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International trends in cancer incidence in middle-aged and older adults in 44 countries

--Manuscript Draft--

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Abstract:	Objective: We examine international incidence trends of lung, colorectal, prostate and breast cancers, as well as all cancers combined excluding non-melanoma skin cancer (NMSC) in adults aged 50 and older, over a 15-year period using data from 113 high quality population-based cancer registries included in the Cancer in Five Continents (CI5) series and NORDCAN. Materials and Methods: We calculated annual incidence rates between 1998 and 2012 for ages 50–64, 65-74, and 75+, by sex and both sexes combined. We estimated average annual percentage change (AAPC) in rates using quasi-Poisson regression models.Results: From 1998 to 2012, incidence trends for all cancers (excluding NMSC) have increased in most countries across all age groups, with the greatest increase observed in adults aged 75+ in Ecuador (AAPC=+3%). Colorectal cancer incidence rates increased in the majority of countries, across all age groups. Lung cancer rates amongst females have increased but decreased for males. Prostate cancer rates have sharply increased in men aged 50-64 with AAPC between 5% and 15% in 24 countries, while decreasing in the 75+ age group in 21 countries, by up to -7% in Bahrain. Female breast cancer rates have increased across all age groups in most countries, especially in the 65-74 age group and in Asia with AAPC increasing to 7% in the Republic of Korea. Conclusions: These findings assist with anticipating changing patterns and needs internationally. Due to the specific needs of older patients, it is urgent that cancer systems adapt to address their growing number.

Suggested Reviewers:	Isabelle Soerjomataram, MD, PhD IARC: International Agency for Research on Cancer soerjomatarami@iarc.fr
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Opposed Reviewers:	
Response to Reviewers:	Reviewer #1: This paper aimed at describing international incidence time trends in incidence between 1998 and 2012 of lung, colorectal, prostate and breast cancers, and all cancers using data from cancer population-based registries. The analyses are well conducted, the results are clearly presented as well as supplementary materials. We thank the Reviewer for this comment. Yet, I have major remarks concerning the interest and novelty provided by these results. This is a 'compilation' of information (through Cancer incidence in five continents and through NORDCAN publications), which doesn't provide real new unpublished outcomes in terms of results and in term of discussion. We thank the reviewer for their comment. Indeed, CI5 data are often used to describe trends in cancer incidence over time. However, to our knowledge, this is the first time that trends for several cancer sites are described and compared between middle-aged patients and older patients in 44 countries. We found these other papers using CI5 data but none presented specific data for the 3 age groups we studied: This paper described trends in incidence of colorectal cancer, but not by age group: https://gut.bmj.com/content/66/4/683.long These two papers on breast cancer showed data for <50 & >50 years old: https://onlinelibrary.wiley.com/doi/10.1002/ijc.27841; https://pubmed.ncbi.nlm.nih.gov/32710860/ This one on lung cancer focused on young adults: https://pubmed.ncbi.nlm.nih.gov/32020598/ This one described trends incidence of several cancer sites in AYA: https://pubmed.ncbi.nlm.nih.gov/32016323/ This one is about trends incidence of lung cancer in 12 countries: https://pubmed.ncbi.nlm.nih.gov/24524818/ Culp et al published a description of the prostate burden using GLOBOCAN and CI5 data but did not stratify their results by age group: https://pubmed.ncbi.nlm.nih.gov/31493960/ I don't agree with the assumption that sub-national geographic levels of registration cannot reflect the trends at the national level. In these countries, different validated statistical modelling (such as using mortality as correlate of incidence for example) provide robust national trends in incidence. I thank the reviewer for this comment. The reviewer is correct. However, to be able to model incidence using mortality data, we need to have reliable mortality data that are not available in all countries. We added a comment in the discussion that reads: "Some countries have cancer registries covering sub-national geographic levels only. Although different validated statistical modelling using mortality as a correlate of incidence is possible, reliable mortality data are not available in all countries. Therefore, we cannot confirm that observed incidence trends in these countries reflect the trends at the national level." I don't find very interesting describing and geographically comparing time trends in incidence for All cancers combined (excluding NMSC) : this is a real heterogenous

group with opposite time trends varying according to location and related to multiple factors (screening, registration…). The interpretation is difficult, above all without information on stage at diagnosis.

We thank the Reviewer for their comment. We acknowledge the Reviewer's concern. However, we wish to keep results about the trends in incidence of all cancer combined because it is a good summary of the cancer burden on the healthcare system. We also regret that CI5 data does not have stage information.

I don't think that data from Uganda may offer real new information on time trends due to the extreme small number of registered cases and thus very limited statistical power.

We thank the Reviewer for their comment. This remark is also true for Valdivia, Chile Kuwait and Bahrain. We understand the Reviewer's concern, but we decided not to exclude registries based on number of cases to represent all world regions as this represents one of the novelties of our analysis. As the Reviewer noted, we acknowledge this is a limitation in our discussion.

Reviewer #2: I would congratulate the authors for their efforts. Methodology sounds good and the manuscript is well-written.

We thank the Reviewer for their kind comment.

If the authors have access to the data, it would also be interesting to see incidence trends of the 10 more frequent cancers and their distribution in each continent (for sake of brevity, rather than per each country).

We thank the Reviewer for their suggestion. We agree that describing trends by continent may be interesting. However, doing so would assume that cancer incidence is similar in terms of magnitude and trends in all countries within a particular continent, which is not true as shown in our data.
Making this choice would also mean not to show data for sub-Saharan Africa. Uganda is the only sub-Saharan African (SSA) country in the CI5 dataset used, and it is not representative of all SSA countries.
There was consensus among all co-authors for not adding other cancer sites in the paper that is already dense. The description of trends in incidence of other cancer sites may be the object of future publications.

August 24th, 2021

Dear Doctor Enrique Soto,

We would like to thank you for enabling us to further improve our paper JGERIONC-D-21-00085 entitled “International trends in cancer incidence in middle-aged and older adults in 44 countries”.

Please find below a detailed response to the comments of the reviewers.

We look forward to hearing from you,

Yours sincerely,

Dr Sophie Pilleron
On behalf of co-authors

Reviewer #1: This paper aimed at describing international incidence time trends in incidence between 1998 and 2012 of lung, colorectal, prostate and breast cancers, and all cancers using data from cancer population-based registries.
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This paper described trends in incidence of colorectal cancer, but not by age group: https://gut.bmj.com/content/66/4/683.long

These two papers on breast cancer showed data for <50 & >50 years old: https://onlinelibrary.wiley.com/doi/10.1002/ijc.27841; https://pubmed.ncbi.nlm.nih.gov/32710860/

This one on lung cancer focused on young adults: https://pubmed.ncbi.nlm.nih.gov/32020598/

This one described trends incidence of several cancer sites in AYA: https://pubmed.ncbi.nlm.nih.gov/32016323/

This one is about trends incidence of lung cancer in 12 countries: https://pubmed.ncbi.nlm.nih.gov/24524818/

Culp et al published a description of the prostate burden using GLOBOCAN and CI5 data but did not stratify their results by age group: https://pubmed.ncbi.nlm.nih.gov/31493960/

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We thank the Reviewer for their comment. We acknowledge the Reviewer's concern. However, we wish to keep results about the trends in incidence of all cancer combined because it is a good summary of the cancer burden on the healthcare system. Additionally, trends in the incidence of all cancers combined have been previously described (see https://pubmed.ncbi.nlm.nih.gov/32016323/). We also regret that CI5 data does not have stage information.

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International trends in cancer incidence in middle-aged and older adults in 44 countries

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Keywords: older adults, neoplasms, incidence, trends, epidemiology, population-based cancer registries

List of abbreviations: AAPC: Average annual percentage of change; CI: Confidence Interval; CI5: Cancer Incidence in Five Continents; HRT: hormone replacement therapy; NMSC: non-melanoma skin cancer, NORDCAN: Association of Nordic Cancer Registries; USA: United States of America

Abstract

Objective: We examine international incidence trends of lung, colorectal, prostate and breast cancers, as well as all cancers combined excluding non-melanoma skin cancer (NMSC) in adults aged 50 and older, over a 15-year period using data from 113 high quality population-based cancer registries included in the Cancer in Five Continents (CI5) series and NORDCAN.

Materials and Methods: We calculated annual incidence rates between 1998 and 2012 for ages 50–64, 65-74, and 75+, by sex and both sexes combined. We estimated average annual percentage change (AAPC) in rates using quasi-Poisson regression models.

Results: From 1998 to 2012, incidence trends for all cancers (excluding NMSC) have increased in most countries across all age groups, with the greatest increase observed in adults aged 75+ in Ecuador (AAPC=+3%). Colorectal cancer incidence rates increased in the majority of countries, across all age groups. Lung cancer rates amongst females have increased but decreased for males. Prostate cancer rates have sharply increased in men aged 50-64 with AAPC between 5% and 15% in 24 countries, while decreasing in the 75+ age group in 21 countries, by up to -7% in Bahrain. Female breast cancer rates have increased across all age groups in most countries, especially in the 65-74 age group and in Asia with AAPC increasing to 7% in the Republic of Korea.

Conclusions: These findings assist with anticipating changing patterns and needs internationally. Due to the specific needs of older patients, it is urgent that cancer systems adapt to address their growing number.

Introduction

Globally, adults aged 65+ accounted for approximately half of all new cancer cases in 2020[1]. Recent studies have projected a worldwide doubling of new cancers diagnosed in adults aged 65+ and a tripling in those aged 80+ in the next decades with significant variation across regions and countries[2,3]. However, these projections take into account demographic changes only. Epidemiological research has focused on cancer at all ages combined and, most recently, in children[4] and young adults[5]; but there is little international evidence about trends in the older age groups, that is, 65+[6,7].

Analysis of cancer incidence trends in this emergent population is necessary to assess the impact of cancer control measures on older adults and to ensure sufficient and appropriate resources to manage the needs of this population. Incidence rates may be impacted by change in risk factors profile, and national screening guidelines and programs. Interrogating such differences in cancer incidence trends amongst older adults internationally will lend insight into current and future health and cancer system needs.

Older adults with cancer are a heterogeneous group that has specific needs due to ageing-related physiological changes, a higher level of comorbidity, polypharmacy with a higher risk of interactions and side-effects, and treatment toxicities, and a more limited life expectancy[8–10]. Many older adults also experience cognitive impairment, depression and changes in social support that may complicate cancer management[11–13].

We, therefore, describe international trends in the incidence of all cancers combined (excluding non-melanoma skin cancer) in adults aged 50-64, 65-74 and 75+ years in 44 countries over a 15-year period. We also consider the specific incidence rates of lung, colorectal, prostate and breast cancers, the four most common cancer sites diagnosed in adults aged 65 years and older in 2020[1].

Methods

Data sources

We obtained annual cancer incidence data and corresponding population by 5-year age band (0-4, 5-9,…, 85+) and sex for the period 1998-2012 from the Cancer Incidence in Five Continents Plus (https://ci5.iarc.fr/CI5plus/Default.aspx) database for lung (including trachea) cancer, colorectal cancer, breast cancer (only in females), and prostate cancer, and all cancers combined excluding non-melanoma skin cancer (NMSC) for the following national cancer registries: Austria, Bahrain, Belarus, Bulgaria, Costa Rica (up to 2011), Croatia, Cyprus, Czech Republic, Denmark, Estonia, Iceland, Ireland, Israel, Kuwait, Lithuania, Malta, the Netherlands, New Zealand, Norway, Slovakia (up to 2010), and Slovenia. We also included the following subnational cancer registries that we grouped together by country: Canada (all provinces and territories except Nunavut, Quebec, and Yukon), Chile (1 registry: Valdivia), Colombia (1 registry: Cali), Ecuador (1 registry: Quito), India (1 registry: Chennai), United States of America (USA - 9 SEER registries), Australia (7 registries: Northern-Territories, New South Wales - Australian Capital Territory, Queensland, Tasmania, Victoria, South Australia, Western Australia), Brazil (1 registry: Goiânia), Spain (9 registries: Albacete, Basque Country, Canary Islands, Cuenca, Girona, Granada, Murcia, Navarra, Tarragona), Thailand (4 registries: Chiang Mai, Khon Kaen, Lampang, Songkhla), Uganda (1 registry: Kampala), the United Kingdom (UK - 11 registries: England: East-England, East-Midlands, London, North-East, North-West, East, South-West, West-Midlands, Yorkshire-Humber; Northern Ireland, Scotland), China (5 registries: Harbin, Hong Kong, Jiashan, Shanghai, Zhongshan), France (10 registries: Bas-Rhin, Calvados, Doubs, Haut-Rhin, Herault, Isere, Loire-Atlantique, Manche, Martinique, Somme), Germany (2 registries: Hamburg, Saarland), Italy (8 registries: Biella, Ferrara, Modena, Naples, Parma, Ragusa, Romagna, Veneto. Up to 2010), Japan (4 registries: Fukui, Miyagi, Nagasaki, Osaka. Up to 2010), Poland (1 registry: Kielce), Switzerland (6 registries: Geneva, Neuchatel, St Gall-Appenzell, Ticino, Valais, Vaud), Turkey (2 registries: Antalya, Izmir), Republic of Korea (5 registries: Busan, Gwangju, Incheon, Seoul, Ulsan). Additionally, we obtained annual incidence data and corresponding person·years at risk for the national registries in Finland and Sweden from the NORDCAN (Association of Nordic Cancer Registries) website (https://www-dep.iarc.fr/NORDCAN/english/frame.asp).

Statistical analysis

We calculated annual incidence rates and analyzed trends in cancer incidence by sex and for all sexes combined for the following age groups: 50–64, 65-74, and 75+. For each country, we fitted quasi-Poisson models with a cubic spline effect for year with two knots placed at the years 2002 and 2007 and an interaction term between age group and year to provide smoothed lines through the scatterplot of incidence rates by year and age group. We plotted rates on a semi-log scale. We also estimated the average annual percentage change (AAPC) in incidence rates, and its 95% confidence interval (95%CI) using age-adjusted quasi-Poisson regression models with a linear effect for year of incidence and an interaction term between year and age group to obtain AAPC for each age group. Quasi-Poisson models were used instead of Poisson models to account for overdispersion. We considered increasing or decreasing trends as significant if the 95%CI around AAPC did not include the value 0.

We performed statistical analyses and plotted incidence rates using R statistical software (version 3.4.0; R Development Core Team, 2017).

Ethics

No ethical approval was requested as no individual data were analyzed.

Results

Table 1 outlines the absolute number of new cancer cases, and age-specific incidence rates in 1998 and 2012 for all cancers combined excluding NMSC. Supplementary Tables 1-4 present the same information for lung, colorectal, prostate and breast cancers, respectively.

International trends in incidence for all cancers combined, excluding NMSC, diagnosed between 1998 and 2012 in adults aged 50-64, 65-74 and 75+ years old are presented with all sexes combined in Figure 1 and by sex in Supplementary Figures 1 and 2. Supplementary Figures 1-9 present trends for the other cancers by sex and for all sexes combined when appropriate. AAPC with their 95% CI over the 15 years for all cancers, excluding NMSC, all sexes combined, as well for lung (for females and males, respectively), colorectal (all sexes combined), prostate and breast cancers are presented in Figures 3-9. Figures 10-13 present AAPC for all cancers excluding NMSC and colorectal cancer by sex.

All cancers combined excluding NMSC

Overall, incidence rates varied greatly across countries and did not always follow the same trends across age groups within the same country. Among the countries that had similar trends in all age groups, the incidence of all cancers has significantly increased in 17 countries, mainly those in Asia and Eastern and Northern Europe. Conversely, in Austria, Bahrain, Chile, New Zealand, Poland, and the USA, rates have decreased in all age groups. Rates remained stable in Brazil, Finland, and Sweden. In Canada, Colombia, Costa Rica, and Israel, rates remained stable among adults aged 50-64 years, but they have significantly decreased in older adults. In France and Uganda, rates have increased in the 50-64 age group (respectively, AAPC = 1.0%; 95%CI: 0.5 to 1.8 and 0.9%; 0.1 to 1.8) and stabilized in older adults.

The sharpest increase in incidence over the study period in the 50-64 age group was seen in Ecuador and the Republic of Korea with an average annual increase of +2.8% in both countries. In the 65-74 age group, the greatest increase was observed in Turkey (+2.6%; 1.7

to 3.5), and for the 75+ age group, in India (+4.0%; 3.2 to 4.7). On the contrary, the most important decrease in incidence was seen in Bahrain for the three age groups (-2.8%; -3.7 to -1.9 in the 50-64 age group, -2.9%; -3.8 to -2.0 in the 65-74 age group, and -3.7%; -5.8 to -1.6 in the 75+ age group.

Lung cancer

Lung cancer incidence was systematically lower in females than in males. However, trends in females were opposite to those in males in the majority of countries. Indeed, among females, the incidence of lung cancer has increased in all age groups in most European countries but also in Japan, Cyprus, Israel, India, and Turkey, with higher AAPCs observed in Spain, Malta, and France. In South America, trends were stabilizing except for the 65-74 age group in Goiâna, Brazil, and the 75+ age group in Quito, Ecuador where lung cancer incidence has significantly increased 3.5% and 5.9% on average annually, respectively. A significant decrease in the incidence of lung cancer has been observed in all age groups in Bahrain, adults younger than 75 years old in the USA (-2.2; -2.5 to -2.0 in the 50-64 age group, and -1.2; -1.6 to -0.7 in the 65-74 age group), in the 50-64 age group in Canada, Kuwait, and Thailand, and in the 75+ age group in China (-1.2%; -1.7 to -0.7).

In contrast, the incidence of lung cancer among males has decreased in all age groups in the great majority of countries. This decrease was less marked among males aged 75+ than in younger males. However, lung cancer incidence has significantly risen (between 2.5% and 3.4%) in all age groups in Cyprus, in adults aged over 65 between 2.9% and 5.2% in India and between 0.7% and 1.9% Bulgaria, and in males aged 75+ in Thailand, Israel, Slovakia, Denmark, Estonia, Norway, Sweden, and Malta. In France, male lung cancer incidence rates have increased in the 50-64 and 75+ age groups, while they were stabilizing in the 65-74 age group.

Colorectal cancer

The incidence of colorectal cancer has increased in all age groups in 24 (out of 45) countries, mainly in Asia, Europe, and South America. However, other countries have seen decreasing rates. This is the case in Israel with AAPC between -1.1% and -2.6% across age groups, Czech Republic with AAPC between -0.9% and -0.4%, Austria with AAPC around -2.5%, Germany with AAPC between -1.3% and -0.6%, and Canada with AAPC between -0.9% and -0.3%. A bigger decrease has been observed in the USA: -1.2% in the 50-64 age group, -3.8% in the 65-74 age group, and -3.4% in the 75+ age group. In Australia and New Zealand, the decrease in the incidence of colorectal cancer was restricted to adults aged 50-74. In France, the decrease was significant in adults aged 65 years or older, rates being stable in the 50-64 age group. Rates were stable in Kuwait, Iceland, Malta, and Chile.

Trends were similar in males and females (supplemental Figures 4, 5, 12, and 13).

Prostate cancer

The incidence of prostate cancer in the 50-64 age group has considerably increased in most countries (36/45 countries), with AAPC higher than 10% in Japan, Republic of Korea, Czech Republic, Slovakia, Denmark, Lithuania and Estonia. Incidence rates were stable over the study period in the remaining countries. In the 65-74 age group, 29 out of 45 countries have seen their incidence significantly increased over the 15 years, while rates have decreased in Austria (-2.5%, -3.5 to -1.5), Canada (-1.4%, -2.2 to -0.6), and the USA (-1.9%, -2.7 to -1.1) over the same period. In the oldest age group, prostate cancer incidence has markedly increased in all Asian countries except Bahrain (-6.9%, -11.9 to -1.5), and Israel (-2.5%, -3.8 to -1.2) where rates have decreased. Rates have also significantly risen in several Eastern European countries (Belarus: 6.8%, 5.9 to 7.7, Bulgaria: 4.6%, 3.1 to 6.0, and Slovakia: 3.7%, 2.7 to 4.6), as well as Estonia (2.8%, 1.3 to 4.3) and Ecuador (3.1%, 1.0 to 5.2). Most European countries, Canada, the USA, Australia, Oceania, and most South American countries have seen an important decrease in the incidence of prostate cancers in the oldest adults over the 1998-2012 period.

Female breast cancer

The incidence of breast cancer has increased in all age groups in Asian and Eastern European countries, except for Israel where incidence has decreased in all age groups. Incidence rates have also significantly decreased in all age groups in the USA. The decrease was restricted to the 50-64 age group in Switzerland (-1.2%; -1.7 to -0.7) and the oldest age group in Austria (-0;9%; -1.4 to -0.5), the Netherlands (-0.6%; -0.9 to -0.2), Colombia (-2.5%; -4.4 to -0.6), and Brazil (-2.0%; -3.8 to -0.1). Rates remained stable in all age groups in Uganda, Bahrain, Poland, New Zealand, and Chile.

Discussion

With a total of 113 populations in 44 countries covering all continents, this comprehensive study is the first to describe international trends in incidence specifically in older adults compared to trends in middle-aged adults. Because of the unprecedented demographic growth in the number of older adults globally, examining incidence trends is particularly important in planning for appropriate healthcare resources and in assessing prevention programs, in particular, cancer screening programs.

Overall, cancer incidence in adults aged 75+ has been increasing in a similar magnitude to that in middle-aged people. Cancer management in older adults may be challenging because of higher incidence of comorbidity, age-related physiological changes, poor social support, reduced functional status, cognitive impairment, and limited life expectancy[9–13]. In addition, older adults are seldom included in clinical trials, limiting the evidence of the benefit-risk balance and leaving the cancer management team without appropriate guidance for treatment decision-making[14]. As a consequence, older adults with cancer are more likely to receive suboptimal treatment (e.g., both over-and under-treatment)[15] and have poorer cancer outcomes[16]. In addition, in under-resourced settings, older adults are not prioritized by health care programs and policies because of competing health demands. Yet, the number of older adults with cancer will disproportionately increase in less developed regions[2,3].

Lung cancer incidence trends reflect patterns of smoking prevalence with a latency period of 20-30 years. We observed decreasing incidence in males and increasing incidence in females following the different stages of the tobacco epidemic[17]. In males, the decrease in incidence was less marked in those aged 75+, reflecting the birth cohort effect, with the largest proportion of smokers and number of pack-years in the past[18]. In addition to smoking, environmental and occupational factors can also cause lung cancer; their importance depends on the region[17]. Recent studies have shown different trends based on lung cancer histology. In European and Asian countries, the incidence of squamous-cell carcinomas has decreased in recent decades while the incidence of adenocarcinomas has risen, especially in women[18,19]. However, in the USA, Canada and Australia, the incidence of adenocarcinomas was levelling off in both sexes[18]. These trends also reflect trends in smoking behavior, especially the type of tobacco (e.g., adenocarcinoma has been shown to be associated with smoking low-tar filter cigarettes[20]). With more and more countries adopting tobacco control strategies, the incidence of lung cancer will likely further decrease in both males and females and all age groups, following the expected decrease in the prevalence of tobacco use in all age groups and all world regions[21].

Colorectal cancer incidence has increased in all age groups in many countries. In countries in epidemiological transition, this increase has been correlated to shift from a traditional to a more westernized diet, a decrease in physical activity, and a higher prevalence of overweight and obesity[22]. The decrease observed in some high-income countries may be partially related to screening such as in the USA[23] but also a change in risk factors profile. Indeed, we observed a decrease in some high-income countries in the absence of national screening programs such as in New Zealand, and in the oldest age group that are generally not targeted by screening programs such as in the USA. However, the decreasing incidence in adults aged 75+ may also be the result of less screening among those for whom the harms are deemed to outweigh the benefits [24].

Prostate cancer incidence trends are highly correlated to the use of prostate-specific antigen (PSA) testing. Areas with more intensive PSA screening have higher biopsy rates and incidence rates of prostate cancer than areas with lower PSA screening rates[25]. The prostate cancer incidence rate decreased after the U.S. Services Task Force recommended against PSA-based prostate cancer screening after the age of 75 in 2008[26] and recommendations extended to all men in 2012[27]. We found an increasing trend in prostate cancer incidence in most Asian countries, where others found an increasing trend in mortality as well[28]. Potential reasons for the increasing trend are multifactorial. Some hypothesized that lifestyles due to more westernized diets and/or more frequent PSA screening might have contributed to the observed trends[28,29].

Breast cancer incidence is increasing in all age groups in most countries. However, the increase in incidence observed in Asian countries is important. This has previously been described and attributed to early menarche, late menopause, older age at first delivery, and a lower number of full-term pregnancies over recent decades[30,31]. In many high-income countries, including Australia, North American countries, Northern and Western European countries, decrease in breast cancer incidence in the 50-64 age group may be related to the reduced use of hormone replacement therapy (HRT)[32–34] after evidence of a possible increase in the risk of cardiovascular diseases and breast cancer in women using HRT in the early 2000s[35,36]. Contrary to colorectal cancer screening that may detect pre-cancerous lesions (ie. polyps), mammography aims to detect early-stage breast cancers. A decrease in the incidence of advanced-stage breast cancer is expected after the roll-out of a breast cancer screening program[37]; however, that will not impact the incidence of breast cancer all stages combined in the targeted age range. In the 75+ age group, the incidence of breast cancers that can be detected through screening may be indirectly impacted by cancer screening in middle-aged adults. Cancer development is generally a long process and evidence showed that cancers in older adults are more likely to be diagnosed at more advanced stages[38]. It is then likely that cancer diagnosed after the age of 75 years could have been identified at an earlier age with optimal cancer screening programs, resulting in a decrease in the incidence in the oldest age group. This could explain, at least partly, the decreasing trends observed in the older age group in the Netherlands or Norway where the national breast cancer screening programs have been fully operational since 1997 and 2004, respectively.

Strengths of our study are the high quality of incidence data imposed for inclusion in the CI5 series, and the availability of annual incidence data for such a long period even in countries having fewer resources, such as Uganda or India. The limitations of this study include the unequal coverage of continents, notably the African continent due to the absence of registries in many countries. Also, cancer cases in older adults are likely under-reported, especially in poorly resourced settings where access to diagnostic facilities may be limited, and in all countries where incidence data cannot be completed using death certificates. Some countries have cancer registries covering sub-national geographic levels only. Although different validated statistical modelling using mortality as a correlate of incidence is possible, reliable mortality data are not available in all countries. Therefore, we cannot confirm that observed incidence trends in these countries reflect the trends at the national level. In addition, we did not have data on stage at diagnosis. We focused on the incidence of cancers but describing the trends in cancer mortality and survival in older adults would have complemented our work. Finally, incidence rates greatly fluctuated notably in Bahrain, Kuwait, and Uganda because of relatively small numbers of cancer cases reported, particularly in older age groups.

Conclusion

In addition to the unprecedented demographic growth of older adults worldwide, cancer incidence in older adults is increasing. Strained health care systems need to adapt to managing cancer in an increasing number of older patients with specific needs. Adopting existing cancer management guidelines for older adults with cancer[39,40], and utilizing the full capacity of the multidisciplinary team, may enable better care for this population. However, the response should be tailored to available resources, regional context, and culture[41].

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Where authors are identified as personnel of the International Agency for Research on Cancer/World Health Organization, the authors alone are responsible for the views expressed in this article and they do not necessarily represent the decisions, policy or views of the International Agency for Research on Cancer/World Health Organization.

Conflicts of interest

The authors declare no conflict of interest.

Author's contribution

SP designed, analyzed, drafted, and edited the manuscript.

JF data collection, data quality check, management CI5 series, reviewed the manuscript.

All co-authors provided insightful comments, help with interpretation, and contributed equally to the manuscript.

Data availability

The data used in this study are publicly available at http://ci5.iarc.fr/Default.aspx and https://www-dep.iarc.fr/NORDCAN/english/frame.asp (both sites accessed on February 24th, 2021).

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Tables and Figures

Table 1. Absolute number of new cancer cases, and age-specific incidence rates in 1998 and 2012 for all cancers combined excluding NMSC, all sexes combined, in 44 countries

Figure 1. Trends in the incidence of all cancers combined excluding NMSC, all sexes combined, by age group in 44 countries.

Figure 2. Estimated average annual percentage change for all cancers combined excluding NMSC, all sexes combined, by age group in 44 countries

Figure 3. Estimated average annual percentage change for lung cancer in females by age group in 44 countries

Figure 4. Estimated average annual percentage change for lung cancer in males by age group in 44 countries

Figure 5. Estimated average annual percentage change for colorectal cancer, all sexes combined, by age group in 44 countries

Figure 6. Estimated average annual percentage change for prostate cancer by age group in 44 countries

Figure 7. Estimated average annual percentage change for breast cancer by age group in 44 countries

International trends in cancer incidence in middle-aged and older adults in 44 countries

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List of abbreviations: AAPC: Average annual percentage of change; CI: Confidence Interval; CI5: Cancer Incidence in Five Continents; HRT: hormone replacement therapy; NMSC: non-melanoma skin cancer, NORDCAN: Association of Nordic Cancer Registries; USA: United States of America

Abstract

Objective: We examine international incidence trends of lung, colorectal, prostate, and breast cancers, as well as all cancers combined excluding non-melanoma skin cancer (NMSC) in adults aged 50 and older, over a fifteen-year period using data from 113 high quality population-based cancer registries included in the Cancer in Five Continents (CI5) series and NORDCAN.

Materials and Methods: We calculated annual incidence rates between 1998 and 2012 for ages 50–64, 65-74, and 75+, by sex and both sexes combined. We estimated average annual percentage change (AAPC) in rates using quasi-Poisson regression models.

Results: From 1998 to 2012, incidence trends for all cancers (excluding NMSC) have increased in most countries across all age groups, with the greatest increase observed in adults aged 75+ in Ecuador (AAPC=+3%). Colorectal cancer incidence rates increased in the majority of countries, across all age groups. Lung cancer rates amongst females have increased but decreased for males. Prostate cancer rates have sharply increased in men aged 50-64 with AAPC between 5% and 15% in 24 countries, while decreasing in the 75+ age group in 21 countries, by up to -7% in Bahrain. Female breast cancer rates have increased across all age groups in most countries, especially in the 65-74 age group and in Asia with AAPC increasing to 7% in the Republic of Korea.

Conclusions: These findings assist with anticipating changing patterns and needs internationally. Due to the specific needs of older patients, it is urgent that cancer systems adapt to address their growing number.

Introduction

Globally, adults aged 65+ accounted for approximately half of all new cancer cases in 2020[1]. Recent studies have projected a worldwide doubling of new cancers diagnosed in adults aged 65+ and a tripling in those aged 80+ in the next decades with significant variation across regions and countries[2,3]. However, these projections take into account demographic changes only. Epidemiological research has focused on cancer at all ages combined and, most recently, in children[4] and young adults[5]; but there is little international evidence about trends in the older age groups, that is, 65+[6,7].

Analysis of cancer incidence trends in this emergent population is necessary to assess the impact of cancer control measures on older adults and to ensure sufficient and appropriate resources to manage the needs of this population. Incidence rates may be impacted by change in risk factors profile, and national screening guidelines and programs. Interrogating such differences in cancer incidence trends amongst older adults internationally will lend insight into current and future health and cancer system needs.

Older adults with cancer are a heterogeneous group that has specific needs due to ageing-related physiological changes, a higher level of comorbidity, polypharmacy with a higher risk of interactions and side-effects, and treatment toxicities, and a more limited life expectancy[8–10]. Many older adults also experience cognitive impairment, depression and changes in social support that may complicate cancer management[11–13].

We, therefore, describe international trends in the incidence of all cancers combined (excluding non-melanoma skin cancer) in adults aged 50-64, 65-74 and 75+ years in 44 countries over a fifteen year period. We also consider the specific incidence rates of lung, colorectal, prostate, and breast cancers, the four most common cancer sites diagnosed in adults aged 65 years and older in 2020[1].

Methods

Data sources

We obtained annual cancer incidence data and corresponding population by five year age bands (0-4, 5-9,…, 85+) and sex for the period 1998-2012 from the Cancer Incidence in Five Continents Plus (https://ci5.iarc.fr/CI5plus/Default.aspx) database for lung (including trachea) cancer, colorectal cancer, breast cancer (only in females), and prostate cancer, and all cancers combined excluding non-melanoma skin cancer (NMSC) for the following national cancer registries: Austria, Bahrain, Belarus, Bulgaria, Costa Rica (up to 2011), Croatia, Cyprus, Czech Republic, Denmark, Estonia, Iceland, Ireland, Israel, Kuwait, Lithuania, Malta, the Netherlands, New Zealand, Norway, Slovakia (up to 2010), and Slovenia. We also included the following subnational cancer registries that we grouped together by country: Canada (all provinces and territories except Nunavut, Quebec, and Yukon), Chile (1 registry: Valdivia), Colombia (1 registry: Cali), Ecuador (1 registry: Quito), India (1 registry: Chennai), United States of America (USA - 9 SEER registries), Australia (7 registries: Northern-Territories, New South Wales - Australian Capital Territory, Queensland, Tasmania, Victoria, South Australia, Western Australia), Brazil (1 registry: Goiânia), Spain (9 registries: Albacete, Basque Country, Canary Islands, Cuenca, Girona, Granada, Murcia, Navarra, Tarragona), Thailand (4 registries: Chiang Mai, Khon Kaen, Lampang, Songkhla), Uganda (1 registry: Kampala), the United Kingdom (UK - 11 registries: England: East-England, East-Midlands, London, North-East, North-West, East, South-West, West-Midlands, Yorkshire-Humber; Northern Ireland, Scotland), China (5 registries: Harbin, Hong Kong, Jiashan, Shanghai, Zhongshan), France (10 registries: Bas-Rhin, Calvados, Doubs, Haut-Rhin, Herault, Isere, Loire-Atlantique, Manche, Martinique, Somme), Germany (2 registries: Hamburg, Saarland), Italy (8 registries: Biella, Ferrara, Modena, Naples, Parma, Ragusa, Romagna, Veneto. Up to 2010), Japan (4 registries: Fukui, Miyagi, Nagasaki, Osaka. Up to 2010), Poland (1 registry: Kielce), Switzerland (6 registries: Geneva, Neuchatel, St Gall-Appenzell, Ticino, Valais, Vaud), Turkey (2 registries: Antalya, Izmir), Republic of Korea (5 registries: Busan, Gwangju, Incheon, Seoul, Ulsan). Additionally, we obtained annual incidence data and corresponding person·years at risk for the national registries in Finland and Sweden from the NORDCAN (Association of Nordic Cancer Registries) website (https://www-dep.iarc.fr/NORDCAN/english/frame.asp).

Statistical analysis

We calculated annual incidence rates and analyzed trends in cancer incidence by sex and for all sexes combined for the following age groups: 50–64, 65-74, and 75+. For each country, we fitted quasi-Poisson models with a cubic spline effect for year with two knots placed at the years 2002 and 2007 and an interaction term between age group and year to provide smoothed lines through the scatterplot of incidence rates by year and age group. We plotted rates on a semi-log scale. We also estimated the average annual percentage change (AAPC) in incidence rates, and its 95% confidence interval (95%CI) using age-adjusted quasi-Poisson regression models with a linear effect for year of incidence and an interaction term between year and age group to obtain AAPC for each age group. Quasi-Poisson models were used instead of Poisson models to account for overdispersion. We considered increasing or decreasing trends as significant if the 95%CI around AAPC did not include the value 0.

We performed statistical analyses and plotted incidence rates using R statistical software (version 3.4.0; R Development Core Team, 2017).

Ethics

No ethical approval was requested as no individual data were analyzed.

Results

Table 1 outlines the absolute number of new cancer cases, and age-specific incidence rates in 1998 and 2012 for all cancers combined excluding NMSC. Supplementary Tables 1-4 present the same information for lung, colorectal, prostate, and breast cancers, respectively.

International trends in incidence for all cancers combined, excluding NMSC, diagnosed between 1998 and 2012 in adults aged 50-64, 65-74 and 75+ years old are presented with all sexes combined in Figure 1 and by sex in Supplementary Figures 1 and 2. Supplementary Figures 1-9 present trends for the other cancers by sex and for all sexes combined when appropriate. AAPC with their 95% CI over the fifteen years for all cancers, excluding NMSC, all sexes combined, as well for lung (for females and males, respectively), colorectal (all sexes combined), prostate and breast cancers are presented in Figures 3-9. Figures 10-13 present AAPC for all cancers excluding NMSC and colorectal cancer by sex.

All cancers combined excluding NMSC

Overall, incidence rates varied greatly across countries and did not always follow the same trends across age groups within the same country. Among the countries that had similar trends in all age groups, the incidence of all cancers has significantly increased in seventeen countries, mainly those in Asia and Eastern and Northern Europe. Conversely, in Austria, Bahrain, Chile, New Zealand, Poland, and the USA, rates have decreased in all age groups. Rates remained stable in Brazil, Finland, and Sweden. In Canada, Colombia, Costa Rica, and Israel, rates remained stable among adults aged 50-64 years, but they have significantly decreased in older adults. In France and Uganda, rates have increased in the 50-64 age group (respectively, AAPC = 1.0%; 95%CI: 0.5 to 1.8 and 0.9%; 0.1 to 1.8) and stabilized in older adults.

The sharpest increase in incidence over the study period in the 50-64 age group was seen in Ecuador and the Republic of Korea with an average annual increase of +2.8% in both countries. In the 65-74 age group, the greatest increase was observed in Turkey (+2.6%; 1.7

to 3.5), and for the 75+ age group, in India (+4.0%; 3.2 to 4.7). On the contrary, the most important decrease in incidence was seen in Bahrain for the three age groups (-2.8%; -3.7 to -1.9 in the 50-64 age group, -2.9%; -3.8 to -2.0 in the 65-74 age group, and -3.7%; -5.8 to -1.6 in the 75+ age group.

Lung cancer

Lung cancer incidence was systematically lower in females than in males. However, trends in females were opposite to those in males in the majority of countries. Indeed, among females, the incidence of lung cancer has increased in all age groups in most European countries but also in Japan, Cyprus, Israel, India, and Turkey, with higher AAPCs observed in Spain, Malta, and France. In South America, trends were stabilizing except for the 65-74 age group in Goiâna, Brazil, and the 75+ age group in Quito, Ecuador where lung cancer incidence has significantly increased 3.5% and 5.9% on average annually, respectively. A significant decrease in the incidence of lung cancer has been observed in all age groups in Bahrain, adults younger than 75 years old in the USA (-2.2; -2.5 to -2.0 in the 50-64 age group, and -1.2; -1.6 to -0.7 in the 65-74 age group), in the 50-64 age group in Canada, Kuwait, and Thailand, and in the 75+ age group in China (-1.2%; -1.7 to -0.7).

In contrast, the incidence of lung cancer among males has decreased in all age groups in the great majority of countries. This decrease was less marked among males aged 75+ than in younger males. However, lung cancer incidence has significantly risen (between 2.5% and 3.4%) in all age groups in Cyprus, in adults aged over 65 between 2.9% and 5.2% in India and between 0.7% and 1.9% Bulgaria, and in males aged 75+ in Thailand, Israel, Slovakia, Denmark, Estonia, Norway, Sweden, and Malta. In France, male lung cancer incidence rates have increased in the 50-64 and 75+ age groups, while they were stabilizing in the 65-74 age group.

Colorectal cancer

The incidence of colorectal cancer has increased in all age groups in 24 (out of 45) countries, mainly in Asia, Europe, and South America. However, other countries have seen decreasing rates. This is the case in Israel with AAPC between -1.1% and -2.6% across age groups, Czech Republic with AAPC between -0.9% and -0.4%, Austria with AAPC around -2.5%, Germany with AAPC between -1.3% and -0.6%, and Canada with AAPC between -0.9% and -0.3%. A bigger decrease has been observed in the USA: -1.2% in the 50-64 age group, -3.8% in the 65-74 age group, and -3.4% in the 75+ age group. In Australia and New Zealand, the decrease in the incidence of colorectal cancer was restricted to adults aged 50-74. In France, the decrease was significant in adults aged 65 years or older, rates being stable in the 50-64 age group. Rates were stable in Kuwait, Iceland, Malta, and Chile.

Trends were similar in males and females (supplemental Figures 4, 5, 12, and 13).

Prostate cancer

The incidence of prostate cancer in the 50-64 age group has considerably increased in most countries (36/45 countries), with AAPC higher than 10% in Japan, Republic of Korea, Czech Republic, Slovakia, Denmark, Lithuania and Estonia. Incidence rates were stable over the study period in the remaining countries. In the 65-74 age group, 29 out of 45 countries have seen their incidence significantly increased over the fifteen years, while rates have decreased in Austria (-2.5%, -3.5 to -1.5), Canada (-1.4%, -2.2 to -0.6), and the USA (-1.9%, -2.7 to -1.1) over the same period. In the oldest age group, prostate cancer incidence has markedly increased in all Asian countries except Bahrain (-6.9%, -11.9 to -1.5), and Israel (-2.5%, -3.8 to -1.2) where rates have decreased. Rates have also significantly risen in several Eastern European countries (Belarus: 6.8%, 5.9 to 7.7, Bulgaria: 4.6%, 3.1 to 6.0, and Slovakia: 3.7%, 2.7 to 4.6), as well as Estonia (2.8%, 1.3 to 4.3) and Ecuador (3.1%, 1.0 to 5.2). Most European countries, Canada, the USA, Australia, Oceania, and most South American countries have seen an important decrease in the incidence of prostate cancers in the oldest adults over the 1998-2012 period.

Female breast cancer

The incidence of breast cancer has increased in all age groups in Asian and Eastern European countries, except for Israel where incidence has decreased in all age groups. Incidence rates have also significantly decreased in all age groups in the USA. The decrease was restricted to the 50-64 age group in Switzerland (-1.2%; -1.7 to -0.7) and the oldest age group in Austria (-0;9%; -1.4 to -0.5), the Netherlands (-0.6%; -0.9 to -0.2), Colombia (-2.5%; -4.4 to -0.6), and Brazil (-2.0%; -3.8 to -0.1). Rates remained stable in all age groups in Uganda, Bahrain, Poland, New Zealand, and Chile.

Discussion

With a total of 113 populations in 44 countries covering all continents, this comprehensive study is the first to describe international trends in incidence specifically in older adults compared to trends in middle-aged adults. Because of the unprecedented demographic growth in the number of older adults globally, examining incidence trends is particularly important in planning for appropriate healthcare resources and in assessing prevention programs, in particular, cancer screening programs.

Overall, cancer incidence in adults aged 75+ has been increasing in a similar magnitude to that in middle-aged people. Cancer management in older adults may be challenging because of higher incidence of comorbidity, age-related physiological changes, poor social support, reduced functional status, cognitive impairment, and limited life expectancy[9–13]. In addition, older adults are seldom included in clinical trials, limiting the evidence of the benefit-risk balance and leaving the cancer management team without appropriate guidance for treatment decision-making[14]. As a consequence, older adults with cancer are more likely to receive suboptimal treatment (e.g., both over-and under-treatment)[15] and have poorer cancer outcomes[16]. In addition, in under-resourced settings, older adults are not prioritized by health care programs and policies because of competing health demands. Yet, the number of older adults with cancer will disproportionately increase in less developed regions[2,3].

Lung cancer incidence trends reflect patterns of smoking prevalence with a latency period of 20-30 years. We observed decreasing incidence in males and increasing incidence in females following the different stages of the tobacco epidemic[17]. In males, the decrease in incidence was less marked in those aged 75+, reflecting the birth cohort effect, with the largest proportion of smokers and number of pack-years in the past[18]. In addition to smoking, environmental and occupational factors can also cause lung cancer; their importance depends on the region[17]. Recent studies have shown different trends based on lung cancer histology. In European and Asian countries, the incidence of squamous-cell carcinomas has decreased in recent decades while the incidence of adenocarcinomas has risen, especially in women[18,19]. However, in the USA, Canada and Australia, the incidence of adenocarcinomas was levelling off in both sexes[18]. These trends also reflect trends in smoking behavior, especially the type of tobacco (e.g., adenocarcinoma has been shown to be associated with smoking low-tar filter cigarettes[20]). With more and more countries adopting tobacco control strategies, the incidence of lung cancer will likely further decrease in both males and females and all age groups, following the expected decrease in the prevalence of tobacco use in all age groups and all world regions[21].

Colorectal cancer incidence has increased in all age groups in many countries. In countries in epidemiological transition, this increase has been correlated to shift from a traditional to a more westernized diet, a decrease in physical activity, and a higher prevalence of overweight and obesity[22]. The decrease observed in some high-income countries may be partially related to screening such as in the USA[23] but also a change in risk factors profile. Indeed, we observed a decrease in some high-income countries in the absence of national screening programs such as in New Zealand, and in the oldest age group that are generally not targeted by screening programs such as in the USA. However, the decreasing incidence in adults aged 75+ may also be the result of less screening among those for whom the harms are deemed to outweigh the benefits [24].

Prostate cancer incidence trends are highly correlated to the use of prostate-specific antigen (PSA) testing. Areas with more intensive PSA screening have higher biopsy rates and incidence rates of prostate cancer than areas with lower PSA screening rates[25]. The prostate cancer incidence rate decreased after the U.S. Services Task Force recommended against PSA-based prostate cancer screening after the age of 75 in 2008[26] and recommendations extended to all men in 2012[27]. We found an increasing trend in prostate cancer incidence in most Asian countries, where others found an increasing trend in mortality as well[28]. Potential reasons for the increasing trend are multifactorial. Some hypothesized that lifestyles due to more westernized diets and/or more frequent PSA screening might have contributed to the observed trends[28,29].

Breast cancer incidence is increasing in all age groups in most countries. However, the increase in incidence observed in Asian countries is important. This has previously been described and attributed to early menarche, late menopause, older age at first delivery, and a lower number of full-term pregnancies over recent decades[30,31]. In many high-income countries, including Australia, North American countries, and Northern and Western European countries, decrease in breast cancer incidence in the 50-64 age group may be related to the reduced use of hormone replacement therapy (HRT)[32–34] after evidence of a possible increase in the risk of cardiovascular diseases and breast cancer in women using HRT in the early 2000s[35,36]. Contrary to colorectal cancer screening that may detect pre-cancerous lesions (ie. polyps), mammography aims to detect early-stage breast cancers. A decrease in the incidence of advanced-stage breast cancer is expected after the roll-out of a breast cancer screening program[37]; however, that will not impact the incidence of breast cancer all stages combined in the targeted age range. In the 75+ age group, the incidence of breast cancers that can be detected through screening may be indirectly impacted by cancer screening in middle-aged adults. Cancer development is generally a long process and evidence showed that cancers in older adults are more likely to be diagnosed at more advanced stages[38]. It is then likely that cancer diagnosed after the age of 75 years could have been identified at an earlier age with optimal cancer screening programs, resulting in a decrease in the incidence in the oldest age group. This could explain, at least partly, the decreasing trends observed in the older age group in the Netherlands or Norway where the national breast cancer screening programs have been fully operational since 1997 and 2004, respectively.

Strengths of our study are the high quality of incidence data imposed for inclusion in the CI5 series, and the availability of annual incidence data for such a long period even in countries having fewer resources, such as Uganda or India. The limitations of this study include the unequal coverage of continents, notably the African continent due to the absence of registries in many countries. Also, cancer cases in older adults are likely under-reported, especially in poorly resourced settings where access to diagnostic facilities may be limited, and in all countries where incidence data cannot be completed using death certificates. Some countries have cancer registries covering sub-national geographic levels only. Although different validated statistical modelling using mortality as a correlate of incidence is possible, reliable mortality data are not available in all countries. Therefore, we cannot confirm that observed incidence trends in these countries reflect the trends at the national level. In addition, we did not have data on stage at diagnosis. We focused on the incidence of cancers but describing the trends in cancer mortality and survival in older adults would have complemented our work. Finally, incidence rates greatly fluctuated notably in Bahrain, Kuwait, and Uganda because of relatively small numbers of cancer cases reported, particularly in older age groups.

Conclusion

In addition to the unprecedented demographic growth of older adults worldwide, cancer incidence in older adults is increasing. Strained health care systems need to adapt to managing cancer in an increasing number of older patients with specific needs. Adopting existing cancer management guidelines for older adults with cancer[39,40], and utilizing the full capacity of the multidisciplinary team, may enable better care for this population. However, the response should be tailored to available resources, regional context, and culture[41].

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Where authors are identified as personnel of the International Agency for Research on Cancer/World Health Organization, the authors alone are responsible for the views expressed in this article and they do not necessarily represent the decisions, policy or views of the International Agency for Research on Cancer/World Health Organization.

Conflicts of interest

The authors declare no conflict of interest.

Author's contribution

SP designed, analyzed, drafted, and edited the manuscript.

JF data collection, data quality check, management CI5 series, reviewed the manuscript.

All co-authors provided insightful comments, help with interpretation, and contributed equally to the manuscript.

Data availability

The data used in this study are publicly available at http://ci5.iarc.fr/Default.aspx and https://www-dep.iarc.fr/NORDCAN/english/frame.asp (both sites accessed on February 24th, 2021).

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Tables and Figures

Table 1. Absolute number of new cancer cases, and age-specific incidence rates in 1998 and 2012 for all cancers combined excluding non-melanoma skin cancer, all sexes combined, in 44 countries

Figure 1. Trends in the incidence of all cancers combined excluding NMSC, all sexes combined, by age group in 44 countries.

Figure 2. Estimated average annual percentage change for all cancers combined excluding non-melanoma skin cancer, all sexes combined, by age group in 44 countries

Figure 3. Estimated average annual percentage change for lung cancer in females by age group in 44 countries

Figure 4. Estimated average annual percentage change for lung cancer in males by age group in 44 countries

Figure 5. Estimated average annual percentage change for colorectal cancer, all sexes combined, by age group in 44 countries

Figure 6. Estimated average annual percentage change for prostate cancer by age group in 44 countries

Figure 7. Estimated average annual percentage change for breast cancer by age group in 44 countries

Table 1 – Number of new cancer cases excluding NMSC, for both sexes combined (crude incidence rates per 100,000 person-years) by age group and country in 1998 and 2012

		1998			2012		
Region	**Country**	**50-64**	**65-74**	**75+**	**50-64**	**65-74**	**75+**
Africa	Uganda*	174 (418.6)	91 (801.7)	51 (582.3)	376 (498.3)	169 (831.2)	130 (708.5)
Asia - Eastern	China*	10156 (493.7)	13047 (1156.1)	10150 (1673.7)	22049 (535.6)	12318 (1056.1)	18774 (1563.7)
Asia - Eastern	Japan*	15939 (564.6)	17700 (1407.2)	15834 (1997.7)	19795 (726.0)	26052 (1575.9)	33237 (2359.4)
Asia - Eastern	Korea*	12316 (547.0)	7103 (1193.3)	4325 (1450.9)	30499 (791.3)	18433 (1444.0)	12098 (1814.6)
Asia - South-Eastern	Thailand*	2364 (389.5)	1526 (659.8)	765 (717.3)	3969 (371.0)	2258 (693.1)	1964 (864.1)
Asia - Southern	India	1533 (350.1)	718 (501.2)	261 (384.5)	2167 (344.1)	1179 (603.4)	662 (637.5)
Asia - Western	Bahrain	101 (375.4)	67 (714.3)	61 (1446.2)	224 (329.6)	105 (658.6)	95 (1087.2)
Asia - Western	Cyprus	427 (426.2)	452 (1027.3)	382 (1501.3)	939 (607.5)	879 (1312.4)	794 (1674.8)
Asia - Western	Israel	4944 (729.5)	5603 (1642.1)	5646 (2284.0)	8030 (720.6)	6644 (1527.2)	7499 (1978.0)
Asia - Western	Kuwait	151 (312.8)	75 (561.3)	63 (1079.1)	379 (392.6)	212 (760.0)	133 (1030.4)
Asia - Western	Turkey*	2130 (404.2)	1603 (789.3)	472 (702.7)	5579 (582.7)	3637 (1172.3)	2337 (1201.7)
Europe - Eastern	Belarus	10152 (672.8)	10208 (1105.1)	3897 (945.6)	14118 (713.3)	9087 (1330.8)	7663 (1238.5)
Europe - Eastern	Bulgaria	9006 (597.9)	8272 (955.6)	4484 (1033.2)	10716 (689.0)	9611 (1230.7)	7790 (1282.6)
Europe - Eastern	Czech Republic	13236 (741.9)	14279 (1623.3)	11537 (2183.7)	17785 (839.1)	18421 (1791.0)	14868 (2106.5)
Europe - Eastern	Poland*	1158 (707.3)	1321 (1379.7)	679 (1243.7)	1877 (670.6)	1237 (1249.4)	1208 (1246.6)
Europe - Eastern	Slovakia	5510 (729.1)	5278 (1369.9)	3807 (1707.4)	8731 (818.0)	6509 (1694.5)	6056 (2111.5)
Europe - Northern	Denmark	6929 (717.2)	6986 (1676.3)	7942 (2122.2)	9337 (873.1)	11225 (1921.2)	9886 (2459.1)
Europe - Northern	Estonia	1706 (709.9)	1735 (1318.5)	1113 (1563.0)	2086 (791.8)	2149 (1713.3)	2055 (1853.0)
Europe - Northern	Finland	5649 (620.6)	6225 (1432.1)	7079 (2234.6)	7824 (686.7)	8500 (1552.3)	9963 (2234.3)
Europe - Northern	Iceland	252 (708.7)	276 (1527.5)	335 (2467.0)	400 (699.2)	413 (1884.8)	365 (1911.8)
Europe - Northern	Ireland	3213 (626.7)	3675 (1531.9)	4022 (2230.4)	6340 (849.6)	5771 (1836.2)	5609 (2385.3)
Europe - Northern	Lithuania	3795 (667.8)	3936 (1282.7)	2338 (1406.9)	5072 (850.4)	4598 (1623.7)	4447 (1713.1)
Europe - Northern	Norway	4679 (681.0)	5414 (1561.9)	7499 (2184.9)	7414 (808.4)	8146 (1906.4)	8590 (2440.3)
Europe - Northern	Sweden	10071 (621.3)	11353 (1508.9)	14355 (1834.1)	13031 (745.3)	16800 (1622.6)	15328 (1881.0)
Europe - Northern	UK*	59170 (636.6)	70688 (1501.5)	91452 (2253.8)	78902 (720.3)	90934 (1652.5)	116953 (2461.0)

		1998			2012		
Region	**Country**	**50-64**	**65-74**	**75+**	**50-64**	**65-74**	**75+**
Europe - Southern	Croatia	5017 (611.9)	5462 (1313.9)	3558 (1551.0)	7036 (773.7)	6191 (1494.5)	6558 (1848.2)
Europe - Southern	Italy*	8326 (796.0)	10353 (1780.1)	10557 (2317.3)	10066 (826.9)	11508 (1738.6)	14642 (2222.4)
Europe - Southern	Malta	330 (525.1)	358 (1311.8)	339 (1927.2)	560 (622.6)	514 (1237.4)	562 (1941.5)
Europe - Southern	Slovenia	2322 (694.9)	2512 (1450.4)	1610 (1726.5)	3557 (811.9)	3040 (1647.1)	3110 (1895.1)
Europe - Southern	Spain*	8089 (672.6)	9452 (1342.9)	9141 (1892.7)	12281 (771.9)	11258 (1523.9)	14388 (1902.1)
Europe - Western	Austria	9632 (717.5)	10712 (1552.1)	11320 (2108.8)	11023 (669.8)	11553 (1388.9)	11436 (1680.6)
Europe - Western	France*	8640 (779.0)	9675 (1548.3)	8083 (1749.7)	11784 (862.8)	9605 (1624.7)	11275 (1807.9)
Europe - Western	Germany*	4339 (798.2)	4247 (1642.1)	4643 (2196.4)	4375 (797.1)	4992 (1726.2)	5299 (2001.8)
Europe - Western	Netherlands	18154 (695.5)	19427 (1632.5)	19310 (2075.6)	27767 (817.5)	29148 (1860.6)	26837 (2229.4)
Europe - Western	Switzerland*	2908 (737.4)	2888 (1585.0)	3255 (2029.5)	3660 (750.5)	3989 (1685.5)	4364 (2101.5)
Northern America	Canada*	25236 (755.0)	28589 (1800.3)	29017 (2357.6)	41118 (753.5)	35410 (1676.6)	38015 (2177.1)
Northern America	USA*	31027 (847.7)	32268 (2003.0)	35667 (2453.3)	45626 (793.6)	35751 (1688.7)	36210 (2115.8)
Oceania	Australia*	21607 (777.7)	23164 (1782.3)	23612 (2398.5)	36564 (888.9)	33343 (1874.0)	35946 (2497.8)
Oceania	New Zealand	4174 (783.8)	4840 (1936.2)	5003 (2630.0)	6308 (782.3)	6059 (1762.2)	6263 (2368.3)
South - America	Brazil*	527 (584.4)	368 (1329.4)	231 (1754.1)	1028 (586.6)	705 (1324.6)	562 (1812.7)
South - America	Chile*	181 (449.9)	218 (1298.9)	195 (1921.9)	236 (376.7)	255 (1065.3)	250 (1544.4)
South - America	Colombia*	811 (456.8)	708 (1152.8)	746 (2093.2)	1422 (438.6)	1112 (1052.6)	1108 (1593.2)
South - America	Costa Rica	1162 (370.0)	1218 (1014.0)	1231 (1654.2)	2363 (387.0)	1652 (891.1)	1409 (1107.2)
South - America	Ecuador*	420 (335.3)	382 (854.1)	453 (1323.7)	943 (497.1)	690 (1079.3)	814 (1887.7)

*Regional data

Fig 1

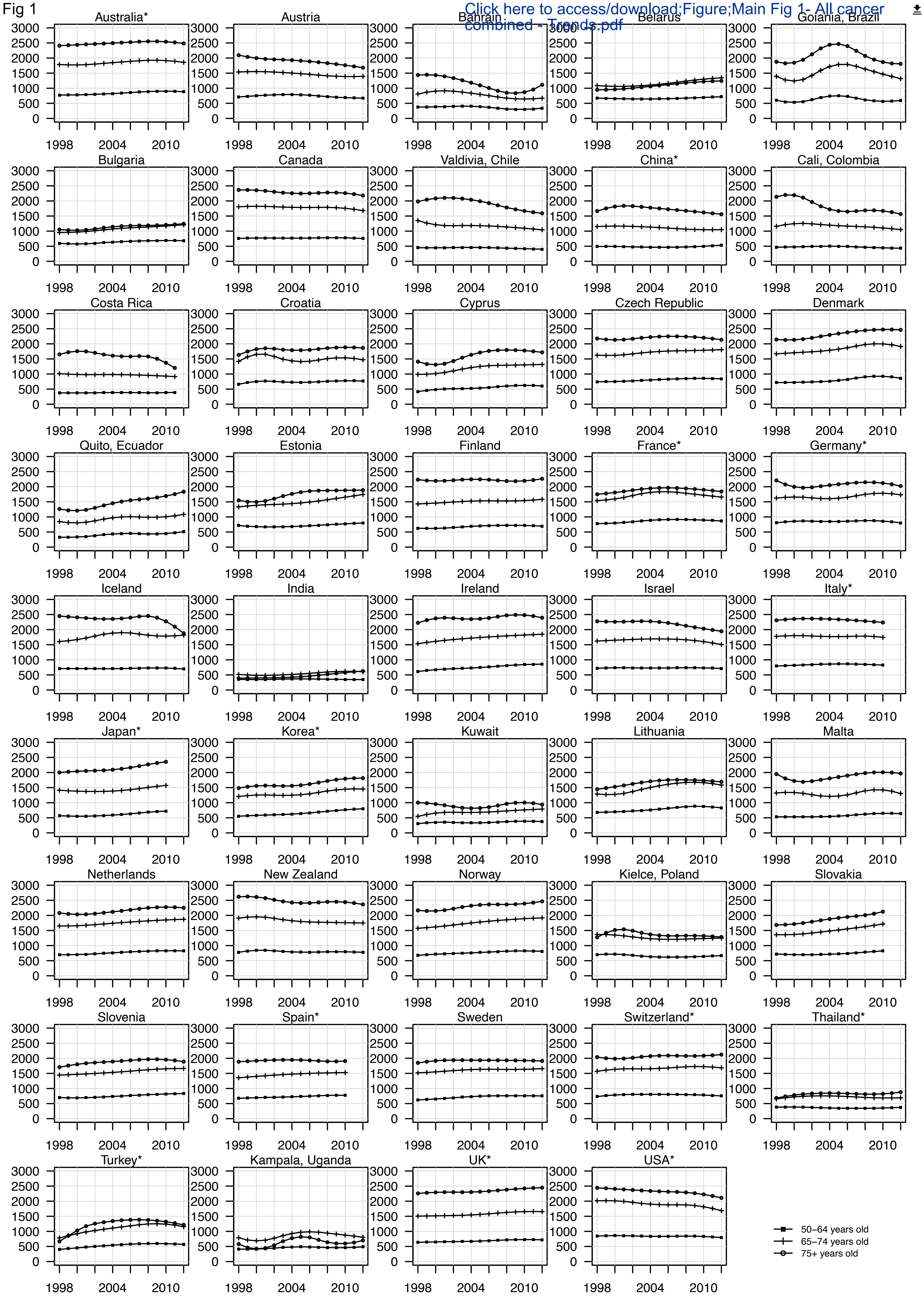

Australia*
Austria
Bahrain
Belarus
Goiania, Brazil
Bulgaria
Canada
Valdivia, Chile
China*
Cali, Colombia
Costa Rica
Croatia
Cyprus
Czech Republic
Denmark
Quito, Ecuador
Estonia
Finland
France*
Germany*
Iceland
India
Ireland
Israel
Italy*
Japan*
Korea*
Kuwait
Lithuania
Malta
Netherlands
New Zealand
Norway
Kielce, Poland
Slovakia
Slovenia
Spain*
Sweden
Switzerland*
Thailand*
Turkey*
Kampala, Uganda
UK*
USA*
0
500
1000
1500
2000
2500
3000
1998
2004
2010
50–64 years old
65–74 years old
75+ years old

Fig 2

Click here to access/download;Figure;Main Fig 2.pdf

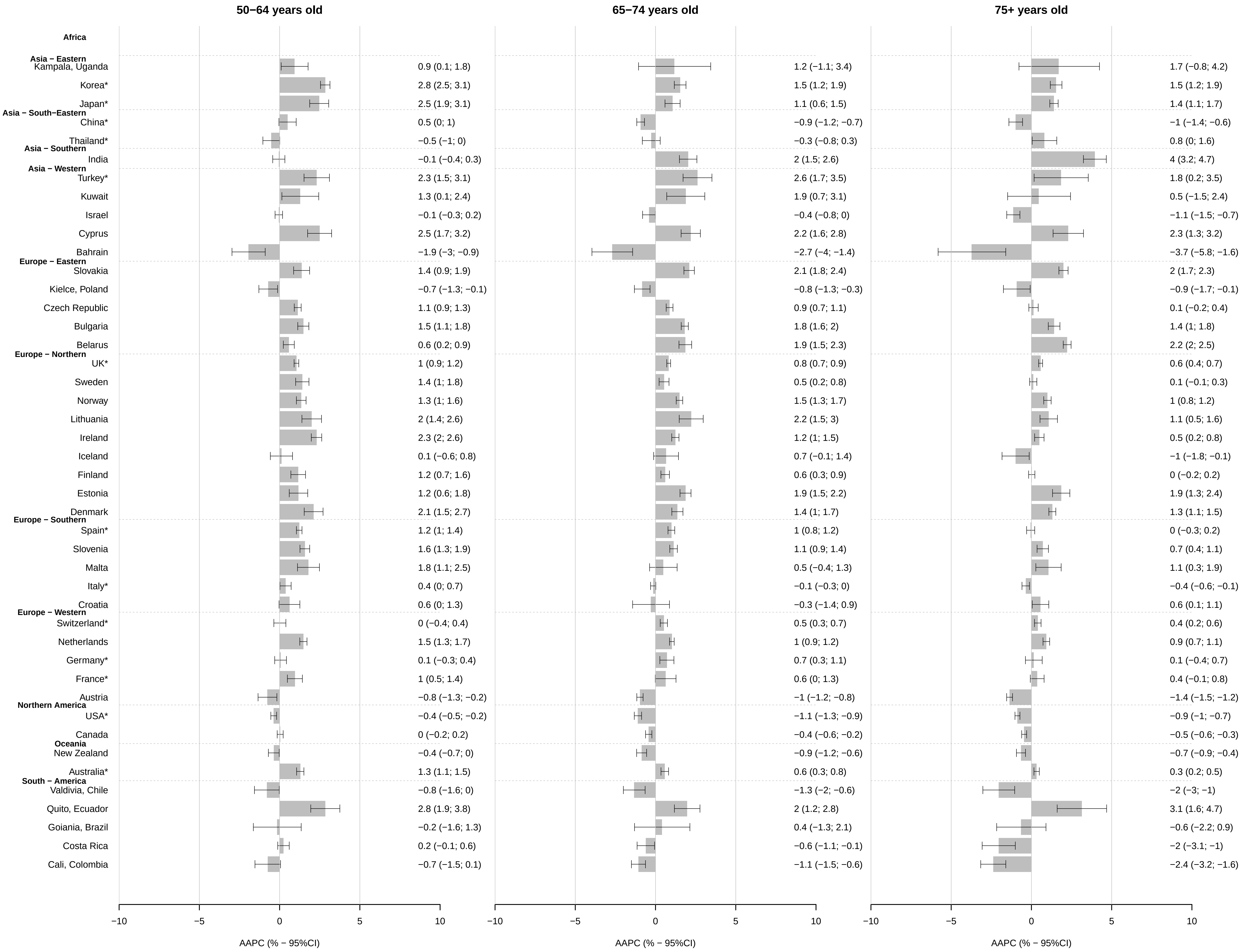
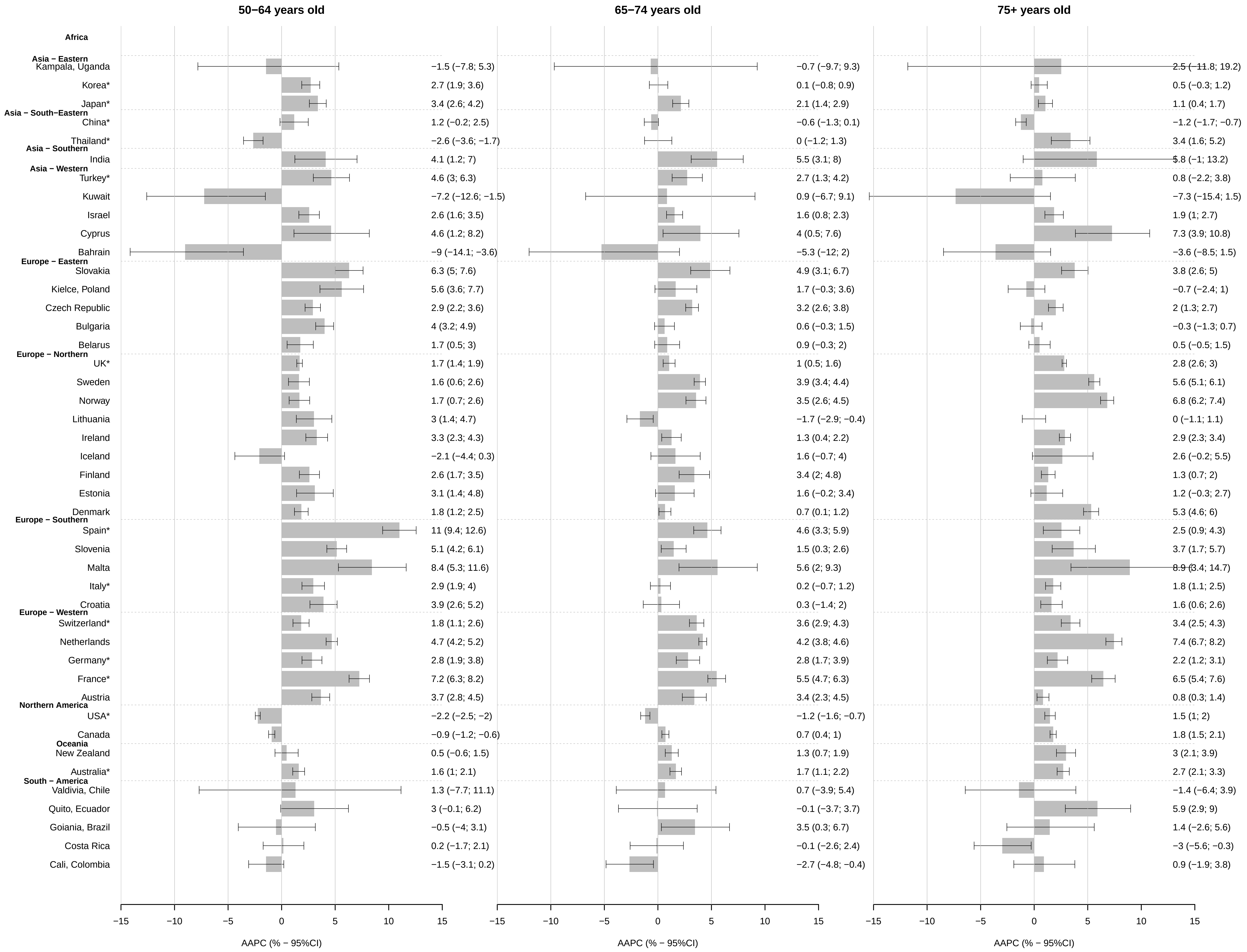


Fig 3


50−64 years old
65−74 years old
75+ years old
Africa
Asia − Eastern
Kampala, Uganda
Korea*
Japan*
Asia − South−Eastern
China*
Thailand*
Asia − Southern
India
Asia − Western
Turkey*
Kuwait
Israel
Cyprus
Bahrain
Europe − Eastern
Slovakia
Kielce, Poland
Czech Republic
Bulgaria
Belarus
Europe − Northern
UK*
Sweden
Norway
Lithuania
Ireland
Iceland
Finland
Estonia
Denmark
Europe − Southern
Spain*
Slovenia
Malta
Italy*
Croatia
Europe − Western
Switzerland*
Netherlands
Germany*
France*
Austria
Northern America
USA*
Canada
Oceania
New Zealand
Australia*
South − America
Valdivia, Chile
Quito, Ecuador
Goiania, Brazil
Costa Rica
Cali, Colombia
−1.5 (−7.8; 5.3)
2.7 (1.9; 3.6)
3.4 (2.6; 4.2)
1.2 (−0.2; 2.5)
−2.6 (−3.6; −1.7)
4.1 (1.2; 7)
4.6 (3; 6.3)
−7.2 (−12.6; −1.5)
2.6 (1.6; 3.5)
4.6 (1.2; 8.2)
−9 (−14.1; −3.6)
6.3 (5; 7.6)
5.6 (3.6; 7.7)
2.9 (2.2; 3.6)
4 (3.2; 4.9)
1.7 (0.5; 3)
1.7 (1.4; 1.9)
1.6 (0.6; 2.6)
1.7 (0.7; 2.6)
3 (1.4; 4.7)
3.3 (2.3; 4.3)
−2.1 (−4.4; 0.3)
2.6 (1.7; 3.5)
3.1 (1.4; 4.8)
1.8 (1.2; 2.5)
11 (9.4; 12.6)
5.1 (4.2; 6.1)
8.4 (5.3; 11.6)
2.9 (1.9; 4)
3.9 (2.6; 5.2)
1.8 (1.1; 2.6)
4.7 (4.2; 5.2)
2.8 (1.9; 3.8)
7.2 (6.3; 8.2)
3.7 (2.8; 4.5)
−2.2 (−2.5; −2)
−0.9 (−1.2; −0.6)
0.5 (−0.6; 1.5)
1.6 (1; 2.1)
1.3 (−7.7; 11.1)
3 (−0.1; 6.2)
−0.5 (−4; 3.1)
0.2 (−1.7; 2.1)
−1.5 (−3.1; 0.2)
−0.7 (−9.7; 9.3)
0.1 (−0.8; 0.9)
2.1 (1.4; 2.9)
−0.6 (−1.3; 0.1)
0 (−1.2; 1.3)
5.5 (3.1; 8)
2.7 (1.3; 4.2)
0.9 (−6.7; 9.1)
1.6 (0.8; 2.3)
4 (0.5; 7.6)
−5.3 (−12; 2)
4.9 (3.1; 6.7)
1.7 (−0.3; 3.6)
3.2 (2.6; 3.8)
0.6 (−0.3; 1.5)
0.9 (−0.3; 2)
1 (0.5; 1.6)
3.9 (3.4; 4.4)
3.5 (2.6; 4.5)
−1.7 (−2.9; −0.4)
1.3 (0.4; 2.2)
1.6 (−0.7; 4)
3.4 (2; 4.8)
1.6 (−0.2; 3.4)
0.7 (0.1; 1.2)
4.6 (3.3; 5.9)
1.5 (0.3; 2.6)
5.6 (2; 9.3)
0.2 (−0.7; 1.2)
0.3 (−1.4; 2)
3.6 (2.9; 4.3)
4.2 (3.8; 4.6)
2.8 (1.7; 3.9)
5.5 (4.7; 6.3)
3.4 (2.3; 4.5)
−1.2 (−1.6; −0.7)
0.7 (0.4; 1)
1.3 (0.7; 1.9)
1.7 (1.1; 2.2)
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−0.1 (−3.7; 3.7)
3.5 (0.3; 6.7)
−0.1 (−2.6; 2.4)
−2.7 (−4.8; −0.4)
2.5 (−11.8; 19.2)
0.5 (−0.3; 1.2)
1.1 (0.4; 1.7)
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3.4 (1.6; 5.2)
5.8 (−1; 13.2)
0.8 (−2.2; 3.8)
−7.3 (−15.4; 1.5)
1.9 (1; 2.7)
7.3 (3.9; 10.8)
−3.6 (−8.5; 1.5)
3.8 (2.6; 5)
−0.7 (−2.4; 1)
2 (1.3; 2.7)
−0.3 (−1.3; 0.7)
0.5 (−0.5; 1.5)
2.8 (2.6; 3)
5.6 (5.1; 6.1)
6.8 (6.2; 7.4)
0 (−1.1; 1.1)
2.9 (2.3; 3.4)
2.6 (−0.2; 5.5)
1.3 (0.7; 2)
1.2 (−0.3; 2.7)
5.3 (4.6; 6)
2.5 (0.9; 4.3)
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8.9 (3.4; 14.7)
1.8 (1.1; 2.5)
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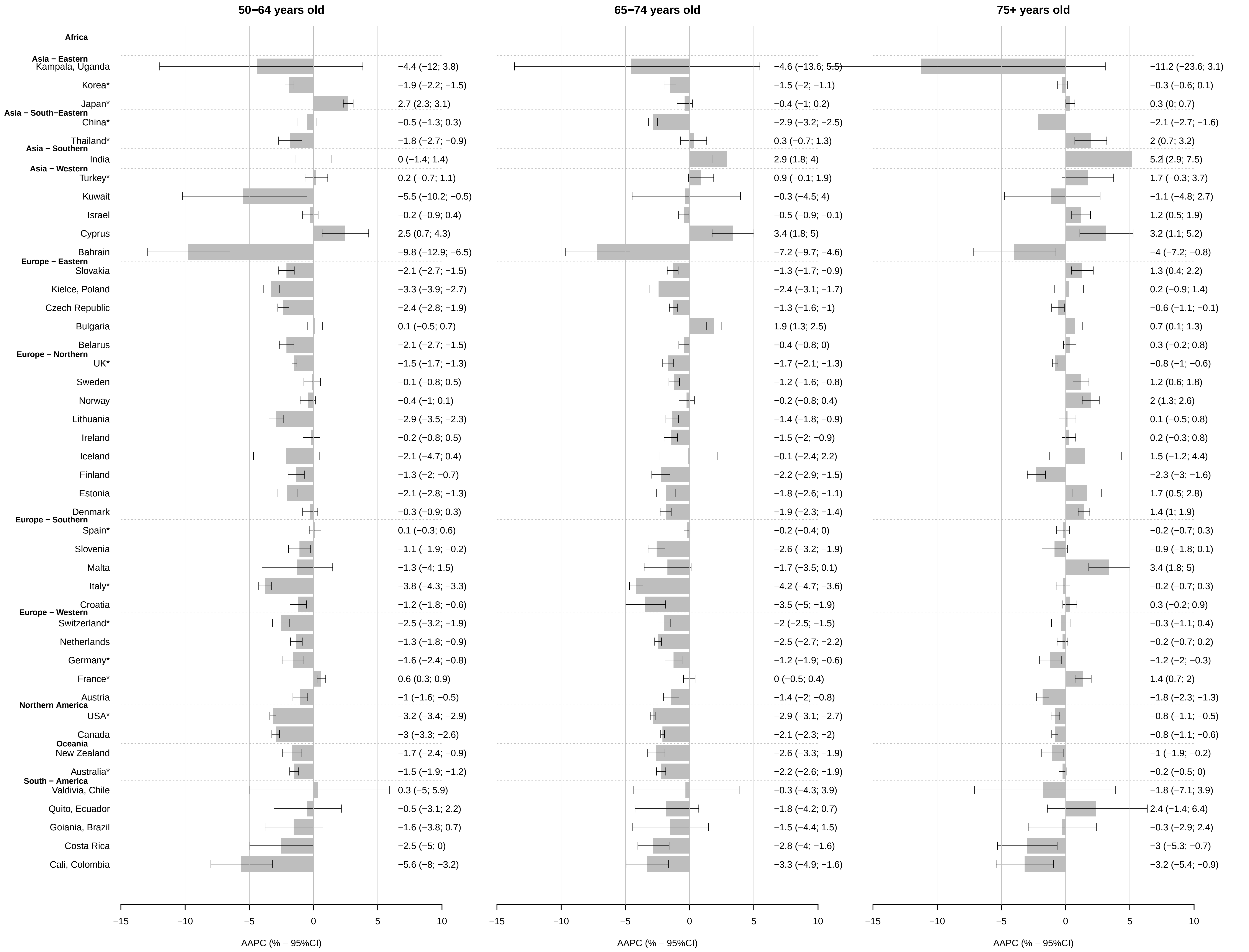
3.4 (2.5; 4.3)
7.4 (6.7; 8.2)
2.2 (1.2; 3.1)
6.5 (5.4; 7.6)
0.8 (0.3; 1.4)
1.5 (1; 2)
1.8 (1.5; 2.1)
3 (2.1; 3.9)
2.7 (2.1; 3.3)
−1.4 (−6.4; 3.9)
5.9 (2.9; 9)
1.4 (−2.6; 5.6)
−3 (−5.6; −0.3)
0.9 (−1.9; 3.8)
−15
−10
−5
0
5
10
15
AAPC (% − 95%CI)

Fig 4


50−64 years old
65−74 years old
75+ years old
Africa
Asia − Eastern
Kampala, Uganda
Korea*
Japan*
Asia − South−Eastern
China*
Thailand*
Asia − Southern
India
Asia − Western
Turkey*
Kuwait
Israel
Cyprus
Bahrain
Europe − Eastern
Slovakia
Kielce, Poland
Czech Republic
Bulgaria
Belarus
Europe − Northern
UK*
Sweden
Norway
Lithuania
Ireland
Iceland
Finland
Estonia
Denmark
Europe − Southern
Spain*
Slovenia
Malta
Italy*
Croatia
Europe − Western
Switzerland*
Netherlands
Germany*
France*
Austria
Northern America
USA*
Canada
Oceania
New Zealand
Australia*
South − America
Valdivia, Chile
Quito, Ecuador
Goiania, Brazil
Costa Rica
Cali, Colombia
−4.4 (−12; 3.8)
−1.9 (−2.2; −1.5)
2.7 (2.3; 3.1)
−0.5 (−1.3; 0.3)
−1.8 (−2.7; −0.9)
0 (−1.4; 1.4)
0.2 (−0.7; 1.1)
−5.5 (−10.2; −0.5)
−0.2 (−0.9; 0.4)
2.5 (0.7; 4.3)
−9.8 (−12.9; −6.5)
−2.1 (−2.7; −1.5)
−3.3 (−3.9; −2.7)
−2.4 (−2.8; −1.9)
0.1 (−0.5; 0.7)
−2.1 (−2.7; −1.5)
−1.5 (−1.7; −1.3)
−0.1 (−0.8; 0.5)
−0.4 (−1; 0.1)
−2.9 (−3.5; −2.3)
−0.2 (−0.8; 0.5)
−2.1 (−4.7; 0.4)
−1.3 (−2; −0.7)
−2.1 (−2.8; −1.3)
−0.3 (−0.9; 0.3)
0.1 (−0.3; 0.6)
−1.1 (−1.9; −0.2)
−1.3 (−4; 1.5)
−3.8 (−4.3; −3.3)
−1.2 (−1.8; −0.6)
−2.5 (−3.2; −1.9)
−1.3 (−1.8; −0.9)
−1.6 (−2.4; −0.8)
0.6 (0.3; 0.9)
−1 (−1.6; −0.5)
−3.2 (−3.4; −2.9)
−3 (−3.3; −2.6)
−1.7 (−2.4; −0.9)
−1.5 (−1.9; −1.2)
0.3 (−5; 5.9)
−0.5 (−3.1; 2.2)
−1.6 (−3.8; 0.7)
−2.5 (−5; 0)
−5.6 (−8; −3.2)
−4.6 (−13.6; 5.5)
−1.5 (−2; −1.1)
−0.4 (−1; 0.2)
−2.9 (−3.2; −2.5)
0.3 (−0.7; 1.3)
2.9 (1.8; 4)
0.9 (−0.1; 1.9)
−0.3 (−4.5; 4)
−0.5 (−0.9; −0.1)
3.4 (1.8; 5)
−7.2 (−9.7; −4.6)
−1.3 (−1.7; −0.9)
−2.4 (−3.1; −1.7)
−1.3 (−1.6; −1)
1.9 (1.3; 2.5)
−0.4 (−0.8; 0)
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−1.4 (−1.8; −0.9)
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−1.9 (−2.3; −1.4)
−0.2 (−0.4; 0)
−2.6 (−3.2; −1.9)
−1.7 (−3.5; 0.1)
−4.2 (−4.7; −3.6)
−3.5 (−5; −1.9)
−2 (−2.5; −1.5)
−2.5 (−2.7; −2.2)
−1.2 (−1.9; −0.6)
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−1.4 (−2; −0.8)
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−2.1 (−2.3; −2)
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−1.8 (−4.2; 0.7)
−1.5 (−4.4; 1.5)
−2.8 (−4; −1.6)
−3.3 (−4.9; −1.6)
−11.2 (−23.6; 3.1)
−0.3 (−0.6; 0.1)
0.3 (0; 0.7)
−2.1 (−2.7; −1.6)
2 (0.7; 3.2)
5.2 (2.9; 7.5)
1.7 (−0.3; 3.7)
−1.1 (−4.8; 2.7)
1.2 (0.5; 1.9)
3.2 (1.1; 5.2)
−4 (−7.2; −0.8)
1.3 (0.4; 2.2)
0.2 (−0.9; 1.4)
−0.6 (−1.1; −0.1)
0.7 (0.1; 1.3)
0.3 (−0.2; 0.8)
−0.8 (−1; −0.6)
1.2 (0.6; 1.8)
2 (1.3; 2.6)
0.1 (−0.5; 0.8)
0.2 (−0.3; 0.8)
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−2.3 (−3; −1.6)
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−0.9 (−1.8; 0.1)
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−0.2 (−0.7; 0.3)
0.3 (−0.2; 0.9)
−0.3 (−1.1; 0.4)
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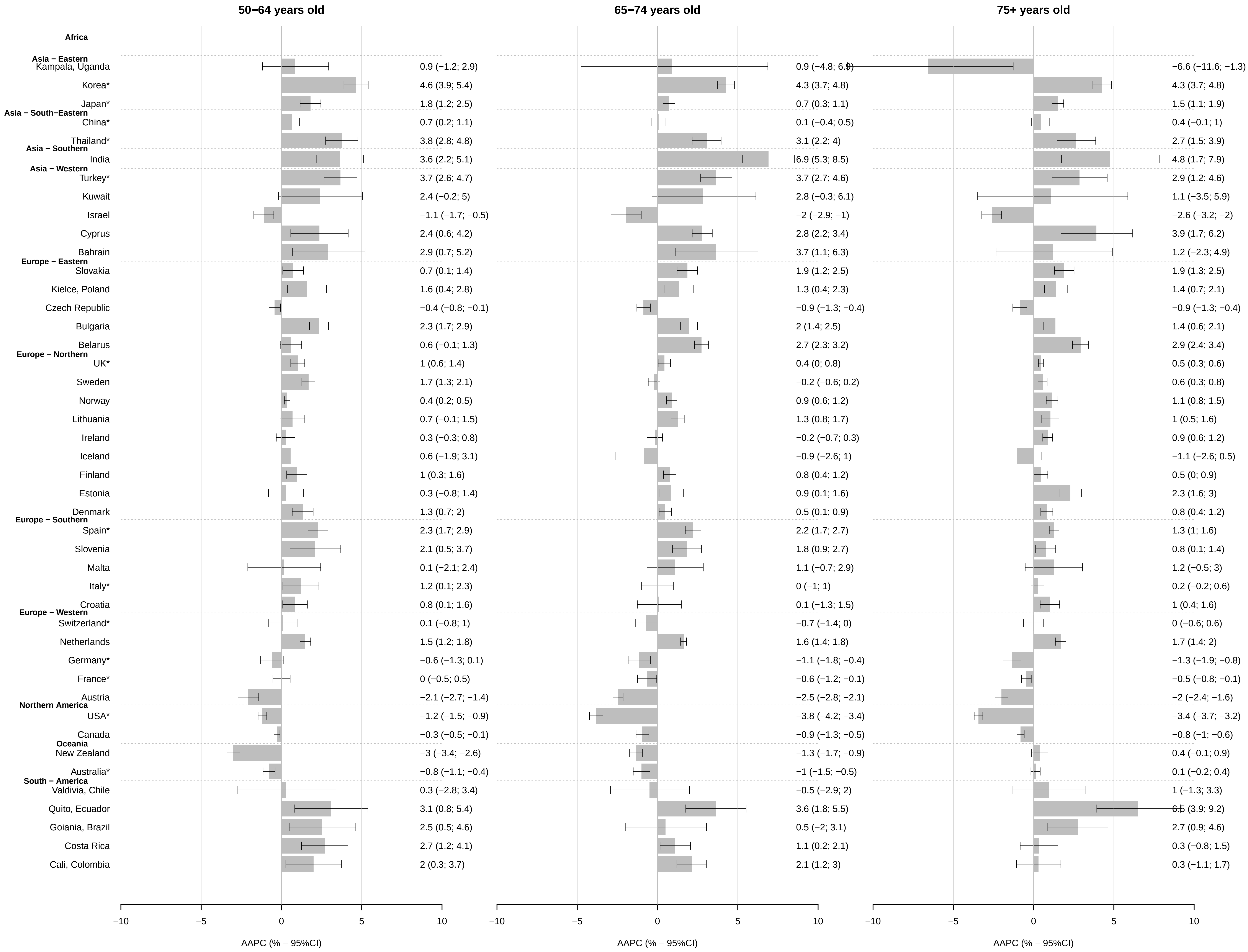
1.4 (0.7; 2)
−1.8 (−2.3; −1.3)
−0.8 (−1.1; −0.5)
−0.8 (−1.1; −0.6)
−1 (−1.9; −0.2)
−0.2 (−0.5; 0)
−1.8 (−7.1; 3.9)
2.4 (−1.4; 6.4)
−0.3 (−2.9; 2.4)
−3 (−5.3; −0.7)
−3.2 (−5.4; −0.9)
−15
−10
−5
0
5
10
AAPC (% − 95%CI)

Fig 5


50−64 years old
65−74 years old
75+ years old
Africa
Asia − Eastern
Kampala, Uganda
Korea*
Japan*
Asia − South−Eastern
China*
Thailand*
Asia − Southern
India
Asia − Western
Turkey*
Kuwait
Israel
Cyprus
Bahrain
Europe − Eastern
Slovakia
Kielce, Poland
Czech Republic
Bulgaria
Belarus
Europe − Northern
UK*
Sweden
Norway
Lithuania
Ireland
Iceland
Finland
Estonia
Denmark
Europe − Southern
Spain*
Slovenia
Malta
Italy*
Croatia
Europe − Western
Switzerland*
Netherlands
Germany*
France*
Austria
Northern America
USA*
Canada
Oceania
New Zealand
Australia*
South − America
Valdivia, Chile
Quito, Ecuador
Goiania, Brazil
Costa Rica
Cali, Colombia
0.9 (−1.2; 2.9)
4.6 (3.9; 5.4)
1.8 (1.2; 2.5)
0.7 (0.2; 1.1)
3.8 (2.8; 4.8)
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3.7 (2.6; 4.7)
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0.7 (0.1; 1.4)
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0.6 (−0.1; 1.3)
1 (0.6; 1.4)
1.7 (1.3; 2.1)
0.4 (0.2; 0.5)
0.7 (−0.1; 1.5)
0.3 (−0.3; 0.8)
0.6 (−1.9; 3.1)
1 (0.3; 1.6)
0.3 (−0.8; 1.4)
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2.3 (1.7; 2.9)
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−0.8 (−1.1; −0.4)
0.3 (−2.8; 3.4)
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2.5 (0.5; 4.6)
2.7 (1.2; 4.1)
2 (0.3; 3.7)
0.9 (−4.8; 6.9)
4.3 (3.7; 4.8)
0.7 (0.3; 1.1)
0.1 (−0.4; 0.5)
3.1 (2.2; 4)
6.9 (5.3; 8.5)
3.7 (2.7; 4.6)
2.8 (−0.3; 6.1)
−2 (−2.9; −1)
2.8 (2.2; 3.4)
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0.4 (0; 0.8)
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0.9 (0.6; 1.2)
1.3 (0.8; 1.7)
−0.2 (−0.7; 0.3)
−0.9 (−2.6; 1)
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1.8 (0.9; 2.7)
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−0.7 (−1.4; 0)
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−0.6 (−1.2; −0.1)
−2.5 (−2.8; −2.1)
−3.8 (−4.2; −3.4)
−0.9 (−1.3; −0.5)
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−0.5 (−2.9; 2)
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0.5 (−2; 3.1)
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−2.6 (−3.2; −2)
3.9 (1.7; 6.2)
1.2 (−2.3; 4.9)
1.9 (1.3; 2.5)
1.4 (0.7; 2.1)
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0.8 (0.1; 1.4)
1.2 (−0.5; 3)
0.2 (−0.2; 0.6)
1 (0.4; 1.6)
0 (−0.6; 0.6)
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−2 (−2.4; −1.6)
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−0.8 (−1; −0.6)
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0.1 (−0.2; 0.4)
1 (−1.3; 3.3)
6.5 (3.9; 9.2)
2.7 (0.9; 4.6)
0.3 (−0.8; 1.5)
0.3 (−1.1; 1.7)
−10
−5
0
5
10
AAPC (% − 95%CI)

Fig 6

Click here to access/download;Figure;Main Fig 6_AAPC_males_Prostate.pdf

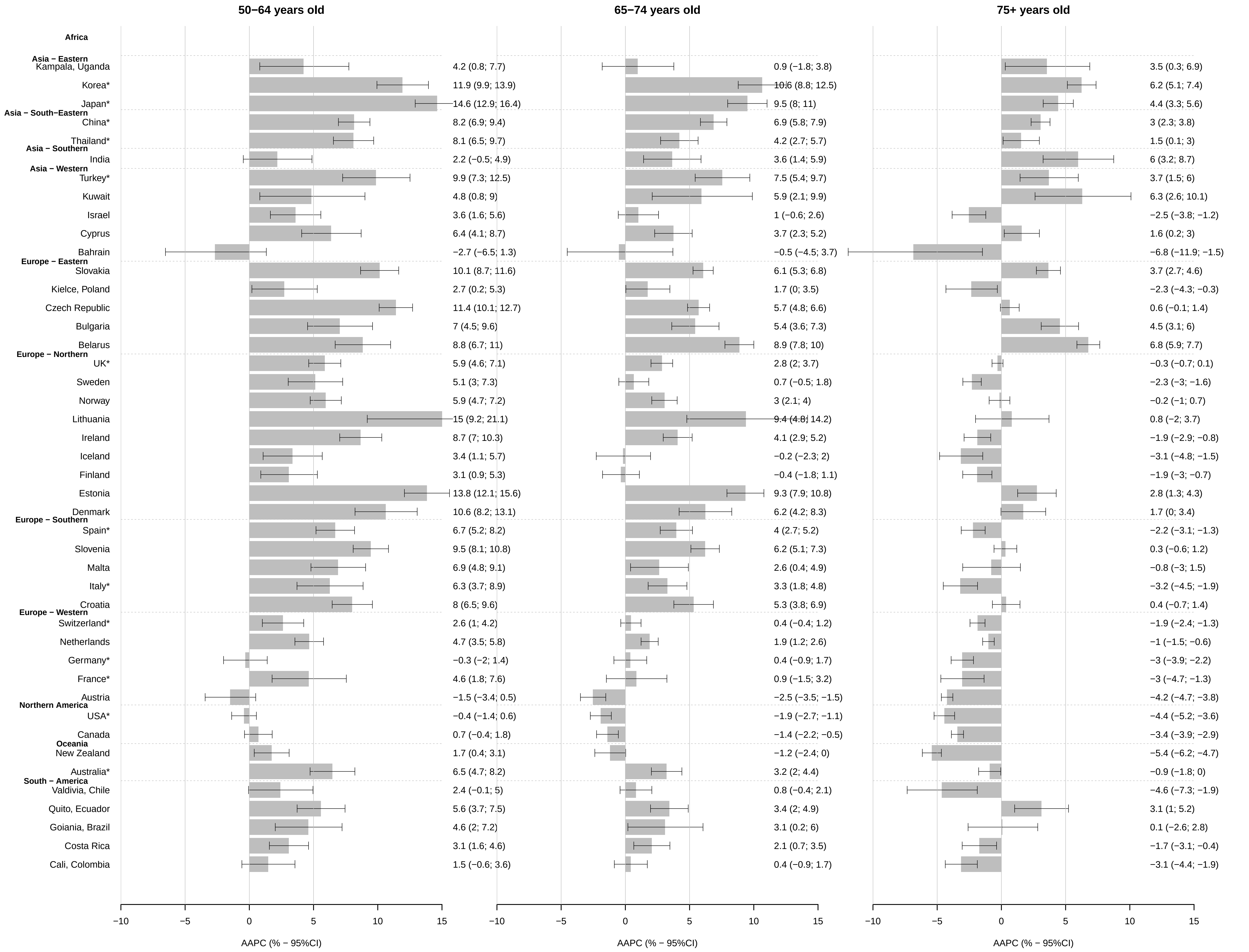
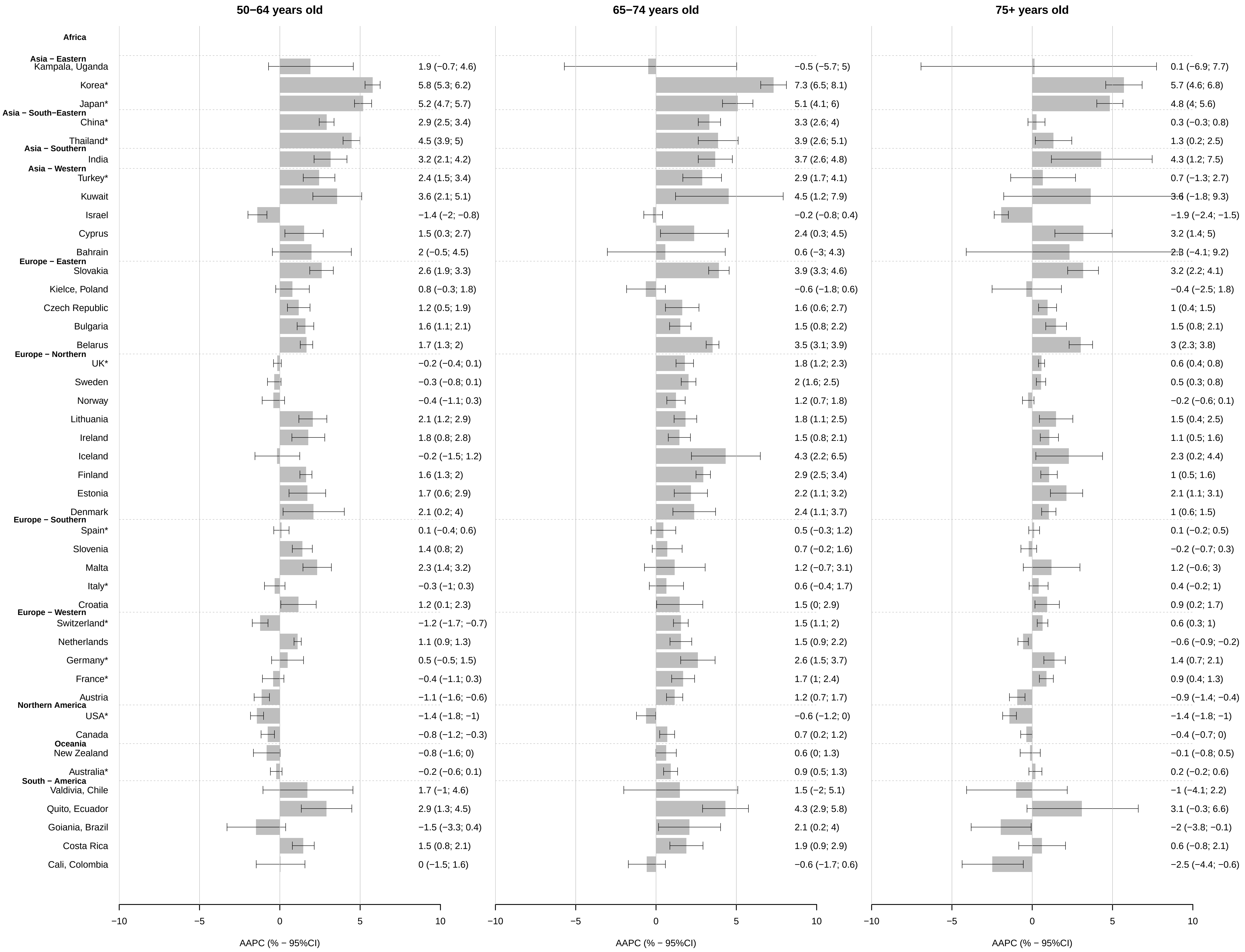


Fig 7


50−64 years old
65−74 years old
75+ years old
Africa
Asia − Eastern
Kampala, Uganda
1.9 (−0.7; 4.6)
−0.5 (−5.7; 5)
0.1 (−6.9; 7.7)
Korea*
5.8 (5.3; 6.2)
7.3 (6.5; 8.1)
5.7 (4.6; 6.8)
Japan*
5.2 (4.7; 5.7)
5.1 (4.1; 6)
4.8 (4; 5.6)
Asia − South−Eastern
China*
2.9 (2.5; 3.4)
3.3 (2.6; 4)
0.3 (−0.3; 0.8)
Thailand*
4.5 (3.9; 5)
3.9 (2.6; 5.1)
1.3 (0.2; 2.5)
Asia − Southern
India
3.2 (2.1; 4.2)
3.7 (2.6; 4.8)
4.3 (1.2; 7.5)
Asia − Western
Turkey*
2.4 (1.5; 3.4)
2.9 (1.7; 4.1)
0.7 (−1.3; 2.7)
Kuwait
3.6 (2.1; 5.1)
4.5 (1.2; 7.9)
3.6 (−1.8; 9.3)
Israel
−1.4 (−2; −0.8)
−0.2 (−0.8; 0.4)
−1.9 (−2.4; −1.5)
Cyprus
1.5 (0.3; 2.7)
2.4 (0.3; 4.5)
3.2 (1.4; 5)
Bahrain
2 (−0.5; 4.5)
0.6 (−3; 4.3)
2.3 (−4.1; 9.2)
Europe − Eastern
Slovakia
2.6 (1.9; 3.3)
3.9 (3.3; 4.6)
3.2 (2.2; 4.1)
Kielce, Poland
0.8 (−0.3; 1.8)
−0.6 (−1.8; 0.6)
−0.4 (−2.5; 1.8)
Czech Republic
1.2 (0.5; 1.9)
1.6 (0.6; 2.7)
1 (0.4; 1.5)
Bulgaria
1.6 (1.1; 2.1)
1.5 (0.8; 2.2)
1.5 (0.8; 2.1)
Belarus
1.7 (1.3; 2)
3.5 (3.1; 3.9)
3 (2.3; 3.8)
Europe − Northern
UK*
−0.2 (−0.4; 0.1)
1.8 (1.2; 2.3)
0.6 (0.4; 0.8)
Sweden
−0.3 (−0.8; 0.1)
2 (1.6; 2.5)
0.5 (0.3; 0.8)
Norway
−0.4 (−1.1; 0.3)
1.2 (0.7; 1.8)
−0.2 (−0.6; 0.1)
Lithuania
2.1 (1.2; 2.9)
1.8 (1.1; 2.5)
1.5 (0.4; 2.5)
Ireland
1.8 (0.8; 2.8)
1.5 (0.8; 2.1)
1.1 (0.5; 1.6)
Iceland
−0.2 (−1.5; 1.2)
4.3 (2.2; 6.5)
2.3 (0.2; 4.4)
Finland
1.6 (1.3; 2)
2.9 (2.5; 3.4)
1 (0.5; 1.6)
Estonia
1.7 (0.6; 2.9)
2.2 (1.1; 3.2)
2.1 (1.1; 3.1)
Denmark
2.1 (0.2; 4)
2.4 (1.1; 3.7)
1 (0.6; 1.5)
Europe − Southern
Spain*
0.1 (−0.4; 0.6)
0.5 (−0.3; 1.2)
0.1 (−0.2; 0.5)
Slovenia
1.4 (0.8; 2)
0.7 (−0.2; 1.6)
−0.2 (−0.7; 0.3)
Malta
2.3 (1.4; 3.2)
1.2 (−0.7; 3.1)
1.2 (−0.6; 3)
Italy*
−0.3 (−1; 0.3)
0.6 (−0.4; 1.7)
0.4 (−0.2; 1)
Croatia
1.2 (0.1; 2.3)
1.5 (0; 2.9)
0.9 (0.2; 1.7)
Europe − Western
Switzerland*
−1.2 (−1.7; −0.7)
1.5 (1.1; 2)
0.6 (0.3; 1)
Netherlands
1.1 (0.9; 1.3)
1.5 (0.9; 2.2)
−0.6 (−0.9; −0.2)
Germany*
0.5 (−0.5; 1.5)
2.6 (1.5; 3.7)
1.4 (0.7; 2.1)
France*
−0.4 (−1.1; 0.3)
1.7 (1; 2.4)
0.9 (0.4; 1.3)
Austria
−1.1 (−1.6; −0.6)
1.2 (0.7; 1.7)
−0.9 (−1.4; −0.4)
Northern America
USA*
−1.4 (−1.8; −1)
−0.6 (−1.2; 0)
−1.4 (−1.8; −1)
Canada
−0.8 (−1.2; −0.3)
0.7 (0.2; 1.2)
−0.4 (−0.7; 0)
Oceania
New Zealand
−0.8 (−1.6; 0)
0.6 (0; 1.3)
−0.1 (−0.8; 0.5)
Australia*
−0.2 (−0.6; 0.1)
0.9 (0.5; 1.3)
0.2 (−0.2; 0.6)
South − America
Valdivia, Chile
1.7 (−1; 4.6)
1.5 (−2; 5.1)
−1 (−4.1; 2.2)
Quito, Ecuador
2.9 (1.3; 4.5)
4.3 (2.9; 5.8)
3.1 (−0.3; 6.6)
Goiania, Brazil
−1.5 (−3.3; 0.4)
2.1 (0.2; 4)
−2 (−3.8; −0.1)
Costa Rica
1.5 (0.8; 2.1)
1.9 (0.9; 2.9)
0.6 (−0.8; 2.1)
Cali, Colombia
0 (−1.5; 1.6)
−0.6 (−1.7; 0.6)
−2.5 (−4.4; −0.6)
−10
−5
0
5
10
AAPC (% − 95%CI)

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