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Research Article

Keywords: the “Belt and Road”, cancer prevalence, risk factors, strategies

DOI: https://doi.org/10.21203/rs.3.rs-674885/v1

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Prevalence and Risk Factors for Cancers of the Member Countries in the "Belt and Road" Initiative

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Abstract

Background We analyze the prevalence and risk factors of cancer in the member states of the “Belt and Road”, to explore the basis of health and medical cooperation between countries, and to provide a foundation for formulating cancer prevention and control policies for building the healthy "Belt and Road". Methods We apply incidence, mortality, age-standardized rates, and population attributable fractions (PAFs) to measure the prevalence and risk factors of cancers in the “Belt and Road” countries. Results Lung, breast, colorectal, stomach, liver, prostate, cervical, esophageal, thyroid, and uterine cancers are the most common and highest mortality cancers in the “Belt and Road” countries. For men, the highest cancer incidence and mortality is Hungary (ASR, 289.3 per 100,000 and ASR, 235.7 per 100,000, respectively), followed by Latvia (ASR, 288.6 per 100,000 and ASR, 196.5 per 100,000, respectively), the United Arab Emirates and Saudi Arabia enjoy the lowest (ASR, 34.3 per 100,000 and ASR, 36.1 per 100,000, respectively). The mortality and incidence rates of cancers in Greek and Brunei are highest in females (ASR, 238.7 per 100,000 and ASR, 192.3 per 100,000, respectively). Tobacco products, infectious factors, and ultraviolet rays are the three main cancer risk factors in the “Belt and Road” countries. Conclusion The overall burden of cancer in the “Belt and Road” member states remains substantial, while the corresponding cancer prevention and control policies need to be improved. Enhancing health cooperation among the member countries will contribute to the joint response to the risks and challenges posed by cancer. (249 words)

Key words the “Belt and Road”; cancer prevalence; risk factors; strategies
1 Background

More than 2,000 years ago, the industrious and brave people on the Eurasian continent explored many trades and cultural exchange routes that connected the major civilizations of Asia, Europe and Africa, and later generations collectively referred to them as the "Silk Road"\(^1\). During his visits to Central and Southeast Asian countries in September and October 2013, Chinese President Xi Jinping proposed to jointly build the "Silk Road Economic Belt" and the "21st Century Maritime Silk Road". The "Belt and Road" achieves the common development and common prosperity of all member states by building a community of interests, destiny, and responsibility in all aspects of political mutual trust, economic integration, and cultural inclusiveness.

In recent years, with the development of society and the economy, the disease burden in low human development index (HDI) and medium HDI countries has shifted from being dominated by communicable, maternal, neonatal, and nutritional deficiency diseases (CMNN) to being dominated by non-communicable diseases (NCDs) and injuries \(^2\). And with the improvement of clinical diagnosis and treatment, cancer has been included in the ranks of chronic non-infectious diseases and is one of the main components of NCD disease burden. Cancer becomes the second leading cause of premature death after cardiovascular disease, accounting for about 4.5 million (29.8%) deaths globally in 2016 \(^3\). As health is a core issue of human development, China's the "Belt and Road" initiative provides a great opportunity for cooperation and collective action among multiple countries. In 2016, General Secretary Xi Jinping proposed to work together to build a healthy Silk Road, taking health as one of the important contents of the “Belt and Road” construction. The development of health undertakings is directly related to the national and regional sustainable development goals and is the driving force for the construction of the "Belt and Road" \(^4\). At present, member states face different types of cancers threats to varying degrees. Understanding the prevalence and risk factors in the “Belt and Road” member states is an important foundation for health cooperation between countries. Therefore, based on the global data of cancer and cancer country profiles released by the World Health Organization in 2020, we analyzed
the prevalence and risk factors of cancer in the member countries of the “Belt and Road” to provide a basis for formulating cancer prevention and control policies for building healthy "One Belt and One Road".

2 Materials and methods

2.1 Data source

We used data from the Global Cancer Observatory (geo.iarc.fr) [5] and Cancer Country Profiles (https://www.who.int/cancer/country-profiles/en/) [6] in 2020. Global Cancer Observatory, an online data set that provides a comprehensive assessment of the Global Cancer burden in 2020 based on GLOBOCAN estimates of morbidity, mortality, and prevalence for 36 cancer types grouped by sex and age in 185 countries or territories in 2020. The methods used in compiling the estimates in GLOBOCAN are country-specific, and the quality of the national estimates depends on the coverage, accuracy, and timeliness of the recorded incidence and mortality data in each country, and more details are described in elsewhere [7]. There is a lack of cancer-related data in Palestine and Yemen in this database. Therefore, this study collected and analyzed cancer data in other 64 member states.

2.2 Index definition

In this study, we used morbidity, mortality, and age-standardized rates to analyze and compare cancer incidence and death in "One Belt and One Road" countries. Incidence, generated by population-based cancer registries (PBCRs), is the number of new cases occurring in a specified period and geographic region which conveyed either as an absolute number of cases per annum or as a rate per 100,000 persons per year. Mortality, similarly, is used to measure the number of deaths per unit of time (overall or attributable to specific factors) in a population of a given size. It is usually expressed in units per 100,000 persons per year. Age-standardized rates (ASRs) per 100,000 person-years are corrected by the direct method and the world standard population to allow for the effects of the differences in age structure of a population. The methods used to estimate the global incidence and mortality in 2020 together with their uncertainty intervals (for all ages) can be found in elsewhere [8,9]. Population attributable
fractions (PAFs) refers to the proportion of the incidence or death of a disease attributable to a certain exposure factor in the total morbidity or death of a disease in the population, that is, the proportion of the morbidity or death of related diseases that can be reduced in the population after the elimination of exposure factors. The contribution of selected risk factors and the percentage of premature deaths from non-communicable diseases due to cancer was measured by PAFS in this article. The specific calculation method is detailed elsewhere [10].

"One Belt and One Road" member country refers to the cooperative organization of politics, economic, cultural, and other fields along the line, including 66 member countries. Apart from Cyprus, the Czech Republic, Greece, Hungary, Israel, and Singapore, the remaining 60 countries are all developing countries: (1) East Asia: China, Mongolia; (2) The association of south-east Asian nations (ASEAN): Singapore, Malaysia, Indonesia, Myanmar, Thailand, Laos, Cambodia, Vietnam, Brunei, and the Philippines; (3) West Asia: Iran, Iraq, Turkey, Syria, Jordan, Lebanon, Israel, Palestine, Saudi Arabia, Yemen, Oman, United Arab Emirates, Qatar, Kuwait, Bahrain, Greece, Cyprus, and Egypt's Sinai Peninsula; (4) South Asia: India, Pakistan, Bangladesh, Afghanistan, Sri Lanka, Maldives, Nepal, and Bhutan; (5) Central Asian: Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, and Kyrgyzstan; (6) The Commonwealth of Independent States (CIS): Russia, Ukraine, Belarus, Georgia, Azerbaijan, Armenia, and the Republic of Moldova; (7) Central and Eastern Europe (CEE): Poland, Lithuania, Estonia, Latvia, Czech Republic, Slovakia, Hungary, Slovenia, Croatia, Bosnia and Herzegovina Mostly, Montenegro, Serbia, Albania, Romania, Bulgaria, and Macedonia.

2.3 Data analysis

We conducted a descriptive analysis and comparison of the incidence and death of cancers in the “Belt & Road” countries, as well as a visual presentation.

3 Results

3.1 Prevalence of cancers in global and geographical distribution of “the Belt & Road” countries

Breast, lung, colorectum, prostate, stomach, liver, cervix uteri, esophagus, thyroid,
and bladder cancers rank amongst the top ten newly cancers, and lung, colorectum, liver, stomach, breast, esophagus, prostate, cervix uteri, bladder, thyroid cancer rank amongst the top ten cancers in terms of deaths, with a total of 12,176,526 new cases and 6,532,679 deaths worldwide, respectively (table 1, figure a1, a2). The cancers with the highest morbidity and mortality in male and female worldwide are lung cancer and breast cancer, respectively (figure1). All along “the Belt & Road” member countries, the top ten new cancers are lung, breast, colorectum, stomach, liver, esophagus, prostate, cervix uteri, thyroid, and corpus uteri cancers. The top ten cancers with the highest mortality rate are lung, liver, stomach, colorectum, oesophagus, breast, cervix uteri, prostate, pancreas, and ovary cancers. Cancers with the highest morbidity and mortality in male and female are the same as in the world. The member countries of the “Belt and Road” has the lower of cancer incidence and the higher of cancer mortality compared to the world (Figure 1).

Among East Asian member countries, the cancers with the highest morbidity and mortality are lung cancer and digestive tract cancers. In the member countries of ASEAN, West Asia, South Asia, and Central Asia, this condition has a breast cancer and lung cancer predominance. In South Asia, lip and oral cavity cancers are the leading cause of mortality, and rank among the top five causes of morbidity. In the countries of CIS and CEE, the greatest number of new cases and deaths are from cancers of the colorectal cancer and lung, and of which the central and eastern European countries have a high incidence of male’s cancers, such as bladder and prostate. See more details in table 1 and figure 1.

Table 1. New Cases and Deaths of main cancers for global and geographical location of “the Belt & Road” countries Combined in 2020[n].

| World | East Asia | ASEAN | West Asia | South Asia | Central Asia | CIS |
|-------|-----------|-------|-----------|------------|--------------|-----|
| New cases | Deaths | New cases | Deaths | New cases | Deaths | New cases | Deaths | New cases | Deaths | New cases | Deaths | New cases | Deaths |
| 2261419 | 684996 | 416559 | 117236 | 158820 | 58622 | 99116 | 33153 | 226537 | 115464 | 11377 | 4701 | 104903 | 34470 |
| 2206771 | 1796144 | 816048 | 71519 | 123221 | 109442 | 77575 | 68712 | 99734 | 91007 | 8717 | 7089 | 89929 | 76256 |
| 1931590 | 935173 | 555637 | 286262 | 106919 | 57022 | 61339 | 31821 | 84176 | 48909 | 6869 | 4077 | 110426 | 59948 |
| 1414259 | 375304 | 115462 | 51111 | 41048 | 15925 | 48716 | 16279 | 43223 | 21071 | 2288 | 1172 | 65160 | 21066 |
| 1089103 | 768793 | 479368 | 374422 | 32012 | 26596 | 34358 | 29065 | 78719 | 69390 | 8992 | 6985 | 52187 | 39424 |
|                | 0  | 50  | 100 | 150 | 200 | 250 | 300 |
|----------------|----|-----|-----|-----|-----|-----|-----|
| Central and eastern Europe | Breast | Prostate | Lung | Colorectum | Cervix uteri | Stomach | Liver |
| CIS             |    |     |     |     |     |     |     |
| Central Asia    |    |     |     |     |     |     |     |
| South Asia      |    |     |     |     |     |     |     |
| West Asia       |    |     |     |     |     |     |     |
| ASEAN           |    |     |     |     |     |     |     |
| East Asia       |    |     |     |     |     |     |     |
| B&R             |    |     |     |     |     |     |     |
| Global          |    |     |     |     |     |     |     |
| ASR(world) per 100 000 | 34 | 30  | 514 | 446 | 13750 | 11603 | 1023 | 905 | 2150 | 1864 | 946 | 809 |

a1. The incidence rate of both sex.
a2. The mortality rate of both sexes.

- Central and eastern Europe
- CIS
- Central Asia
- South Asia
- West Asia
- ASEAN
- East Asia
- B&R
- Global

a3. Male incidence rate.

- Central and eastern Europe
- CIS
- Central Asia
- South Asia
- West Asia
- ASEAN
- East Asia
- B&R
- Global

a4. Male mortality rate.

- Central and eastern Europe
- CIS
- Central Asia
- South Asia
- West Asia
- ASEAN
- East Asia
- B&R
- Global
Figure 1. Comparison of estimated 2020 age-standardized rates (world) between Global and “One Belt & One Road” countries, all ages.

3.2 Distribution of cancer in each member country of the “Belt and Road”

Table 2 shows the total number of the top ten newly diagnosed cancer cases and deaths, the incidence and mortality ASRs separately in each member country of the “Belt and Road” in men and women. Among all the “Belt and Road” member countries, the country with the highest incidence and mortality of cancers among men is Hungary (ASR, 289.3 per 100,000 and ASR, 235.7 per 100,000, respectively), second is Latvian (ASR, 288.6 per 100,000 and ASR, 196.5 per 100,000, respectively), and the United Arab Emirates and Saudi Arabia enjoy the lowest rates of incidence and mortality,
respectively (ASR, 34.3 per 100,000 and ASR, 36.1 per 100,000, respectively). In female, the highest incidence rates are estimated in Greece (ASR, 238.7 per 100,000), followed by Mongolia, Turkey, Cyprus, Singapore, and Brunei. The country with the highest mortality rate is Brunei (ASR, 192.3 per 100,000), followed by Israel, Singapore, Cyprus, Greece, Mongolia. See Table 2 for more details.

**Table 2.** Incidence and Mortality Rates for “the Belt & Road” countries and Sex for the top ten cancers combined (Including Nonmelanoma Skin Cancer) in 2020

| Country         | Incidence | Males | Females | Mortality | Males | Females |
|-----------------|-----------|-------|---------|-----------|-------|---------|
| Cases(n)       | ASR(world)| Cases(n) | ASR(world) | Cases(n) | ASR(world) | Cases(n) | ASR(world) |
| China          | 2071503   | 110.9 | 1569685 | 152.5     | 1699192 | 57.6     | 915248 | 134.3 |
| Mongolia       | 2731      | 208.3 | 2336    | 235.3     | 2346   | 126.1    | 1764   | 160.4 |
| Singapore      | 9670      | 110.7 | 5818    | 186       | 9247   | 67.5     | 4057   | 189.7 |
| Malaysia       | 17375     | 70.3  | 11809   | 104.2     | 20483  | 61.9     | 10506  | 121.2 |
| Indonesia      | 127024    | 67.8  | 85670   | 97.1      | 171816 | 57.8     | 83581  | 116.4 |
| Myanmar        | 24093     | 89.9  | 19613   | 153.6     | 30479  | 65.9     | 20023  | 98.9  |
| Thailand       | 70395     | 94.1  | 52769   | 128.7     | 76657  | 57.6     | 42656  | 134.3 |
| Laos           | 3395      | 112.5 | 2780    | 134.5     | 3540   | 72.8     | 2019   | 121.1 |
| Cambodia       | 5985      | 89     | 4899    | 108       | 7570   | 60.7     | 4593   | 96.6  |
| Vietnam        | 79763     | 89.9  | 62988   | 153.6     | 68348  | 57.6     | 38848  | 134.3 |
| Brunei         | 369       | 105.9 | 205     | 180       | 449    | 74       | 152    | 192.3 |
| Philippines    | 51138     | 93.4  | 36435   | 127       | 71068  | 66.7     | 34434  | 137.5 |
| Iran           | 51511     | 84     | 36096   | 120.7     | 44621  | 55.8     | 23255  | 101.4 |
| Iraq           | 9721      | 67.2  | 6856    | 91.2      | 14805  | 56.7     | 7312   | 107.2 |
| Turkey         | 103677    | 143.7 | 66139   | 227.3     | 75896  | 65       | 33954  | 103.4 |
| Syria          | 6653      | 76.5  | 4681    | 107.3     | 8938   | 62.9     | 4638   | 117.5 |
| Jordan         | 3956      | 79.6  | 2577    | 118.8     | 4960   | 55.7     | 2067   | 125.5 |
| Lebanon        | 4236      | 71.8  | 2631    | 116.7     | 4348   | 55.6     | 2065   | 120.2 |
| Israel         | 11236     | 89.9  | 5034    | 153.6     | 11375  | 56.1     | 4352   | 190   |
| Saudi Arabia   | 9945      | 38.11 | 5284    | 63.7      | 10856  | 36.1     | 3904   | 87.4  |
| Oman           | 1486      | 89.9  | 935     | 153.6     | 1165   | 40.8     | 496    | 83.8  |
| The united Arab emirates | 1530 | 34.3 | 688 | 61.3 | 2186 | 54.7 | 639 | 134 |
| Qatar          | 632       | 50.1  | 320     | 79.6      | 457    | 51.8     | 166    | 103.4 |
| Kuwait         | 1304      | 45.6  | 632     | 78        | 1664   | 53.2     | 580    | 116.6 |
| Bahrain        | 418       | 50.7  | 228     | 82.7      | 519    | 46.6     | 202    | 103.4 |
| Greece         | 29098     | 109.9 | 15835   | 238.7     | 20671  | 55.3     | 9047   | 176.2 |
| Cyprus         | 2217      | 95.81 | 1128    | 216.9     | 1791   | 57.6     | 740    | 185.4 |
| Egypt          | 51272     | 103.7 | 39199   | 130.8     | 51142  | 57.6     | 29165  | 134.3 |
| India          | 417198    | 43.2  | 290541  | 62        | 504113 | 45.84    | 309586 | 73.7  |
| Country            | ASR, Incidence | ASR, Mortality | Incidence | Mortality |
|--------------------|----------------|----------------|-----------|-----------|
| Pakistan           | 55079          | 48.4           | 38697     | 67.9      |
| Bangladesh         | 60755          | 89.9           | 45215     | 153.6     |
| Afghanistan        | 6776           | 61.4           | 5611      | 73.2      |
| Sri Lanka          | 9627           | 45.5           | 6091      | 72.4      |
| Maldives           | 194            | 68             | 136       | 94.1      |
| Nepal              | 5890           | 39.3           | 4345      | 53.1      |
| Bhutan             | 236            | 55.8           | 206       | 63.2      |
| Kazakhstan         | 12181          | 89.9           | 8751      | 153.6     |
| Uzbekistan         | 9834           | 58             | 7401      | 77.6      |
| Turkmenistan       | 1980           | 69.2           | 1524      | 89.2      |
| Tajikistan         | 1989           | 59.1           | 1597      | 71.5      |
| Kyrgyzstan         | 2481           | 89.9           | 2020      | 153.6     |
| Russia             | 216520         | 210.1          | 130042    | 124.6     |
| Ukraine            | 58905          | 181.9          | 35480     | 108       |
| Belarus            | 16723          | 244.7          | 9296      | 134.6     |
| Georgia            | 4813           | 162.8          | 3480      | 115.3     |
| Azerbaijan         | 5998           | 118.4          | 4458      | 88.4      |
| Armenia            | 3987           | 205.9          | 2867      | 144.7     |
| Moldova            | 5658           | 209.7          | 3883      | 143.9     |
| Poland             | 78597          | 221.9          | 49900     | 137       |
| Lithuania          | 6609           | 230.6          | 3177      | 99        |
| Estonia            | 3406           | 287.2          | 1662      | 127.1     |
| Latvia             | 4868           | 288.6          | 2346      | 131.8     |
| Czechia            | 27844          | 256.2          | 10957     | 89.9      |
| Slovakia           | 12182          | 261.1          | 6786      | 136.3     |
| Hungary            | 25449          | 289.3          | 13502     | 147.3     |
| Slovenia           | 6247           | 277.4          | 2839      | 103.32    |
| Croatia            | 10628          | 251.8          | 6383      | 134.78    |
| Bosnia and Herzegovina | 6169   | 196.1          | 4475      | 137       |
| Montenegro         | 1109           | 210.4          | 772       | 137       |
| Serbia             | 18585          | 228.5          | 11831     | 135.8     |
| Albania            | 3296           | 130.8          | 2226      | 83.7      |
| Romania            | 40773          | 230            | 24545     | 133.7     |
| Bulgaria           | 15896          | 153.6          | 8875      | 89.9      |
| Macedonina         | 3448           | 200.4          | 2223      | 123.1     |

Among the top ten cancers in East Asian countries, the total incidence and mortality of cancer in Mongolia are respectively ASR, 158.0 per 100,000 and ASR, 128.8 per 100,000, and both are larger in females than in males. The highest cancer rates and deaths is liver cancer. The total cancer incidence and mortality in China are 146.3 per 100,000 and 84.4 per 100,000, respectively, and the highest cancer incidence
and mortality are lung cancer and breast cancer, respectively (figure 2).
Figure 2. Comparison of estimated 2020 age-standardized rates (world) between Global and East Asia countries, all ages.

Among the ASEAN countries, Singapore has the highest cancer incidence rate (ASR, 149.4 per 100,000) and the second highest mortality rate (ASR, 58.4 per 100,000), while Vietnam has the highest cancer mortality rate (ASR, 58.9 per 100,000). The countries with the highest overall cancer morbidity and mortality among men are Singapore and Laos (ASR, 132.9 per 100,000 and ASR, 80.4 per 100,000, respectively), while women are Brunei, with overall cancer incidence and mortality are ASR, 137.4 per 100,000 and ASR, 52.9 per 100,000, respectively. Cancers of the colorectum, lung, prostate, liver in men, and cancers of the breast, lung, colorectum, and cervix uteri in
women continue to be the most common fatal cancers (figure 3).

c1. The incidence rate of both sex.

c2. The mortality rate of both sex.
c3. Male incidence rate.

| Country   | Lung | Stomach | Colorectum | Liver | Oesophagus | Prostate | Pancreas | Bladder | Leukaemia | Thyroid | Kidney |
|-----------|------|---------|------------|-------|------------|----------|----------|---------|-----------|---------|--------|
| Philippines |     |         |            |       |            |          |          |         |           |         |        |
| Brunei    |     |         |            |       |            |          |          |         |           |         |        |
| Vietnam   |     |         |            |       |            |          |          |         |           |         |        |
| Cambodia  |     |         |            |       |            |          |          |         |           |         |        |
| Laos      |     |         |            |       |            |          |          |         |           |         |        |
| Thailand  |     |         |            |       |            |          |          |         |           |         |        |
| Myanmar   |     |         |            |       |            |          |          |         |           |         |        |
| Indonesia |     |         |            |       |            |          |          |         |           |         |        |
| Malaysia  |     |         |            |       |            |          |          |         |           |         |        |
| Singapore |     |         |            |       |            |          |          |         |           |         |        |

0.00 50.00 100.00 150.00 200.00

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c4. Male mortality rate.

| Country   | Lung | Stomach | Colorectum | Liver | Oesophagus | Prostate | Pancreas | Bladder | Leukaemia | Thyroid | Kidney |
|-----------|------|---------|------------|-------|------------|----------|----------|---------|-----------|---------|--------|
| Philippines |     |         |            |       |            |          |          |         |           |         |        |
| Brunei    |     |         |            |       |            |          |          |         |           |         |        |
| Vietnam   |     |         |            |       |            |          |          |         |           |         |        |
| Cambodia  |     |         |            |       |            |          |          |         |           |         |        |
| Laos      |     |         |            |       |            |          |          |         |           |         |        |
| Thailand  |     |         |            |       |            |          |          |         |           |         |        |
| Myanmar   |     |         |            |       |            |          |          |         |           |         |        |
| Indonesia |     |         |            |       |            |          |          |         |           |         |        |
| Malaysia  |     |         |            |       |            |          |          |         |           |         |        |
| Singapore |     |         |            |       |            |          |          |         |           |         |        |

0.00 20.00 40.00 60.00 80.00 100.00 120.00

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c5. Female incidence rate.

| Country   | Lung | Stomach | Colorectum | Liver | Oesophagus | Pancreas | Leukaemia | Thyroid | Non-Hodgkin lymphoma | Brain, central nervous system | Breast |
|-----------|------|---------|------------|-------|------------|----------|-----------|---------|----------------------|-------------------------------|--------|
| Philippines |     |         |            |       |            |          |           |         |                      |                                |        |
| Brunei    |     |         |            |       |            |          |           |         |                      |                                |        |
| Vietnam   |     |         |            |       |            |          |           |         |                      |                                |        |
| Cambodia  |     |         |            |       |            |          |           |         |                      |                                |        |
| Laos      |     |         |            |       |            |          |           |         |                      |                                |        |
| Thailand  |     |         |            |       |            |          |           |         |                      |                                |        |
| Myanmar   |     |         |            |       |            |          |           |         |                      |                                |        |
| Indonesia |     |         |            |       |            |          |           |         |                      |                                |        |
| Malaysia  |     |         |            |       |            |          |           |         |                      |                                |        |
| Singapore |     |         |            |       |            |          |           |         |                      |                                |        |

0.00 50.00 100.00 150.00 200.00 250.00
Figure 3. Comparison of estimated 2020 age-standardized rates (world) among ASEAN countries, all ages.

Among the member countries in West Asia, the highest cancer incidence rate in Cyprus, Greece, and Israel with a high cancer incidence of breast, prostate, lung, and colorectum, while Turkey, Egypt, and Syria have the highest cancer mortality, and lung, breast, liver, prostate, colorectum, and bladder deaths are the most. Cancer incidence and mortality rates are highest among men respectively in Greece (ASR, 238.7 per 100,000) and Turkey (ASR, 143.7 per 100,000), with lung, prostate, bladder, and colorectum as the main reasons. Israel, Greece, and Cyprus have the highest cancer incidence rates of breast, thyroid, corpus uteri, and colorectum in the women. The top three countries with the highest cancer mortality are Cyprus, Egypt, and Iraq, with principally deaths of cancer are breast, lung, colorectum, ovary, and cervix uteri; and of which, leukaemia, brain, and central nervous system are all in the top five cancer death types in Iraq. See Figure 4 for more details.
d1. The incidence rate of both sex.

- Egypt
- Cyprus
- Greece
- Bahrain
- Kuwait
- Qatar
- United Arab Emirates
- Oman
- Saudi Arabia
- Israel
- Lebanon
- Jordan
- Syria
- Turkey
- Iraq
- Iran

Thyroid
Bladder
Breast
Brain, central nervous system
Cervix uteri
Colorectum
Corpus uteri
Kidney
Leukaemia
Liver
lung

0 50 100 150 200 250 300

d2. The mortality of both sex.

- Egypt
- Cyprus
- Greece
- Bahrain
- Kuwait
- Qatar
- United Arab Emirates
- Oman
- Saudi Arabia
- Israel
- Lebanon
- Jordan
- Syria
- Turkey
- Iraq
- Iran

Thyroid
Bladder
Breast
Brain, central nervous system
Cervix uteri
Colorectum
Corpus uteri
Kidney
Leukaemia
Liver
lung

0 20 40 60 80 100 120

d3. Male incidence rate.

- Egypt
- Cyprus
- Greece
- Bahrain
- Kuwait
- Qatar
- United Arab Emirates
- Oman
- Saudi Arabia
- Israel
- Lebanon
- Jordan
- Syria
- Turkey
- Iraq
- Iran

Oesophagus
Pancreas
Prostate
Testis
Thyroid
Stomach
lung
Leukaemia
Liver
Larynx
Colorectum

0 50 100 150 200 250 300 350
Figure 4. Comparison of estimated 2020 age-standardized rates (world) among West Asia countries, all ages.
Large distribution differences exist in the prevalence of cancers in South Asian member countries, with the total number of newly diagnosed cancer cases in Bhutan are much higher than other countries (ASR, 176.2 per 100,000). Bangladesh has some of the highest cancer incidence rates in men (ASR, 153.6 per 100,000), such as lung, prostate, and colorectum cancers. High incidence of cancers of breast, colorectum, non-Hodgkin lymphoma, and esophagus in women in Afghanistan (ASR, 119.9 per 100,000) and Maldives (ASR, 115.4 per 100,000). On the contrary, deaths are more evenly distributed across countries, with the most deaths from lung cancer and digestive system cancer in men, and most deaths from breast cancer and lung cancer in women. See Figure 5 for more details.
e3. Male incidence rate.

e4. Male mortality rate.

e5. Female incidence rate.
Figure 5. Comparison of estimated 2020 age-standardized rates (world) among South Asia countries, all ages.

Lung, prostate, colorectum, and stomach cancers in men in Kazakhstan and Uzbekistan is of very high incidence among the Central Asian countries, while the small difference of the incidence and death of cancers are observed in women, breast, cervix uteri, colorectum, corpus uteri, and stomach are the main ones (Figure 6).

Figure 6. Female mortality rate.
Figure 6. Comparison of estimated 2020 age-standardized rates (world) among Central Asia countries, all ages.

Among the member states of the Commonwealth of Independent States, the highest cancer incidence among both sex, male, and female in Belarus and Russia with the top five most common cancers of prostate, breast, colorectum, lung, and corpus uteri. Similarly, the highest cancer mortality occurs in Armenia and The Republic of Moldova, with lung, breast, prostate, colorectum, and stomach cancers principally (Figure 7).
g1. The incidence rate of both sex.

The republic of moldova
Armenia
Azerbaijan
Georgia
Belarus
Ukraine
Russia

0 50 100 150 200 250 300

Bladder
Brain, central nervous system
Breast
Cervix uteri
Colorectum
Corpus uteri
Kidney
Liver
Lung
Ovary
Pancreas

0 20 40 60 80 100 120

Russia
Ukraine
Belarus
Georgia
Azerbaijan
Armenia
The republic of moldova

Bladder
Brain, central nervous system
Breast
Cervix uteri
Colorectum
Corpus uteri
Kidney
Liver
Lung
Ovary
Pancreas

g3. Male incidence rate.

The republic of moldova
Armenia
Azerbaijan
Georgia
Belarus
Ukraine
Russia

0 50 100 150 200 250 300

Bladder
Brain, central nervous system
Colorectum
Kidney
Larynx
Leukaemia
Lip, oral cavity
Liver
Lung
Oesophagus
Pancreas
Figure 7. Comparison of estimated 2020 age-standardized rates (world) among CIS countries, all ages.
The incidence of cancer in the member states of Central and Eastern Europe is the highest among all the member states of the “Belt and Road”, the combined cancer incidence is over ASR, 200.0 per 100,000. The cancer mortality rate is relatively low, ASR, 100.0 per 100,000 on average. Hungary is the country with the most serious cancer incidence and death, with a total morbidity rate of ASR, 321.1 per 100,000 and a total mortality rate of ASR, 125.2 per 100,000. Prostate and breast cancers are the two commonly diagnosed cancer types, and lung, colorectum, breast, prostate cancers are the leading causes of cancer death (Figure 8).
h3. Male incidence rate.

- Melanoma of skin
- Non-Hodgkin lymphoma
- Oesophagus
- Pancreas
- Prostate
- Stomach
- Testis
- Bladder
- Brain, central nervous system
- Colorectum
- Kidney

h4. Male mortality rate.

- Melanoma of skin
- Non-Hodgkin lymphoma
- Oesophagus
- Pancreas
- Prostate
- Stomach
- Testis
- Bladder
- Brain, central nervous system
- Colorectum
- Kidney

h5. Female incidence rate.

- Non-Hodgkin lymphoma
- Ovary
- Pancreas
- Stomach
- Thyroid
- Bladder
- Brain, central nervous system
- Breast
- Cervix uteri
- Colorectum
- Corpus uteri
3.3 Distribution of major cancers in the "Belt and Road" member states

The main cancer burdens in the member states of the “Belt and Road” are the cancer of lung, breast, colorectal, stomach, liver, prostate, and cervical. In terms of the incidence and mortality of lung cancer, CEE member countries carry the heaviest one, and the burden of men is approximately 4- to 5-fold that of women (Figure 9, i1). The incidence of breast cancer shows a greatly difference, ranging from ASR, 25.46 per 100,000 to ASR, 56.96 per 100,000. However, these is less marked in mortality (Figure 9, i2). The burden of colorectal cancer in men is twice that of women, and the burden of incidence is twice that of mortality as well. The heaviest burden of colorectal cancer is observed in CEE member states, followed by the CIS and ASEAN (Figure 9, i3). East Asian member states have the largest burden of morbidity and mortality of stomach cancer, which are 2-4 times and 1-5 times that of other member states, respectively (Figure 9, i4). The same happens in liver cancer which are 3-30 times and 6-30 times that of other member states, respectively (Figure 9, i5). The incidence of prostate cancer is relatively high, while the mortality is opposite; and the incidence and mortality burden of prostate cancer in CEE member states is the heaviest, with ASR, 53.81 per 100,000 and ASR, 14.26 per 100,000, respectively (Figure 9, i6). The incidence and mortality of cervical cancer are evenly distributed in Member States, with the exception...
of the lowest incidence in West Asia, the morbidity and mortality in other member countries ranged from ASR, 11.00 per 100,000 to ASR, 17.00 per 100,000 and ASR, 5.00 per 100,000 to ASR, 10.00 per 100,000, respectively (Figure 9, i7).
### i4. Stomach Cancer

**ASR(World) per 100 000**

- **Female mortality**
- **Female incidence**
- **Male mortality**
- **Male incidence**

#### Regions
- CEE
- CIS
- Central Asia
- South Asia
- West Asia
- ASEAN
- East Asia

### i5. Liver Cancer

**ASR(World) per 100 000**

- **Female mortality**
- **Female incidence**
- **Male mortality**
- **Male incidence**

#### Regions
- CEE
- CIS
- Central Asia
- South Asia
- West Asia
- ASEAN
- East Asia
i6. Prostate cancer

i7. Cervical cancer
3.4 Three main risk factors for cancers in the “Belt and Road” member states

According to our statistics, tobacco products, infectious factors, and ultraviolet rays are the three main risk factors for cancers in the “Belt and Road” member countries. Tobacco products are the biggest challenge facing all member states, with the highest burden of cancer incidence and mortality in East Asia and CEE (Figure 10, j1). The mean PAFs scores of tobacco products are estimated 30% and above in 10 member states: Serbia, Greece, Hungary, Bosnia and Herzegovina, Bulgaria, Croatia, Poland, Romania, Turkey, and China; and its’ value above 20% is estimated in a further 27 members. Infectious factors are the most predominant risk factors for cancers in ASEAN, CEE, and East Asia, with PAFs of 151.35%, 87.13%, and 37.00% respectively (Figure 10, j2). There are 5 member states with more than 30% of PAFs: Vietnam, Singapore, Romania, Mongolia, Laos, and 11 member states with more than 20%. The cancer burden caused by ultraviolet rays is mainly concentrated in the member states of CEE, CIS, Central Asia, and West Asia (Figure 10, j3). Similarly, more than 50% of PAFs, dominated by CEE, are estimated in 17 member states: Estonia, Georgia, Kazakhstan, Latvia, Hungary, Israel, Belarus, Bulgaria, Croatia, Cyprus, Czech Republic, Lithuania, Poland, Romania, Russia, Serbia, Slovenia, Ukraine. There are eight other member states with PAFs above 30%.

Figure 9. Bar chart of region-specific incidence and mortality age-standardized rates by sex for cancers in 2020.
Figure 10. Pie chart of Distribution of major cancer risk factors in the “Belt and Road” countries.

4 Discussion

Cancer poses a growing global threat to human health [11]. In 134 out of 183 countries, cancer is the first or second leading cause of premature death (i.e., 30-69 years of age), and in another 45 countries, cancer is ranked at third or fourth [12]. Death rates from non-communicable diseases, particularly cancer, are declining in most high-income countries, but not in low-income countries. By 2040, cancer incidence is projected to increase by the largest percentage in countries with low and medium HDI: from 2018 to 2040, the estimated increase is 100% in the low HDI tier and 75% in the middle HDI tier, looking at population changes alone [3]. Most of countries of the “Belt and Road” are developing countries other than Cyprus, Czech Republic, Greece, Hungary, Israel, and Singapore. Lung cancer, breast cancer, gastrointestinal cancer, prostate cancer, cervical cancer, thyroid cancer, and uterine cancer are the common challenges that the "Belt & Road" countries must face together. Countries with low-to mid-level HDI levels are currently ill-equipped to cope with the coming increase in the cancer burden. Thus, the health "One Belt and One Road" initiative offers new solutions to the challenge of the cancer burden in low- and medium-level HDI countries. Strengthening regional scientific and technological cooperation through targeted, resource-sharing, effective and cost-effective means, such as establishing combined laboratories or research centers, transferring international technology and knowledge, are necessary measure to reduce the burden of cancers [13,14].

Cancer is a complex disease, and the incidence and death of cancer vary widely among Member States. The highest lung and digestive tract cancers incidence has occurred in East Asia, whereas this condition has a breast cancer and lung cancer predominance in ASEAN, West Asia, South Asia, and Central Asia. In South Asia, lip cancer and oral cavity cancer are the leading causes of cancer deaths. South and Central Asia account for more than a third of the global oral cancer burden. In 2018, India had the highest burden of oral cancer, with approximately 120,000 new cases [3]. In the
member countries in CIS and CEE, colorectal cancer and lung cancer are the most
diagnosed cancers with the highest mortality, and of which the CEE countries have a
high incidence of male’s cancers, such as bladder and prostate. These variations might
be related to disparities in genetic vulnerability, lifestyle, and local environmental
exposures among the different locations. For example, the ASR of alcohol-induced
cancer deaths and DALY varies greatly between countries and regions. The highest
burden of alcohol-induced cancers was observed in Eastern Europe, and the lowest in
North Africa and the Middle East[15]. In countries with high HDI, the risk of colorectal
cancer tends to be relatively high, and morbidity and mortality rates have stabilized or
declined[16]. The increased prevalence of obesity and the increased consumption of
dairy products and calcium have previously been associated with an increase in the risk
of prostate cancer. In the black population, for instance, the incidence of prostate cancer
is much higher[17]. Further, the inherent and growing disparities in medical practice and
health infrastructure within and between countries also affect the patterns and trends in
cancer mortality[18, 19, 20, 21]. Two major factors in the decline in prostate cancer deaths
are likely to be prostate cancer associated with PSA testing (i.e., more cancers are found
at an earlier stage) and better management of their patients[22].

Lung cancer remains the most common type of cancer globally, with an estimated
2.1 million new cases and 1.8 million deaths worldwide in 2018[3]. Lung cancer is the
leading cause of cancer morbidity and mortality in men among the “Belt and Road”
countries as well. Smoking is the leading cause of lung cancer, accounting for 63 per
cent of all lung cancer deaths globally and more than 90 per cent in countries where
smoking is common in both sexes[23]. However, the burden of cancer deaths from
tobacco products in the ‘Belt and Road” member countries is heavy, and tobacco control
policies have been failed to adequately implement. In 2018, Turkey, the only member
country, implemented five of the six MPOWER measures. Ten countries (Bulgaria,
Czech Republic, Egypt, Nepal, Russia, Saudi Arabia, Slovenia, Thailand, Greece, and
Iran) implemented three of the six MPOWER measures, but seven countries have not
implemented the MPOWER measures. What’s more, emerging tobacco products have
challenged regulatory approach to control the public health burden of tobacco-related
cancers. Further research should be conducted to determine the risks of emerging tobacco products to accelerate progress in tobacco control, while limiting the hazards of existing traditional tobacco products.

The cancer burden among women in the “Belt and Road” countries is considerably high. Breast cancer remains a serious cancer burden in women. According to the latest data in 2020, breast cancer has surpassed lung cancer and for the first time become the most common cancer in the world (accounting for 11.7% of new cases), ranking the first among the types of cancer worldwide [24]. The rising prevalence of breast cancer is associated with the trend of earlier age at menarche, later age at birth, and parity [25]. Therefore, the incidence of breast cancer can be reduced through regular physical examination screening, postponation or reduction of fertility, reasonable weight control, moderate increase in the amount of exercise and other control measures. However, nine of the “Belt and Road” countries (Afghanistan, Azerbaijan, Brunei, Cambodia, Nepal, Tajikistan, Uzbekistan, Yemen, and Pakistan) have not yet conducted breast cancer screening. The starting age of the target population for breast cancer screening is mainly between 30 and 50 years old, the age of screening in Malaysia, Maldives and Bhutan is below 20 years old. Developing scientific and effective screening methods for breast cancer, improving breast cancer screening programs, and actively carrying out early diagnosis and treatment are still the key points of breast cancer prevention and treatment in the future.

In addition, cervical cancer carries the highest burden in less developed countries and regions in the “Belt and Road” countries [26], and nearly 100% of cervical cancers are caused by high-risk human papilloma virus (HPV) infection [27]. While cervical cancer is the only common cancer with a clear etiology and can be completely effectively prevented by tertiary prevention [28], and HPV vaccination can protect at least 80% of the target population [29]. Only 18 of the member countries have HPV vaccination programmes in place, of which, vaccination coverage of Bhutan, Brunei, Malaysia, and Turkmenistan are more than 80%, while Armenia, the Philippines, Singapore, and Indonesia are less than 5%. Moreover, there are 12 member states (i.e., Afghan, Egypt, Oman, Saudi Arabia, Tajikistan, Uzbekistan, Yemen, Pakistan,
Kyrgyzstan, Kuwait, Iraq, and Iraq) have not yet carried out cervical cancer screening. Therefore, the implementation of HPV vaccination plan and the development of the corresponding screening strategy is the main task of cervical cancer prevention and control in the “Belt and Road” member states.

Infectious agents are the key cause of cancer, particularly in low- and middle-income countries. It was estimated that in 2018, about one-eighth of the 18 million new cancer cases in the world were caused by infection. Hepatitis B virus (HBV) infection, Hepatitis C virus (HCV) infection, liver fluke and Clonorchis’s sinensis remain the leading infectious factors leading to cancer in low- and middle-income countries. Among other infectious factors, including HTLV-1 and large parasites, contribute little to the global burden of cancer, but are significant cause of cancer in endemic populations. What’s more, Helicobacter pylori is responsible for a large number of gastrointestinal cancers and deaths. Combination therapy with antibacterial drugs has potential preventive effects. Since 1982, vaccines have been available to prevent HBV, and direct-acting antiviral drugs have the potential to cure more than 95 per cent of people infected with HCV. Adequate infection control strategies, including cheap and reliable point-of-care diagnostic tests for specific infectious agents for screening, effective treatments, and therapeutic and preventive vaccines, should all play a broader role in cancer control programs. However, to realize these aspirations, a large amount of international investment is required. Therefore, the "Belt and Road" initiative provides a new platform for international health cooperation.

Ultraviolet radiation directly or indirectly induces DNA damage, leads to mutations, triggers inflammation and immunosuppression, finally leads to tumor growth. Photocarcinogenesis is a complex, multi-step pathway, which is triggered by the formation of dipyrimidine photoproducts and leads to the formation of mutations (initial stage). Sunburn and inflammation caused by persistent DNA lesions (including dipyrimidine photoproducts and oxidative DNA lesions) play a role in promoting the process of photocarcinogenesis. The dipyrimidine photoproduct triggers ultraviolet-induced immunosuppression, leading to the failure of immune surveillance and the growth and development of cancer cells. The incidence of both melanoma and non-
melanoma skin cancer is increasing worldwide, not only in Caucasians [37], but also in Asians, where UV mutations are significantly more common in sun-exposed skin areas than in non-sun-exposed skin areas [38]. The most effective way to reduce the incidence of skin cancer is to avoid unnecessary sun exposure and take personal precautions, such as wearing protective clothing, hats, applying sunscreen, and staying in a cool place, which can significantly reduce the risk of sun damage.

5. Conclusion

In summary, the challenges posed by cancer are consistent in the “Belt and Road” member countries: Lung cancer, breast cancer, gastrointestinal cancer, prostate cancer, cervical cancer, thyroid cancer, and uterine cancer are the biggest cancer burdens in the “Belt and Road” countries, and tobacco products, infectious factors, and ultraviolet rays are the main risk factors, while the corresponding cancer prevention and control policies need to be improved. Therefore, in the context of the health "Belt and One Road" initiative, the collaboration of multi-stakeholder and the sharing of resources will play a positive role in jointly coping with the risks and challenges brought by cancer and promoting the healthy development of the medical and health undertakings of all member states and the world.

Abbreviations

| Abbreviation | Description |
|--------------|-------------|
| HDI          | Human Development Index |
| CMNN         | Communicable, Maternal, Neonatal, and Nutritional deficiency diseases |
| NCDs         | Non-Communicable Diseases |
| PBCRs        | Population-Based Cancer Registries |
| ASRs         | Age-Standardized Rates |
| PAFs         | Population Attributable Fractions |
| ASEAN        | The Association of South-East Asian Nations |
| CIS          | The Commonwealth of Independent States |
| CEE          | Central and Eastern Europe |
HPV   Human Papilloma Virus
HBV   Hepatitis B Virus
HCV   Hepatitis C Virus

**Declarations**

- Ethics approval and consent to participate
  Not Applicable.
- Consent to publish
  Yes.
- Availability of data and materials
  Yes.
- Competing interests
  The authors have no conflicts of interest to declare
- Funding
  No funding was obtained for this study.
- Authors' contributions
  BW and FH participated in the design, data analysis and drafting of the first manuscript.
  YH, YS, DW, and QW participated in the data collection and manuscript modification.
  JW participated in the design of the study and review of the draft manuscript. All authors read and approved the final manuscript.
- Acknowledgements
  Not Applicable.

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