Indian J Med Res 160, August 2024, pp ***-***
DOI: 10.25259/ijmr_1671_23

# Global variations in elderly cancer mortality pattern in 2020 & prediction to 2040: A population-based study

Manoj Kalita, Devaraja M., Indranil Saha & Amit Chakrabarti

*ICMR-Centre for Ageing & Mental Health, Kolkata, India*

Received August 22, 2023; Accepted June 27, 2024; Ahead of print October 19, 2024; Published ******** **, 2024

***Background & objectives*: Cancer contributes to decreasing life expectancy, especially in low- and middle- income countries (LMIC) and countries in transition where resources for diagnosis and care are limited. As the world population is ageing, and by 2050, two-thirds of the population in LMIC will be elderly, the greater impact of cancer on the expectation of life in years at a given age of an adult will be seen in these countries.**

***Methods*: Estimated cancer mortality for older adults (60 yr or above) was estimated using statistics available on Globocan 2020 platform (*gco.iarc.fr*). This platform provided the number of deaths and age-standardized truncated mortality rates (per 100,000) by sex and continent. We calculated the projected cancer deaths in 2040 by applying the projection model, considering a stable rate.**

***Results*: Globally, with an estimated 7.5 million deaths, cancer deaths in older population represented a total of 71.2 per cent of all cancer-related deaths. The truncated age-adjusted mortality rate among the older population (both sexes) was estimated as 615.1 deaths per 100,000 and the mortality rate was 62.6 per cent higher in elderly (60 yr or above) males as compared to elderly females. The overall future cancer death among the elderly was estimated to increase from 7.05 to 12.7 million deaths, representing a total 80.2 per cent increase in deaths by 2040.**

***Interpretation & conclusions*: The projected mortality increase will challenge existing healthcare systems, especially in lower or lower medium-income countries where resources are limited. Elderly patients are at an elevated risk of adverse outcomes due to the high prevalence of co-morbid conditions. Geriatric oncology will play an important role in the coming years to ensure the overall health and well-being of elderly patients, which needs to be supported by good stratified data on elderly cancer.**

**Key words** Cancer - elderly - human development index (HDI) - mortality - older adults

The global burden of cancer is increasing rapidly, mainly due to the ongoing demographical and epidemiological transition[1]. Cancer is the leading cause of death globally (about 1 in 6 deaths), with an estimated 10 million deaths in 2020[2,3]. Population ageing has significantly contributed to the rising burden; earlier estimates showed that older ages account for about 50 per cent of all global cancer burden[4]. Despite the high incidence and mortality, limited information is available regarding the disease

burden in this group. Older patients are always at an elevated risk of unfavourable outcomes due to coexisting co-morbidities, and a higher treatment abandonment rate[5,6] and lower survival rates were seen in older adults as compared to younger ones[7].

It is projected that one in every six persons globally will be aged 60 yr or over by 2030[8], which will lead to an increase in both cancer incidence and deaths. This growing burden will make the role of geriatric oncology immense in the coming years to ensure comprehensive and effective treatment and care for this group of patients, particularly when resources are limited. We need good stratified local or national data on elderly cancers, which will also help to formulate effective local cancer control policies.

This study was initiated to provide a detailed global pattern of elderly cancer mortality by world region, sites and gender, which would help develop local elderly cancer care policies.

## Material & Methods

The study was undertaken at ICMR-Centre for Ageing & Mental Health, Kolkata, India from March to July 2023, after obtaining the approval from RIO (Research Integrity Officer).

Cancer mortality (deaths) and future estimates were arrived at using publicly available Globocan 2020 online database [Global Cancer Observatory (*gco.iarc.fr*), cancer today, cancer tomorrow and cancer over time] of the International Agency for Research on Cancer (IARC), World Health Organization (WHO) for all cancers combined (ICD-10, C00-C97, except C44), available for 185 countries or territories for 36 cancer types by sex and age group[9-11]. Data were available for 185 countries or territories. During the continent-wise analyses, data were extracted and reported for Asia, Europe, Northern America, Latin America & the Caribbean, Africa and Oceania.

We reported the number of new deaths among elderly aged 60 yr and above, truncated age-standardized mortality rates (per 100,000) for all cancer sites combined, site-wise, gender-wise and world region-wise. The truncated ASR was calculated for the age group 60 and above using the world standard population method proposed by Segi and modified by Doll *et al*[12]. Estimated results and figures generated online were used with appropriate permission from IARC Section of Cancer Surveillance (CSU).

All the analyses were done using Microsoft Excel, SPSS version 21 (IBM, Armonk, NY, USA) and IARC-WHO online portal (*gco.iarc.fr*, cancer today, cancer tomorrow and cancer over time).

*Data permission*: Necessary permission was obtained from the IARC–WHO for data abstraction, analysis and generating tables and Figures along with proper citation were provided as per the laid out policy (*https://publications.iarc.fr/Terms-Of-Use*).

## Results

It is estimated that 71.2 per cent (70,46,181 deaths excluding non-melanoma of skin) of all cancer-related deaths occur in individuals aged 60 yr and above in 2020, with a higher relative proportion of deaths in Asia (55.7%), followed by Europe (23%), Northern America (8.3%), Africa (5%) and Oceania (0.8%) (Table I, Fig. 1A). A total of 1.42 million deaths were estimated due to lung cancer in both sexes accounting for 20.2 per cent of all cancer deaths among older adults (Fig. 1B). It is quite remarkable to come across such findings among all global elderly deaths due to cancer; China alone accounts for 30.5 per cent when both sexes considered together, among elderly male deaths it accounts for 32.6 per cent and among elderly female deaths, it accounts for 27.7 per cent of total elderly global deaths (Table I).

Global elderly cancer mortality rate among the older population (both sexes) is estimated as 615.1 deaths per 100,000. Highest age adjusted mortality rate is seen in Europe (706.6 deaths per 1,00,000) followed by Asia (616.1 deaths per 1,00,000), Oceania (602.5 per 100,000), Northern America (576.7 per 1,00,000), Latin-America and the Caribbean (531.7 per 1,00,000) and Africa (479 per 1,00,000) (Table I, Fig. 2).

Human Development Index (HDI)-wise estimates show that high HDI countries have the highest mortality rate (704.2 deaths per 100,000), accounting for 44.6 per cent of all global mortality. This is followed by very high HDI (652.4 deaths per 100,000), which accounts for 41.3 per cent of all elderly deaths (Table I).

When further estimated according to the world region, it is seen that Central and Eastern Europe (1092.4 deaths per 100,000) have the highest death rate globally in elderly males and the highest death rates in elderly females is seen in Micronesia (631.7 per 1,00,000) and Oceania country. Disparity in the mortality rate is seen within continents. Stratified

**Table I**. Mortality (deaths, relative %, age-standardized rate) for all cancers (excluding non-melanoma of skin) by sex, continents, human development index and income in 2020

| Population | Males | | | Females | | | Both sexes | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of deaths | Relative % | ASR (World) | No. of deaths | Relative % | ASR (World) | No. of deaths | Relative % | ASR (World) |
| Asia | 2298840 | 57.6 | 782.4 | 1628433 | 53.3 | 473.4 | 3927273 | 55.7 | 616.1 |
| Europe | 899659 | 22.5 | 956.6 | 723847 | 23.7 | 525.1 | 1623506 | 23 | 706.6 |
| Northern America | 310078 | 7.8 | 686.2 | 273984 | 9 | 488.2 | 584062 | 8.3 | 576.7 |
| Latin-America and the Caribbean | 271917 | 6.8 | 653.3 | 234261 | 7.7 | 440.5 | 506178 | 7.2 | 531.7 |
| Africa | 178083 | 4.5 | 552.6 | 171338 | 5.6 | 426 | 349421 | 5 | 479 |
| Oceania | 31418 | 0.8 | 733.2 | 24323 | 0.8 | 491.3 | 55741 | 0.8 | 602.5 |
| World | 3989995 | 100 | 781.5 | 3056186 | 100 | 481 | 7046181 | 100 | 615.1 |
| High HDI | 1848109 | 46.3 | 912.5 | 1294606 | 42.4 | 531.2 | 3142715 | 44.6 | 704.2 |
| Very high HDI | 1619996 | 40.6 | 856.4 | 1289203 | 42.2 | 496.1 | 2909199 | 41.3 | 652.4 |
| Medium HDI | 424313 | 10.6 | 415.1 | 369708 | 12.1 | 328.5 | 794021 | 11.3 | 369.5 |
| Low HDI | 95606 | 2.4 | 469.2 | 101197 | 3.3 | 402.6 | 196803 | 2.8 | 429.9 |
| China | 1300675 | 32.6 | 1064.7 | 847591 | 27.7 | 604.4 | 2148266 | 30.5 | 819.4 |
| India | 242557 | 6.1 | 354.2 | 213988 | 7 | 297.2 | 456545 | 6.5 | 325 |
| Upper middle income | 1971237 | 49.4 | 941.3 | 1389738 | 45.5 | 533.7 | 3360975 | 47.7 | 716.1 |
| High income | 1376719 | 34.5 | 819.2 | 1095713 | 35.9 | 496.5 | 2472432 | 35.1 | 639.1 |
| LMIC | 573402 | 14.4 | 455.1 | 496340 | 16.2 | 346 | 1069742 | 15.2 | 396.4 |
| Low income | 66666 | 1.7 | 490.7 | 72923 | 2.4 | 412.5 | 139589 | 2 | 443.3 |

HDI, Human Development Index; LMIC, low- and middle- income countries; No., number
*Source*: GLOBOCAN 2020 (*gco.iarc.fr*).

analysis in Asia shows that eastern Asia has the third highest mortality rate globally. Still, at the same time, South-Central Asia has the lowest mortality globally in elderly men. A difference of 163.5 per cent mortality rates in elderly males and 83.1 per cent in elderly females is seen between Eastern Asia and South-Central Asia (Fig. 3).

Worldwide, the mortality rate among elderly men is estimated as 62.6 per cent higher (781.5 deaths per 1,00,000) as compared to elderly females (481 deaths per 1,00,000). The highest gender gap in mortality is observed in Europe, where mortality rates are 82.2 per cent higher in males (956.6 per 1,00,000) as compared to elderly females (525.1 per 100,000) and the lowest gap is seen in Africa, where elderly men have 29.7 per cent (552.6 per 1,00,000) higher death rate as compared to elderly females (426 per 1,00,000). The gender gap when compared by HDI, it is found that in Low HDI countries elderly men (469.2 deaths per 100,000) have 16.5 per cent higher death rates in comparison to women (402.6 deaths per 1,00,000) (Table I).

*Comparison of leading cancer mortality sites by world region and sex*: Lung cancer is the leading cause of death globally in both elderly males and females. Of all elderly deaths due to lung cancer, China alone accounts 39.1 per cent of lung cancer deaths. In elderly males, it accounts for 23.4 per cent (933108 deaths) and in elderly females, it accounts for 15.9 per cent (487303 deaths) of all global deaths (Fig. 1B). The age standardize mortality rate for elderly males is estimated as 184.2 deaths per 1,00,000 and for elderly females it is 77.7 per deaths 1,00,000. Lung cancer in elderly males is estimated as the leading cause of death in 90 countries and in females, leading cause of death in 38 countries (Table II & III; Supplementary Fig. 1).

Lung cancer is observed as the leading cause of mortality among elderly males in Asia (accounts for 25.1% of all deaths in Asia) with 196.2 deaths per 1,00,000, in Europe (23.9%), 243.5 deaths per 1,00,000, in Northern America (23.9%) 167.4 deaths per 100,000, and in Oceania (19.25%) 146.1 deaths per 1,00,000. In comparison, it is the second leading cause of death in Latin-America and the Caribbean (15.3%)

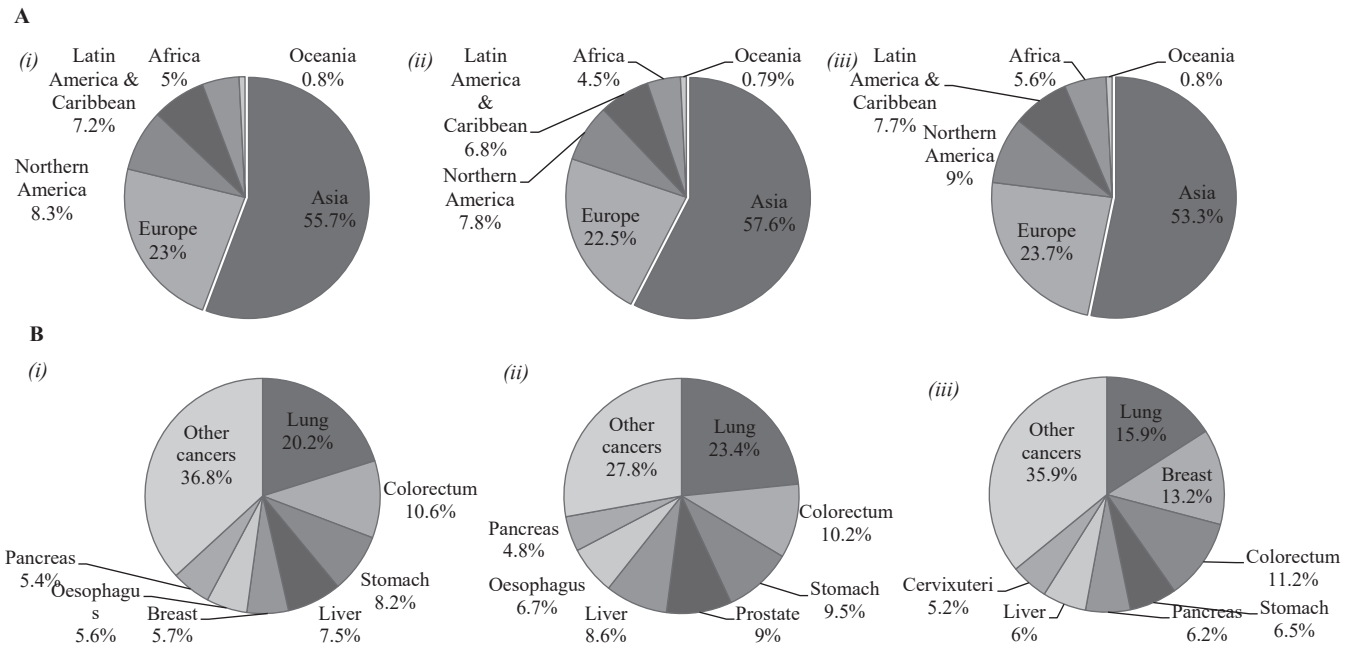


Fig. 1. Estimated distribution of deaths in 2020 in **(A)** Continents and **(B)** cancer sites. In both the panels data is shown for *(i)* both the sexes, *(ii)* males, and *(iii)* for females. The area of the pie chart reflects the proportion of the total number of deaths. *Source*: GLOBOCAN 2020 (*gco.iarc.fr*).

102.1 deaths per 1,00,000 and in Africa (10.7%) 58.2 deaths per 1,00,000.

Colorectum cancer is the second leading cause of death among the older population (both sexes), accounting for a total of 10.2 per cent of global deaths (748192 deaths) (Fig 1B). In elderly men, it is second (78.5 deaths 1,00,000), and in elderly women (49.6 deaths per 1,00,000), it is the third leading cause of death. It is estimated that in 50 countries, it is the second leading cause of death among elderly males and third leading in 74 countries. In elderly females in 51 countries, it is the second leading cause of death, and in 56 countries, it is the third leading cause of death (Table II & III; Supplementary Fig. 1).

Breast cancer among women is the second leading cause of death among elderly females (65.2 deaths per 1,00,000) accounting for a total of 13.2 per cent global deaths (Fig. 1B). Breast cancer is the leading cause of death in 82 countries and second in 70 countries (Table II & III). Region-specific estimates of breast cancer reveal that in Europe (accounts 15.3% of all deaths in Europe) with 80.9 deaths per 1,00,000, and in Latin-America and the Caribbean (14.1%) with 63.7 deaths per 1,00,000 and in Africa (18.2%) with 78.1 deaths per 1,00,000, breast cancer is the leading cause of mortality among elderly women. It ranks as number two in Oceania (13.9%) with 72.1 deaths per 1,00,000, Northern America (13.2%) with 66.4 deaths per 1,00,000 and Asia (11.5%) with 56.7 deaths per 100,000. The age-adjusted mortality rate estimated as highest in Europe (80.9 deaths per 100,000) (Supplementary Table).

Prostate cancer is the fourth leading cause of death (66.7 deaths per 100,000) representing nine per cent of all deaths among elderly men (Fig 1B). It is the leading cause of death in 75 countries and second in 59 countries. In Africa (accounts for 24% of all deaths in Africa, 138 deaths per 1,00,000) and Latin America and the Caribbean (20.3%, and with 123.2 deaths per 1,00,000), prostate cancer is the leading cause of death. A 3.6 fold variation in prostate cancer mortality rate is seen between continents, in African elderly males highest mortality rate is estimated as 122 deaths per 1,00,000 and the lowest is seen among Asian elderly males with 38.6 deaths per 1,00,000 (Supplementary Table).

Stomach cancer is the third leading cause of death globally, representing 8.2 per cent of all deaths (5,77,287 deaths) (Fig. 1B). In elderly men, it is the third leading cause of deaths (9.5%) and in elderly females, it is the fourth leading causes of deaths (6.5%). Stomach cancer is the third leading cause of death in 45 countries in elderly males and in 24 countries in elderly females (Table II & III). Among elderly males,

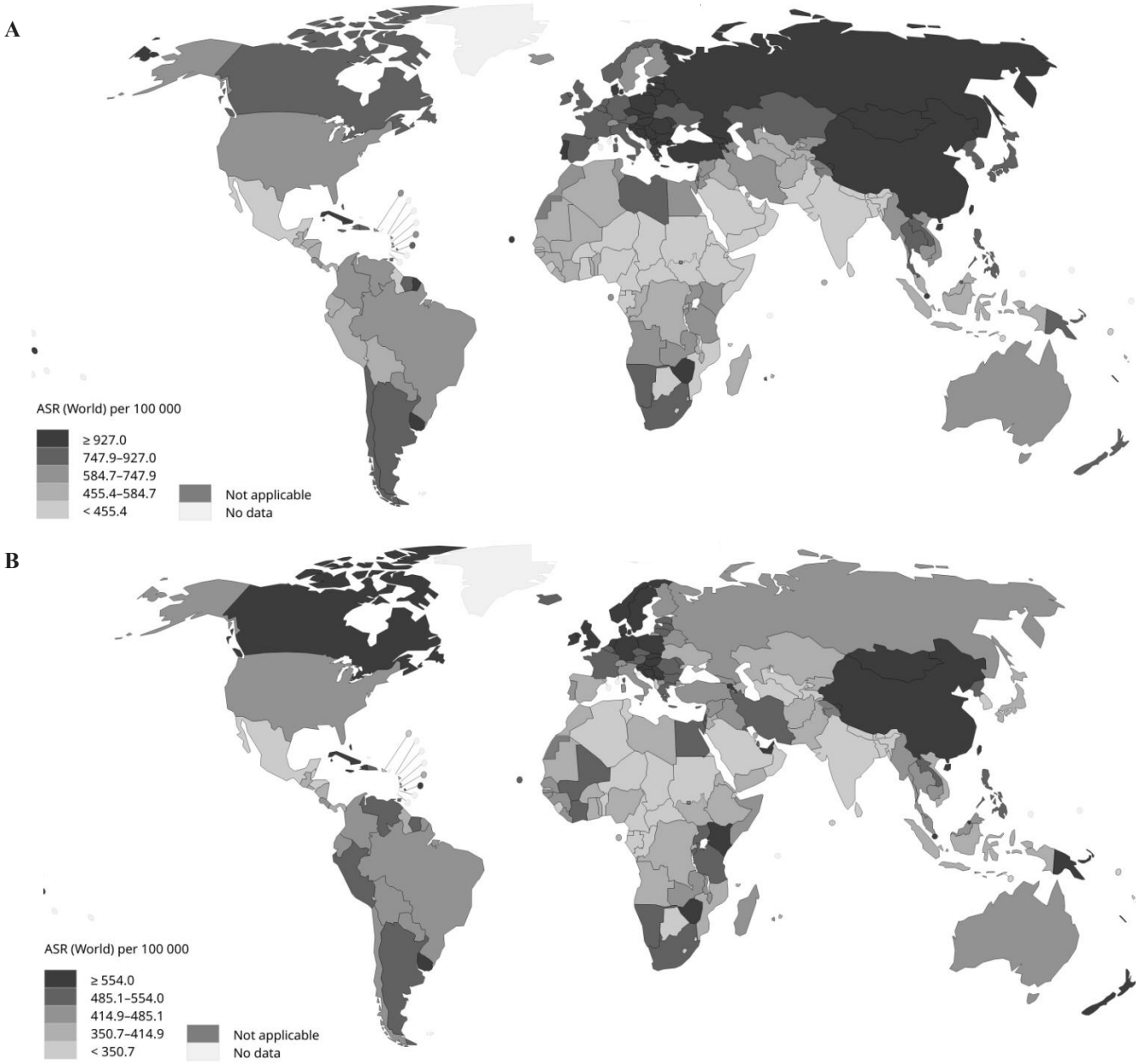


**Fig. 2.** Estimated age-standardized mortality rates worldwide for all cancer sites combined (excluding NMSC) in older adults aged 60 yr and older (per 100,000 populations) in **(A)** males, and **(B)** females. *Source*: GLOBOCAN 2020 (*gco.iarc.fr*).

stomach cancer is the second leading cause of death in Asia (accounting for 12.6% of all deaths in Asia) with 98.4 deaths per 1,00,000, and among elderly females, it is the fourth leading cause of death in Asia (8.6%) with 39.9 deaths per 1,00,000 (Supplementary Table).

*Future burden of deaths by world regions and HDI*: The overall future cancer deaths among the elderly are estimated to increase from 7.05 to 12.7 million deaths representing a total 80.2 per cent increase in deaths by 2040. The highest estimated number of deaths in elderly is predicted to increase in Asia by 93.7 per cent (from 3.93 to 7.61 million deaths), followed by Europe from 1.62 to 2.21 million (36.1% increase), Latin-America and Carrabin from 0.51 to 1 million (97.4%), Northern America from 0.58 to 0.92 million (57.2% increase), Africa from 0.035 to 0.73 million (107.5%) and in Oceania from 0.06 to 0.1 million (74.6% increase) (Fig. 4).

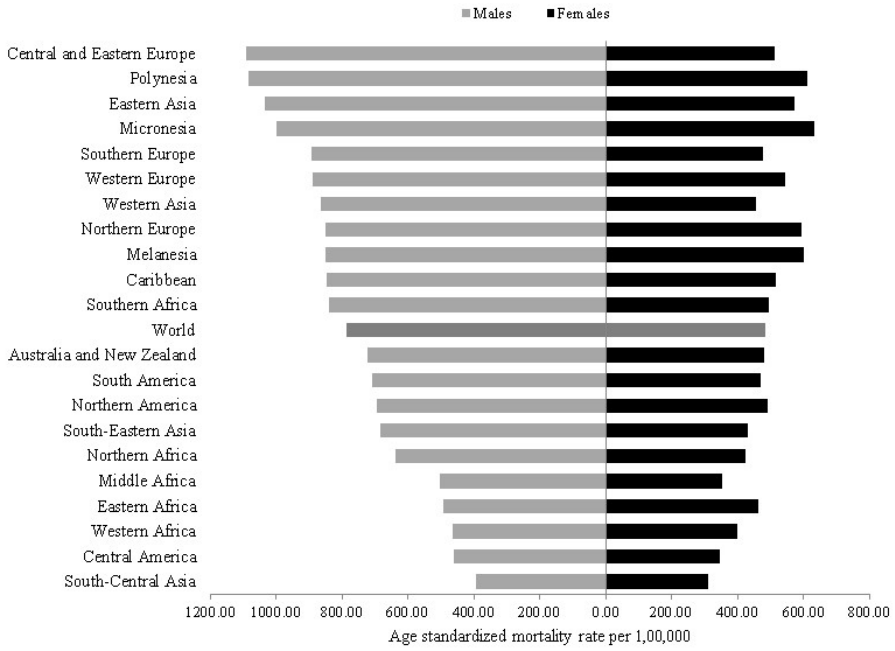


**Fig. 3.** Estimatedage-standardized mortality rates for all cancer sites combined (excluding NMSC) in older adults aged 60 yr and older (per 100,000 populations) by sex and world regions. *Source*: GLOBOCAN 2020 (*gco.iarc.fr*).

**Table II.** Leading sites of mortality (deaths, relative %, age-standardized rate) for all cancers (excluding non-melanoma of skin) by sex.

| Leading mortality sites, males | | | | Leading mortality sites, females | | | |
|---|---|---|---|---|---|---|---|
| Site (ICD 10 classification) | Number | Relative % | ASR (World) | Site (ICD 10 classification) | Number | Relative % | ASR (World) |
| Lung (C33-34) | 933108 | 23.4 | 184.2 | Lung (C33-34) | 487303 | 15.9 | 77.7 |
| Colorectum (C18-21) | 407140 | 10.2 | 78.5 | Breast (C50) | 402255 | 13.2 | 65.2 |
| Stomach (C16) | 378605 | 9.5 | 74.6 | Colorectum (C18-21) | 341052 | 11.2 | 49.6 |
| Prostate (C61) | 358301 | 9 | 66.7 | Stomach (C16) | 198673 | 6.5 | 30.8 |
| Liver (C22) | 343428 | 8.6 | 69.1 | Pancreas (C25) | 188002 | 6.2 | 28 |
| Oesophagus (C15) | 266096 | 6.7 | 53.1 | Liver (C22) | 183889 | 6 | 29.3 |
| Pancreas (C25) | 192745 | 4.8 | 37.7 | Cervixuteri (C53) | 157641 | 5.2 | 27.8 |
| Bladder (C67) | 141259 | 3.5 | 26.6 | Oesophagus (C15) | 129409 | 4.2 | 20.9 |
| Leukaemia (C91-95) | 101176 | 2.5 | 19.6 | Ovary (C56) | 127217 | 4.2 | 21.5 |
| Non-Hodgkin lymphoma (C82-86, C96) | 97006 | 2.4 | 18.8 | Non-Hodgkin lymphoma (C82-86, C96) | 79803 | 2.6 | 12 |
| Kidney (C64-65) | 85896 | 2.2 | 16.8 | Leukaemia (C91-95) | 75166 | 2.5 | 11.5 |
| Brain,central nervous system (C70-72) | 69167 | 1.7 | 13.9 | Corpusuteri (C54) | 73699 | 2.4 | 11.9 |
| Lip,oral cavity (C00-06) | 60889 | 1.5 | 12.4 | Brain,central nervous system (C70-72) | 61655 | 2 | 10.3 |
| Larynx (C32) | 60321 | 1.5 | 12.1 | Kidney (C64-65) | 50035 | 1.6 | 7.5 |
| Multiple myeloma (C88+C90) | 51607 | 1.3 | 10 | Bladder (C67) | 47800 | 1.6 | 6.6 |
| All cancers excl. NMSC (C00-97/C44) | 3989995 | 100 | 781.5 | All cancers excl. NMSC (C00-97/C44) | 3056186 | 100 | 480.6 |

*Source*: GLOBOCAN 2020 (*gco.iarc.fr*)

**Table III.** Most common type of cancer mortality worldwide, by sex ages 60 yr and above (excl.Non Melanoma Skin Cancer)

| | 1ST | 2ND | 3RD | 4TH | 5TH |
|---|---|---|---|---|---|
| Males | | | | | |
| Lung (C33-34) | 90 | 35 | 20 | 11 | 14 |
| Colorectum (C18-21) | 3 | 50 | 74 | 26 | 13 |
| Stomach (C16) | 9 | 20 | 45 | 27 | 19 |
| Prostate (C61) | 75 | 59 | 18 | 7 | 9 |
| Liver (C22) | 8 | 37 | 27 | 11 | 30 |
| Oesophagus (C15) | 0 | 18 | 10 | 10 | 8 |
| Pancreas (C25) | 0 | 1 | 7 | 26 | 39 |
| Bladder (C67) | 0 | 4 | 7 | 12 | 10 |
| Leukaemia (C91-95) | 0 | 0 | 0 | 1 | 4 |
| Non-Hodgkin lymphoma (C82-86, C96) | 0 | 0 | 1 | 6 | 2 |
| Females | | | | | |
| Lung (C33-34) | 38 | 33 | 18 | 18 | 6 |
| Breast (C50) | 82 | 70 | 16 | 6 | 2 |
| Colorectum (C18-21) | 7 | 51 | 56 | 31 | 15 |
| Stomach (C16) | 5 | 8 | 24 | 23 | 19 |
| Pancreas (C25) | 0 | 3 | 24 | 30 | 20 |
| Liver (C22) | 8 | 13 | 13 | 28 | 19 |
| Cervixuteri (C53) | 43 | 22 | 17 | 8 | 15 |
| Oesophagus (C15) | 2 | 8 | 13 | 7 | 4 |
| Ovary (C56) | 0 | 3 | 14 | 16 | 46 |
| Non-Hodgkin lymphoma (C82-86, C96) | 0 | 0 | 4 | 2 | 3 |

*Source*: GLOBOCAN 2020 (*gco.iarc.fr*)

In HDI-wise prediction, it is estimated that the highest burden of deaths will be in high HDI countries with an increase of 98.3 per cent (from 3.14 to 6.23 million deaths), followed by very high HDI by 50.2 per cent (2.91to 4.37 million), medium HDI (0.79 to 1.53 million) and low HDI (0.2 to 0.41 million).

*Future burden of deaths by gender and site*: By 2040, it is predicted that Asia will see the highest number of deaths among both males and females, with an estimated 4.46 million male deaths and 3.15 million female deaths, followed by Europe with 1.27 million male deaths and 0.94 million female deaths. The highest relative change in death percentage is expected in Africa, with a projected increase of 109.7 per cent in cancer deaths among males and 105.3 per cent deaths among females (Fig. 5). The leading future burden of cancer-related deaths among older adults is projected to be from lung cancer, with a relative increase of 78.4 per cent compared to 2020 estimates, resulting in an estimated 2.53 million deaths for both sexes in 2040. This will be followed by stomach cancer (79.5% increase, 1.04 million deaths), liver cancer (75.1% increase, 0.92 million deaths), prostate cancer (100.4% increase, 0.72 million deaths), and breast cancer (73.6% increase, 0.7 million deaths).

## Discussion

Globally, cancer is either the first or second leading cause of death in 112 countries, according to the World Health Organization (WHO) estimates[2]. We estimated that cancer in older adults accounts for 71.2 per cent of all cancer (excluding NMSC) deaths globally and is projected to be on the rise from 7.05 to 12.7 million by 2040. The majority of the cancer burden falls in LMIC; Asia alone shares 55.7 per cent of global deaths. These patients were mostly diagnosed at a late stage where palliative treatment only can be an option. However, according to the lancet commission 2018 report, 80 per cent people living in LMICs have very limited or no access to pain and palliative care relief[13].

Compared to younger, older cancer patients face a wider range of non-cancer-related issues, such as frailty and cognitive deterioration, which makes palliative care more challenging for them[14]. Also, geriatric syndromes are more prevalent in them due to shared risk factors like advanced age, cognitive impairment, functional disability, and restricted mobility, for which these group of patients are more likely to experience unfavourable outcomes and lower quality of life[15].

Of all estimated cancer deaths among elderly males leading five cancers account for 60.7 per cent of deaths and among elderly females, it accounts for 53 per cent of all deaths. Deaths due to lung cancer is most common in both males (23.4%) and females (15.9%), whereas colorectum cancer is the second leading cause of death among elderly males (10.2%) and third leading cause in elderly females (11.2%). Among elderly females, breast cancer is the second leading causes of death, accounting for a total of 13.2 per cent of all elderly cancer deaths.

The overall mortality rate for lung cancer was 62 per cent higher in elderly males as compared to elderly females. Micronesia followed by Polynesia and Central and Eastern Europe (Supplementary Fig. 2) have the highest mortality rates globally. In high-income countries, lung cancer is higher mainly because

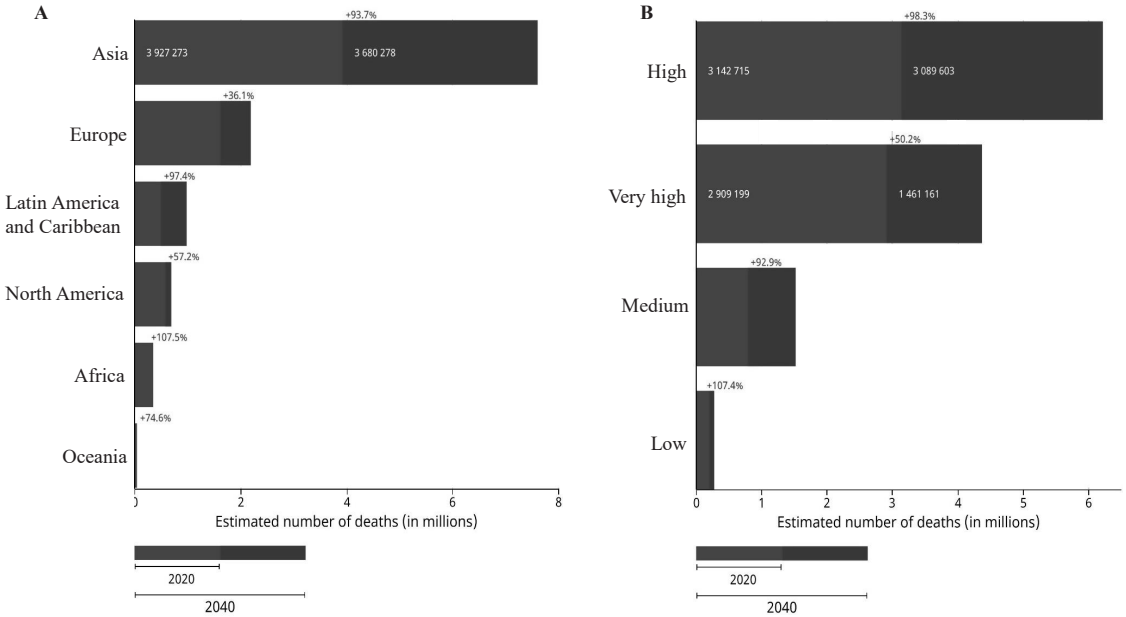


**Fig. 4.** Estimated and projected number of deaths (all cancer sites combined, excluding NMSC) aged 60 yr and older in 2020 and in 2040 (both sex combined) by **(A)** Continent and **(B)** human development index (HDI). *Source*: GLOBOCAN 2020 (*gco.iarc.fr*).

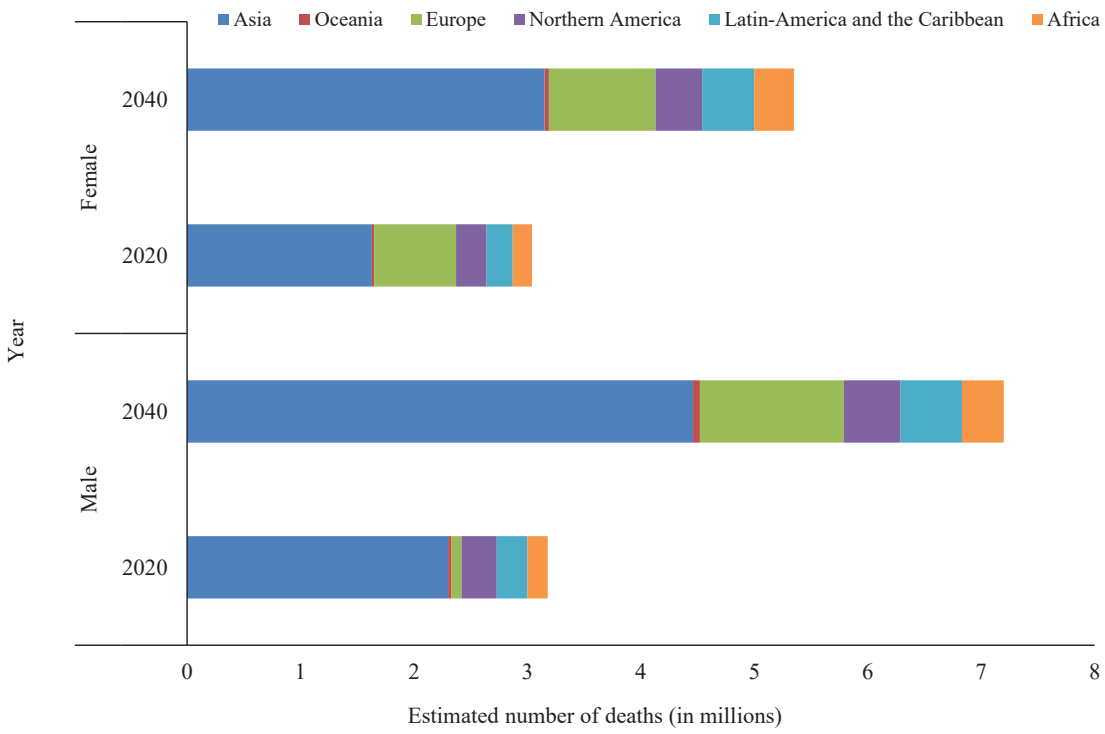


**Fig. 5.** Estimated and projected number of deaths aged 60 yr and older in 2020 and in 2040 by gender. *Source*: GLOBOCAN 2020 (*gco.iarc.fr*).

of the higher prevalence of smoking, and about two thirds of the deaths in these countries were due to lung cancer[16], which can be prevented through adequate tobacco regulations and policy. Lung cancer is lethal, and the mortality to incidence ratio for lung cancer (all ages) is reported as 82 per cent, which suggests the higher death rate due to lung cancer[17]. In lower or lower medium-income countries the survival rate for

lung cancer ranges from 10 to 20 per cent, which is mainly because of late stage at diagnosis[18]. Low dose computed tomography (LDCT) based screening shows the potential to reduce lung cancer mortality, as per the estimates of both the National Lung Screening Trial and Multicentre Italian Lung Detection trials[19,20].

Histological subtypes and molecular biological aspects play important roles in patients' prognosis of the disease; somatic mutation was found significantly associated with increased age[21,22]. Older adults are mostly found to be diagnosed with non-small cell lung cancer (NSCLC), and the five-yr survival significantly varies according to their subtypes. A lower survival rate is seen in squamous cell carcinoma (SCC), which is more prevalent in older adults, than adenocarcinoma, which is more prevalent in younger ones[23-25].

With a six-fold variation in death rates globally, colorectum cancer is the second leading cause of cancer mortality (both sexes) among the elderly and the highest rate of mortality is seen in Europe and lowest in South-Central Asia (Supplementary Fig. 3). Recent trend analysis of mortality rates (1990-2019) shows that in high income countries colorectal cancer mortality rates have been declining mainly due to effective screening programmes, as in Australia the age standardized mortality rate decreased by 33.5 per cent and in North America by 25.3 per cent[26,27]. Importantly, CIMP-high tumours are mostly associated with poor histological differentiation in colorectal cancer and are mostly prevalent among older adults[28,29].

The highest mortality rate of stomach cancer is seen in Eastern Asia (Mongolia has the highest incidence and mortality rate in both males and females). In contrast, lower rates are seen in Northern America and Australia and New Zealand (Supplementary Fig. 4). However, there is diversity in incidence and mortality rates vary among regions; countries like Japan and Korea has high incidence rates globally but considerably low mortality rates. This may be due to the adoption of different screening programmes like National guidelines for gastric cancer screening in 2001 by Korean Gastric Cancer Association or Insurance coverage for a gastric cancer prevention programme by the Japanese government[30,31].

Female breast cancer is the second leading cause of death among elderly females globally. Place of residence and socio-economic status are significantly associated with breast cancer incidence and mortality (Supplementary Fig. 5). Population-based survival (CONCORD programme) of breast cancer shows the five-yr net survival estimates range from higher than 85 per cent in many high-income countries to less than 60 per cent in some regions of sub-Saharan Africa, and country-specific survival estimates are as low as 12 per cent in Uganda[32]. These disparities are mainly because of inequalities in treatment facilities across the globe, mainly linked to inadequate access to diagnostic facilities in lower or lower middle-income countries and also late stage at presentation[33,34]. WHO recommends population-based mammography screening every two yr for women aged between 50–69 yr, which can be helpful for early detection of cases[35].

Ageing is the most important non-modifiable biological risk factor for cancer. This will make the role of geriatric oncology vital in the coming yr, in ensuring older patients functional and nutritional status, social support, cognition, and psychosocial function[36], especially in LMIC like India, where it is seen that 98 per cent of the older patients have at least one deficit[37] and resources are limited.

However, older patients are often not included in randomized trials for which risk and benefits assessment could not to done. Likewise, the lack of evidence available on the benefits of breast cancer screening is due to the fact that screening above 75 yr is not recommended[38,39]. Studies have shown that elderly patients can also benefit from cessation of smoking or alcohol, weight management, and social support[40,41]. Local preventive strategies should also be developed with a focus on cancer types responsible for higher deaths.

This investigation did have some limitations, hence caution exercised while interpreting the results. Firstly, the data quality, particularly national cancer mortality registry, is not uniform across all countries. This may affect the estimations, and it is impossible to rule out overestimation or underestimation. Secondly, IARC data repository on cancer did not provide country-specific deaths by causes, for which association with death rate is not possible. However, despite these limitations, Globocan (IARC-WHO) remains as a reliable global data source to understand the pattern of cancer deaths.

***Acknowledgments*:** Authors acknowledge all the population-based cancer registries worldwide for Globocan 2020 data and IARC staff for providing support and necessary permission.

***Financial support & sponsorship*:** None.

***Conflicts of Interest*:** None.

***Use of Artificial Intelligence (AI)-Assisted Technology for manuscript preparation*:** The authors confirm that there was no use of AI-assisted technology for assisting in the writing of the manuscript and no images were manipulated using AI.

## References


1. Tran KB, Lang JJ, Compton K, Xu R, Acheson AR, Henrikson HJ, *et al.* The global burden of cancer attributable to risk factors, 2010-19: A systematic analysis for the global burden of disease study 2019. *Lancet* 2022; *400* : 563-91.
2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, *et al.* Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2021; *71* : 209-49.
3. LI H. *Global Health Estimates 2016: Deaths by cause, age, sex, by country and by region, 2000-2016*. Geneva, World Health Organization; 2018.
4. Pilleron S, Sarfati D, Janssen-Heijnen M, Vignat J, Ferlay J, Bray F, *et al.* Global cancer incidence in older adults, 2012 and 2035: A population-based study. *Int J Cancer* 2019; *144* : 49-58.
5. Wenkstetten-Holub A, Fangmeyer-Binder M, Fasching P. Prevalence of comorbidities in elderly cancer patients. *Memo* 2021; *14* : 15-9.
6. Dias LM, Bezerra MR, Barra WF, Rego F. Refusal of medical treatment by older adults with cancer: a systematic review. *Ann Palliat Med* 2021; *10* : 4868-4877.
7. DeSantis CE, Miller KD, Dale W, Mohile SG, Cohen HJ, Leach CR, *et al.* Cancer statistics for adults aged 85 years and older, 2019. *CA Cancer J Clin* 2019; *69* : 452-67.
8. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Ageing 2019: Highlights*. Available from: *https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf*, accessed on June 5, 2023.
9. International Agency for Research on Cancer. World Health Organization. *Global Cancer Observatory: Cancer Today*. Available from: *https://gco.iarc.fr/today*, accessed on June 11, 2023.
10. International Agency for Research on Cancer. World Health Organization. *Global Cancer Observatory: Cancer Tomorrow*. Available from: *https://gco.iarc.fr/tomorrow*, accessed on June 11, 2023.
11. International Agency for Research on Cancer. World Health Organization. *Global Cancer Observatory: Cancer Over Time*. Available from: *https://gco.iarc.fr/overtime*, accessed on June 11, 2023.
12. R Doll, P Payne, J Waterhouse, editors. Cancer incidence in five continents: A technical report, Berlin: Springer Verlag, 1966.
13. Knaul FM, Farmer PE, Krakauer EL, De Lima L, Bhadelia A, Kwete XJ, *et al.* Alleviating the access abyss in palliative care and pain relief-an imperative of universal health coverage: The Lancet Commission report. *Lancet* 2018; *391* : 1391-454.
14. Balducci L, Dolan D, Hoffe SE. Palliative care in older patients with cancer. *Cancer Control* 2015; *22* : 480-8.
15. Mohile SG, Fan L, Reeve E, Jean-Pierre P, Mustian K, Peppone L, *et al.* Association of cancer with geriatric syndromes in older medicare beneficiaries. *J Clin Oncol* 2011; *29* : 1458.
16. Parkin DM, Bray FI, Devesa SS. Cancer burden in the year 2000. The global picture. *Eur J Cancer* 2001; *37* : 4-66.
17. Sharma R. Mapping of global, regional and national incidence, mortality and mortality-to-incidence ratio of lung cancer in 2020 and 2050. *Int J Clin Oncol* 2022; *27* : 665-75.
18. Soerjomataram I, Cabasag C, Bardot A, Fidler-Benaoudia MM, Miranda-Filho A, Ferlay J, *et al.* Cancer survival in Africa, central and south America, and Asia (SURVCAN-3): A population-based benchmarking study in 32 countries. *Lancet Oncol* 2023; *24* : 22-32.
19. National Lung Screening Trial Research Team. Reduced lung-cancer mortality with low-dose computed tomographic screening. *N Engl J Med* 2011; *365* : 395-409.
20. Pastorino U, Silva M, Sestini S, Sabia F, Boeri M, Cantarutti A, *et al.* Prolonged lung cancer screening reduced 10-year mortality in the MILD trial: New confirmation of lung cancer screening efficacy. *Ann Oncol* 2019; *30* : 1162-9.
21. Perrotta F, Rocco D, Vitiello F, De Palma R, Guerra G, De Luca A, *et al.* Immune checkpoint blockade for advanced NSCLC: A new landscape for elderly patients. *Int J Mol Sci* 2019; *20* : 2258.
22. Risques RA, Kennedy SR. Aging and the rise of somatic cancer-associated mutations in normal tissues. *PLoS Genetics* 2018; *14* : e1007108.
23. Zhong W, Zhao J, Huang K, Zhang J, Chen Z. Comparison of clinicopathological and molecular features between young and old patients with lung cancer. *Int J Clin Exp Pathol* 2018; *11* : 1031.
24. Goodgame B, Viswanathan A, Zoole J, Gao F, Miller CR, Subramanian J, *et al.* Risk of recurrence of resected stage I non-small cell lung cancer in elderly patients as compared with younger patients. *J Thorac Oncol* 2009; *4* : 1370-4.
25. Venuta F, Diso D, Onorati I, Anile M, Mantovani S, Rendina EA. Lung cancer in elderly patients. *J Thorac Dis* 2016; *8* : S908.
26. Navarro M, Nicolas A, Ferrandez A, Lanas A. Colorectal cancer population screening programs worldwide in 2016: An update. *World J Gastroenterol* 2017; *23* : 3632.
27. Zauber AG. The impact of screening on colorectal cancer mortality and incidence: Has it really made a difference? *Dig Dis Sci* 2015; *60* : 681-91.

28. Vedeld HM, Merok M, Jeanmougin M, Danielsen SA, Honne H, Presthus GK, *et al.* CpG island methylator phenotype identifies high risk patients among microsatellite stable BRAF mutated colorectal cancers. *Int J Cancer* 2017; *141* : 967-76.
29. Barault L, Charon-Barra C, Jooste V, de la Vega MF, Martin L, Roignot P, *et al.* Hypermethylator phenotype in sporadic colon cancer: Study on a population-based series of 582 cases. *Cancer Res* 2008; *68* : 8541-6.
30. Yashima K, Shabana M, Kurumi H, Kawaguchi K, Isomoto H. Gastric cancer screening in Japan: A narrative review. *J Clin Med* 2022; *11* : 4337.
31. Kim TH, Kim IH, Kang SJ, Choi M, Kim BH, Eom BW, *et al.* Korean practice guidelines for gastric cancer 2022: An evidence-based, multidisciplinary approach. *J Gastric Cancer* 2023; *23* : 3.
32. Allemani C, Matsuda T, Di Carlo V, Harewood R, Matz M, Nikšić M, *et al.* Global surveillance of trends in cancer survival 2000-14 (CONCORD-3): analysis of individual records for 37 513 025 patients diagnosed with one of 18 cancers from 322 population-based registries in 71 countries. *Lancet* 2018; *391* : 1023-75.
33. Francies FZ, Hull R, Khanyile R, Dlamini Z. Breast cancer in low-middle income countries: abnormality in splicing and lack of targeted treatment options. *Am J Cancer Res* 2020; *10* : 1568.
34. Afaya A, Ramazanu S, Bolarinwa OA, Yakong VN, Afaya RA, Aboagye RG, *et al.* Health system barriers influencing timely breast cancer diagnosis and treatment among women in low and middle-income Asian countries: Evidence from a mixed-methods systematic review. *BMC Health Serv Res* 2022; *22* : 1601.
35. World Health Organization (WHO). *WHO Position Paper on Mammography Screening.* Geneva: WHO; 2014.
36. Loh KP, Soto-Perez-de-Celis E, Hsu T, de Glas NA, Battisti NM, Baldini C, *et al.* What every oncologist should know about geriatric assessment for older patients with cancer: Young international society of geriatric oncology position paper. *J Oncol Pract* 2018; *14* : 85-94.
37. Noronha V, Ramaswamy A, Dhekle R, Talreja V, Gota V, Gawit K, *et al.* Initial experience of a geriatric oncology clinic in a tertiary cancer center in India. *Cancer Res Stat Treat* 2020; *3* : 208-17.
38. Sedrak MS, Freedman RA, Cohen HJ, Muss HB, Jatoi A, Klepin HD, *et al.* Older adult participation in cancer clinical trials: A systematic review of barriers and interventions. *CA Cancer J Clin* 2021; *71* : 78-92.
39. Schonberg MA. Decision-making regarding mammography screening for older women. *J Am Geriatr Soc* 2016; *64* : 2413-8.
40. Jankovic N, Geelen A, Winkels RM, Mwungura B, Fedirko V, Jenab M, *et al.* Adherence to the WCRF/AICR dietary recommendations for cancer prevention and risk of cancer in elderly from Europe and the United States: A meta-analysis within the CHANCES project. *Cancer Epidemiol Biomarkers Prev* 2017; *26* : 136-44.
41. Wakai K, Marugame T, Kuriyama S, Sobue T, Tamakoshi A, Satoh H, *et al.* Decrease in risk of lung cancer death in Japanese men after smoking cessation by age at quitting: Pooled analysis of three large-scale cohort studies. *Cancer Sci* 2007; *98* : 584-9.

*For correspondence*: Mr Manoj Kalita, ICMR-Centre for Ageing & Mental Health, Kolkata 700 091, West Bengal, India
e-mail: manojkalita5354@gmail.com