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RESEARCH ARTICLE

A Single Measure of Cancer Burden Combining Incidence with Mortality Rates for Worldwide Application

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Abstract

We attempted to develop an indicator combining incidence with mortality rates (single measure of cancer burden, SMCB) and to compare the magnitudes of cancer burden by world region. The SMCB was used to measure the size of cancer burden summarizing the incidence and mortality. The incidence and mortality were divided in equivalent forms and were split. The criteria dividing the size of cancer burden were used as the maximum incidence and mortality by men and women according to the world database, and the value corresponding to 10% of each maximum was set as the cut-off value. In SMCB, the size of cancer burden was highest for men with lung cancer (SMCB=18) and for women with breast cancer (SMCB=14) in MDR (more developed regions) compared to the size of burden in LDR (lower developed regions) (lung, SMCB=11, breast, SMCB=8). For men, the size of cancer burden by region was highest in EURO (SMCB=18, lung), followed by WPRO (SMCB=16, lung), PAHO (SMCB=14, prostate), AFRO (SMCB=8, prostate) and SEARO (SMCB=7, lung). Moreover, for women, the size of cancer burden was greatest in EURO (SMCB=14, breast), followed by PAHO (SMCB=13, breast), AFRO (SMCB=11, cervix uteri), EMRO (SMCB=9, breast) or SEARO (SMCB=8, cervix uteri) and WPRO (SMCB=7, lung). The summary indicator will help to provide a priority setting for reducing cancer burden in health policy.

Keywords: Single measure of cancer burden - incidence - mortality - regions

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Introduction

Cancer is one of the leading causes of death worldwide (WHO, 2004; 2008). In 2008, it was reported that 12.7million people were newly diagnosed with cancer and that 7.6 million people died of cancer (Ferlay et al., 2010). In addition, the 5-year global cancer prevalence is estimated to be 28.8 million in 2008 (Bray et al., 2013). The rates of cancer occurrence in low-and-middle income countries are expected to reach as high as 61 percent in the world by 2050 (Bray and MÃller, 2006).

Patterns of cancer (Jemal et al., 2010; Kamangar et al., 2006) are very diverse, depending on the region (Kimman et al., 2012; Dsouza et al., 2013; Ismail et al., 2013), race (McCracken et al., 2007; Ollberding et al., 2011; Siegel et al., 2012) and age (Parkin and Fernández, 2006). Regional differences were shown in a study by Jemal et al. (2010) The study showed that Eastern Europe and Asia have high rates of lung cancer in men and that Europe and America have high rates of prostate cancer in men. In the future, it is expected that more diverse types of cancer will appear due to population growth and aging which will in turn increase cancer burden. Therefore, we can predict that cancer burden will be an important issue in the field of health care (Parkin et al., 2001; Jemal et al., 2011; Siegel et al., 2013).

It is important for countries to set the priority of cancer control as a policy for reducing cancer burden. However, prior to prioritization, we should be aware that diagnosed cancer and cancer as a cause of death are different from each other (Vainio, 2002; Ferlay et al., 2010; Bray et al., 2012). Cancer incidence and mortality are thought have different meanings, and thus, the priority of national cancer burden can be changed.

When cancer incidence is high, cancer mortality is relatively lower due to a high survival rate (Parkin and Fernández, 2006). In addition, while some cancers have high fatality, more cancer cases are being detected early through cancer screening tests (Choi et al., 2009; Parkin et al., 2005). In this regard, although the incidence and mortality of cancer in setting the burden of cancer should be measured in combination with each other, they have been interpreted separately up to now (Jemal et al., 2008; Parkin, 2001). Therefore, we developed a single measure of cancer burden (SMCB) combining incidence and mortality and compared the world regions.

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Materials and Methods

Data

Data were obtained from the GLOBOCAN 2008 IARC (The International Agency for Research on Cancer) and age-standardized (ASRs, per 100,000 populations) incidence and mortality rates of cancer (WHO). Cancer types included 22 in men and 24 women, and Kaposi sarcoma (C46) was excluded from the analysis due to insufficient data by region. Analyses included world, more developed regions, MDR; less developed regions, LDR, and WHO 6 regions (Africa region, AFRO; Americas region, PAHO; East mediterranean region, EMRO; Europe reion, EURO; South-east Asia region, SEARO; Western Pacific region, WPRO).

Single measure of cancer burden (SMCB)

We developed the SMCB, in order to compare the sizes of regional cancer burden. The SMCB was defined as the summary measuring the incidence and mortality from cancer: ***SMCB=INC+MOR***

The sizes of incidence and mortality was measured the each size to classified as equivalent form. The sizes were based on the maximum incidence and mortality rates by men and women according to the world database. The value corresponding to 10% of the maximum was set as the cut-off value. The sizes of incidence and mortality were defined using the maximum and cut-off, and were classified into a total of 10 stages. The maximum incidence was 66.7, and the maximum mortality was 42.0.

The size of incidence or mortality was classified using the formula below:

$$(n-1)\times\frac{INC_{\max}}{10} < INC_{(a)} \le n\times\frac{INC_{\max}}{10}$$

Where n refers to the size for the incidence or mortality vary from 1 to 10. In order to divide the range for each of the sizes, 1 was subtracted from n, and the result was multiplied by 10 percent of the maximum incidence or mortality. The calculated value corresponded to one part of range, and in the other part, n was multiplied by 10% of the maximum incidence or mortality.

Thus, if the size of incidence or mortality was 1, the range corresponded to the values up to 10% between the minimum and maximum; each maximum was included in the 10. This method was applied to incidence and mortality, respectively. The higher the size of cancer burden, the higher the n. In addition, the more number of SMCB increase, the more the cancer burden increase.

Results

The overall cancer burden was higher for men than for women. In a comparison of incidence and mortality by sex, total cancer incidence of the World was 187.1 in men and 152.2 in women, and total cancer mortality of the World was 116.2 in men and 78.7 in women. Total cancer incidence in the more developed regions (MDR; men 281.8, women 212.6) was higher than that in the less developed regions (LDR; men 144.5, women 125.7). In addition, total cancer mortality in the more developed regions (MDR; men 130.1, women 78.6) was higher than that in the less developed regions (LDR; men 107.9, women 77.0). Total cancer incidence for men in the MDR was approximately 2-fold higher than that in the LDR. However, regarding total cancer mortality in women, there was a very small difference between the LDR and MDR. With regard to total cancer incidence in men and women in WHO 6th continents, men had the highest incidence in EURO (262.2) and women had the highest incidence in PAHO (197.1), while total cancer mortality was the highest in both men and women in WPRO. Total cancer incidence and mortality were lowest compare to other regions in SEARO for men (incidence 90.2, mortality 72.1) and in EMRO for women (incidence 91.2, mortality 63.2). Cancers with the highest incidence across all continents were prostate cancer (66.7) in men and breast cancer (62.8) in women. These cancers had the highest incidences in PAHO (men) and in EURO (women), respectively. On the other hand, cancers that resulted in the highest mortality were lung cancer (42.0) in men and cervix uteri cancer

Table 1. Age-standardized Cancer Incidence and Mortality Rates of Cancer Sites by Sex and Regions

Regions	Male					Female				
	Total	Max		Min		Total	Max		Min	
Incidence										
World	187.1	33.8	Lung	1.2	Hodgkins	152.2	38.9	Breast	0.6	Larynx
More Developed Regions (MDR)	281.8	61.7	Prostate	0.6	Nasopharynx	212.6	66.4	Breast	0.2	Nasopharynx
Less Developed Regions (LDR)	144.5	27.6	Lung	0.7	Melanoma	125.7	27.1	Breast	0.5	Hodgkins
WHO Africa Region (AFRO)	91.2	20.4	Prostate	0.4	Gallbladder, Testis	104.2	30.7	Cervix Uteri	0.3	Larynx
WHO Americas Region (PAHO)	235.7	66.7	Prostate	0.5	Nasopharynx	197.1	57.2	Breast	0.2	Nasopharynx
WHO East Mediterranean Region (EMRO)	92.5	12.0	Lung	0.5	Melanoma	91.2	29.3	Breast	0.4	Melanoma
WHO Europe Reion (EURO)	262.2	55.3	Prostate	0.6	Nasopharynx	193.1	62.8	Breast	0.2	Nasopharynx
WHO South-East Asia Region (SEARO)	90.2	16.6	Lung	0.2	Melanoma	107.5	26.1	Breast	0.2	Melanoma
WHO Western Pacific Region (WPRO)	210.9	44.0	Lung	0.5	Hodgkins	150.8	26.3	Breast	0.3	Hodgkins Other Pharynx
Mortality										
World	116.2	29.2	Lung	0.3	Testis, Thyroid	78.7	12.4	Breast	0.3	Hodgkins,Larynx
More Developed Regions (MDR)	130.1	39.2	Lung	0.3	Nasopharynx, Testis, Thyroid	78.6	15.3	Breast	0.1	Nasopharynx
Less Developed Regions (LDR)	107.9	24.4	Lung	0.3	Melanoma, Testis, Thyroid	77.0	10.7	Breast	0.3	Hodgkins Melanoma
WHO Africa Region (AFRO)	76.0	14.5	Prostate	0.2	Testis	76.2	21.7	Cervix Uteri	0.2	Larynx
WHO Americas Region (PAHO)	103.0	28.1	Lung	0.2	Nasopharynx	79.5	15.9	Lung	0.1	Nasopharynx
WHO East Mediterranean Region (EMRO)	74.5	11.2	Lung	0.3	Melanoma	63.2	16.0	Breast	0.2	Melanoma
WHO Europe Reion (EURO)	139.5	42.0	Lung	0.3	Nasopharynx, Thyroid	80.7	16.7	Breast	0.1	Nasopharynx
WHO South-East Asia Region (SEARO)	72.1	15.2	Lung	0.1	Melanoma of Skin	68.5	13.7	Cervix Uteri	0.1	Melanoma
WHO Western Pacific Region (WPRO)	146.3	37.2	Lung	0.1	Testis	82.5	15.7	Lung	0.1	Hodgkins

*Except Kaposi Sarcoma

Table 2. Priority of Cancer Incidence, Mortality and Single Measure of Cancer Burden (SMCB) by Region (Men)

Regions	Ranks	Incidence		Size	Mortality		Size	SMCB	
World	1	Lung	33.8	6	Lung	29.2	7	Lung	13
	2	Prostate	27.9	5	Liver	14.5	4	Colorectum	7
	3	Colorectum	20.3	4	Stomach	14.2	4	Prostate	7
	4	Stomach	19.7	3	Colorectum	9.6	3	Stomach	7
	5	Liver	16.0	3	Oesophagus	8.5	3	Liver	7
More Developed Regions (MDR)	1	Prostate	61.7	10	Lung	39.2	10	Lung	18
	2	Lung	47.1	8	Colorectum	15.1	4	Prostate	13
	3	Colorectum	37.7	6	Prostate	10.5	3	Colorectum	10
	4	Stomach	16.7	3	Stomach	10.3	3	Stomach	6
	5	Bladder	16.3	3	Pancreas	7.9	2	Bladder	5
Less Developed Regions (LDR)	1	Lung	27.6	5	Lung	24.4	6	Lung	11
	2	Stomach	20.9	4	Liver	17.3	5	Liver	8
	3	Liver	18.8	3	Stomach	15.9	4	Stomach	8
	4	Colorectum	12.1	2	Oesophagus	10.1	3	Oesophagus	5
	5	Prostate	11.9	2	Colorectum	6.8	2	Colorectum	4
WHO Africa Region (AFRO)	1	Prostate	20.4	4	Prostate	14.5	4	Prostate	8
	2	Liver	12.5	2	Liver	12.6	4	Liver	6
	3	Oesophagus	8.0	2	Oesophagus	7.7	2	Colorectum	4
	4	Colorectum	7.0	2	Lung	6.3	2	Oesophagus	4
	5	Lung	6.6	1	Colorectum	5.7	2	Lung	3
WHO Americas Region (PAHO)	1	Prostate	66.7	10	Lung	28.1	7	Prostate	14
	2	Lung	34.0	6	Prostate	12.9	4	Lung	13
	3	Colorectum	23.8	4	Colorectum	8.8	3	Colorectum	7
	4	Bladder	13.0	2	Stomach	7.8	2	Stomach	4
	5	Stomach	10.7	2	Pancreas	5.9	2	Leukaemia	4
WHO East Mediterranean Region (EMRO)	1	Lung	12.0	2	Lung	11.2	3	Lung	5
	2	Bladder	10.0	2	Stomach	7.8	2	Bladder	4
	3	Stomach	8.4	2	Bladder	6.7	2	Colorectum	4
	4	Prostate	7.6	2	Prostate	5.7	2	Prostate	4
	5	Colorectum	6.7	2	Non-Hodgkin lymphoma	5.2	2	Stomach	4
WHO Europe Reion (EURO)	1	Prostate	55.3	9	Lung	42.0	10	Lung	18
	2	Lung	48.1	8	Colorectum	16.3	4	Prostate	12
	3	Colorectum	35.3	6	Stomach	11.9	3	Colorectum	10
	4	Bladder	16.5	3	Prostate	11.7	3	Stomach	6
	5	Stomach	15.1	3	Pancreas	7.7	3	Bladder	5
WHO South-East Asia Region (SEARO)	1	Lung	16.6	3	Lung	15.2	4	Lung	7
	2	Lip, oral cavity	8.4	2	Liver	6.2	2	Colorectum	4
	3	Colorectum	7.4	2	Lip, oral cavity	5.7	2	Liver	4
	4	Liver	6.7	2	Other pharynx	5.7	2	Lip, oral cavity	4
	5	Other pharynx	6.6	1	Stomach	5.6	2	Oesophagus	3
WHO Western Pacific Region (WPRO)	1	Lung	44.0	7	Lung	37.2	9	Lung	16
	2	Stomach	39.9	6	Liver	30.9	8	Liver	14
	3	Liver	34.4	6	Stomach	26.5	7	Stomach	13
	4	Colorectum	21.3	4	Oesophagus	15.0	4	Colorectum	7
	5	Oesophagus	18.9	3	Colorectum	9.4	3	Oesophagus	7

*Except Kaposi Sarcoma

(21.7) in women. Also, they had the highest values in EURO (men) and in AFRO (women). Thus, EURO was found to have the highest cancer incidence as well as the highest cancer mortality for both men and women.

In Tables 2 and 3, we identified a priority of regional cancer burden by cancer incidence and mortality, and according to the SMCB in order from highest to lowest. The sizes of incidence and mortality were calculated by applying the calculation method. The SMCB was shown to be a result of a combined size of cancer incidence and cancer mortality in the same cancer site.

For the priority of cancer burden, there were varied differences in cancer incidence, mortality, and SMCB, depending on the cancer site. Ranking of the SMCB combining the sizes of incidence and mortality became more marked. In particular, the SMCB showed a distinct difference in the ratio of existing cancer sites because the SMCB's incidence and mortality were measured in equivalent forms. Incidence, mortality and SMCB in men in the world had the highest value priority of lung cancer. However, the incidence in men in MDR was highest in prostate cancer, and the mortality and SMCB were highest in lung cancer. By region, the incidence in men in PAHO and EURO had the highest values in prostate cancer, but the mortality and SMCB in both PAHO and EURO had the highest values in lung cancer. On the other hand, the incidence, mortality and SMCB in men in AFRO had the highest values in prostate cancer.

Regarding breast cancer in women, incidence, mortality and SMCB had the highest values in the world, MDR and LDR, and the results were the same as those in EMRO and EURO, while cervix uteri cancer had the highest value incidence, mortality and SMCB in AFRO. Cancer of priority in PAHO (Breast cancer) had the same as incidence and SMCB, while SEARO and WPRO had the same as mortality and SMCB. However, in SEARO (Cervix uteri cancer) and WPRO (Lung cancer), the same results were shown between mortality and SMCB. Based on these results (Table 2 and 3), we compared the sizes of regional cancer burden worldwide corresponding to

Table 3. Priority of Cancer Incidence, Mortality and Summary Measure of Cancer Burden (SMCB) by Region (Women)

Regions	Ranks	Incidence	Size		Mortality	Size		SMCB	
World	1	Breast	38.9	6	Breast	12.4	3	Breast	9
	2	Cervix uteri	15.2	3	Lung	10.9	3	Lung	6
	3	Colorectum	14.6	3	Cervix uteri	7.8	2	Cervix uteri	5
	4	Lung	13.5	3	Colorectum	7.0	2	Colorectum	5
	5	Stomach	9.1	2	Stomach	6.9	2	Stomach	4
More Developed Regions (MDR)	1	Breast	66.4	10	Breast	15.3	4	Breast	14
	2	Colorectum	24.3	4	Lung	13.6	4	Colorectum	7
	3	Lung	18.8	3	Colorectum	9.7	3	Lung	7
	4	Corpus uteri	13.0	2	Ovary	5.1	2	Ovary	4
	5	Ovary	9.3	2	Pancreas	5.1	2	Stomach	4
Less Developed Regions (LDR)	1	Breast	27.1	5	Breast	10.7	3	Breast	8
	2	Cervix uteri	17.7	3	Cervix uteri	9.7	3	Cervix uteri	6
	3	Lung	11.1	2	Lung	9.6	3	Lung	5
	4	Stomach	9.9	2	Stomach	8.1	2	Colorectum	4
	5	Colorectum	9.4	2	Liver	7.2	2	Liver	4
WHO Africa Region (AFRO)	1	Cervix uteri	30.7	5	Cervix uteri	21.7	6	Cervix uteri	11
	2	Breast	26.5	4	Breast	15.4	4	Breast	8
	3	Liver	6.1	1	Liver	6.3	2	Liver	3
	4	Colorectum	4.9	1	Colorectum	4.0	1	Bladder	2
	5	Oesophagus	4.0	1	Oesophagus	3.8	1	Brain, nervous system	2
WHO Americas Region (PAHO)	1	Breast	57.2	9	Lung	15.9	4	Breast	13
	2	Lung	21.9	4	Breast	13.7	4	Lung	8
	3	Colorectum	18.3	3	Colorectum	7.1	2	Colorectum	5
	4	Cervix uteri	15.3	3	Cervix uteri	6.5	2	Cervix uteri	5
	5	Corpus uteri	10.5	2	Pancreas	4.5	2	Ovary	4
WHO East Mediterranean Region (EMRO)	1	Breast	29.3	5	Breast	16.0	4	Breast	9
	2	Cervix uteri	9.0	2	Cervix uteri	5.8	2	Cervix uteri	4
	3	Colorectum	5.4	1	Colorectum	4.1	1	Colorectum	2
	4	Ovary	4.8	1	Stomach	4.0	1	Bladder	2
	5	Stomach	4.3	1	Ovary	3.7	1	Brain, nervous system	2
WHO Europe Reion (EURO)	1	Breast	62.8	10	Breast	16.7	4	Breast	14
	2	Colorectum	22.7	4	Colorectum	10.3	3	Colorectum	7
	3	Lung	12.7	2	Lung	10.3	3	Lung	5
	4	Corpus uteri	12.3	2	Stomach	5.7	2	Stomach	4
	5	Cervix uteri	10.1	2	Ovary	5.3	1	Ovary	4
WHO South-East Asia Region (SEARO)	1	Breast	26.1	4	Cervix uteri	13.7	4	Cervix uteri	8
	2	Cervix uteri	24.4	4	Breast	12.5	3	Breast	7
	3	Colorectum	6.5	1	Lung	5.3	2	Colorectum	3
	4	Ovary	6.2	1	Colorectum	4.5	2	Ovary	3
	5	Lung	5.9	1	Ovary	4.4	2	Lung	3
WHO Western Pacific Region (WPRO)	1	Breast	26.3	4	Lung	15.7	4	Lung	7
	2	Lung	19.1	3	Stomach	12.4	3	Breast	6
	3	Stomach	17.3	3	Liver	11.5	3	Stomach	6
	4	Colorectum	14.7	3	Breast	6.7	2	Colorectum	5
	5	Liver	12.4	2	Colorectum	6.6	2	Liver	5

*Except Kaposi Sarcoma

SMCB ≥7 through schematization.

Overall, cancers corresponding to SMCB ≥7 were Lung, Prostate, Colorectum, Stomach and Liver cancers in men, and Breast, Cervix uteri, Colorectum and Lung cancers in women. Among them, Lung cancer and Prostate cancer in men and Breast cancer and Cervix uteri cancer in women showed more cancer burden by region. For cancer burden with respect to the incidence and mortality in all regions, men showed the highest incidence in PAHO (Prostate=10) and the highest mortality in EURO (Lung=10). Women showed the highest incidence in EURO (Breast=10) and the highest mortality in AFRO (Cervix uteri=6), showing regional differences in the size of cancer burden according to incidence and mortality. Cancer burden in the aspect of the incidence of prostate cancer in men and breast cancer in women showed a significant difference compared to cancer burden in the aspect of mortality. On the other hand, the cancer burden of Lung cancer mortality in men seemed to be higher than that of lung cancer incidence in men; however, the difference was not significant.

In most regions, it was shown that men showed a more diverse distribution of cancer than women; also, cancer burden was higher for men than that for women. However, women showed a more diverse pattern of cancer compared to men in AFRO, SEARO and EMRO. Especially in AFRO, the highest burden of cervix cancer (SMCB=11) was noted in the region. Lung cancer (SMCB=13) in men and Breast cancer (SMCB=9) in women showed the highest burden in the world. In MDR and LDR, the burdens of these cancers showed the highest values. The sizes of Lung cancer (SMCB=18) in men and Breast cancer (SMCB=14) in women in MDR were very large compared to the sizes of Lung cancer in men and Breast cancer in women in LDR (Lung, SMCB=11, Breast, SMCB=8). In all regions, cancer burden in men was highest in EURO (SMCB=18, Lung), followed by WPRO (SMCB=16, Lung), PAHO (SMCB=14, Prostate), AFRO

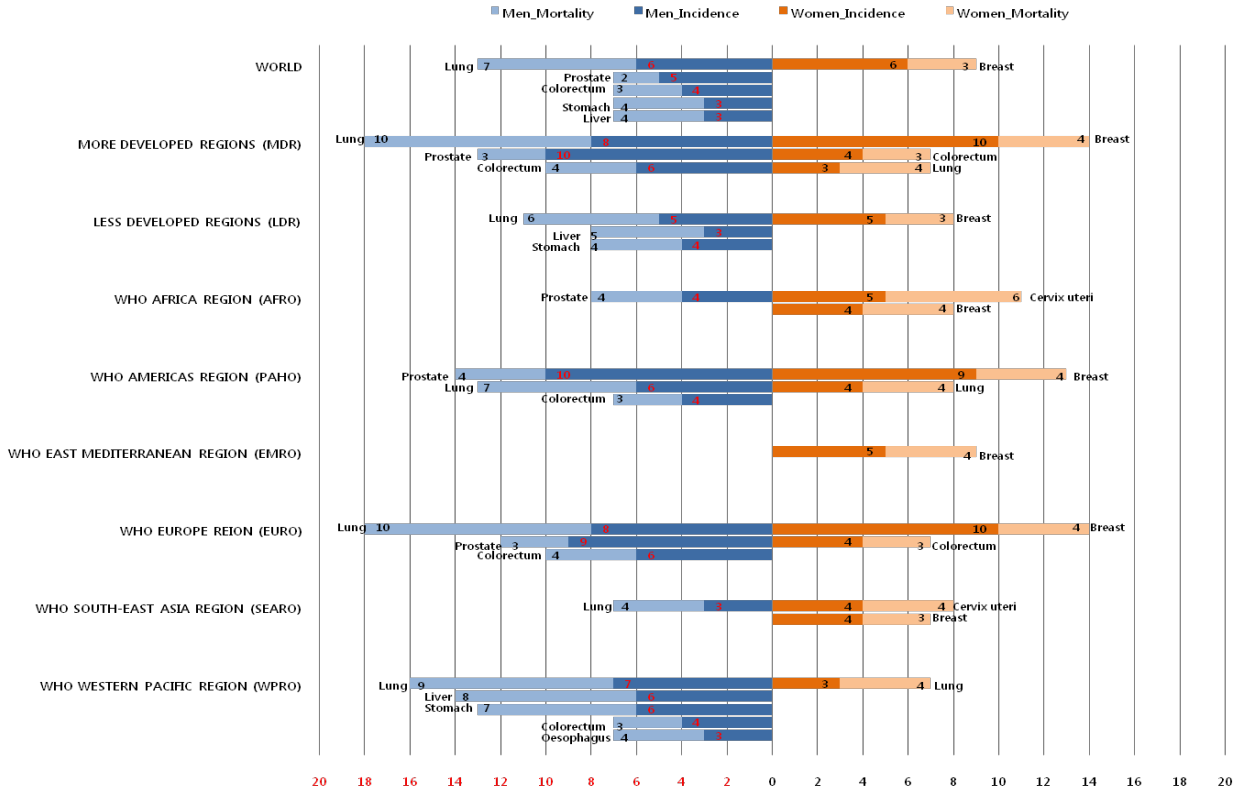

Figure 1. High Single Measure of Cancer Burden (SMCB ≥7) by Regions

(SMCB=8, Prostate) and SEARO (SMCB=7, Lung). The size of cancer burden in women was highest in EURO (SMCB=14, Breast), followed by PAHO (SMCB=13, Breast), follow by AFRO (SMCB=11, Cervix uteri), and EMRO (SMCB=9, Breast) or SEARO (SMCB=8, Cervix uteri), and WPRO (SMCB=7, Lung), indicating varied differences by region.

Discussion

We compared the sizes of regional cancer burden using the Single Measure of Cancer Burden (SMCB). As the SMCB developed through combining incidence and mortality, a measure were quantified by compose to equal values since incidence and mortality sizes.

As the results of the SMCB, there was a regional difference in the size of cancer burden and diversity according to the cancer site. Lung cancer in men and breast cancer in women had a very high burden in most regions. Overall, lung cancer in men had the highest cancer burden in mortality, and Breast cancer in women had the highest cancer burden in incidence. These cancers were also the highest priorities in MDR and LDR. These patterns also varied by region. To be more specific, lung cancer in men included PAHO, EMRO, EURO, SEARO and WPRO, except for AFRO, and Breast cancer in women included AFRO, PAHO, EMRO, EURO and SEARO, except for WPRO. Therefore, these cancers were identified as important factors that increased the cancer burden around the world.

The SMCB results show that the priority of regional cancer burden was significantly different from the priority of incidence and mortality. In particular, the SMCB showed the same results when the same cancer incidence and mortality were equal ranking. However, when the ranking of incidence and mortality was equal or the cancer site was different from each other, the SMCB included a new cancer or became lower than the ranking of incidence and mortality. The result was confirmed that even if any one of the rates incidence or mortality were high, the ranking of the SMCB was not decide for the direction.

The incidence of prostate cancer was 27.9, and the incidence of stomach cancer was 19.7 in the world, indicating that the incidence of prostate cancer was higher than the incidence of stomach cancer. On the other hand, the mortality of prostate cancer was 7.4, and the mortality of stomach cancer was 14.2, indicating that the mortality of stomach cancer was higher than the mortality of prostate cancer. However, when the incidence and mortality of these cancers were added up by the same cancer site, the value of prostate cancer was higher than the value of stomach cancer. Nevertheless, the SMCB results show that prostate cancer and stomach cancer were of the same priority. Based on these results, we identified that could be increased or decreased when the summary measurement simply adding the incidence and mortality, if ratio of the either part considerably increased or decreased due to the characteristics.

The SMCB is to measure population health. The DALY (Disability Adjusted Life-Year) has often been used as an indicator of summary measurement for disease burden (Gold, 2002; WHO, 2002). The DALY can be regarded as a clear indicator because it uses the weight of disability as a quantitative value to measure the burden caused by the disease, disability and death at the national level (Barker and Green, 1996).

However, the DALY can occur different the burden of disease (WHO, 2001). When the age disability weight (Anand and Hanson, 1997) assessment for disability (Mont, 2007) and measuring the national burden of disease because it uses disability weight that can reasonably reflect the social preferences of the disease by country besides the common GBD (Global burden of disease) disability weight. Nevertheless, incidence and mortality are used as important indices for evaluating cancer burden (Hakama et al., 1975), MI ratio (Mortality-to-Incidence rate ratio) can identify trend of cancer but cannot evaluate the size of cancer burden(Sant et al., 2006). Moreover, because log transformation of data results in a greater ratio, this is not different from the separate measurement of incidence and mortality. Thus, we developed SMCB to assess the indicator size of cancer burden.

In the future, it is expected that the development of medical technology and aging of the world population will cause increased incidence and decreased mortality from cancer (Bray et al., 2012; Jemal et al., 2010). When comparing a single indicator that considers the absolute size of mortality, like the DALY (Soerjomataram et al., 2012) and the SMCB which considers the relative size of mortality, the SMCB gives prominence to cancer whose incidence is high but whose mortality is very low like prostate cancer. This indicates that the SMCB can be used to suggest important policy implications at this time when the character of chronic disease from cancer is enhanced. In addition, in regard to the DALY focuses on human resources of employment or housework of social has been raised continuously criticism that it has give weighted to young people excessively, the SMCB reflecting a balanced age structure can be a remarkable alternative indicator in preparation for the aging society.

The SMCB showed clarified results by wearing off each magnitude for incidence and mortality. In addition, cancer site and region were discriminated. The SMCB has large implications because it is simple and presents a comprehensive draw of priorities and interventions as a result of disease status and mortality. Therefore, the SMCB considers the validity of calculation of cancer burden and has meaning by comparing the results for major disease burden.

However, the SMCB is not an officially standardized method, and does not include objective criteria. Therefore, it should be noted that it is difficult to avoid controversy due to such limitations. Nevertheless, the current report showed that the incidence in MDR and mortality in LDR were present as the main factors of cancer burden worldwide. Also, the types of cancer that increased cancer burden in various regions in the world were presented. Thus, we recommend the SMCB method because of the effects relating to unusual priority peculiar differences in comparing and assessing the size of cancer burden by region.

We strongly recommend the method of SMCB. Worldwide cancer burden caused by increased cancer incidence is not a simple national health care problem, because this can be the burden for the global economy, as well as being the socio-economic burden for the nation. Nevertheless, resources are still being continuously wasted due to cancer, but cancer burden has not been reduced.

Cancer can be reduced or controlled by implementing evidence-based strategies through prevention and early detection. However, because early detection or new treatment methods of cancer can cause abrupt changes in incidence and mortality, it may be difficult to predict cancer burden. Therefore, as a prediction plan for cancer burden, we should understand the position of the problem by setting the priority and determining the direction by presenting sufficient evidence using limited resources (Woolf and Stange, 2006). Through this, we will be able to obtain enhanced health outcomes (Thun et al., 2010).

National policies were very complicated to determine whether preferentially solve what due to incurred expenses and potential differences even if using the appropriate method for any problems. This study can help to assess resources allocations and to review information and input. It also has a similar meaning as the health indicators of the state of Maryland in the United States ("Health people 2010 Toolkit. A field guide to health planning" 2002).

In the future, regional cancer burden is required through the development of a standardized tool that can be helpful in conducting a variety of research and guidance through continuous monitoring and accurate estimation according to the changes of period. Therefore, the single measure that we developed will be able to provide specific quantitative information for determination of a policy to reduce cancer burden. The SMCB can be used as a valuable tool for decision making requiring diseases that can be identified through a variety of figures and intervention programs as well as an independent tool for outlining goals and a vision for effective cancer control.

The single measure will help to priority setting for reducing cancer burden in health policy. In the future, this tool is expected to be utilized for research on cancer burden to correctly reflect the changing trends of cancer.

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