are likely to contribute to improved survival rate observed in our sample compared to that predicted by previous calibrations.

The NHFS performs consistently well in predicting mortality and functional outcomes, but poorly in predicting postoperative complications. Clinical benefit may be derived from broadening the predictive scope of the NHFS to include post-operative complications. This may be achieved through combining the NHFS with another validated outcome predictor; though AMTS and ASA are practical options, as they are routinely collected, neither had superior performance to the NHFS across the outcome measures. Alternatively, a novel variable could be collected; a potential candidate is handgrip strength, which may add predictive value through measuring domains of pathophysiology that are not captured within

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the NHFS, namely sarcopenia. Handgrip strength is easy to collect, strongly aligned to function across multiple body systems and predicts all-cause mortality in older people.[24] Unlike tests of lower limb function, handgrip strength can be measured preoperatively for hip fracture patients, even in the presence of cognitive impairment. Initial data suggests that handgrip strength predicts functional outcomes after hip fracture,[25,26] but no studies have assessed whether it can improve the discriminant abilities the NHFS when used in combination. Another alternative is to incorporate a frailty measurement; these have been operationalised in several different ways, including via a phenotypic score including grip strength,[27] a cumulative deficit score that can be collected electronically,[28] and a simple pictorial assessment of preoperative function.[29]

Implications for clinical practice and research

Our results confirm the utility of the NHFS in predicting postoperative mortality,[6,7] and extend the external validation of the NHFS as a predictor of functional outcomes.[7] The NHFS is therefore useful to adjust for casemix in these outcomes at an organisation level, and to inform prognostic discussions with patients. The NHFS has modest utility in adjusting for casemix in length of stay statistics and is not well suited in adjusting for casemix in terms of postoperative complications. Future research could focus on comparing other easy to collect tools, such as handgrip strength or frailty measures, with the NHFS in predicting a range of outcomes, or adding these to the NHFS to improve its predictive ability. Having well-calibrated outcome prediction tools for hip fracture surgery are important in resource management; in an economically strained healthcare system, with one of the lowest ratios of hospital beds/population in the western world, the ability to predict in-hospital mortality,

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discharge destination and length of stay allow for bed management and aid clinical decisions made by orthopaedic and geriatric medicine teams.

Strengths and limitations

Strengths of the study include use of a large patient cohort with prospectively collected data, and examination of multiple important outcomes rather than mortality alone. Although this study included 3092 patients, some were excluded due to missing data on postoperative complications (n=116), and only half of patients had data at 120-days. 120-day follow up was conducted by telephone, thus responses directly from patients could have been limited by cognitive impairment, ill health, change in place of permanent residence, and death. We did, however, collect data from patient relatives, and in the case of patients in institutions, from trained staff and carers, which could ameliorate a proportion of this effect. There was a large discrepancy in ASA grade results between our dataset and the 2015 validation dataset;[6] fewer than 1% of patients in the 2015 dataset were ASA grade 1 or 2 vs 29.5% in our dataset. The large discrepancy in ASA grade highlights the inconsistent, subjective nature of the assessment; reports of high numbers of patients with ASA grade 1 or 2 is a systemic issue seen at units across the UK.[13] The single-centre nature of this study limits the generalisability of results; although the study area contains varied levels of socioeconomic deprivation, the older population in the catchment of Northumbria is overwhelmingly white, limiting generalisability to other ethnic groups. Finally, in this study we did not adjust our p value threshold for multiple comparisons, which could potentially increase the risk of type 1 error.

Conclusion and Implications

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The Nottingham Hip Fracture Score performs well at predicting mobility and moderately at predicting mortality, but is less effective at predicting length of stay or postoperative complications. A modest recalibration was required to reflect local mortality rates, but our results confirm that the score is useful in predicting mortality and in predicting who will return to independent living. Additional measures may improve the ability of the NHFS to predict other important outcomes – particularly length of stay and postoperative complications. Simple measures that reflect multisystem body function or frailty, for instance handgrip strength, could provide this additional information and merits further investigation.

Conflicts of interest

The authors declare no competing interests.

Tables and figures

Table 1. Preoperative characteristics of 3092 included patients.

Variable	
Age, mean (SD) (years)	82.7 (8.6)
Female sex (%)	2192 (70.9%)
ASA grade	
1	76 (2.5)
2	838 (27.1)
3	1752 (56.7)
4	426 (13.8)
NHFS	
0 (%)	60 (1.9)
1	57 (1.8)
2	33 (1.01)
3	374 (12.1)
4	736 (23.8)
5	769 (24.9)

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6	583 (18.9)
7	358 (11.6)
8	93 (3.0)
9	24 (0.8)
10	5 (0.2)
Median (IQR)	5 (4-6)
Mean (SD)	4.9 (1.6)
AMT score	
Median (IQR)	8 (3-10)
Mean (SD)	6.6 (3.8)
Pre-fracture Residential status (%)	
Nursing care	117 (3.8)
Other hospital site of this trust	40 (1.3)
Other hospital trust	2 (0.1)
Own home/sheltered housing	2338 (75.6)
Residential care	570 (18.4)
This hospital site	25 (0.8)
Pre-fracture Mobility status (%)	
Mobile outdoors without aids	974 (31.5)
Mobile outdoors with one aid	519 (16.8)
Mobile outdoors with two aids or frame	337 (10.9)
No mobility	105 (3.4)
Some indoor mobility but never goes outside without help	1156 (37.4)
Pathological fracture (%)	
Atypical	2 (0.1)
Atypical bisphosphonate type subtrochanteric fracture	5 (0.2)
Malignancy	43 (1.4)
Non-pathological	3041 (98.4)

NHFS: Nottingham Hip Fracture Score. AMT: Abbreviated Mental Test. ASA: American Society of Anaesthesiologists.

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Table 2. Prevalence of post-surgical outcomes in the Northumbria hip fracture cohort (n=3092).

Post-surgical outcomes	N (%)
Mortality	
Mortality at 30-days	194/3083 (6.3)
Mortality at 120-days	278/1503 (18.5)
In-hospital mortality	243/3087 (7.9)
Discharge destination	
Own home or sheltered housing at 30-days	1330/3083 (43.1)
Own home or sheltered housing at 120-days	777/1503 (51.7)
Postoperative mobility	
Mobile outdoors without aids at 30-days	6/829 (0.7)
Mobile outdoors without aids at 120-days	93/881 (10.6)
Mobile outdoors with/without aids at 30-days	122/829 (14.7)
Mobile outdoors with/without aids at 120-days	254/881 (28.8)
No mobility at 30-days	319/829 (38.5)
No mobility at 120-days	81/881 (9.2)
Postoperative complications	
Deep venous thrombosis or pulmonary embolism within 60-days	47/1908 (2.5)
Urinary tract infection within 30-days	215/1908 (11.3)
Pneumonia within 30-days	55/1908 (2.9)
Stroke/myocardial infarction within 30-days	47/1908 (2.5)

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Any postoperative complication (excluding DVT/PE) within 30-days	726/1908 (38.1)

DVT: Deep venous thrombosis. PE: Pulmonary embolism

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Table 3. Discriminant statistics for outcomes predicted by NHFS, AMTS and ASA grade.

		c-statistics [95% CI]		
Variables	**N**	**NHFS**	**AMTS**	**ASA grade**
Mortality				
Mortality at 30-days	3083	.690 [.652-.727]	.624 [.585-.663]	.695 [.658-.732]
Mortality at 120-days	1503	.676 [.641-.710]	.627 [.591-.662]	.702 [.669-.735]
In-hospital Mortality	3087	.684 [.650-.718]	.614 [.579-.648]	.699 [.667-.732]
Discharge destination				
Own home/sheltered housing at 30-days	3083	.769 [.752-.785]	.793 [.778-.809]	.688 [.669-.707]
Own home/sheltered housing at 120-days	1503	.793 [.770-.816]	.823 [.802-.845]	.713 [.688-.739]
Postoperative mobility				
Mobile outdoors without aids at 30-days	829	.834 [.722-.946]	.609 [.443-.774]	.876 [.807-.945]
Mobile outdoors without aids at 120-days	881	.766 [.718-.814]	.676 [.621-.731]	.739 [.683-.795]
Mobile outdoors with/without aids at 30-days	829	.779 [.739-.820]	.785 [.749-.820]	.741 [.691-.790]
Mobile outdoors with/without aids at 120-days	881	.737 [.704-.770]	.750 [.717-.783]	.678 [.641-.715]
No mobility at 30-days	829	.693 [.656-.729]	.707 [.670-.743]	.653 [.616-.690]
No mobility at 120-days	881	.672 [.617-.728]	.788 [.745-.831]	.654 [.595-.713]

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Postoperative complications				
DVT/ PE within 60-days	1908	.536 [.452-.620]	.502 [.422-.583]	.529 [.457-.602]
Urinary tract infection within 30-days	1908	.589 [.550-.628]	.577 [.538-.616]	.536 [.498-.574]
Pneumonia within 30-days	1908	.585 [.510-.661]	.562 [.496-.627]	.614 [.543-.684]
Stroke/ myocardial infarction within 30-days	1908	.571 [.498-.644]	.519 [.452-.586]	.614 [.540-.688]
Any postoperative complication (excluding DVT and PE) within 30-days	1908	.579 [.547-.611]	.561 [.529-.592]	.568 [.537-.599]

NHFS: Nottingham Hip Fracture Score. AMTS: Abbreviated Mental Test Score. ASA: American Society of Anaesthesiologists. DVT: Deep venous thrombosis. PE: Pulmonary embolism

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Figure 1. Flowchart of included patients.

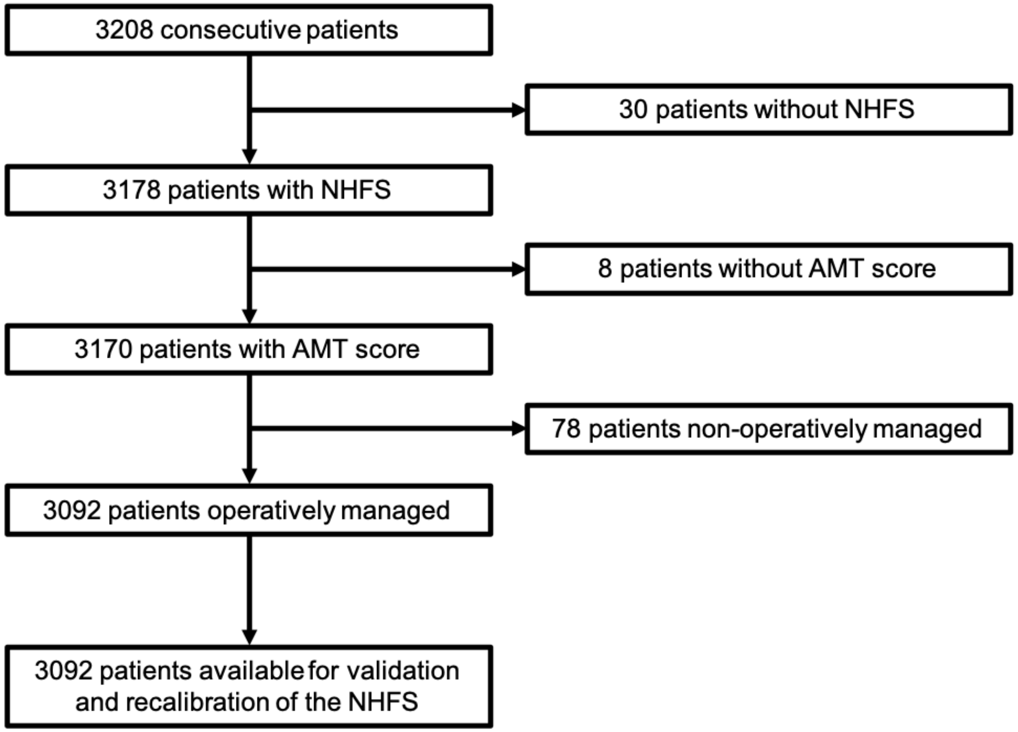

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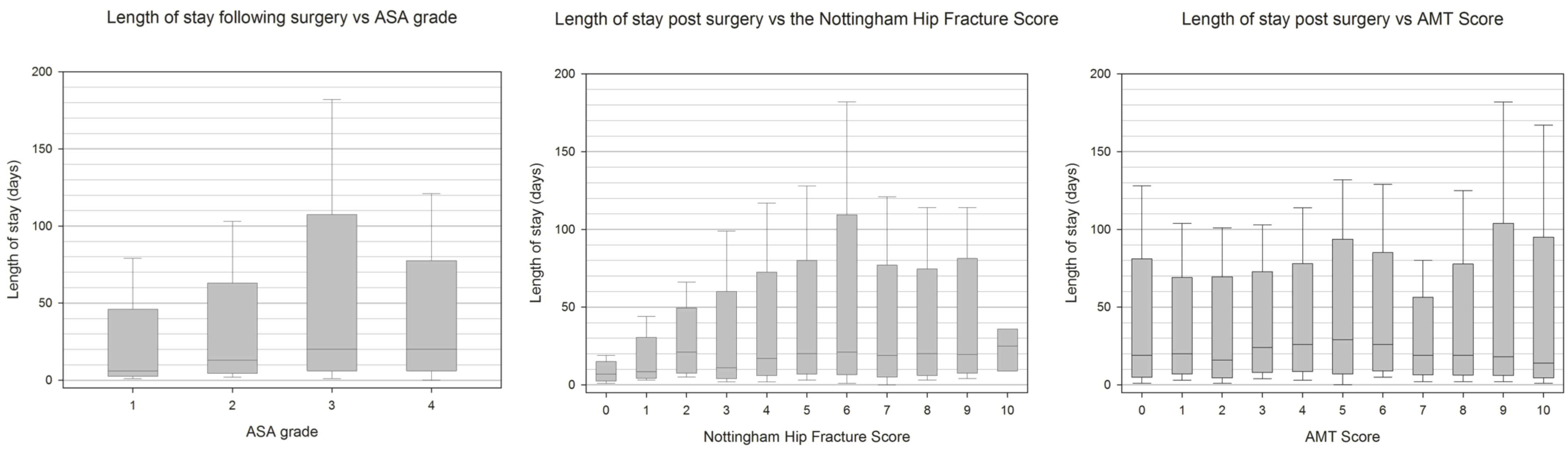
Figure 2. Relationship between predictor variables and median length of stage (n=1908).



p<0.001 by Jonckheere-Terpstra test

p<0.001 by Jonckheere-Terpstra test

p<0.001 by Jonckheere-Terpstra test

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