

Geriatric anesthesia: Demographics, epidemiology, state of the art at international level, educational needs, and future perspectives

ABSTRACT

Population aging has induced in the last year a corresponding aging inside the surgical population, currently accounting for 45%-50% of the total surgical population in the majority of the advanced countries. This has induced a number of new challenges in the daily anesthesia practice, ranging from the need of implementing specific education in the field of geriatric medicine, organizational adjustments aimed to adapt our preoperative evaluation methodology to the needs older patients present, and a careful redesign of the whole perioperative course for these patients. Today's anesthesiologists are called to become familiar with the aging processes and their impact on the patho-physiological perioperative course, with the concept of functional impairment and frailty and with the dimensions of poly-pathology, poly-medication, and reduced functional reserves. The introduction of new trends such as the team-based approach and interdisciplinary culture are essential to overcome these emerging criticalities.

Key words: Education in geriatrics, geriatric surgery, population aging

Introduction

Population aging has induced in the last year a corresponding aging within the surgical population, currently accounting for 45%-50% of the total surgical population in the majority of the advanced countries. This has induced a number of new challenges in the daily anesthesia practice, ranging from the need of implementing specific education in the field of geriatric medicine, organizational adjustments aimed to adapt our preoperative evaluation methodology to the needs older patients present, and a careful redesign of the whole perioperative course for these patients.


Today's anesthesiologists are called to become familiar with the aging processes and their impact on the patho-physiological perioperative course, with the concept of functional impairment and frailty and with the dimensions of poly-pathology, poly-medication, and reduced functional reserves.

The introduction of new trends such as the team-based approach and interdisciplinary culture are essential to overcome these emerging criticalities.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Bettelli G. Geriatric anesthesia: Demographics, epidemiology, state of the art at international level, educational needs, and future perspectives. Saudi J Anaesth 2023;17:467-73.

| Access this article online | |
|--|---|
| Website: https://journals.lww.com/sjan | Quick Response Code  |
| DOI: 10.4103/sja.sja_411_23 | |

GABRIELLA BETTELLI

Specialist in Anaesthesia and Intensive Care, Specialist in Cardiology, MSc in Geriatric Medicine, Scientific Director, 2nd Level Master in Perioperative Geriatric Medicine, San Marino University, Past Director Dpt. of Anesthesia, Intensive Care, Day Surgery and Pain Treatment, Past Director Geriatric Surgery Area, IRCCS INRCA – Italian National Research Centre on Aging, Ancona, Italy

Address for correspondence: Prof. Gabriella Bettelli, Via Emilia Est 133 – 41121 Modena – Italy.
 E-mail: gabriella.bettelli@unirmsm

Submitted: 15-May-2023, **Revised:** 16-May-2023, **Accepted:** 17-May-2023, **Published:** 18-Aug-2023

General overview

Although affecting the different areas of the world in a inhomogeneous way, population aging represents an ubiquitous trend and a multifaceted challenge, encompassing social, economic, and healthcare-related aspects.

Data from the World Health Organization indicate that by 2030, 1 in 6 people in the world will be aged 60 years or more and that the proportion of the world's population over 60 is expected to nearly double between 2015 and 2050, passing from 12% to 22%^[1]; the same source also reports that, in 2050, 80% of older people will be living in low-income and-middle-income countries.

In accordance with the World Economic Forum, the number of people aged 65 years and more is expected to double over the next three decades, reaching 1.6 billion in 2050; Asia is leading this trend, with Hong Kong, South Korea, and Japan expected to have the highest share of people aged 65 years and more by 2050.^[2]

Data published on 2022 by the U.S. Census Bureau and the Administration for Community Living report that in 2019 people aged 65 years and more represented 16% of the population but are expected to grow to be 21.6% of the population by 2040. The 85 years and older population is projected to more than double from 6.6 million in 2019 to 14.4 million in 2040.^[3]

Data from Eurostat show that in 2022 half of the EU's population was older than 44.4 years and that one-fifth was aged 65 years and more, with the highest median age in Italy and the lowest in Cyprus. The share of older people continues to increase, and the EU's population is projected to increase to 449.3 million around 2026.^[4]

As per the United Nations Population Fund, in 2020 the number of aging people in Saudi Arabia was 6% of the population but will be more than 20% by 2050. Further data about aging in this country were recently reported.^[5]

The increasing in life expectancy worldwide has stimulated the production of an enormous amount of research focused on aging itself, healthcare in older persons and related clinical and nonclinical aspects.^[6] However, despite the wide number of related studies, a shared definition of the age at which a person should be considered "old"—and appropriate measures of aging to be adopted when investigating this field—are still debated between scientists worldwide.

In a recent review by Behr,^[7] three systematic literature searches are collected, analyzed, and reported, covering the basal concepts and definitions of healthy aging, outcomes and measures in aging studies and scores and indices of healthy aging: given the wide amount of data reported and the good quality of the methodological issues provided, reading this publication is widely recommended.

Among the main phenomena related to the increased life expectancy, a parallel growth in the volume of activities related with healthcare for older persons, such as geriatric surgery, has been registered in the last 20 years. From the anesthesiologists' point of view, this situation opens a great number of challenges in terms of clinical practice, organization, knowledge, and education. Presently, in fact, neither preoperative evaluation of the pathophysiological specificities' older patients presents nor postoperative complications prevention are systematically and diffusely exerted, while only a small number of institutions has implemented dedicated clinical path for geriatric surgery; at the same time, targeted educational initiatives are very few.

The geriatric surgical patient

Approaching geriatric surgical patients is an everyday increasing task for today's anesthesiologists, requiring extended knowledge of the consequences of aging processes on the different organs and apparatuses, the associate conditions frequently presenting with the features of poly-pathology, and possible problems related to chronically assumed medication, such as use of inappropriate medication or prescription duplication. Moreover, under the organizational point of view, a complete and exhaustive assessment of these patients often requires longer times than those usually sufficient in younger patients. This frequently conflicts with the timing reserved by the hospital organization to the anesthesia preoperative consultation, mostly in cases where further specialistic consultations are needed.

Being the quality of surgical outcome strictly related to the accuracy with which preoperative investigations are conducted, this problem requires the adoption of team-based initiatives among professionals involved and a close connection with the hospital top management.

1. Chronological and biological age

Aging is accompanied by a variable degree of functional impairment related to the personal clinical history, aging processes, genetics, lifestyle, and associated conditions. Therefore, older patients represent a highly inhomogeneous patients' group, inside which the chronological age almost

never provides criteria for deciding about surgery: among the few conditions in which chronological age can be assumed as determinant in decision-making against surgery, there is the case in which the patient's age is extremely advanced—such as in centenarians—and surgery is only aimed to prolong life. In any case, there is increasing agreement about the fact that whenever aimed to provide symptom relief, surgery should be taken into account also in the oldest old.

Much more important than the chronological age, is the concept of biological age, which includes variables such as the amount of residual functional reserves, mental, sensorial, and emotional status and the level of independence, together with the impact exerted by the associated conditions and the medication regimen. However, a synthetic, reliable, and universally sheared definition of biological age has not yet been established.

2. Functional status (FS)

Functional disability is defined as an acquired difficulty in performing basic everyday tasks, such as dressing, bathing, using the toilet (i.e., BADL: Basal Activities of Daily Living), or more complex tasks needed for independent living, such as using the telephone, managing money, preparing meals, using transportation, and managing medication intake (i.e., IADL: Instrumental activities of Daily Living). In other words, FS expresses the individual level of independence.

As detailed in the follows, the degree of functional disability is widely influenced by the type, number, and severity of associated conditions. Further factors that promote functional impairment are alcohol consumption, depression, and frailty.^[8]

Other variables to take into account in assessing FS and in defining the level of functional disability include the cognitive, emotional, sensory, and nutritional status and the availability of family or social support. Different evaluation scales are available to assess them: cognition is usually assessed by tests such as Clock Test, Mini-Cog, and Mini Mental State Examination; depression is assessed by Geriatric Depression Scale (available in basic and more articulated structure and including 15 or 30 questions); nutritional status is usually assessed by Mini Nutritional Assessment.

This set of functional measures represents an organized approach to the assessment of an older person's FS, his/her general conditions, and mental health and is defined "Comprehensive Geriatric Assessment" or CGA. CGA is a pivotal tool in geriatrics, whose structure, number, and type of included variables and corresponding complexity are determined by the purpose for which it is executed (definition

of the medical, functional, or psychological patient's needs and consequent coordinated and integrated treatment plan or long-term follow-up, demographic studies, resources allocation, preoperative evaluation, or others).^[9-11] Implementing essential components of CGA [Table 1] in preoperative evaluation and—hopefully as a part of the anesthesia consultation—is recommended by a number of guidelines^[12,13] and institutions.^[14] This will allow an early individuation of the areas of vulnerability and of a first plan for preoperative optimization. Major deficits will require specific interventions, such as geriatric, neuropsychiatric, nutritional, or physio-kinetic therapist consultation.

3. Frailty

Frailty is increasingly recognized as a distinctive health state related to the aging processes, in which multiple body systems gradually lose their functional reserves. The most widely accepted definition, provided by Fried, is that of "an age-dependent status of reduced resistance to stressors and related to a cumulative physiologic decline, comorbidity, disability, risk of institutionalization, and death".^[15] Both a frailty phenotype (physical model) and a deficit accumulation model (biomedical and psychosocial model) were postulated as conceptual models for its development.

Its pathophysiological essence stays in a latent vulnerability of the general conditions, whose consequence is that even a minor pathophysiological adverse event may induce a sudden, precipitating functional decline, due to the limits in functional reserves.^[16]

Frailty prevalence among older surgical patients has been found higher than in the general population of the same age, and adverse postoperative outcomes have been reported to be higher and more severe in frail patients.^[17-19]

Two main groups of measuring tools exist to investigate frailty: surrogate single measures such as forearm grip strength, gait speed, Timed Up & Go, or other monodimensional tools and scoring scales such as the Clinical Frailty Scale,^[20] Fried Score,^[21] Edmonton Frailty Score,^[22] or similar [Table 2].

Table 1: Essential components of CGA

| Items evaluated | Most used Scales |
|--|----------------------------|
| Weighted evaluation of associate illnesses | Charlson Index, CIRS |
| Level of independence | BADL&IADL |
| Cognition | Clock Test, Mini-Cog, MMSE |
| Emotional evaluation | Geriatric Depression Scale |
| Nutrition | MNA |
| Availability of family or social support | No scale |
| Sensory impairment | No scale |

Table 2: Examples of Frailty assessment scales

| Surrogate single measures | | Scoring scales | |
|--|--|--|--|
| Test | Results evaluation | Test | Parameters |
| Forearm grip strength (Fess, 1992) ^[23] Strength is measured using a calibrated hydraulic hand dynamometer | Grip strength <20 in females and <30 in males: FRAIL Grip strength >20 in females and >30 in males: NON_FRAIL | Fried Frailty Phenotype (Fried <i>et al.</i> 2001) ^[21] | <ul style="list-style-type: none"> Weakness or poor handgrip strength Unintentional weight loss Self-reported exhaustion Slow walking Low physical activity |
| TUG (Podsiadlo and Richardson, 1991) ^[24] Patients are instructed to stand from a seated position in a chair, walk at their normal pace 3 meters to a mark on the floor, turn around, return to the chair and sit back down. | Time <15' indicates frailty | Edmonton Frailty Scale (Rolfson\, 2000) ^[22] | <ul style="list-style-type: none"> Cognitive impairment Health attitudes Social support Medication use nutrition Mood Continence Functional abilities |
| Gait Speed (Bohannon 1997) ^[25] Time needed to walk 4 metres | Time longer than 5 seconds (<0.8 m/s) suggests frailty | PRISMA 7 (Raïche) Questionnaire | <ul style="list-style-type: none"> Age, gender Limitation in daily activities Need for regular assistance Health problems confining home Need of caregiver Use of wheelchair or walking aids |

Intercepting frailty before surgery is fundamental to identify higher risk patients: this task should be part of basal preoperative routine and a component of the anesthesia consultation.

Although reliable estimations are difficult to obtain due to extreme variability in the methodological approach adopted in the different studies,^[26] the distribution of the patterns above among the surgical population worldwide is widely influenced by social and economic factors, with higher concentration of disabilities in poorest countries.^[27,28] A correlation between different age brackets and FS with the surgical outcome in the very elderly (aged more than 85 years) has been shown in a wide patients' group.^[29]

4. Epidemiology of associated conditions

The impact of associated conditions on surgical outcome in older patients has been largely investigated in the last 20 years. Hypertension, that affects 45%-50% of patients aged more than 70 years, and diabetes mellitus (12%-15%) have been found to be the most common.^[30] Other common conditions are coronary artery disease (35%) and chronic obstructive pulmonary disease (9). The prevalence of these conditions has a variable distribution across the different surgical specialties.^[31-34]

More than 50% of patients aged more than 70 years suffer from at least one infirmity and 30% suffer from two or more. This feature, also known as poly-pathology, indicates a condition in which clinical patterns, evolution, and treatment are more complicated than the simple sum of all illnesses; at the same time, a reduced capability to cope with the surgical stress coexists.

Stiffened myocardium and vasculature, blunted beta-adrenoreceptor responsiveness, and impaired autonomic reflex control of heart rate are the most important patterns to take into account when delivering perioperative care to older cardiac patients. Preoperative risk assessment should focus on the procedure-related risk, patient FS, and the risk of postoperative cardiac complications. Surgical stress response, that increases myocardial oxygen consumption and alters the balance between prothrombotic and fibrinolytic factors, should be limited adopting minimally invasive procedures and performing combined general-epidural anesthesia techniques.

Mean values of the prevalence of cognitive impairment in patients aged 65 years and more are reported to be 15%-20% and more, depending from sources. This condition is strictly related to the development of postoperative cognitive complications, such as postoperative delirium (POD) and postoperative cognitive decline; both are recognized risk factors for adverse long-term outcome, longer hospital stay, increased cost, high risk of institutionalization after discharge, and impaired quality of life. Although the risk factors for POD are well defined,^[35] their preoperative scoring is not systematically performed and both targeted prevention measures and close monitoring of the cognitive status regrettably do not represent an ubiquitous praxis.

Concerning respiratory conditions, the prevalence of chronic obstructive pulmonary disease among over 65 years is estimated around 14.2% (11% to 18%);^[36] however, this datum is probably underestimated due to the reduced use of respiratory tests. In heavy smokers, its prevalence reaches 50%. Asthma prevalence in over 65 years is estimated between 4% and 8% and this condition is more severe among older patients.^[37]

Aging processes affecting respiratory function have great impact on intraoperative gas exchanges, due to a decline in thoracic elasticity, weakening of respiratory muscles, and decrease in both the alveolar surface and central nervous system responsiveness. Pulmonary loss of elasticity and stiffness of the thoracic cage reduce vital capacity and thoracic compliance, whereas the respiratory responses to hypoxia and hypercapnia are reduced. Protective reflexes involved in coughing and swallowing are diminished, increasing the risk of pulmonary aspiration.

Sensorial deficits are common after 60 years. The prevalence of presbycusis in 70-year-old patients is reported around 50%; however, in patients aged 75 years and more, this datum is significantly higher.^[38] Australian studies have shown that the prevalence of cataract doubles with each decade of age after 40 years and that nearly everyone aged 90 years or more suffers from this condition.

Visual impairment due to cataract is higher in developing countries, and in India it has been reported three times more than in the United States, with 82% of Indians aged 75 to 83 years affected by cataract.^[39] Macular degeneration and glaucoma affect, respectively, 14% and 12% of over 65 years.

Collecting clinical history may be challenging in older patients due to communication difficulties related to sensorial deficits or cognitive impairment. The presence of a relative or a caregiver may be helpful in these cases.

Geriatric surgery activities in the world

1. Volume of activities and most frequently performed surgeries in older patients

Global statistics on the volume of geriatric surgery performed worldwide are not available; however, it is estimated that the percentage of patients aged more than 65 years currently represents about 40%-50% of the global surgical population in the advanced countries.

In accordance with the majority of reports, the most common surgeries needed by older patients are cancer surgeries, cataract, joint replacement, and cholecystectomy. Hip fracture is probably the most common emergent procedure in this patients' group. Cardiac surgery in octogenarians is increasingly performed.^[40]

In accordance with a recent report by Dobson,^[41] more than 300 million major surgeries are performed each year, with a global mortality of 1%-4% corresponding to around 8 millions, serious postoperative morbidity up to 15%, and 5%-15% of hospital readmissions within 30 days. Global postoperative mortality represented up to 14% of the deaths worldwide

in 2018. Actions aimed to reduce preventable deaths and postoperative complications would save billions of dollars in healthcare cost. Part of the global problem resides in differences in institutional practice patterns in high-income and low-income countries. This is mostly true in the field of geriatric surgery.

2. State of the art

The enormous expansion in geriatric surgery is related to the increase in life expectancy worldwide. The need to optimize outcomes among older patients goes beyond the aspects usually considered in the adult population, such as postoperative complications rate and mortality. In fact, the effects of aging processes, associated conditions, frailty and disabilities as causes of increased perioperative morbidity, and related cost increase have contributed in accumulating specific knowledge and induced new trends in the management of these patients.

Prehabilitation, multiprofessional team-based perioperative care involving geriatricians, POD prevention, and the need to minimize postoperative functional decline are modifying the traditional approach to this patients' group.

Among the different countries, professionals' awareness toward these new needs is extremely varied, ranging from intrinsically proactive approaches such as those defined and implemented in the United States by the American College of Surgeons and the Coalition for Quality in Geriatric surgery, to diffuse immobility and acritical continuation of traditional praxis, far from older patients' needs still present in many European and non-European countries.

As observed in 2008 by a group of authors that included the prominent public health researcher and medicine philosopher Atul Gawande, "our finding suggests that surgery now occurs at a tremendous volume worldwide, in settings both rich and poor... A public health strategy for surgical care is paramount".^[42]

Educational needs and available initiatives

The contents expressed above draft a challenging panorama for those who deal with surgery and anesthesia in the present time. A fundamental point is that specific knowledge is required to investigate the health and FS in older patients, identify appropriate preoperative optimization strategies, and reduce postoperative complications and related cost. However, educational initiatives aimed to transmit geriatric culture to surgeons and anesthesiologists are very few; as observed by Pearce,^[43] "there is a clear societal need to address perioperative care for older surgical patients".

Whereas the American Society of Anesthesiologists has introduced since years a syllabus on Geriatric Anesthesiology that can be downloaded directly from the American Society of Anesthesiologists website, similar initiatives do not exist in Europe, where only two dedicated postgraduate university-based courses are operating: the Diplôme d'Université "Anesthésie et Réanimation du patient âgé" provided by the Sorbonne University in Paris and the Second Level University Master in Perioperative Geriatric Medicine co-managed by the University of San Marino and the Catholic University in Rome. The institution of similar courses is deeply advocated.

Perioperative care for older patients widely goes beyond the traditional outcomes of time to scan, time to surgery, or length of stay. An individualized comprehensive approach taking into consideration premorbid function, comorbidities, personal wishes, quality of life, and functional recovery should also be incorporated to ensure that the care for this special patients' group is holistic and complete.^[44]

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

- World Health Organization: Aging and health, 2022. Available from: [https://www.who.int/news-room/fact-sheets/detail/ageing-and-health#:~:text=By%202030%2C%201%20in%206,will%20double%20\(2.1%20billion\)](https://www.who.int/news-room/fact-sheets/detail/ageing-and-health#:~:text=By%202030%2C%201%20in%206,will%20double%20(2.1%20billion).).
- World Economic Forum: Ageing and Longevity, Feb. 22, 2023
- United States Census Bureau: Older Population and Aging. Available from: <https://www.census.gov/topics/population/older-ageing.html>.
- Eurostat: Population structure and ageing, 2022. [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Population_structure_and_ageing#:~:text=In%202022%2C%20more%20than%20one,was%20aged%2065%20and%20over.&text=The%20median%20age%20of%20the,was%20older%20than%2044.4%20years](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Population_structure_and_ageing#:~:text=In%202022%2C%20more%20than%20one,was%20aged%2065%20and%20over.&text=The%20median%20age%20of%20the,was%20older%20than%2044.4%20years.). [Last accessed 2023 Jun 10].
- Salam AA. Ageing in Saudi Arabia: New dimensions and intervention strategies. *Sci Rep* 2023;13:4035.
- Lobman R. Geriatrics in practice and research. *Geriatrics (Basel)* 2016;1:1
- Behr LC, Simm A, Klutting A, Grosskopf Großkopf A. 60 years of healthy aging: On definitions, biomarkers, scores and challenges. *Ageing Res Rev* 2023;88:101934
- Virtuoso JS, Martins CA, Roza LB, Silva de Paulo TR, Lopes Ribeiro M, Tribess S. Prevalence of disability and associated factors in the elderly. *Text Context Nursing* 2015;24:521-9.
- Ellis G, Gardner M, Tsiachristas A, Langhorne P, Burke O, Harwood RH, *et al.* Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane database Syst Rev* 2017;9:CD006211. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6484374/>. [Last accessed on 2023 Jun 16].
- Dhesi J, Moonesinghe SR, Partridge J. Comprehensive geriatric assessment in the preoperative setting: Where next? *Age Ageing* 2019;48:624-7.
- Miller RL, Barnes JD, Mouton R, Braude P, Hinchliffe R. Comprehensive Geriatric Assessment (CGA) in perioperative care: A systematic review of a complex intervention. *BMJ Open* 2022;12:e06729.
- Aceto P, Antonelli Incalzi R, Bettelli G, Carron M, Chiumento F, Corcione A, *et al.* Perioperative Management of Elderly patients (PriME): Recommendations from an Italian intersociety consensus. *Ageing Clin Exp Res* 2020;32:1647-73.
- Griffiths R, Beech F, Brown A, Dhesi J, Foo I, Goodall J, *et al.* Perioperative care of the elderly. *Anaesthesia* 2014;69(Suppl 1):81-98.
- Berian J, Rosenthal RA. Hospital standards to promote optimal surgical care of the older adult: A report from the Coalition for Quality in Geriatric Surgery. *Ann Surg* 2017;265:280-90.
- Fried LP, Ferrucci L, Darer L, Williamson JD, Anderson G. Untangling the concept of disability, frailty and comorbidity: Implications from improved targeting and care. *J Gerontol* 2004;59:255-63.
- Bettelli G. Preoperative evaluation. In: Bettelli G, editor. *Perioperative Care of the Elderly: Clinical and Organizational Aspects*. Cambridge: Cambridge University Press; 2017 p. 18.
- Makary MA, Segev DL, Pronovost PJ, Syin D, Bandeen-Roche K, Patel P, *et al.* Frailty as a predictor of surgical outcomes in older patients. *J Am Coll Surg* 2010;210:901-8.
- Hewitt J, Long S, Carter B, Bach S, McCarthy K, Clegg A. The prevalence of frailty and its association with clinical outcomes in general surgery: A systematic review and meta-analysis. *Age Ageing* 2018;47:793-800.
- Panayi AC, Orkaby AR, Sakthivel D, Endo Y, Varon, D, Roh D, *et al.* Impact of frailty on outcomes in surgical patients: A systematic review and meta-analysis. *Am J Surg* 2019;218:393-400.
- Church S, Rogers E, Rockwood K, Theou O. A scoping review of the clinical frailty score. *BMC Geriatr* 2020;20:393.
- Fried LP, Tangen CM, Walston J. Frailty in older adults: Evidence for a phenotype. *J Gerontol Med Sci* 2001;56:M146-56.
- Rolfson DB, Majumdar SR, Tsuyuki TR, Tahir A, Rockwood K. Validity and reliability of the Edmonton frail scale. *Age Ageing* 2006;35:526-9.
- Fess EE, 'Grip strength'. In: Casanova JS, editor. *Clinical assessment recommendations*, 3rd edn., New Jersey: American Society for Hand Therapists; 1992. p. 41-5. [Google Scholar].
- Podsiadlo D, Richardson S. The timed "Up&Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991;39:142-48.
- Bohannon RW, Williams Andrews A. Normal walking speed: a descriptive meta-analysis. *Physiotherapy* 2011;97:182-9.
- O'Caomh R, Sezgin D, O'Donovan MR, Molloy DW, Clegg A, Rockwood K, *et al.* Prevalence of frailty in 62 countries across the world: A systematic review and meta-analysis of population-level studies. *Age Ageing* 2021;50:96-104.
- Alqahtani B, Alshehri MM, Elnaggar RK, Alsaad SM, Alsayer AA, Almadani N, *et al.* Prevalence of frailty in the Middle East: Systematic review and meta-analysis. *Healthcare (Basel)* 2022;10:108.
- Vu HTT, Nguyen TX, Nguyen TN, Nguyen AT, Cumming R, Hilmer S, *et al.* Prevalence of frailty and its associated factors in older hospitalized patients in Vietnam. *BMC Geriatrics* 2017;17:216.
- Silva DJN, Casimiro LGG, Oliveira MIS, Ferreira LBDC, Abelha FJPA. The very elderly surgical population in a critically ill scenario: Clinical characteristics and outcome. *Braz J Anesthesiology* 2020;70:3-8.
- Chawan AP, Rathore YS, Chumber S, Kataria K. Surgical diseases and surgical outcomes in geriatric patients. *Int Surg J* 2020;7:3315-20.
- Extermann M. Measuring comorbidity in older cancer patients. *Eur J Cancer* 2000;36:453-71.
- Prout GR Jr, Wesley MN, Yancik R, Ries AG, Havlik RJ, Edwards BK. Age and comorbidity impact surgical therapy in older bladder carcinoma patients. *Cancer* 2005;104:1638-47.

33. Chikuda H, Yasunaga H, Horiguchi H, Takeshita K, Sugita S, Taketomi S, *et al.* Impact of age and comorbidity burden on mortality and major complications in older adults undergoing orthopaedic surgery: An analysis using the Japanese diagnosis procedure combination database. *BMC Musculoskelet Disord* 2013;14:173.
34. Ho VP, Schiltz NK, Reimer AP, Madigan EA, Koroukian S. High-risk comorbidity combinations in older patients undergoing emergency general surgery. *J Am Geriatr Soc* 2019;67:503-10.
35. Aldecoa C, Bettelli G, Bilotta F, Sanders RD, Audisio R. European Society of Anaesthesiology evidence-based and consensus based guideline on postoperative delirium. *Eur J Anaesthesiol* 2017;34:192-214.
36. Halbert RJ, Natoli JL, Gano A, Badamgarav E, Buist AS, Mannino DM. Global burden of POCD: Systematic review and meta-analysis. *Eur Respir J* 2006;28:523-32.
37. Skloot GS, Busse PJ, Braman SS, Kovacs EJ, Dixon AE, Vaz Fragoso CA, *et al.* On official American Thoracic Society workshop report: Evaluation and management of asthma in the elderly. *Ann Am Thorac Soc* 2016;13:2064-77.
38. Wattamwar K, Qian ZJ, Otter J, Leskowitz MJ, Caruana FF, Siedlecki B, *et al.* Increases in the rate of age-related hearing loss in the older old. *JAMA Otolaryngol Head Neck Surg* 2017;143:41-5.
39. Brian G, Taylor H. Cataract blindness – challenges for the 21st century. *Bulletin of the WHO* 2001;79:249-56.
40. Jones JM, Loubani M, Grant SW, Goodwin AT, Trivedi U, Kendall S, *et al.* Cardiac surgery in older patients: Hospital outcomes during a 15-year period from a complete national series. *Inter Cardiovasc Thorac Surg* 2022;34:532-9.
41. Dobson GP. Trauma of major surgery: A global problem that is going away. *Int J Surg* 2020;81:47-54.
42. Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, *et al.* An estimation of the global volume of surgery: A modelling strategy based on available data. *Lancet* 2008;372:139-44.
43. Pearce L, Bunni J, MsCarthy K, J Hewitt. Surgery in older person: Training needs for the provision of multidisciplinary care. *Ann R Coll Surg Engl* 2016;98:367-70.
44. Ning Goh SS, Chia CLK. Improving outcomes in geriatric surgery: Is there more to the equation? *World J Clin Case* 2022;10:4321-3.