ORIGINAL ARTICLE

Length of Hospital Stay and Its Associated Factors among Surgical Patients in Hospital Serdang

Siti Nursyafiqah Sulaiman, Zalina Abu Zaid, Barakatun Nisak Mohd Yusof, A'ishah Zafirah Abdul A'zim

Department of Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

ABSTRACT

Introduction: Hospital length of stay (LOS) is one of the measurable indicators which can be used to evaluate hospital administration, operative performance, and quality of patient care. Prolonged LOS has been associated with poor outcomes in patients and inefficient use of hospital resources. Due to the scarcity of findings in this field in Malaysia, this study aims to identify the factors affecting LOS. **Methods:** A single health facility-based retrospective cross-sectional study was conducted in Hospital Serdang. Data of patients admitted to the surgical ward from 2017 to 2021 were retrieved. **Result:** A total of 114 surgical patients' data were analysed, of which most were adults (72.8%), female (69.3%) and Malay (67.5%). The mean LOS was 5.90 ± 4.35 days. Pearson correlation revealed age ($r = 0.309$, $p = 0.001$) and preoperative albumin ($r = -0.397$, $p < 0.001$) having a significant correlation with LOS. An independent samples T-test showed that males had significantly higher mean LOS than females ($t = 2.653$, $p = 0.009$). Surprisingly, having been seen by dietitians and being supplemented by oral nutrition supplements (ONS) had longer stay compared to groups who were not seen by dietitians and given ONS respectively ($t = 4.278$, $p<0.001$), ($t = 3.111$, $p = 0.002$). Furthermore, those with a moderate and high risk of malnutrition spent approximately 3.27 days longer hospitalized than low-risk patients ($t = -2.868$, $p = 0.007$). **Conclusion:** Factors that influence LOS are age, gender, preoperative albumin, seen by a dietitian, risk of malnutrition and oral nutrition supplementation.
Malaysian Journal of Medicine and Health Sciences (2023) 19(5):51-58. doi:10.47836/mjmhs19.5.9

Keywords: Prolonged length of stay, Surgery, Dietitian, Malnutrition, Perioperative

Corresponding Author:
Zalina Abu Zaid , PhD
Email: zalina@upm.edu.my
Tel: +603 9769 2468

INTRODUCTION

The average length of stay (LOS) is frequently used as an indicator in the diagnostic and surgical division to evaluate healthcare quality among hospitals (1). Prolonged length of stay (PLOS) has been associated with unfavourable outcomes, including increased healthcare costs (2). Syed et al. (2021)(3) highlighted in their study that was carried out in Malaysia that rising healthcare expenditure in developing countries has caused public sectors to be squeezed due to financial constraints. Surgical services are one of the services that have high resource consumption (4). Besides the financial pressure, PLOS also leads to an increased risk of hospital-acquired infection (HAI), hospital bed shortages and increased mortality (5, 6). Thus, extensive research has been carried out in this field for the past two decades, especially on identifying factors that affect PLOS (1). In the first bibliography on LOS by Katsnelson (2021), she analysed that the highly researched region in this field was among the European countries. However, most developing countries are still lacking this research including Malaysia. Thus, this study aims to identify the mean length of stay and the association of factors affecting LOS in Malaysian surgical population settings. There is a need to carry out further studies in this area especially as the world healthcare system has made a significant investment in the COVID-19 pandemic since early 2020, leading to tremendous use of resources as reported by the World Health Organization (2022) (7). In addition, the increase in life expectancy and a linear rise in non-communicable diseases over the years will further require more resources, pressuring the healthcare economy which would jeopardize its quality of care (7). Thus, ruling out the factors that impact LOS may ensure optimum care for all patients admitted to hospitals.

MATERIALS AND METHODS

Study area, period and design

This is a retrospective cross-sectional study that aims to determine factors associated with the length of stay among surgical patients in Hospital Serdang. Hospital Information System (HIS), an electronic data system, used to manage various data in this hospital. The

participants of this study are surgical patients admitted to the surgical ward from 2017 to 2021. The data collection was conducted for a period of 6 months.

Inclusion and exclusion criteria

The inclusion criteria are those aged 18 years and above, having surgery carried out in Hospital Serdang and having at least 1 day of LOS. Those patients who were non-Malaysian will be excluded from this study. Paediatric patients were also excluded as the difference in physiology might affect the result of this study. A list of surgical patients' Movement Reference Number (MRN) was retrieved from the surgical department and data were filtered according to the inclusion and exclusion criteria.

Study variables

The dependent variable of this study is the length of stay. The independent variables of this study are age, gender, ethnicity, body mass index (BMI), preoperative albumin, seen by dietitians, risk of malnutrition and type of admission. Intake-related variables include preoperative protein intake adequacy, the average amount of protein consumed before surgery, and oral nutrition supplements, which are the intake of formulas that were taken to provide additional macro or micronutrients.

Sample size and sampling technique

The formula of sample size by Stephen et al. (2013) (8) was used to obtain the optimal sample size. The highest number of samples was chosen as the final sample size of this study. The methods used are as follows:

$N = [(Z\alpha + Z\beta)/C]2 + 3$

Where,

N = Number of respondents required

$Z\alpha$ = The standard deviation for α (1.96)

$Z\beta$ = The standard deviation for β (1.28)

$C = 0.5 * \ln [(1+r)/(1-r)]$

r = The expected correlation coefficient

After the literature review, the correlation between preoperative protein intake adequacy and LOS had the lowest correlation coefficient among the other variables (r = 0.350) (9).

$N = \{(1.96 + 1.28)/ 0.5 * \ln [(1+0.35) / (1-0.35)]\}2 + 3 = 62$

The sample size was adjusted with the sample design effect and an expected response rate of 80%. 80% response rate was chosen as missing data was expected for some of the variables in the system due to incomplete documentation. Hence, a total of 101 participants were required in this study.

Data collection instruments

The data of surgical patients of Hospital Serdang were retrieved from an electronic data system that stores the patient's medical reports. There were a few instruments used in this study. The Malaysian elderly cut-off was used where those aged 60 years and above were categorised as elderly (10). Two cut-offs were used for BMI which are the Asian BMI cut-off (11) for those who are below 65 years and Queensland elderly cut-off for those who are 65 years and above (12). A different cut-off was used for those who are 65 years and above as a meta-analysis reported that being slightly overweight had a lower mortality risk thus a higher range of BMI was recommended for these age groups (13). Malnutrition Universal Screening Tool (MUST) was used to evaluate the risk of malnutrition (14). It is a validated tool in hospital settings and is suitable to be used in surgical patients. It is a five-step instrument where the total score, in the end, is categorized into 3 groups: low risk (score of 0), medium risk (score of 1) and high risk (score of ≥ 2). Preoperative protein intake adequacy which is the intake that was reported in the medical report, will be divided with calculated recommended needs and reported in unit percentage (%). The recommended needs for protein were set to 1.2g/kg body weight as suggested for surgical patients (15).

Study approval

Prior to the study, approval from the Medical Research & Ethics Committee (MREC) was obtained. The letter of allowance to proceed with the study was sought under protocol number NMRR-18-2625-43546. MREC letter was then sent to Hospital Serdang and permission to carry out the study was approved.

Statistical analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) version-26 software. First, the data was evaluated for its normality distributions. A significance level of P-value equal to or less than 0.05 was used. The variables are analysed by descriptive statistics. Pearson Correlation (parametric variables) and Spearman Rank (non-parametric variable) tests were used for continuous variables to determine the association of the factors with length of stay. Lastly, Independent samples T-test was carried out to compare means among groups of the categorical independent variables on length of stay. For missing data, the case for that specific variable was omitted using the option 'exclude case pairwise' and the remaining data were analysed.

RESULTS

Patients' characteristics

A total of 114 surgical patients were included in this study. The mean (± SD) age of the patients was 47.30 ± 16.50 years where 72.8% were adults and 27.2% were elderly. Majority of them were female (69.3%). 67.5% were Malay, 21.9% were Chinese and 10.5% were Indian.

The mean (± SD) body mass index (BMI) of the patients was 25.75 ± 5.88 kg/m2. Almost half of the patients were obese (44.2%), followed by normal (28.8%), underweight

Table I: Sociodemographic, anthropometric, biochemical, clinical, dietary characteristics and mean length of stay of the patients

Variables	n (%)	Mean ± SD
Sociodemographic characteristics (n = 114)		
Age (years)		47.30 ± 16.50
Adults (18-59)	83 (72.8)	
Elderly (≥60)	31 (27.2)	
Gender		
Male	35 (30.7)	
Female	79 (69.3)	
Ethnicity		
Malay	77 (67.5)	
Chinese	25 (21.9)	
Indian	12 (10.5)	
Anthropometric characteristic (n = 104)		
Body Mass Index (kg/m²)		25.75 ± 5.88
Underweight (<18.50)[a] / (<23.00)[b]	16 (15.4)	
Normal (18.50 – 22.99)[a] / (23.00 – 30.00)[b]	30 (28.8)	
Overweight (23.00 – 24.99)[a] / (>30.00)[b]	12 (11.5)	
Obese (≥25.00)[a]	46 (44.2)	
Biochemical characteristic (n = 74)		
Preoperative albumin (g/L)		34.32 ± 6.05
Low (<34)	29 (39.2)	
Normal (34 – 54)	45 (60.8)	
Clinical characteristics		
Seen by dietitian (n = 114)		
Yes	17 (14.9)	
No	97 (85.1)	
Risk of malnutrition (n = 104)		
Low risk	79 (69.3)	
Medium risk	10 (8.8)	
High risk	15 (13.2)	
Type of admission (n = 114)		
Elective	107 (93.9)	
Emergency	7 (6.1)	
Dietary characteristic		
Preoperative protein intake adequacy (%) (n = 31)		67.50 (50.30)*
Inadequate intake (<75%)	19 (61.3)	
Adequate intake (≥ 75)	12 (38.7)	
Oral nutrition supplements (n = 114)		
Yes	13 (11.4)	
No	101 (88.6)	
Length of stay (days) (n = 114)		5.90 ± 4.35

[a]adults Asian cut-off
[b]elderly Queensland cut off (≥ 65 years)
*Median (Interquartile range)

(15.4%) and overweight (11.5%). Preoperative albumin had a mean (± SD) of 34.32 ± 6.05g/L. 2 out of 5 patients had low preoperative albumin levels (39.2%). Most patients were not seen by dietitian (85.1%) while 14.9% were referred to dietitian. 22.0% of patients were at risk (medium and high) of developing malnutrition. Almost all the patients (93.9%) had elective admission. The median (interquartile range) of preoperative protein intake adequacy was 67.50 (50.30)%. Majority of patients (61.3%) had insufficient protein intake, while 38.7% had adequate protein intake.1 out of 10 patients received oral nutrition supplements (ONS) (11.4%) (Table I). Upon running descriptive statistics, the mean (± SD) LOS is 5.90 ± 4.35 days.

Association of selected variables and hospital length of stay

Table II shows a medium positive correlation between age (r=0.309) and LOS and the results were statistically significant (p = 0.001). The result indicates that as the age increases, the days spent in hospital also increase linearly. This study demonstrated a weak negative correlation between body mass index (BMI) (r = -0.173) and length of stay (r = -0.173); however, the results were statistically insignificant (p = 0.080). This suggests that BMI is not associated with LOS. A medium negative correlation was observed between preoperative albumin (r= -0.397) with LOS and the results were highly significant (p<0.001). As preoperative albumin levels rise, patients' have eventually shorter LOS. Lastly, there is a negligible relationship between protein intake adequacy (r = 0.044) with length of stay (LOS) and the results were statistically insignificant (p = 0.814). This suggests that LOS is not affected by preoperative protein intake adequacy.

Table II: Results of Pearson correlation and Spearman correlation of selected variables and length of stay

Variables	Length of stay (days)	
	r	*p*-value
Age	0.309	0.001
Body mass index	-0.173	0.080
Preoperative albumin	-0.397	<0.001
Preoperative protein intake adequacy*	0.044	0.814

*Spearman correlation

Means among group of selected variables on hospital length of stay

An independent samples T-test and ANOVA test were conducted to compare the length of stay (LOS) with selected independent variables. For sociodemographic factors, males (7.49 ± 4.54 days) had significantly higher mean LOS than females (5.20 ± 4.10 days) t = 2.653, p = 0.009. No significant differences in LOS were observed between Malay and non-Malay t = -1.672, p = 0.101. There is also an insignificant effect of body mass index (BMI) on length of stay (LOS) (F = 1.648, p = 0.183). Patients who have been seen by dietitian (11.29 ± 5.96 days) had significantly higher mean LOS compared to patients that dietitians have not seen (4.96 ± 3.21 days) t = 4.278, p<0.001. Patients with a moderate and high risk of malnutrition (8.40 ± 5.35 days) had significantly higher mean LOS than those with a low risk of malnutrition (5.13 ± 3.51 days), t = -2.868, p = 0.007. There was also no significant difference in LOS between emergency and elective admission t = -0.386, p = 0.700. For dietary factor, patients who were given ONS (9.31 ± 3.64 days) had significantly longer mean LOS than patients who were not given (5.47 ± 4.25) t = 3.111, p = 0.002.

DISCUSSION

LOS in the surgical population is the total perioperative period which is the sum of preoperative, operative and postoperative days. Comparing average LOS among hospitals has been a practice to determine the hospitals' performance (1). This current study's mean (± SD) LOS

Table III: Independent samples T-test of selected variables on LOS

Variables	Mean	SD	t/F-value	*p*-value
Gender				
Male	7.49	4.54	2.653	0.009
Female	5.20	4.10		
Ethnicity				
Malay	5.35	3.41	-1.672	0.101
Non-Malay	7.05	5.73		
BodyMassIndex(kg/m²)				
Underweight (<18.50)[a]/(<23.00)[b]	7.56	6.44	1.648	0.183
Normal (18.50–22.99)[a]/(23.00–30.00)[b]	6.40	4.13		
Overweight (23.00–24.99)[a]/(>30.00)[b]	5.92	4.50		
Obese (≥25.00)[a]	5.02	3.07		
Seen by dietitian				
Yes	11.29	5.96	4.278	<0.001
No	4.96	3.21		
Risk of malnutrition				
Low risk	5.13	3.51	-2.868	0.007
Moderate and high risk	8.40	5.35		
Type of admission				
Emergency	5.29	4.11	-0.386	0.700
Elective	5.94	4.38		
Oral nutrition supplements				
Yes	9.31	3.64	3.111	0.002
No	5.47	4.25		

[a]adults Asian cut-off
[b]elderly Queensland cut off (≥ 65 years)

is 5.90 ± 4.35 days. Previous studies on general surgical patients reported LOS for 5 days and 6 days in Korea and the United Kingdom respectively (16,17). On the other hand, LOS in an Ethiopian study was 25.06 ± 21.415 days which involved all patients admitted to the surgical ward (18). Therefore, the result of this current study was in the range of previous studies except as compared to the Ethiopian study as this may be due to Ethiopia being a low socioeconomic country with a high rate of hospital-acquired infection in the study as discussed by the author herself.

The age of the patient is associated with LOS in regard to this study. The finding is in line with a previous study that reported a significant association between age and LOS (19–21). Khosravizadeh et al. (2016) (20) found that those aged 40 and above had longer stay compared to those who were 20 to 30 years old. As justified by Tan et al. (2021) (21), the reason the number of days spent in hospital increases along with age is the higher prevalence of comorbidities among older groups compared to younger adults. Furthermore, longer LOS can also be attributed by a slower healing process as one ages due to changes in physiological performance, leading to a slower metabolic response that is part of the ageing process (22).

Males were found to have longer LOS compared to females. The current study results are inconsistent with previous findings on hepatobiliary surgery, neurosurgery, colorectal surgery and appendectomy patients where there was no significant difference in LOS among the genders (23–25). There are a few possibilities behind the results obtained. Firstly, it may be due to more surgery in males related to motor vehicle accidents requiring more extended periods of stay for post-trauma stabilization (21). Another possible reason could be due to differences in median age in this study between both of these groups, which could be a confounding factor, similar to the study reported by Song & Bian (2014) (26) where the male had 4 years of higher median age compared to female, resulting in male having longer LOS compared to females. Insignificant differences were observed in LOS among groups in ethnicity. Aligned with studies conducted previously that reported that different ethnic groups among the Singapore population are not a determinant of LOS (5,23).

BMI was not associated with LOS. The current finding contrasts with previous studies that reported patients with higher BMI had longer LOS (27,28). Though more recent studies suggest the existence of obesity paradox among surgical patients where it is reported that underweight and obese patients had the longest LOS while overweight patients had the shortest LOS, the current study is not consistent with it (29,30). Previous studies used World Health Organization (WHO) BMI cut-off, which may be why the findings yielded differences compared to this current study (27–30). Using the WHO BMI cut-off, places elderlies with 25.0 to 30.0 kg/m2 in the overweight group. Some studies have found that being moderately overweight among elderlies with a BMI of 23.0 to 30.0 kg/m2 serves a protective effect (12,31). Thus, overweight elderly patients in previous studies might have shorter LOS affecting the differences in mean among the BMI groups.

The current study suggests that as preoperative albumin increases, LOS decreases. The finding is consistent with previous studies in which most researchers described preoperative albumin as one of the predictors of prolonged LOS among major gastrointestinal, urinary and colorectal cancer surgical patients (32–34). Low albumin impairs optimum wound healing time by leading to decreased collagen production (an essential component in tissue formation in surgical wounds) and also impairs immunological response (35). Consequently, some studies reported that low albumin levels increase the risk of complications such as infections in the postoperative period, prolonging treatment (35,36). Therefore, including preoperative albumin as part of preoperative assessment could identify hypoalbuminemic patients and allow for management prior to surgery to improve

postoperative outcomes.

An unexpected result was observed for the variable seen by dietitian and oral nutrition supplementation where those who were seen by dietitian and supplemented had longer LOS. The result is in contrast with the previous findings where it was stated otherwise; a group seen by dietitians and had ONS had significantly reduced LOS compared to patients who did not (37–39). Several studies indicate that patients supplemented with ONS had better perioperative outcomes in terms of gaining weight and improving muscular strength (39,40). However, in this study, the contrast findings were due to the practice in Hospital Serdang, patients seen by dietitians or/and are given ONS only when a patient is already at medium or high nutritional risk, which requires higher LOS to be treated.

The result suggests that patients at moderate and high risk spent approximately 3.27 days longer hospitalization compared to those at low risk. The result is aligned with the majority of previous studies that reported the risk of malnutrition as a predictor of prolonged LOS (41–43). The risk of malnutrition is associated with a range of adverse outcomes including depression of the immune system, imbalance in metabolic response and impaired wound healing which delays LOS (44). Consequently, due to the physiological effects of malnutrition, it puts an individual who is at risk to develop postoperative complications (45,46). Thus, the European Society for Clinical Nutrition and Metabolism (ESPEN) (2017) (46) on the guidelines for clinical nutrition in surgery recommended delaying surgery for a period of 7 to 14 days for patients at severe risk of malnutrition. Screening for malnutrition is crucial in an inpatient setting especially in surgical as patients will experience surgical-led trauma during the post-surgery state (46). With early identification of patients at risk of malnutrition, nutritional therapy can be given to improve their nutritional status to have an optimum outcome postoperatively.

There were no differences in mean LOS among electively admitted and emergency-admitted patients. However, there was a contrast in findings compared to previous studies where according to an experimental study by Casalino et al. (2019) (47), emergency patients had 3 days longer stay than electively admitted patients. Similarly, two local studies also agreed that type of admission is associated with LOS (48,49). A Malaysian report also stated that 85% of perioperative mortality is caused by emergency surgery (48). However, the current study had different findings which might be due to only a small number of patients having emergency admission in this study as due to the emergency-admitted-patients were registered via the emergency department; thus the MRN number was not registered in surgery clinic list that the hospital provided.

No association was observed between preoperative protein intake adequacy and LOS. The results disagree with earlier studies that have found preoperative protein intake adequacy leads to prolonged LOS (25,50). The reason for different findings might be due to only a small number of patients having their protein intake recorded in their medical files which the size of the sample is insufficient to observe significant changes. Only patients referred to dietitians had the data on their preoperative protein intake. Assessing this data as a part of preoperative assessment could determine a patient's nutritional status and future studies might be able to further assess its relationship with LOS.

The present results must be interpreted within the context of several limitations. Firstly, there were a number of missing data on two of the variables that did not meet the sample size: preoperative albumin and preoperative protein intake adequacy. An increment of non-response rate when calculating sample size can be done when including this variable in future studies to achieve adequate sample size. Next, the variables seen by dietitian and oral nutrition supplements had nutritional risk as its confounding factor and have largely impacted the results. This is because only patients at risk of nutritional status are referred to dietitian and given oral nutrition supplements. Thus, future studies may focus on comparing groups at moderate and high risk of nutritional status for both of those variables stated previously instead of including well-nourished patients. On the other note, patients' compliance towards dietary advice and tolerance towards oral nutritional supplements were also not able to be assessed in this study and thus might have an impact on the results. A prospective study on surgical patients would be able to minimize these confounding factors as adherence could be assessed. This study provides a new insight into the relationship between BMI that was analysed with two different cut-offs (Asian BMI cut-off and NEMO elderly cut-off) as this is the first study that did so. Using these cut-offs allow to place individuals of different body physiology in a suitable cut-off.

CONCLUSION

This research presents that the mean length of stay of surgical patients was 5.90 days. Results revealed a significant association between age and preoperative albumin with LOS. There were also significant differences among groups in gender, seen by dietitian, risk of malnutrition and oral nutrition supplementation on LOS. Nevertheless, variables such as seen by dietitian and oral nutrition supplementation has its own confounding factor. Further research on the factors associated with LOS, especially in Malaysia's hospital settings, is recommended to identify the factors and in effort to provide optimum patient care.

ACKNOWLEDGEMENT

Special thanks to Surgical Clinic Hospital Serdang for giving me the opportunity to conduct this study. My utmost appreciation goes towards Universiti Putra Malaysia for funding this study through Grant Putra Insentif Pensyarah Muda (GP-IPM/2018/9613500).

REFERENCES

1. Katsnelson A. Length of stay in hospitals: A bibliometric analysis and mapping of 1999 - 2019 research output [Internet]. Central Michigan University; 2021 [cited 2021 Sep 29]. Available from: https://www.proquest.com/openview/7759919fd01d5d6ca3aba0837f655de9/1?pq-origsite=gscholar&cbl=18750&diss=y
2. Almashrafi A, Alsabti H, Mukaddirov M, Balan B, Aylin P. Factors associated with prolonged length of stay following cardiac surgery in a major referral hospital in Oman: a retrospective observational study. BMJ Open [Internet]. 2016 Jun 1 [cited 2021 Dec 23];6(6). doi: 10.1136/bmjopen-2015-010764.
3. Yunus SZSA, Puteh SEW, Ali AM, Daud F. The Covid Impact to Public Healthcare Utilization Among Urban Low-Income Subsidized Community in Klang Valley Malaysia. Health Serv Res Manag Epidemiol. 2021;8:23333928211002407. doi:10.1177/23333928211002407
4. Toh HJ, Lim ZY, Yap P, Tang T. Factors associated with prolonged length of stay in older patients. Singapore Med J [Internet]. 2017 Mar 1 [cited 2022 Feb 15];58(3):134–8. doi: 10.11622/smedj.2016158
5. Fetene D, Tekalegn Y, Abdela J, Aynalem A, Bekele G, Molla E. Prolonged Length of Hospital Stay and Associated Factors among Patients Admitted at a Surgical Ward in Selected Public Hospitals Arsi Zone, Oromia, Ethiopia, 2022. medRxiv [Internet]. 2022 Oct 21 [cited 2023 Sep 1];2022.10.18.22281234. Available from: https://www.medrxiv.org/content/10.1101/2022.10.18.22281234v1
6. Ofori-Asenso R, Liew D, Mertensson J, Jones D. The frequency of, and factors associated with prolonged hospitalization: A multicentre study in Victoria, Australia. J Clin Med. 2020;9(9):1–14. doi: 10.3390/jcm9093055.
7. World Health Organization. World health statistics 2022 (Monitoring health of the SDGs) [Internet]. 2022. 1–131 p. Available from: http://apps.who.int/bookorders.
8. Stephen B. H, Steven R. C, Warren S. B, Deborah G. G, Thomas B. N. Designing clinical research. 4th edition. Rebecca G, editor. Replication and Evidence Factors in Observational Studies. Lippincott Williams & Wilkins; 2013. 381 p.
9. Suga H, Hashimoto H. Age threshold for recommending higher protein intake to prevent age-related muscle weakness: A cross-sectional study in Japan. PLoS One [Internet]. 2018;13(12):1–12. doi: 10.1371/journal.pone.0208169
10. Institute for Public Health (IPH), National Institutes of Health (NIH), Ministry of Health Malaysia. National Health and Morbidity Survey (NHMS) 2018: Elderly Health [Internet]. 2019 [cited 2022 Jul 23]. 182 p. Available from: https://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2018/NHMS2018ElderlyHealthVolume2.pdf
11. World Health Organization. Asia Pacific perspective: Redefining obesity and its treatment. 2000. p. 8–45.
12. Queensland Government of health. Using body mass index – Metro North Hospital and Health Service. 2017;(April):2017–9. Available from: http://www.health.qld.gov.au/masters/copyright.asp
13. Winter JE, MacInnis RJ, Nowson CA. The influence of age the BMI and all-Cause mortality association: A meta-analysis. J Nutr Health Aging [Internet]. 2017 Dec 1 [cited 2023 Jan 23];21(10):1254–8. doi: 10.1007/s12603-016-0837-4.
14. Elia M. The "MUST" report the "MUST" report nutritional screening of adults: a multidisciplinary responsibility development and use of the "malnutrition universal screening tool" ('MUST') for adults. Malnutrition Advisory Group (MAG), a standing committee of BAPEN; 2003.
15. Borloni B, Huettner H, Schuerholz T. Preoperative Nutritional Conditioning: Why, When and How. Visc Med [Internet]. 2019 Oct 1 [cited 2023 Jan 23];35(5):299. doi: 10.1159/000503041
16. Baek H, Cho M, Kim S, Hwang H, Song M, Yoo S. Analysis of length of hospital stay using electronic health records: A statistical and data mining approach. 2018 [cited 2021 Sep 24]; doi: 10.1371/journal.pone.0195901.t002
17. Ward TL, Raybould SJ, Mondal A, Lambert J, Patel B. Predicting the length of stay at admission for emergency general surgery patients a cohort study. Ann Med Surg [Internet]. 2021 Feb 1 [cited 2022 Jul 31];62:127. doi: 10.1016/j.amsu.2021.01.011.
18. Tefera GM, Feyisa BB, Umeta GT, Kebede TM. Predictors of prolonged length of hospital stay and in-hospital mortality among adult patients admitted at the surgical ward of Jimma University medical center, Ethiopia: Prospective observational study. J Pharm Policy Pract [Internet]. 2020 Jun 16 [cited 2022 Jan 12];13(1):1–11. doi:10.1186/s40545-020-00230-6
19. Frugoni B, Gabriel RA, Rafaat K, Abanobi M, Rantael B, Brzenski A. A predictive model for prolonged hospital length of stay in surgical burn patients. Burns [Internet]. 2020 Nov 1 [cited 2022 Jan 12];46(7):1565–70. doi: 10.1016/j.burns.2020.04.021.
20. Khosravizadeh O, Vatankhah S, Bastani P, Kalhor R, Alirezaei S, Doosty F. Factors affecting length

of stay in teaching hospitals of a middle-income country. Electron physician [Internet]. 2016 Oct 25 [cited 2021 Sep 29];8(10):3042–7. doi: 10.19082/3042
21. Yew Tan F, Selvaraju K, Audimulam H, Chuan Yong Z, Hilda Adnan T, Balasundram S. Length of hospital stay among oral and maxillofacial patients: a retrospective study. 2021 [cited 2022 Jan 12]; doi:10.5125/jkaoms.2021.47.1.25
22. Amarya S, Singh K, Sabharwal M. Ageing process and physiological changes. [Internet]. Gerontology. InTech; 2018. [cited 2022 Jul 31]; doi: 10.5772/intechopen.76249
23. Lee SY, Lee S-H, Tan JHH, Foo HSL, Phan PH, Kow AWC, et al. Factors associated with prolonged length of stay for elective hepatobiliary and neurosurgery patients: a retrospective medical record review. BMC Health Serv Res. 2018 Jan;18(1):5. doi: 10.1186/s12913-017-2817-8.
24. Martínez-Pérez A, Payá-Llorente C, Santarrufina-Martínez S, Juan ·, Sebastián-Tomás C, Elнas Martínez-Lypez ·, et al. Predictors for prolonged length of stay after laparoscopic appendectomy for complicated acute appendicitis in adults. Surg Endosc [Internet]. 2021;35:3628–35. doi:10.1007/s00464-020-07841-9
25. Yeung SE, Hilkewich L, Gillis C, Heine JA, Fenton TR. Protein intakes are associated with reduced length of stay: a comparison between Enhanced Recovery After Surgery (ERAS) and conventional care after elective colorectal surgery. Am J Clin Nutr. 2017 Jul;106(1):44–51. doi: 10.3945/ajcn.116.148619.
26. Song Y, Bian Y. Gender differences in the use of health care in China: Cross-sectional analysis. Int J Equity Health [Internet]. 2014;13(1):1–6. doi:10.1186/1475-9276-13-8
27. Akinyemiju T, Meng Q, Vin-Raviv N. Association between body mass index and in-hospital outcomes: Analysis of the nationwide inpatient database. Medicine (Baltimore) [Internet]. 2016 Jul 1 [cited 2022 Jul 31];95(28). doi: 10.1097/MD.0000000000004189.
28. Nguyen AT, Tsai CL, Hwang LY, Lai D, Markham C, Patel B. Obesity and mortality, length of stay and hospital cost among patients with sepsis: A nationwide inpatient retrospective cohort study. PLoS One [Internet]. 2016 Apr 1 [cited 2022 Jul 31];11(4):e0154599. doi:10.1371/journal.pone.0154599
29. Dotan I, Shochat T, Shimon I, Akirov A. The association between BMI and mortality in surgical patients. World J Surg. 2021 May;45(5):1390–9. doi: 10.1007/s00268-021-05961-4.
30. Tulinský L, Mitták M, Tomá ková H, Ostruszka P, Penka I, Ihnát P. Obesity paradox in patients undergoing lung lobectomy - Myth or reality? BMC Surg [Internet]. 2018 Aug 17 [cited 2022 Jan 16];18(1):1–6. doi: 10.1186/s12893-018-0395-2.
31. El Moheb M, Jia Z, Qin H, El Hechi MW, Nordestgaard AT, Lee JM, et al. The obesity paradox in elderly patients undergoing emergency surgery: A nationwide analysis. J Surg Res. 2021 Sep 1;265:195–203. doi: 10.1016/j.jss.2021.02.008
32. Arun P, Vikraman B, Harikrishnan CP, Jacob Anton C, Ghreeshma P, Tintumole CT. Clinical correlation between preoperative serum albumin and postoperative outcome in major gastrointestinal surgeries. Saudi J Med. 2020 Mar 25;05(03):145–50. doi: 10.36348/sjm.2020.v05i03.003
33. Bhalla RG, Wang L, Chang SS, Tyson MD. Association between preoperative albumin levels and length of stay after radical cystectomy. J Urol [Internet]. 2017 Nov 1 [cited 2022 Jan 29];198(5):1039–45. doi: 10.1016/j.juro.2017.05.066.
34. Lalhruaizela S, Lalrinpuia B, Gupta VD. Serum Albumin is a Predictor for Postoperative Morbidity and Mortality in Gastrointestinal Surgeries. J Clin Diagnostic Res. 2020; 14(5):PC01-06. doi: 10.7860/JCDR/2020/44315.13682
35. Ahmed J, Sarma NM. Preoperative serum albumin as predictor of adverse outcome in emergency abdominal surgery. Int Surg J. 2022;9(5):1034. doi: 10.18203/2349-2902.isj20221151
36. Larson DW, Abd El Aziz MA, Perry W, D'Angelo AL, Behm KT, Mathis KL, et al. Additional value of preoperative albumin for surgical risk stratification among colorectal cancer patients. Ann Nutr Metab [Internet]. 2020 Mar 1 [cited 2022 Jan 29];76(6):422–30. doi: 10.1159/000514058.
37. Ehresman J, Ahmed AK, Schilling A, Pennington Z, Lubelski D, Cottrill E, et al. Preoperative nutrition consults associated with decreased postoperative complication rate and decreased length of hospital stay after spine metastasis surgery. World Neurosurg [Internet]. 2020 Jan 1 [cited 2022 Feb 1];133:e173–9. doi: 10.1016/j.wneu.2019.08.197
38. Hussen L, Tadesse E, Teferi DY. Preoperative nutritional status and its consequences on abdominal surgery in Wolaita Zone, Southern Ethiopia: An institution-based observational study. J Nutr Metab. 2020;2020. doi: 10.1155/2020/2324395.
39. Mullin GE, Fan L, Sulo S, Partridge J. The association between oral nutritional supplements and 30-day hospital readmissions of malnourished patients at a US Academic Medical Center. J Acad Nutr Diet [Internet]. 2019 Jul 1 [cited 2022 Feb 4];119(7):1168–75. doi: 10.1016/j.jand.2019.01.014
40. Wong TX, Wong WX, Chen ST, Ong SH, Shyam S, Ahmed N, et al. Effects of perioperative oral nutrition supplementation in Malaysian patients undergoing elective surgery for breast and colorectal cancers—A randomised controlled trial. Nutrients [Internet]. 2022 Feb 1 [cited 2022 Aug 3];14(3):615. doi: 10.3390/nu14030615.
41. Budzyński J, Tojek K, Czerniak B, Banaszkiewicz

Z. Scores of nutritional risk and parameters of nutritional status assessment as predictors of in-hospital mortality and readmissions in the general hospital population. Clin Nutr. 2016 Dec 1;35(6):1464–71. doi: 10.1016/j.clnu.2016.03.025.

42. Gomes F, Emery PW, Weekes CE. Risk of malnutrition is an independent predictor of mortality, length of hospital stay, and hospitalization costs in stroke patients. J Stroke Cerebrovasc Dis. 2016 Apr 1;25(4):799–806. doi:10.1016/j.jstrokecerebrovasdis.2015.12.017
43. Maia I, Xará S, Vaz D, Shiang T, Amaral TF. Undernutrition risk at hospital admission and length of stay among pulmonology inpatients. Pulmonology. 2018 Nov 1;24(6):330–6. doi: 10.1016/j.pulmoe.2018.01.004
44. Barker LA, Gout BS, Crowe TC. Hospital malnutrition: Prevalence, identification and impact on patients and the healthcare system. Int J Environ Res Public Health [Internet]. 2011 [cited 2022 Jul 5];8(2):514. doi: 10.3390/ijerph8020514
45. Inciong JFB, Chaudhary A, Hsu HS, Joshi R, Seo JM, Trung LV, et al. Hospital malnutrition in northeast and southeast Asia: A systematic literature review. Clin Nutr ESPEN [Internet]. 2020;39:30–45. doi:10.1016/j.clnesp.2020.06.001
46. Weimann A, Braga M, Carli F, Higashiguchi T, Hübner M, Klek S, et al. ESPEN guideline: Clinical nutrition in surgery. Clin Nutr [Internet]. 2017 [cited 2021 Aug 19];36:623–50. doi:10.1016/j.clnu.2017.02.013
47. Casalino E, Perozziello A, Choquet C, Curac S, Leroy C, Hellmann R. Evaluation of hospital length of stay and revenues as a function of admission mode, clinical pathways including observation unit stay and hospitalization characteristics. Heal Serv Manag Res [Internet]. 2019 Feb 1 [cited 2022 Mar 3];32(1):16–25. doi:10.1177/0951484818767606
48. Palayan K, Tang Y, Xuan Sam C, Wayne Kee C, Naim Rusman M, Aflah Mohd Derus A, et al. Emergency general surgery in a public hospital in Malaysia. Med J Malaysia. 2020 Sep 5;75(5):467–71.
49. Wong KA, Holloway S. An observational study of the surgical site infection rate in a General Surgery Department at a General Hospital in Malaysia - Wounds International [Internet]. Wounds International. 2019 [cited 2022 Mar 3]. Available from: https://www.woundsinternational.com/resources/details/observational-study-surgical-site-infection-rate-general-surgery-department-general-hospital-malaysia
50. De Assis MCS, De Moraes Silveira CR, Beghetto MG, De Mello ED. Decreased calorie and protein intake is a risk factor for infection and prolonged length of stay in surgical patients: A prospective cohort study. Rev Nutr. 2016 May 1;29(3):307–16. doi: 10.1590/1678-98652016000300001