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Understanding international measures of health spending

Age-adjusting expenditure on health

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Executive Summary

Comparing the performance of a country's health system over time, between different sub-groups, or across countries typically means comparing populations with very different characteristics, including age structure. For example, the share of the total population aged 65 years and over varies significantly among OECD countries, from less than 10% in some of the Latin American countries of the OECD, to 20% in a number of southern European countries, and approaching 3 in 10 of the population in Japan. In the same vein, populations are also aging rapidly in most OECD countries such that, on average, the size of the population over 65 grew by almost 20% between 2015 and 2022 – and considerably faster in some countries.

Since the risk of illness and ill-health generally increases with age, a population with an older demographic structure (all else being equal) might expect higher mortality rates, greater incidence and prevalence of certain diseases, and thus higher demands for healthcare and, by consequence, higher spending on health.

In assessing health system performance, one of the cross-cutting dimensions relates to efficiency. Analysing efficiency explores how the available resources or inputs (whether physical, human, or expressed in financial terms) going into the health system relate to the outputs and outcomes of the system, either on a system level or by sub-component (e.g., the primary care or hospital sectors). This is of particular importance when resources are constrained, and demand is growing. Efficiency of the health system can therefore be expected to vary depending on the demographic structure of the population, that is the age and sex distribution. But, while outcomes such as indicators of health status (e.g., rates of mortality and morbidity) and outputs such as health system activity (e.g., hospital admission and surgical rates) are typically age-adjusted to take account of these variations between populations or over time, there has been less focus on adjusting the inputs such as health expenditure. In fact, age-adjusting health spending has been carried by only a few OECD countries, often to provide complementary information to decision makers, for example, to take account of differences in the demographic composition across regions for budget allocations.

This Health Working Paper aims to respond to the premise that the level of health spending depends not only on the size of the population (among other factors), but also on the demographic structure of the population, since, with health needs increasing with age, the age structure of populations has an impact on health expenditure growth. In doing so, the paper reviews some of the international literature on age-adjusting health spending, highlighting the challenges and limitations. This report identifies and examines three methods of age-adjustment and provides preliminary results for OECD countries and recommends a preferred approach to report and compare health expenditure data adjusted by age between OECD countries and over time.

The three approaches identified and tested to adjust health spending, are:

- **Simple adjustment**; applying e.g., the relative share of the population over 65 as a multiplicative factor to health spending.
- **Indirect standardisation**, using a derived OECD-wide age-spending profile to apply to a country's health population structure; and
- **Direct standardisation**, whereby a standard OECD population structure is applied to a country's specific age-spending profile.

The applicability of each approach varies, dependent to a large extent on data requirements. Consequently, each approach produces a set of results requiring careful interpretation based on the underlying assumptions.

A simple adjustment method requires no breakdown of health spending by age group, by only using the share of the population over 65. Thus, the 'adjustment' naively assumes that health expenditures change by an amount equal to the proportional change in the proportion of the 65+ population across countries.

The indirect standardisation approach derives an 'average' OECD age-spending profile, based on available country studies which can then be applied to all countries. As such, the use of a standard profile is somewhat arbitrary and by applying it across the board removes any country-specify variation in age-spending. This in contrast to the direct standardisation approach which is more statistically robust and captures the important variations across countries but has greater data requirements and is subject to methodological variations.

While this study shows that direct standardisation of health spending is preferred, it highlights that it is more challenging than age-adjusting health outcomes or output measures for the following reasons:

- **Ensuring complete country coverage.** Of the 38 OECD countries, health expenditure data disaggregated by a set of common age groups could only be assembled for only around half of the countries. Allocation to age of mortality statistics, or administrative data (e.g., hospital admissions, vaccination status, etc) is generally more clearcut. The distribution of health spending data to age, which may encompass many different components is subject to more variation and uncertainty.
- **Establishing a common reference year.** This was also an issue as the study periods varied considerably between OECD countries. As such, the application of an age-spending profile from one period assumes that there is no change in the age-spending profile over time.
- **Comparability of underlying estimates.** In contrast to measures of health status such as mortality there may be greater uncertainty regarding the underlying comparability of current health expenditures, which may then be amplified in any disaggregation by age.
- **Comprehensiveness of allocation.** For many countries, it is not always possible to allocate all areas of health spending according to age groups. Allocated expenditure may also be limited to a financing sub-system – such as the social health insurance or government spending. Different methodologies and assumptions to allocate residual health spending can introduce bias when health spending is disaggregated by age.

In summary, while all three approaches to age-standardise health spending are feasible, the direct standardisation approach is considered the most appropriate method – both statistically and for policy use. However, the availability of consistent disaggregated data on health spending for all OECD countries remains a challenge. Adopting a standard age-spending profile to (indirect) standardise *all* countries reduces the data requirements (while producing similar results), but this ignores some of the inherent differences between countries to be measured and therefore raises issues on the interpretation of the results.

Overall, the preliminary results of the analysis are in line with expectations showing that for countries with an overall younger population adjusted health expenditure would be higher relative to the OECD average and vice versa, although in most cases the adjustments are minor. Such results are intended to further inform the debate on the need to produce age-adjusted health spending data on a regular basis.

Résumé

Comparer les performances du système de santé d'un pays dans le temps, entre différents sous-groupes ou entre pays signifie généralement comparer des populations aux caractéristiques très différentes, y compris en termes de structure d'âge. Par exemple, la part de la population totale âgée de 65 ans et plus varie considérablement d'un pays de l'OCDE à l'autre, allant de moins de 10 % dans certains pays d'Amérique latine à 20 % dans un certain nombre de pays d'Europe du Sud, en passant par près de 3 personnes sur 10 au Japon. Dans le même ordre d'idées, les populations vieillissent rapidement dans la plupart des pays de l'OCDE, de sorte qu'en moyenne, la taille réelle de la population âgée de plus de 65 ans a augmenté de près de 20 % entre 2015 et 2022 - et beaucoup plus rapidement dans certains pays.

Étant donné que le risque de maladie et de mauvais état de santé augmente généralement avec l'âge, une population dont la structure démographique est plus âgée (toutes choses égales par ailleurs) peut s'attendre à des taux de mortalité plus élevés, à une incidence et une prévalence plus importantes de certaines maladies, et donc à une demande accrue de soins de santé se traduisant, par conséquent, par des dépenses de santé plus élevées.

L'une des dimensions transversales de l'évaluation de la performance des systèmes de santé est l'efficience. L'analyse de l'efficience porte sur la manière dont les ressources ou les intrants disponibles (qu'ils soient physiques, humains ou exprimés en termes financiers) entrant dans le système de santé sont liés aux produits et aux résultats du système, soit au niveau du système, soit par sous-composant (par exemple, le secteur des soins primaires ou le secteur hospitalier). Cela revêt une importance particulière lorsque les ressources sont limitées et que la demande augmente. On peut donc s'attendre à ce que l'efficience du système de santé varie en fonction de la structure démographique de la population, c'est-à-dire de la répartition par âge et par sexe. Cependant, alors que les résultats tels que les indicateurs d'état de santé (par exemple, les taux de mortalité et de morbidité) et les produits tels que l'activité du système de santé (par exemple, les taux d'admission à l'hôpital et de chirurgie) sont généralement ajustés en fonction de l'âge pour tenir compte de ces variations entre les populations ou dans le temps, l'ajustement des intrants tels que les dépenses de santé a fait l'objet d'une attention moins particulière au niveau international. En fait, seuls quelques pays de l'OCDE ont procédé à l'ajustement des dépenses de santé en fonction de l'âge, souvent pour fournir des informations complémentaires aux décideurs, par exemple pour prendre en compte les différences de composition démographique entre les régions pour les allocations budgétaires.

Ce document de travail vise à répondre à l'hypothèse selon laquelle le niveau des dépenses de santé dépend non seulement de la taille de la population (parmi d'autres facteurs), mais aussi de la structure démographique de la population. En effet, les besoins de santé augmentant avec l'âge, la structure par âge des populations a un impact sur la croissance des dépenses de santé. Ce faisant, le document passe en revue une partie de la littérature internationale sur l'ajustement des dépenses de santé en fonction de l'âge, en soulignant les défis et les limites. Ce rapport identifie et examine trois méthodes d'ajustement par l'âge et fournit des résultats préliminaires pour les pays de l'OCDE afin de recommander une approche privilégiée pour rapporter et comparer les données de dépenses de santé ajustées par l'âge entre les pays de l'OCDE et dans le temps.

Les trois approches identifiées et testées pour ajuster les dépenses de santé sont les suivantes :

- **Un ajustement simple**, en appliquant par exemple la part relative de la population âgée de plus de 65 ans comme facteur multiplicatif des dépenses de santé.

- **Une standardisation indirecte**, qui consiste à utiliser un profil de dépenses par âge dérivé à l'échelle de l'OCDE pour l'appliquer à la structure de la population de santé d'un pays ; et
- **Une standardisation directe**, qui consiste à appliquer une structure de population standard de l'OCDE au profil de dépenses par âge spécifique d'un pays.

L'applicabilité de chaque approche varie en fonction des données requises. Par conséquent, chaque approche produit un ensemble de résultats nécessitant une interprétation prudente basée sur les hypothèses sous-jacentes. Par exemple, la méthode d'ajustement simple ne nécessite aucune ventilation des dépenses de santé par groupe d'âge, en utilisant uniquement la part de la population âgée de plus de 65 ans. Ainsi, l'ajustement" suppose naïvement que les dépenses de santé changent d'un montant égal à la variation proportionnelle de la part de la population de plus de 65 ans dans les pays.

L'approche de standardisation indirecte dérive un profil "moyen" de dépenses par âge de l'OCDE, basé sur les études nationales disponibles, qui peut ensuite être appliqué à tous les pays. En tant que telle, l'utilisation d'un profil standard est quelque peu arbitraire et, en l'appliquant à l'ensemble des pays, elle supprime toute variation des dépenses par âge propre à chaque pays. Cette approche contraste avec celle de la standardisation directe, qui est plus robuste sur le plan statistique et qui saisit les variations entre les pays que nous souhaitons mesurer, mais elle nécessite davantage de données et est sujette à des variations méthodologiques.

Si cette étude montre que la standardisation directe des dépenses de santé est réalisable, elle souligne qu'elle est plus difficile que l'ajustement des résultats de santé ou des mesures de production en fonction de l'âge, et ce pour les raisons suivantes :

- **Assurer une couverture complète des pays**. Sur les 38 pays de l'OCDE, les données sur les dépenses de santé ventilées selon un ensemble de groupes d'âge communs n'ont pu être rassemblées que pour la moitié d'entre eux environ. La répartition par âge des statistiques de mortalité ou des données administratives (par exemple, les admissions à l'hôpital, le statut vaccinal, etc) est plus établie. La répartition par âge des données sur les dépenses de santé, qui peuvent englober de nombreuses composantes différentes, est sujette à davantage de variations et d'incertitudes.
- **L'établissement d'une année de référence commune.** Cette question s'est également posée dans la mesure où les périodes d'étude varient considérablement entre les pays de l'OCDE. Ainsi, l'application d'un profil de dépenses par âge d'une période donnée suppose qu'il n'y a pas de changement dans le profil de dépenses par âge au fil du temps.
- **Comparabilité des estimations sous-jacentes.** Contrairement aux mesures d'état de santé telles que la mortalité, il peut y avoir une plus grande incertitude concernant la comparabilité sous-jacente des dépenses de santé actuelles, qui peut alors être amplifiée dans toute désagrégation par âge.
- **L'exhaustivité de l'allocation**. Pour de nombreux pays, il n'est pas toujours possible de répartir tous les domaines de dépenses de santé par groupes d'âge. Les dépenses affectées peuvent également être limitées à un sous-système de financement, tel que l'assurance maladie sociale ou les dépenses publiques. Les différentes méthodologies et hypothèses de répartition des dépenses de santé résiduelles peuvent introduire des biais lorsque les dépenses de santé sont ventilées par âge.

En résumé, bien que les trois approches de standardisation des dépenses de santé par âge soient réalisables, l'approche de standardisation directe est considérée comme la méthode la plus appropriée - à la fois sur le plan statistique et pour l'utilisation politique. Cependant, la disponibilité de données désagrégées cohérentes sur les dépenses de santé pour tous les pays de l'OCDE reste un défi. L'adoption d'un profil standard de dépenses par âge pour standardiser (indirectement) tous les pays réduit les besoins en données (tout en produisant des résultats similaires), mais cela ne tient pas compte de certaines des différences inhérentes entre les pays et soulève donc des questions quant à l'interprétation des résultats.

Dans l'ensemble, les résultats de l'analyse sont conformes aux attentes et montrent que, dans les pays où la population est globalement plus jeune, les dépenses de santé ajustées sont plus élevées par rapport à la moyenne de l'OCDE et vice versa, même si, dans la plupart des cas, les ajustements sont mineurs. Ces résultats sont destinés à alimenter le débat sur la nécessité de produire régulièrement des données sur les dépenses de santé ajustées en fonction de l'âge.

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1. Introduction

1. Evaluating health system performance requires an assessment of a set of health indicators over time, between sub-groups, or across countries. In performing any meaningful analysis, measures of health status, health system activities and health outcomes typically need to be compared across populations with often different age structures and subject to significant variation over time. Across OECD countries, population structures vary widely and are rapidly changing. The share of the population aged 65 and over ranges from between 7% and 12% in the Latin American countries of the OECD to more than 20% in some southern European countries, and as much as 29% of the population in Japan. The variation at higher age groups is even more pronounced with less than 2% of the population over 80 in several countries while almost 10% of the population in Japan (OECD, 2021[1]). Most OECD countries are also rapidly ageing. While average population growth was less than 5% between 2015 and 2022, the number of those over 65 increased by 19% on average over the same period.

2. Since the risk of ill-health generally increases with age, it might be expected that a population with an older demographic structure will experience higher mortality rates, greater incidence and prevalence of certain diseases, leading to higher demands for healthcare – and, by consequence, higher spending on health. Many studies have examined the complex relationship between age and health spending. With a significant proportion of an individual's lifetime health spending often occurring during their final months or years of life, it is often pointed out that it is the higher probability of proximity to death at higher ages that drives the relationship between age and health spending rather than age *per se*.

3. Standardising health statistics (such as mortality rates, and morbidity e.g., diabetes and cancer prevalence) according to age is particularly important for comparing health outcomes in any analysis of health system performance, as well as for better informed decision making, for example, in resource allocations. Restricting any analysis to crude (unadjusted) rates may not provide the critical insight necessary to understand why, for example, rates of cardio-vascular disease or diabetes are higher in one country or region compared to another (OECD, 2015[2]). For many healthcare indicators, adjusting to account for the effect of age (and sex) is therefore essential, even if the results of any adjustment ultimately prove to be minor. For example, many of the health outcome and quality indicators published in OECD Health Statistics (OECD, 2021[3]) and OECD Health at a Glance (OECD, 2021[1]), such as hospital admissions for acute care conditions, 30-day survival rates after stroke and myocardial infarction or 5-year cancer survival rates, are adjusted to take into account the demographic differences between countries.

4. There are many academic studies showing that healthcare utilisation and thereby costs increase with age and that aging is one (albeit not the most important) driver of health spending growth over time. In contrast, there is a lack of scientific literature using the systematic application of age standardisation for comparing health spending across different populations. Some government agencies in, for example, Australia, Canada and Ireland have taken differences in the age-structure of (sub-)populations into account when comparing key health spending figures. But additional benchmarking information could be particularly helpful for countries with a young population (e.g., Latin American countries, Türkiye and Israel) and for those with a relatively old population (e.g., Japan, Italy and Greece) to see whether their

overall spending is in line with what is expected –given their demographic. In analysing the efficiency of the healthcare system or sub-system (e.g. primary care or hospital sectors) it is necessary to explore how the resources going into the system relate to the measured outputs and outcomes of the system. Hence, a discussion whether such an approach can be helpful to better assess the performance of health systems in OECD countries would seem appropriate.

5. Age-adjusting healthcare activities is also useful for international comparisons. In 2013, a study commissioned by the OECD examined international variations across five different surgical procedures (McPherson, Gon and Scott, 2013[4]). The analysis used data from 17 OECD countries to calculate age-specific and age-standardised rates, and consequently allowed for more robust comparisons between countries. Having this type of information is crucial to identify appropriate policy recommendations. For example, a large number of hip and knee surgeries after age-adjusting may point to over-provision in a particular country or sub-national region, while simply comparing (crude) numbers of these interventions (that is, not age-adjusted) may simply reflect differences in healthcare needs related to an older demographic.

6. The most widely used international comparative indicators for aggregate health expenditures are expressed either as a percentage of Gross Domestic Product (GDP) or as health expenditures per capita converted to a common currency (typically adjusted for differences in purchasing parities). Age-adjusted health spending indicators for international comparisons have so far not been systematically produced by international organisations. However, the question has been raised as to whether further adjustments to these indicators should be made to take account of some of the structural drivers behind observed differences, in this case, the demographic structure of the population.[1] Countries, such as Israel with a much younger population (around half of Israel's population is under 30 years old) have deemed the age structure of the population of particular importance to warrant the development of additional comparative measures of health spending to take age structure into account. In other countries, such as Ireland, the interest in age-adjusting spending has extended beyond the health sector to consider other areas of public expenditure, such as education and pensions (Meaney, Oyewole and Bedogni, 2018[5]).

7. This Health Working Paper examines the impact of age-adjusting health expenditures for the improvement of international comparisons and to better examine health system efficiency. As part of the exercise, three approaches for age adjustment have been identified and are assessed as appropriate methods to report and compare health expenditure data between OECD countries and over time.

8. This remainder of this paper is structured as follows: ***Section 2*** provides an overview of what is currently known about the relationship between health spending and ageing, reviewing some of the national and international evidence for adjusting health spending, including examples of countries that have made used age-adjustment for national purposes. ***Section 3*** provides a brief review of the different methodologies behind age-adjusting as well as the status of available spending data. The different methodologies of standardisation are compared, noting the limitations and caveats in each approach. In ***Section 4***, the main results from age-adjusting health spending of OECD countries are presented and compared to the unadjusted indicators, while ***Section 5*** draws some conclusions and discusses the feasibility, use and interpretation of the regular production and publication of adjusted spending estimates.

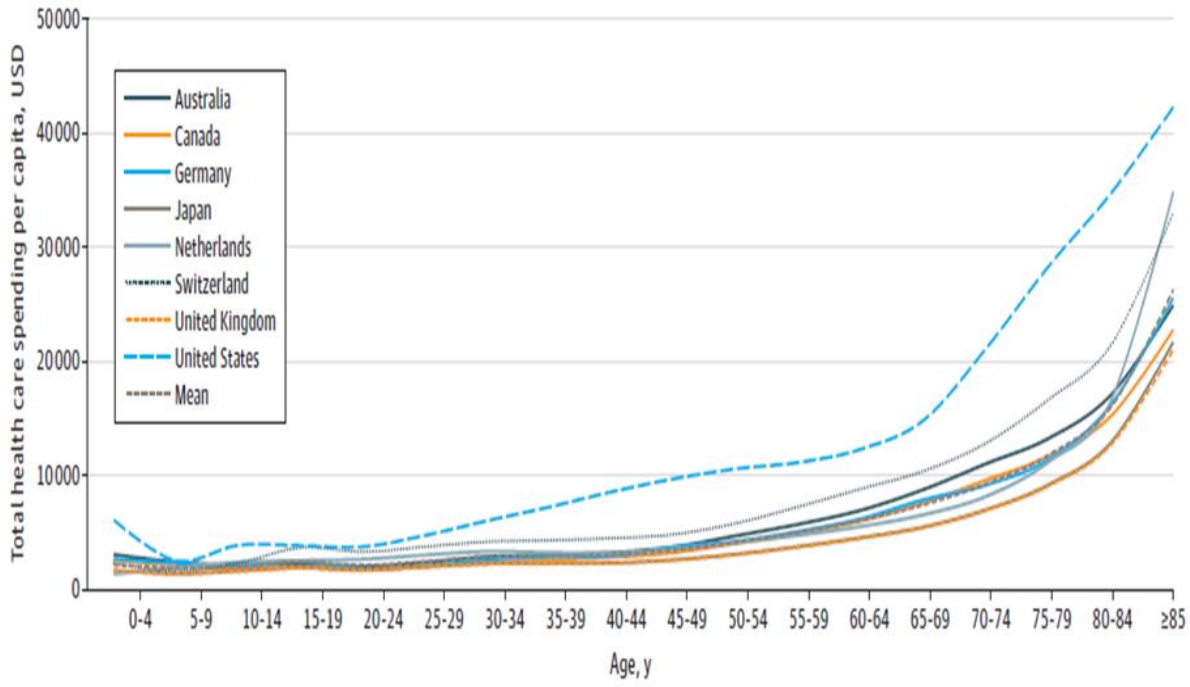
[1] It is arguable whether it is appropriate to present adjusted health expenditure as a share of GDP, since the age structure of a population is likely to also have an impact on the level of GDP.

2. Age and health spending: a selected review of national and international studies

9. There is a body of evidence that ageing leads to declining health status of older people and increasing healthcare needs. Older people tend to use healthcare goods and services more frequently and with higher resource intensity. For example, results from the 2022 Health Interview Survey in Hungary showed that the number of people suffering from chronic illness increased with age, reaching more than 80% among those aged 75 years and over (Hungarian Central Statistical Office, 2022[6]). In the Netherlands, the number of GP consultations among people aged 75 and over was 8.6 per person, compared with 4.5 for those aged 40-49 years (CBS, 2022[7]). According to the 2017 German hospital statistics, the share of admitted patients aged 65 and over (for all diagnoses) was greater, when compared with the general population. For example, 55% of all admitted cancer patients were 65 and over although they only constitute 21% of the general population (Destatis, 2017[8]). Older patients also have longer inpatient stays. For instance, patients aged 80-84 years who have been diagnosed with skin cancer experienced a 40% longer length of stay than those aged 40-44 years (Destatis, 2017[8]). Regarding medication, higher use is also associated with age. Analysis of the Canadian Health Measures Survey data, combined for the years 2007 to 2011, shows that people between 65 and 79 years old were more likely (83%) to take prescription medications than those in younger age groups (Rotermann et al., 2014[9]). For example, 30% of those in the 65-79 age group took five or more prescription drugs compared to only 11% among those between 45 and 64. Finally, the use of long-term care services – which accounts for an average 14% of total health spending across OECD countries - is heavily concentrated in older population groups. Overall, higher healthcare needs in older ages generally translate into higher utilisation of healthcare services.

10. As a consequence of higher utilisation, costs also tend to increase with age (once infants survive their first year of life). In OECD countries, this cost progression starts at a moderate pace and in most countries a sizable uptick in costs will only be observed among people older than 50 years or later. For example, Papanicolas et al. (2020[10]) examined the levels of healthcare spending by age group across eight high-income countries to better understand the differences and the potential impact of the type of healthcare financing system in the United States and seven other countries. While the study sought to understand the role that Medicare plays in the expenditure of people 65 years and over, the cross-sectional study compared nominal and relative spending by 5-year age groups in the United States, with Australia, Canada, Germany, Japan, the Netherlands, Switzerland and the United Kingdom. When comparing the level of per capita spending by age group (Figure 2.1), the US healthcare system proved more costly than health systems in other countries particularly at the older age groups, even if the curves followed very similar trajectories.

Figure 2.1. Per Capita Healthcare Spending by Age Groups in 8 High-Income Countries in 2015



Note: Spending is PPP - purchasing power parity–adjusted. The mean includes all countries except the US. USD indicates US dollars.
Source: (Papanicolas et al., 2020[10])

11. The simultaneous increase in the share of the aged population and in the proportion of the GDP dedicated to health spending over the last decades in many developed countries has led many researchers to investigate the links between health spending and ageing. While ageing is one factor that can explain the increase in health spending over time, most studies find that other drivers (such as technological progress or rising incomes) exert a bigger impact, (Chernew, 2012[11]) (Lorenzoni et al., 2019[12]). Extensive research has been carried out to quantify the impact of the various drivers with a view to modelling future spending trends (Marino, 2017[13]). The following studies have looked into spending trends for different age groups:

- (Dormont, Grignon and Huber, 2006[14]) examined trends in healthcare expenditure between 1992 and 2000 in France, particularly among the older population, comparing the demographic effect with to other trends, such as changes in morbidity and in treatment practices over time. Using a microsimulation model, they were able to disentangle the aggregate effects of demographic, morbidity and practice changes on health expenditure growth. The impact of changes in practice, particularly increases in pharmaceutical spending due to technological progress and innovation, on the growth of healthcare expenditures was found to be almost four times that of the demographic change (aging population).
- (Hagist and Kotlikoff, 2009[15]) also explored the demographic effect on health expenditure growth in ten OECD countries between 1970 and 2002 (using age-health expenditure profiles). They found that the rise in healthcare spending per capita was primarily explained by an increase in the benefit levels (expenditures per person at a given age) driven, for example, by technological change in treatment, rather than the changes in age population structure *per se*.
- (Seshamani, 2002[16]) analysed changes in age-specific per capita health expenditure, changes in population demographics, and the allocation to different age groups in England and Wales from the mid-1980s to 1999, and compared their findings with those in Australia, Canada and Japan. In

contrast to Canada, Australia and Japan, England and Wales showed a slower rise in per capita health expenditures with the share of health spending allocated to the older population decreasing from 40% to 35% over this period. Demographic changes contributed less than a fifth of the increase in health spending in England and Wales.

- (Meara, 2004[17]) looked at US spending trends over approximately 40-year period and while spending grew more rapidly among the older age groups overall, this trend did reverse in the 90s as a result of reforms to Medicare's physician and hospital payment systems. Looking at the period from 2002-10, the study by (Lassman, 2014[18]) also found that while per capita spending for the elderly remained about five times higher than spending for children, per capita spending for children did grew more rapidly than that of working-age adults and the elderly.
- Several studies highlight that it is not ageing *per se* that drives health spending but the proximity to death as the last years of a person's life are associated with the highest healthcare costs (Breyer and Lorenz, 2021[19]), with most deaths occurring in higher age groups. In other words, the relationship between healthcare spending and age may be caused by the simple fact that at age 80, for example, there are many more individuals living in their last 2 years than at age 65 (Zweifel, 2004[20]).

12. Notwithstanding this stream of work, relatively few studies have focused on adjusting current health spending to account for differences in population structure to enable international comparisons of aggregate health spending.

13. (Esmail and Walker, 2008[21]) considered the specific age-structure of countries in developing alternative measures for international comparisons of health spending and other health system performance indicators. The authors adjusted health expenditures to reflect the smaller share of the older population in Canada compared to other OECD countries, to respond to the question of whether Canada spent too little on healthcare. Two different approaches were trialled:

- First, a basic method, simply adjusting health expenditure as a percentage of GDP using the proportion of people 65 years and over in the population. This method involved multiplying actual health spending as a share of GDP with a factor relating the average population share of older people across all countries analysed (i.e., 28 OECD countries in total) with the population share of older people in the country of interest.
- The second adjustment approach was more complex. This approach also takes account of the fact that not all variation in health spending across countries can be attributed to aging. Hence an additional factor is calculated that relates the increase in the share of the senior population between 1980 and 2000 in Canada with the increase in total real health expenditure over the same period.

14. In 2005, Canada's healthcare spending as a percentage of GDP ranked seventh in the OECD. After adjusting healthcare expenditures using either method, Canada ranked second, underscoring the importance of the demographic structure in international comparisons of health spending.

15. However, the methodology used in the above study assumes that information on age structure from Canada can be applied across the board, with the authors recognising that otherwise "adjustment requires a great deal of data on health expenditures by population age group, which is not readily available for all countries" (Esmail and Walker, 2008[21]). Interestingly, the study also adjusted other healthcare resource indicators such as the number of doctors or medical equipment per 1,000 population to ascertain whether Canada is well equipped with workforce and infrastructure given their demographic situation.

16. Barua and Jacques (2018[22]) also compared Canada's health system performance with that of 27 other high-income OECD countries. Overall, 47 age-adjusted indicators (including health expenditure, resource availability and resource use) were used to make this comparison. Age-adjusting per capita health spending for each country *i* was based on the formula:

$$\text{Health expenditure p.c. } i_{\text{ age-adjusted}} = \text{Health expenditure p.c. } i \ * (1 + 0.03098)^{(\beta oecd - \beta i)}$$

with β*i* referring to the proportion of the population aged more than 65 in country *i*, and β*oecd* to the average proportion of the population aged more than 65 across the 27 OECD countries. A static growth factor of 3.1% was derived from the historical trend in Canada's health spending data from 1980-2000 (disaggregated by age group) and means that per capita healthcare expenditure increases by 3.1% for every 1 percentage point increase in the share of the population older than 65 years.

17. In examining similarities and differences between the Israeli and Danish health systems, Rotenberg et al. (2022[23]) age-adjusted health spending using Barua and Jacques' 2018 method. They also applied the same 3.1% growth factor (derived by Barua and Jacques with Canadian data) to adjust health spending for Israel assuming the same proportion of the older population as in Denmark. After adjustment, per capita health spending in Denmark was only 53% higher than that of Israel's (compared to 92% higher if unadjusted).

18. A broader study looked at the impact of the relatively young population in Ireland on public spending. (Meaney, Oyewole and Bedogni, 2018[5]) adjusted public spending for health, education, and social protection to account for differences in the age structure compared with other countries in the European Area (EA). Similar to the basic method used by Esmail and Walker (2008[18]), the adjustment was carried out by applying the share of people 65 and over to public spending as share of GDP. After such an adjustment, Ireland's public spending on health was well above the EA average (without adjustment the public health to GDP ratio was around the EA average).

19. Age-standardisation of health spending has tended to be used more at sub-national levels, for example, in Canada or Australia. These comparisons can lead to a better understanding of patterns of healthcare expenditures between regions with very different population structures.

- In Australia, for instance, age standardisation was used to compare health expenditures between the states and territories in a 2011 report, to identify different patterns of healthcare service costs depending on the level of remoteness of areas (Australian Institute of Health and Welfare, 2011[24]).
- Canada has used standardisation to compare spending per capita across jurisdictions with very different demographic structures (Canadian Institute for Health Information, 2013[25]). The National Health Expenditures Trends Report shows health expenditures for each region broken down into nineteen age categories and then recalculated using the standard Canadian population. For Alberta, Northwest Territories, Yukon and Nunavut, adjusted per capita health spending can be considerably higher than the actual health expenditures per capita. This is due to the specific population structure of these territories, which is younger than in other provinces (Table 2.1).

Table 2.1. Health expenditures by provinces and territories in Canada, 2011

	Actual ($)	Standardised ($)	Percentage Change
Newfoundland and Labrador	5,061	4,958	-2.0%
Prince Edward Island	4,291	4,174	-2.7%
Nova Scotia	4,073	3,843	-5.6%
New Brunswick	4,104	3,872	-5.6%
Quebec	3,443	3,338	-3.1%
Ontario	3,657	3,689	0.9%
Manitoba	4,194	4,211	0.4%
Saskatchewan	4,287	4,193	-2.2%
Alberta	4,486	5,045	12.5%
British Columbia	3,618	3,532	-2.4%
Yukon	5,846	8,035	37.4%
Northwest Territories	7,200	10,778	49.7%
Nunavut	10,235	17,478	70.8%
Canada	**3,790**	**3,790**	

Source: Adapted from (Canadian Institute for Health Information, 2013[25]).

20. In summary, the various initiatives at country level or global research suggest that there is sufficient interest in adjusting international health expenditure comparisons to take account of differences in the demographic composition of populations.

3. Data sources and methods used to adjust health spending for age

21. The level of health spending in a country at any one time is dependent on a range of social, demographic, and economic factors, as well as political priorities and institutional arrangements in place. While the question of ascertaining the right level of health spending is a difficult one to answer, having a comparable measure of health spending across countries and over time is paramount to enable analyses of the drivers behind observed differences. The most widely used international comparative indicators of health spending are aggregate health expenditures expressed either as a percentage of GDP or health expenditures per capita. [2]

22. Generally, for international comparisons, both spending indicators are based on "crude" rates. They are easy to calculate as they are derived by simply dividing the total amount of health spending in a year for each country by the total population (or by its GDP). However, "crude" rates do not consider the different age structures of populations across countries or over time, as a result of changes in mortality, birth rates and migration.

23. Due to this shortcoming, the analysis of "crude" rates is generally not the preferred option when comparing health outcome indicators (such as deaths or hospital admissions per 1,000 population) internationally. Simply dividing the total number of events by the total population and expressing results per 1,000 population[3] is perceived as insufficient as certain health events can be more prevalent in certain age groups compared to others. The age composition of populations is deemed important, and by consequence health outcome indicators are generally age-adjusted.

24. Age adjustment is a statistical technique commonly used to account for differences in age structures between populations or over time, allowing the derived rates to be compared. In this paper, three standard approaches are examined to examine their applicability to 'adjusting' health spending data (Box 3.1). These methods are:

- basic adjustment;
- direct standardisation; and
- indirect standardisation.

25. Notwithstanding the overall advantages in adjusting health spending estimates, the limited availability of health spending data disaggregated by age across OECD countries is a key factor in the application of each of the above methods.

[2] Per capita health spending estimates in national currency units are converted into a common currency (typically adjusted for differences in purchasing parities).

[3] Depending on the indicator, rates may also be expressed as per 100 or 100,000 population.

Box 3.1. Three approaches for adjusting health spending according to population age structure

Basic population adjustment

26. This is a simple methodology that uses the difference in the share of *one* particular population group to adjust aggregate indicators. For example, the relative share of the older population (> 65 years) is applied to calculate an adjustment factor to overall health spending. It does not require the use of any health spending data disaggregated by age.

27. Two more advanced methods (direct and indirect standardisation) are used to adjust "crude" health spending rates (e.g., health spending as a share of the GDP or per capita) by taking into account differences in population structures and using age-spending profiles:

Indirect standardisation

28. Indirect standardisation is an adjustment approach used to remove extraneous sources of variation and allow comparing populations with different characteristics when the specific rate (e.g., health spending) attached to each age category is unknown. In this case, the rate (e.g., health spending) from one (standard) population is applied to all other populations.

29. Indirect standardisation is more generally expressed as a comparison of observed to expected numbers of events rather than standardised rates. It is derived by applying one standard set of age-specific (spending) rates (from a 'standard population') to the study population. Unlike direct standardisation, indirect standardisation is not a widely used technique. It tends to be used when age-specific rates in the study population are volatile due to the small number of events when broken down into age groups.

Direct standardisation

30. Direct standardisation is an adjustment approach used to remove extraneous sources of variation and allow the comparison of populations with different characteristics. In direct standardisation, age-specific rates (e.g., health spending) for all populations to be studied are required and are applied to a common structured (standard) population to compare different populations.

31. Direct age standardised rates are theoretical rates, based on the rates observed in the study population within the chosen age groups, and the relative frequencies of these age groups within the standard population. The replacement of the age group frequencies in the study population with those in the standard population gives the rate that would be observed if the age structure of the study population were the same as that of the standard population.

Source : https://www.nlm.nih.gov/nichsr/stats_tutorial/section2/mod5_age.html

3.1. Applying a basic adjustment methodology

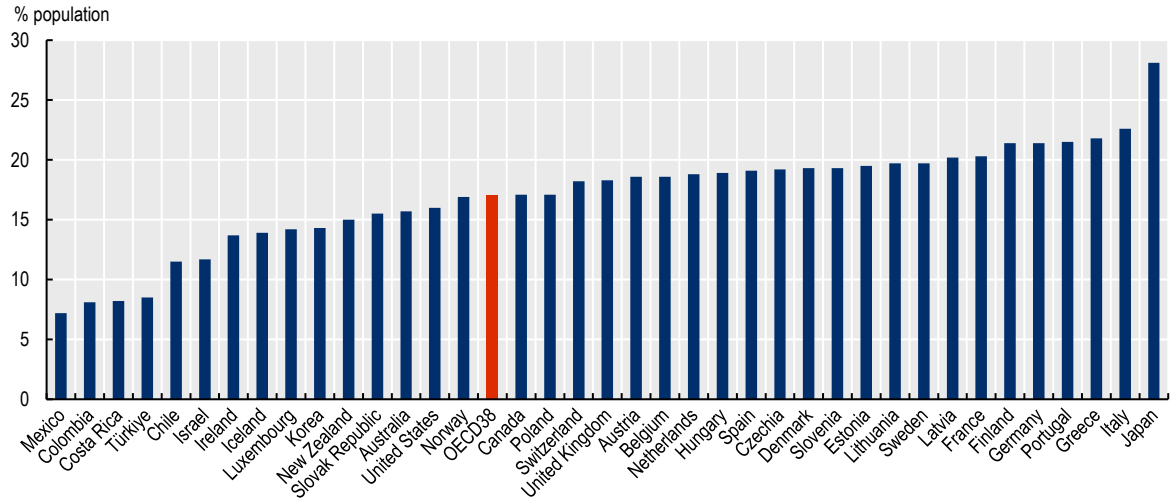
32. The simplest method with least data requirements is a *basic adjustment method*, as used by both (Esmail and Walker, 2008[21]) and (Meaney, Oyewole and Bedogni, 2018[5]). It applies the relative share of the older population (65 years and older) in the total population as an adjustment factor to a country's health spending per capita or as a share of GDP using the following formula:

$$Adjusted\ health\ exp\ p.c.\ in\ county\ i = \frac{OECD2018\ share\ of older\ people}{Country\ i\ share\ of\ older\ people} * health\ exp\ p.c.\ in\ country\ i$$

33. This approach does not require information on health spending by age group or even a detailed demographic profile of countries (beyond the share of those 65 and older in the total population). This simplified method assumes that the determining factor of health spending is the proportion of older people in a population and takes into account neither differences in the health spending for different age groups within a country nor the fact that the distribution of health spending by age groups can differ widely between countries.

34. A glance at the variation in the population structure across OECD countries provides an indication of the impact of adjusting health spending using the basic adjustment method (Figure 3.1). In Japan, the share of the 2018 population above 65 years was 28%, around 11 percentage points greater than the OECD average. In a number of European countries including Italy, Greece, Portugal but also Germany and Finland, more than one in five of the population is over 65. On the other hand, Australia and the United States have shares just below the OECD average. Türkiye, Costa Rica, Colombia and Mexico feature among a group of OECD countries where the proportion of the population over 65 is less than 10% of the population, with the share in Mexico around a quarter of that in Japan. The population pyramids for a selected number of OECD countries are presented in Annex B.

Figure 3.1. Share of the population older than 65 years in 2018



Source: OECD Health Statistics 2022.

3.2. Using indirect and direct standardisation approaches

35. In addition to the simple adjustment method described above, direct and indirect standardisation are two techniques that could be applied to adjust health spending.

36. ***Indirect standardisation*** of health spending by age requires information on average per capita health spending for a set of defined age groups for one population (e.g., Country A) and the age distribution (using the same age groups as for the spending break-down) for all comparator countries. The age-cost profile of Country A is then applied to the country-specific age distribution for all comparator countries to calculate the expected health spending (Box 3.2). This methodology is similar to that applied in the second approach of (Esmail and Walker, 2008[21]) using Canada as the standard population, as well as being the basis for the initial study by the Ministry of Finance of Israel that served as a precursor to this study, using Israel as the base. The advantage of this approach is the readily available population data for all countries but is dependent on constructing a suitable and relevant age-spending profile as a

base (either a single country or an "artificial" profile derived from an average across a number of countries), and therefore does not take into account the specific differences in the age-spending profile of the comparator countries.

37. To obtain the ***indirect standardized*** per capita health expenditure, CHE, for the study population of a comparator country B we can use the following formula:

$$age-standardised\ CHE\ p.c.\ in\ country\ B = CHE\ p.c.(B) \times \frac{\sum_i (n(A)i * r(A)i) / \sum_i n(A)i}{(\sum_i n(B)i * r(A)i) / \sum_i n(B)i}$$

where CHE p.c (B) refers to the observed per capita current health expenditure in country B, $r(A)_i$ to the per capita health expenditure of age group $_i$ in the standard population of Country A, and $n(X)_i$ to the number of persons in age group $_i$ of country A or B. In general terms, the indirectly age-standardised per capita spending in country B is equal to the observed per capita spending in country B multiplied with a factor relating the observed spending in the comparator country and the expected spending in county B if country B had the same age-specific spending rates as the comparator country.

Box 3.2. Hypothetical example of indirect standardisation of health spending

38. The indirect method of standardisation can be used when age-specific health spending is unavailable for one or more countries (but it needs to be available at least for one country).

Table 3.1. Observed health spending in country A and B

	Country A			Country B		
Age group	Total health spending in mn USD PPP	population in mn	Health spending per capita in USD PPP	Total health spending in mn USD PPP	population in mn	Health spending per capita in USD PPP
0-14	815	2.50	326		0.94	
15-64	9,185	5.50	1,670		1.74	
65 and over	12,000	3.00	4,000		0.32	
Total	**22,000**	**11.00**	**2,000**	**6,000**	**3.00**	**2,000**

Note: Illustrative example to show approach. In reality, age groups should be much narrower for reliable results.

39. The indirect method of standardisation calculates the expected spending if Country B had the same age-specific spending rates as Country A.

Table 3.2. Indirect standardisation

	Country A	Country B
0-14: Expected spending (in mn USD PPP)	815	306
15-64: Expected spending (in mn USD PPP)	9,185	2,906
65 and over: Expected spending (in mn USD PPP)	12,000	1,280
Total expected spending (in mn USD PPP)	22,000	4,492
Expected per capita spending in USD PPP	2,000	1,497
Total observed spending (in mn USD PPP)	22,000	6,000
Ratio Observed/Expected spending	1.00	**1.34**

40. This result means that the observed spending in Country B is 34% higher than the amount we would expect if Country B had the same age group specific spending per capita as Country A.

41. By contrast***, direct standardisation*** uses the country-specific differences in health spending across age groups and applies them to a standard population structure to derive an adjusted per capita healthcare expenditure. The population can be an artificially derived population with a distribution by defined age categories. As such, the calculated "age-adjusted" indicators are derived figures and therefore do not signify actual observed values. They provide a value that should be considered in relative terms to other countries or periods adjusted using the same standard population.

42. As (Esmail and Walker, 2008[21]) noted, for direct standardisation, age-specific health spending data are required for all comparator countries, which may not be readily available and/or comparable. In contrast to acquiring data on health outcomes such as hospital admissions and deaths across different age groups for a population, estimating and allocating health spending according to age is a more complex challenge.

43. Then, the ***directly standardized*** per capita health expenditure, for the study population in country B is:

$$age - standardised\ CHE\ p.c.\ in\ country\ B = \sum(n(A)_i * r(B)_i)/\sum n(A)_i$$

where n_i is the number of persons in age group *i* in the standard population (of country A) and r_i is the age specific per capita health expenditure rate in the study population of country B for age group *i*.

Box 3.3. Standard populations in OECD Health Statistics

44. One key component in calculating age-standardised rates is the choice of a standard population. Direct age-standardisation accounts applies the different age-specific rates to a standard population structure, while the indirect approach applies age-specific rates for one population to the corresponding age compositions of the study populations.

45. Choosing a standard population with higher proportions of people at older ages tends to weight events (or spending) at these ages disproportionately, and the opposite is true for a standard population which is much younger (Ahmad O.B., 2009[26]). Ideally, the standard population should reflect an age distribution not greatly different from that of the study populations.

46. There are two basic types of standard populations: internal or external. *Internal* standard populations are the total pooled population of the study populations to be compared (e.g., weighted average of the study populations). One limitation of this is that rates standardised to a specific study population are not comparable to rates from studies using other standard populations. *External* standard populations are standard populations drawn from sources outside the analysis, for example covering a different set of countries than those under analysis. The choice of an external standard is arbitrary, depending on the purposes of the study, but for international comparisons, there are official standard populations used to ensure that the resulting age-standardised rates are comparable (Australian Institute of Health and Welfare, 2011[27]).

47. The current standard population used in OECD Health Statistics is the 2015 standard population It represents the population structure per 100,000 people that existed in 2015 across its 38 member countries. The age profile of the standard population affects not only the value of age-standardised rates but also the relative standing of the populations being compared. Other standard populations include the World Standard Population (WHO, 2001[28]), which is a relatively 'young' population and not generally appropriate for OECD countries. The European Standard Population (ESP) is an artificial population structure used to age-standardised mortality and incidence data. The ESP was adopted in 2013 and based on an average of EU member states' population projections for 2011 - 2030.

51. Several factors related, for example, to data availability and different estimation methodologies can impact the derived age-specific spending rates. For each country, the age group specific healthcare expenditure (in USD PPP) needs to be calculated and then applied to the age structure of an internally or externally derived standard population (Box 3.4). By consequence, the capacity to compute standardised health spending using a direct approach is limited to countries able to provide a comprehensive breakdown of spending by age. As an alternative, country-specific age-spending profiles would need to be estimated or modelled based on profiles from other countries.

Box 3.4. Hypothetical example for the direct standardisation of health spending

48. The direct method of standardisation can be used when age-specific health spending is available for two or more countries.

Table 3.3. Observed health spending in country A and B

	Country A			Country B		
Age group	Total health spending in mn USD PPP	population in mn	Health spending per capita in USD PPP	Total health spending in mn USD PPP	population in mn	Health spending per capita in USD PPP
0-14	815	2.50	326	704	0.94	749
15-64	9,185	5.50	1,670	4,176	1.74	2,400
65 and over	12,000	3.00	4,000	1,120	0.32	3,500
Total	**22,000**	**11.00**	**2,000**	**6,000**	**3.00**	**2,000**

Note: Illustrative example to show approach. In reality, age groups should be much narrower for reliable results.

Table 3.4. External standard population

	Standard population
0-14	15,000
15-64	65,000
65+	20,000
Total	**100,000**

49. The direct method of standardisation allows for a calculation of the amount of expected spending for countries A and B applied to a standard population.

Table 3.5. Direct standardisation of health spending using an external standard population

	Country A	Country B
Expected spending 0-14 in USD PPP	4,890,000	11,234,043
Expected spending 15-64 in USD PPP	108,550,000	156,000,000
Expected spending 65+ in USD PPP	80,000,000	70,000,000
Total expected spending in USD PPP	193,440,000	237,234,043
Total expected spending per capita in USD PPP	1,934	2,372

50. After controlling for the confounding effects of age, expected per capita spending in Country B is 23% higher than in country A.

52. Table 3.6 provides an overview of the main advantages and disadvantages of direct and indirect standardisation. In general, if sufficiently large cell sizes can be generated and age brackets are sufficiently detailed, direct standardisation of health spending is generally considered the preferred option of age-adjusting health spending.

Table 3.6. Advantages and disadvantages of direct and indirect standardisation

Direct standardisation	Indirect standardisation
Advantages • Preserves the consistency between the populations in comparison, i.e., if each age-specific rate in Population A is greater than each of the corresponding age-specific rates in Population B, then the directly standardised rate for Population A will always be higher than that of Population B. As a result, the direct method is preferred for comparing different populations against each other. • When using the same standard population, directly age-standardised rates can be readily compared over time. • Because directly standardised rates can be readily compared, they can also be ranked as they are based on the same population weights. Indirectly age-standardised rates cannot be ranked because each rate is based on a different population weight. • Best method to use: – when making multiple comparisons (e.g. by sex, age and state of usual residence) – when undertaking time series analyses – for practical reasons, such as, to maintain consistency throughout a report.	Advantages • It has minimal data requirements. When calculating indirect standardisation rates, the age-specific numbers of event cases are not required; only the total number of observed events is required. • Indirect age-standardisation is considered useful when: – the age-specific rates for the population being studied are not known but the total number of events is known – calculating rates for small populations where fluctuations in age-specific rates can affect the reliability of rates calculated using the direct method – comparing observed and expected events. • It is more stable as it minimises the variance, giving a smaller standard error and narrower confidence intervals than the direct method
Disadvantages • Sensitive to small cell sizes. This can occur in the case of rare events, events that occur mostly in some age groups and not in others or where the breakdown of the population into sub-groups (e.g. by sex, age, state of usual residence) leads to very small populations and events in some sub-groups. • The direct method requires that the number of events be available, and be broken down by age. This information is not always available, and even when it is available, it may not always be reliable.	Disadvantages • In most cases, indirectly standardised rates will not be strictly comparable, in particular, when the age structures of populations are different. • The ratios from study populations can only be legitimately compared with the standard and not with other study populations because different weighting is used to generate each ratio (the weights depend on the age distribution of the study population). • Cannot be used for time series analysis as age-specific event rates in the standard population will vary over time. • In most cases, indirectly standardised rates cannot be ranked because they measure performance relative to the standard. • Although in most cases the indirect standardisation method can produce more stable results, this is not the case when the age distributions of events are substantially different. A problem with indirect standardisation is that the ratio of two rates determined by pooling observed and expected events across age groups may sometimes lie completely outside the range of the age specific rate ratios.

Source: Adapted from (Australian Institute of Health and Welfare, 2011[27])

3.3. Current availability of health expenditure data disaggregated by age

53. As described in the previous section, direct standardisation requires a breakdown of health spending by specified age groups for all countries for which health spending is to be age-adjusted[4]. For the purposes of this study, using existing data sources, desk research and a general request for countries,

[4] For the indirect method, an age-breakdown of one country is sufficient.

health spending data by age was compiled for 19 OECD countries: Australia, Austria, Canada, Colombia, Estonia, Finland, Germany, Hungary, Israel, Italy, Japan, Korea, Latvia, Luxembourg, the Netherlands, Slovak Republic, Sweden, Switzerland, the United States.

54. A 2012-13 OECD project produced guidelines for distributing aggregate (and principal components of) healthcare spending according to patient characteristics (disease, age and gender) and at the time collected health spending data by age categories for a number of countries (OECD, 2016[29]). Data for Austria, Hungary, Finland, Slovak Republic and Sweden were produced as part of the Health Expenditures by Diseases and Conditions (HEDIC) project (Box 3.5), which essentially followed the same methodological approach as the OECD study and produced disaggregated healthcare expenditures according to disease, age and gender categories focussing on EU countries. Many of these data were subsequently updated to reference year 2015 or 2016 as part of a more recent OECD study to develop a health expenditure projection model using health expenditures by age cohort.

55. More recent health expenditures by age for Australia, Canada, Israel and the United States were directly provided or extracted from online governmental reports and databases. Annex A provides full details of the relevant national data sources. In July 2021, a general request for countries to provide health spending breakdowns by specified age groups was issued as part of this project, resulting in updated data for four countries and additional data for Colombia and Estonia.

Box 3.5. Health Expenditures by Diseases and Conditions (HEDIC) survey

56. The HEDIC survey was a Eurostat project, which aimed to break down healthcare expenditures by characteristics of beneficiaries, such as disease, gender and age. The survey covered 14 EU Member States, and data were collected between November 2013 and May 2016. The goal of this survey was to provide information on healthcare expenditures in relation to patient characteristics and the use of healthcare services, in order to contribute to the public health statistics for monitoring healthcare system in Europe. Thus, it provided insights about the impact of ageing populations and diseases pattern through time, or to identify the drivers of healthcare spending as to help modelling future healthcare expenditures.

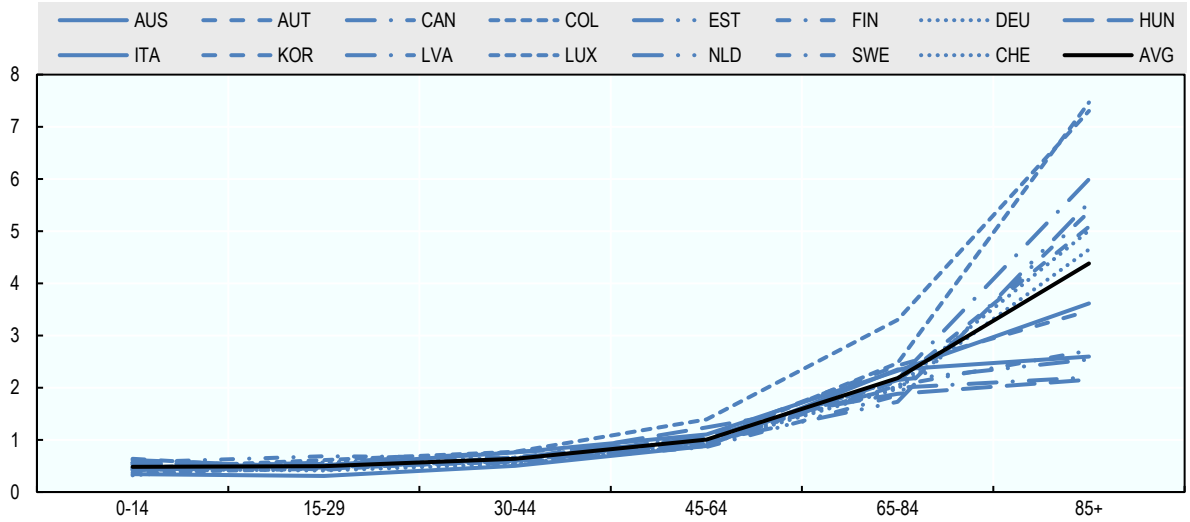
Source: (Eurostat, 2016[30])

57. Spending data by country were aggregated into the following age groups, 0-14, 15-29, 30-44, 45-64, 65-84, 85+, where possible[5]. Figure 3.2 shows the ratio of per capita spending in each age group to the overall per capita spending for 15 countries that were able to provide data according to the specified age groups. The typical profile for all countries shows that per capita spending in the lower age groups (i.e., 0-14, 15-29 and 30-44) is below the average across the entire population. The higher age groups show rapidly increasing per capita spending but with increased divergence between countries only at the highest age group. The ratio of spending at the 65-84 age group remains relatively stable at between 2 to 2.5 times the average per capita for most countries. On the other hand, for the 85+ age group, the ratio ranges from 2.2 times to average in Latvia up to nearly 7.5 times in Luxembourg. This may suggest that the distribution of spending is based on data that did not cover long-term care services (e.g., Sweden), but can also indicate the absence of formal long-term care in Latvia and Hungary, compared with countries such as Germany, the Netherlands and Switzerland.

[5] Ideally, age-standardised rates should be calculated using five-year age groupings (e.g., 0-4). For the purposes of this study, which focused on methodologies, and to ensure a greater number of countries, broader age groups were adopted.

Figure 3.2. Age-spending profiles for selected OECD countries (variable year)

Average per capita health spending for each age group relative to the overall per capita spending for each country.



Note: Data for Israel, Japan, Slovak Republic and the United States were not disaggregated according to the same categories of age and are therefore missing from the chart.
Source: National sources (see Annex A).

58. Several additional factors need to be considered when assessing the coverage and completeness of health spending data disaggregated by age, all of which may have an impact of the quality of standardised expenditure. Spending by all types of financing, providers and types of care should be allocated by age (i.e., ideally 100% of current health expenditures should be allocated to the age groups). In most cases, however, such a comprehensive approach is not feasible; assumptions need to be made in accordance with certain categories of health spending. This may relate to relatively minor components of spending and thus the impact is therefore minimal. However, in other cases, the distribution of spending can be more problematic.

59. For example, disaggregation by age may only be possible for public or social health insurance spending in the case where detailed data on reimbursements or administrative records include information of the age/sex profile of each record, or secondary data can be used to allocate the spending. If the same spending by age profile is applied to private financing schemes, particularly out-of-pocket spending, this may not be appropriate given differences in the population and the services concerned. For example, private spending on pharmaceuticals may exhibit a very different age profile from pharmaceutical spending under a public covered scheme.

60. Similarly, a disaggregation of spending by age for certain providers or types of medical services may not be possible based on available data, and so the question of how to allocate this spending by age category can arise. For example, spending on dental care provided by dentists in Australia is not broken down by age in national reporting. To take into account this relatively important spending item, the age structure of a much smaller spending category on oral care in other providers (e.g., hospitals, clinics, etc.) was available and the spending profile was used to estimate all dental expenditures by age. In this case, it was deemed more appropriate than assuming the dental care spending followed the same underlying distribution as overall healthcare spending.

61. A particular issue concerns the treatment of spending linked to long-term care (LTC). Moreover, the rationale behind this study was the premise that health spending is more concentrated in older age groups and the relative importance of per capita spending in these groups. If the underlying assumptions

for distributing health spending exclude or diminish LTC services that are disproportionately consumed by older age groups, then this can have a significant impact on the underlying calculations of relative health spending and therefore the robustness of any age-adjusted indicators. This can manifest itself both in the exhaustiveness of the distribution of health spending by age (e.g., Italy, Japan do not allocate long-term care), but also in the underlying measure of overall health spending, if significant components of LTC spending are excluded.

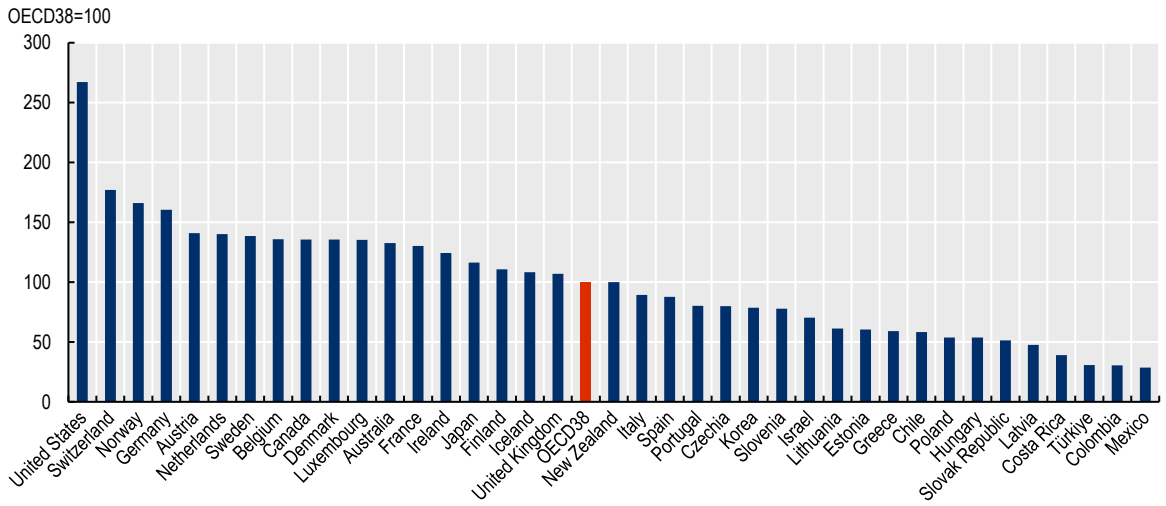
62. To directly age-adjust health spending, this study uses 2018 per capita current health expenditure in USD PPP (Purchasing Power Parities) derived from the 2022 Joint Health Accounts Questionnaire, as well as 2018 population data published in OECD.Stat. Using the share of total health expenditures by age group for each country, the healthcare expenditures for 2018 in USD PPP are disaggregated by age group according to the cost and population structure of each country. For the purposes of these estimates, the structure of the spending by age is assumed to have remained constant over time by applying the most recent age spending profile. Based on the previous literature examining trends in per capita spending in different age groups, we know that this may not hold. However, over the relatively short timeframe of the study, the shifts between age groups are assumed to be minimal.

4. Results of age-adjusting health spending

63. This chapter presents preliminary results of age-adjusted health spending obtained from basic adjustment, indirect and direct standardisation approaches. The focus of the discussion then shifts to the interpretation of the derived standardised health spending indicators using direct and indirect standardisation.

64. Figure 4.1 below shows unadjusted per capita healthcare expenditures for the 38 OECD countries for 2018 expressed as an indicator relative to the unweighted OECD average (i.e., average per capita health spending for OECD=100). Based on these figures, the United States spent 2½ times more than the OECD average, while Türkiye, Mexico and Colombia spent around 30% of the average OECD spending per capita.

Figure 4.1. Per capita healthcare expenditures, 2018 – unadjusted (OECD=100)



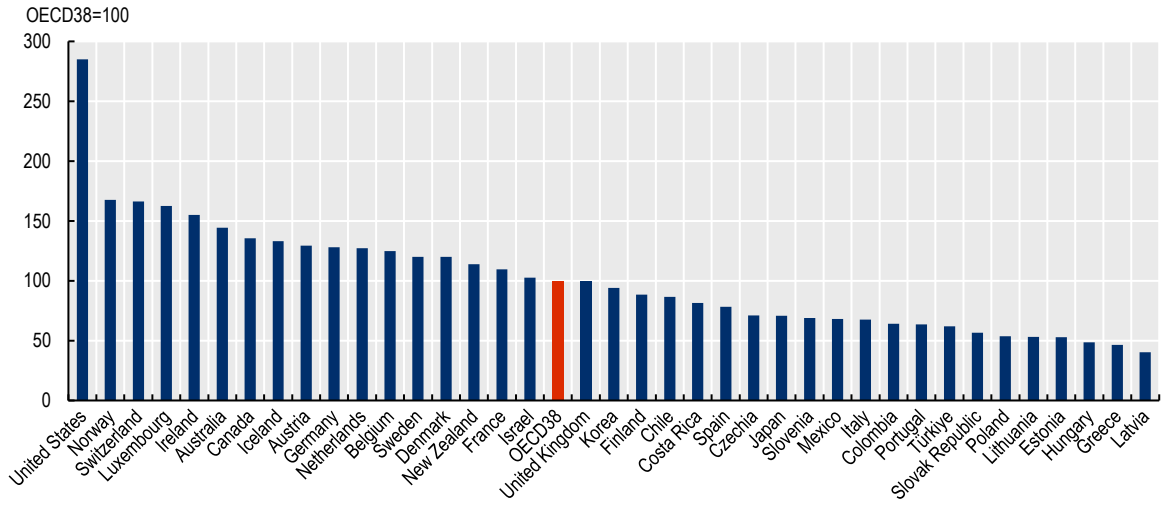
Source: OECD Health Statistics 2022. OECD average is unweighted.

4.1. Basic adjustment of health expenditures

65. First, a basic age adjustment method is used to adjust healthcare expenditures, similar to the simple approach of (Esmail and Walker, 2008[21]). For each country, this involved calculating the ratio of the share of the population 65 years and over compared to that of the average OECD 2018 population,

and multiplying this factor with per capita health spending. This approach is based on the assumption that the ratio of health expenditure per capita for people aged 65 and over to those less than 65 years old is constant across OECD countries. However, the age-health spending cost curves (Figure 3.2) show significant differences between countries with a more than three-fold variation in per capita spending in the oldest age group (85+) can be observed based on the data submitted; this underlines a major limitation of this approach.

Figure 4.2. Per capita healthcare expenditures, 2018 – adjusted using share of population 65+ (OECD=100)



Note: Adjusted figures based on population 65+ relative to the OECD 2018 unweighted population.
Source: OECD Health Statistics 2022,

66. Figure 4.2 shows the results of using this basic adjustment approach, with results again rebased relative to the OECD average (OECD=100). Due to the significant differences in the population structure across OECD countries (Figure 3.1), this method has a significant impact on the relative spending of countries with relatively young populations such as Mexico, Colombia, Costa Rica and Türkiye shifting to the left, when compared to the original country ranking of unadjusted health spending (Figure 4.1). The opposite is true for those countries with higher shares of the population over 65 years old (Japan, Italy and Greece), with shifts to the right as compared with Figure 4.1. As explained above, the use of this adjustment approach represents a significant over-simplifcation by not taking into account the country-specific cost structures of healthcare across different age-groups and a lack of granularity of age groups. The ratio of per capita health spending of the under- and over-65s in each country is assumed to be constant. For this reason, this simplified basic adjustment approach may not be considered as the most appropriate option to age-standardise health spending.

4.2. Indirect standardisation of health expenditures

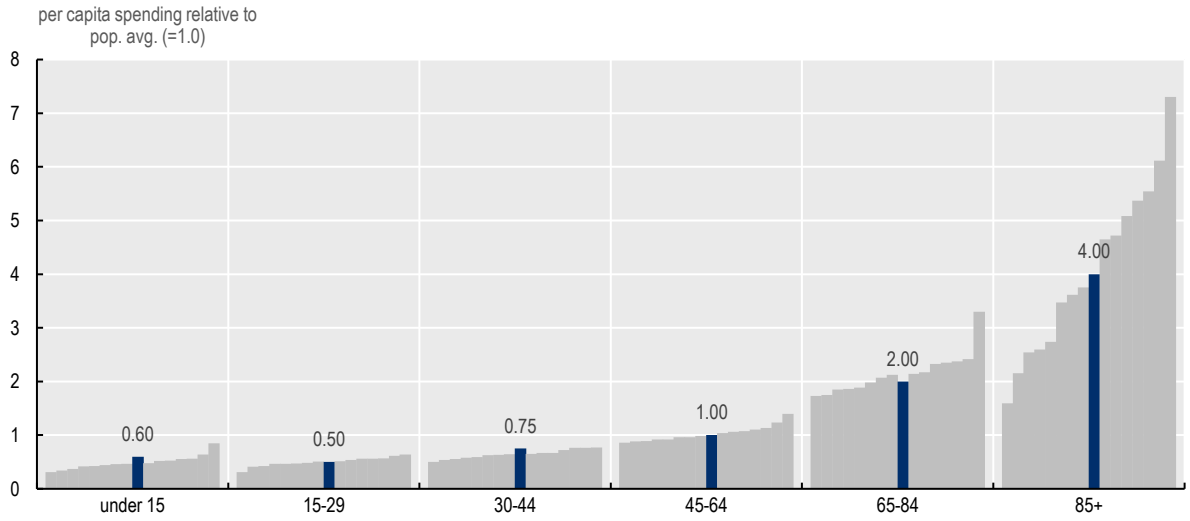
67. An indirect standardisation approach uses *a standard* age-specific spending profile and applies this profile to the different population structures of all OECD countries. This requires multiplying the share of each age group in the total population with each age-specific spending factor and summing these up for all age groups before dividing this value by the actual (unadjusted) spending per capita. The resulting ratio provide a comparison of the observed per capita spending to what would be expected if applying

the standard age-specific spending rates to the study population. For each country this ratio needs to be multiplied with the observed per capita spending of the comparator country on which the age-specific profile was based on to generate a "standardised" spending per capita.

68. For the purposes of the exploratory work presented here, a standard 'OECD' profile was derived – based on the average of the 15 available age-spending profiles.

69. Figure 4.3 shows a derived 'OECD' profile (solid bar) based on individual country spending profiles shown in Figure 3.2. The grey shaded columns show the distribution of spending ratios for each age group across the 15 OECD countries. As discussed in the previous section, the divergence is most apparent in the upper age group, 85+. A *standard* profile was derived based on these ranges taking into account the average, median and the representativeness of the 15 countries.[6] An alternative option is to define the age-specific spending profile of one country as the standard to examine the sensitivity of the results. Therefore, a 'maximum' and 'minimum' profile based on countries with the highest and lowest difference between the age-specific rates of the 0-14 and 85+ age groups was used in the analysis. The major limitation of applying a 'standard' profile, by its nature, is that it assumes the same age spending profile across all countries.

Figure 4.3. 'OECD' age-spending profile to apply indirect standardisation



Note: The blue shaded area shows the range of the age spending profile for 15 countries with consistent age groupings; MIN = age spending profile of country with the lowest ratio between the age-specific rates of the 0-14 and 85+ age groups (Latvia); MAX= age spending profile of country with the highest ratio between the age-specific rates of the 0-14 and 85+ age groups (Luxembourg)."OECD" represents a standard age spending profile used to indirectly age standardise all OECD countries.
Source: National submissions.

70. Applying the set of three age spending profiles (i.e., 'OECD', minimum and maximum) to each country's population structure results in a set of ratios representing the observed spending compared to the expected spending (Table 4.1). The application of the three different standard profiles has a relatively minor effect on the resulting ratios. In the case of Israel, for example, the ratio applying the minimum profile and maximum profiles ranges from 0.86 to 0.89. Countries with a relatively young population will see a ratio lower than 1.0 and vice versa. Countries with a relatively high proportion of older people also display a greater range between when applying the minimum and maximum age-spending profiles (e.g.,

[6] For example, the sample is more biased towards higher spending countries, therefore a shift towards higher spending in the lower age groups was made, and vice versa for the older age groups.

Japan varies from 1.07 to 1.29). This is because the average share of the population aged over 85 in OECD countries is around 2.2% (and up to 4.5% in Japan), and the main divergence in the profiles concerns this age group.

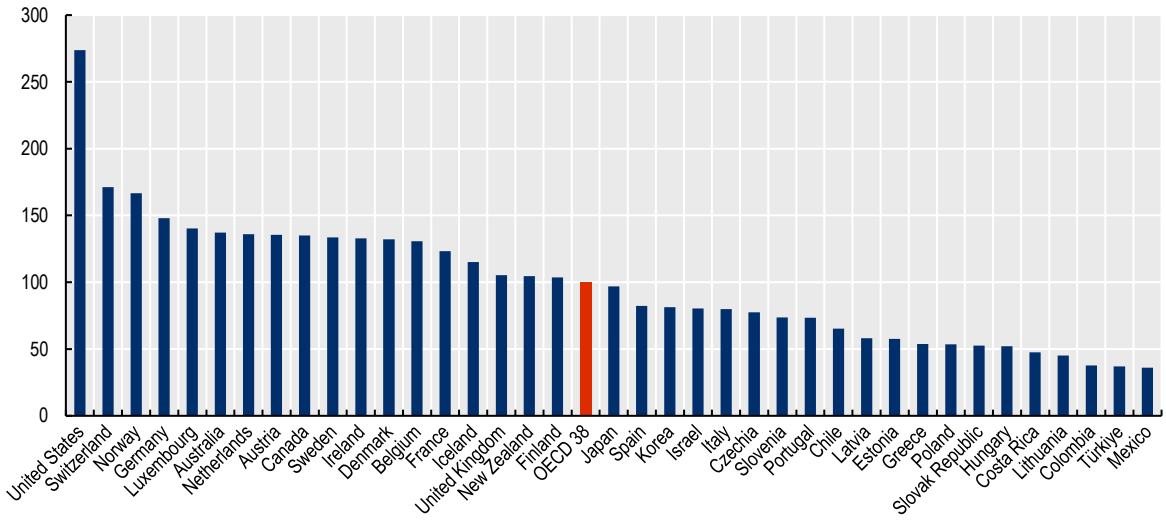
Table 4.1. Indirect age-standardised ratios of observed to expected health spending

	'OECD'	MIN	MAX
Australia	0.97	0.94	1.00
Austria	1.04	0.98	1.10
Belgium	1.04	0.98	1.09
Canada	1.00	0.96	1.05
Chile	0.89	0.89	0.91
Colombia	0.81	0.85	0.80
Costa Rica	0.82	0.85	0.82
Czechia	1.03	0.99	1.09
Denmark	1.03	0.99	1.08
Estonia	1.05	0.99	1.10
Finland	1.07	1.01	1.13
France	1.06	0.99	1.10
Germany	1.08	1.02	1.16
Greece	1.10	1.01	1.16
Hungary	1.03	0.98	1.09
Iceland	0.94	0.92	0.97
Ireland	0.94	0.92	0.96
Israel	0.87	0.89	0.86
Italy	1.12	1.03	1.19
Japan	1.20	1.07	1.29
Korea	0.97	0.95	1.02
Latvia	1.05	1.00	1.12
Lithuania	1.06	1.00	1.12
Luxembourg	0.96	0.93	1.00
Mexico	0.80	0.84	0.78
Netherlands	1.03	0.99	1.09
New Zealand	0.96	0.94	0.99
Norway	1.00	0.96	1.04
Poland	1.00	0.96	1.05
Portugal	1.09	1.01	1.16
Slovak Republic	0.98	0.95	1.02
Slovenia	1.06	1.00	1.12
Spain	1.07	0.99	1.12
Sweden	1.04	0.98	1.09
Switzerland	1.04	0.98	1.09
Türkye	0.83	0.86	0.83
United Kingdom	1.02	0.97	1.06
United States	0.98	0.95	1.01

Note: 'OECD' represents a standard age spending profile used to indirectly age standardise all OECD countries; 'MIN' = age spending profile of country with the lowest ratio between the age-specific rates of the 0-14 and 85+ age groups (Latvia); 'MAX'= age spending profile of country with the highest ratio between the age-specific rates of the 0-14 and 85+ age groups (Luxembourg).
Source: OECD Secretariat.

71. Applying the computed ratios to the per capita spending and recalibrating to an OECD average produces a comparative measure of per capita spending for all 38 OECD countries based on indirect standardisation (Figure 4.4). As a result of this procedure the per capita spending relative to the OECD average for Israel increase to 80% compared to 70% when comparing unadjusted per capita spending (Figure 4.1). The reverse can be observed in countries with comparably older populations: In Japan, per capita spending after adjustment is 97% of the OECD average compared to 116% when looking at non-adjusted spending data.

Figure 4.4. Per capita healthcare expenditures, 2018 - indirect standardisation (OECD=100)



Note: Indirect standardisation based on a standard 'OECD' age-spending profile.
Source: OECD Health Statistics 2022, Authors' calculations.

72. The main advantage of an indirect standardisation approach is that it can be applied to countries where the age-specific rates for the population being studied are not known but the total number of events (in this case per capita spending) is known. This approach is also appropriate when there is some uncertainty about the stability of age-specific rates in the study population – often caused by small counts in some or all age groups. On the downside, the use of indirect standardisation is primarily to compare ratios from study populations with the standard and not necessarily with each other. The main limitation is the application of a single age-spending profile, thus removing a crucial element that in part determines the observed variation between countries.

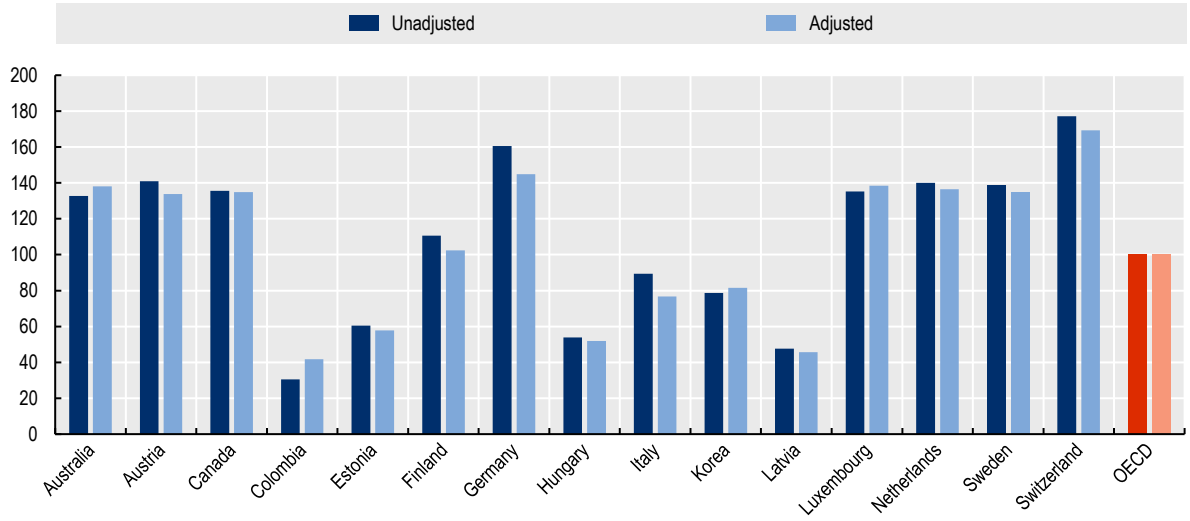
4.3. Direct standardisation of health expenditures

73. By using the same standard population and country specific age-spending profile, in theory, the directly age-standardised rates can be readily compared over time and across countries. In addition, because they can be compared, they can also be ranked since they are based on the same population weights. Figure 4.5 presents results applying direct standardisation using healthcare expenditures breakdown by age for the 15 OECD countries and applying the unweighted OECD 2015 population.

74. Since actual age-spending profiles for all 38 OECD countries were not available, a full comparison between the results of a direct standardisation with indirect standardisation was not possible. A next step could be to model the missing age-spending profiles based on the sub-set of countries currently available. The effect of applying the direct and indirect standardisation approaches yields similar rankings.

Generally, for countries with relatively older populations such as Germany, Japan and Italy age adjusting with direct standardisation result in a shift to the right in the rankings compared with a ranking based on unadjusted health spending. However, while applying the country-specific age spending profiles results is considered a more statistically robust methodology, the use of these profiles exhibiting some incomparability remains an issue.

Figure 4.5. Per capita healthcare expenditures, 2018 - direct standardisation (OECD=100)



Note: Direct standardisation based on country specific age-spending profiles (Annex 1).Health spending per capita expressed relative to OECD average (OECD38=100)
Source: OECD Health Statistics 2022, Authors' calculations.

75. In summary, age-adjusting health spending data is shown to be feasible with the existing data available at the OECD. The simplest method of *basic adjustment* can easily be applied to all OECD countries. However, the assumption of identical age-spending profiles across all countries across only two age groups seems to be an oversimplification. *Indirect standardisation* can also be applied to all OECD countries as the population structure is known for all countries and the method requires only one reference age-spending profile applicable to all countries. There are different options concerning which reference age-spending profile should be used but results differ little. However, the methodology removes some of the underlying country-specific factors from the analysis.

76. *Direct standardisation* is the most robust method but also the most challenging since it requires country-specific age spending profiles for all countries in the study. Only 19 OECD countries could provide some form of age-spending profile and even here differences in the available breakdown and the degree of comparability are apparent. To achieve full country coverage age-spending profiles for the countries could be estimated or refined, based on similarity to profiles from countries with similar characteristics (i.e., level of spending, income, health system, etc.).

77. When it comes to comparing the results of the different methods of age-adjusting, these are not too dissimilar. Adjusting and removing the effect of age structure on healthcare expenditures through either standardisation approach implies that a significantly younger or older population (compared to the majority of OECD countries) can have a significant impact when comparing the level of health spending. It should also be observed that for most countries the impact of age standardisation is marginal.

78. Finally, in addition to spatial comparisons, an important application of direct standardisation, particular with regard to ageing societies, is to examine the impact of population change on health

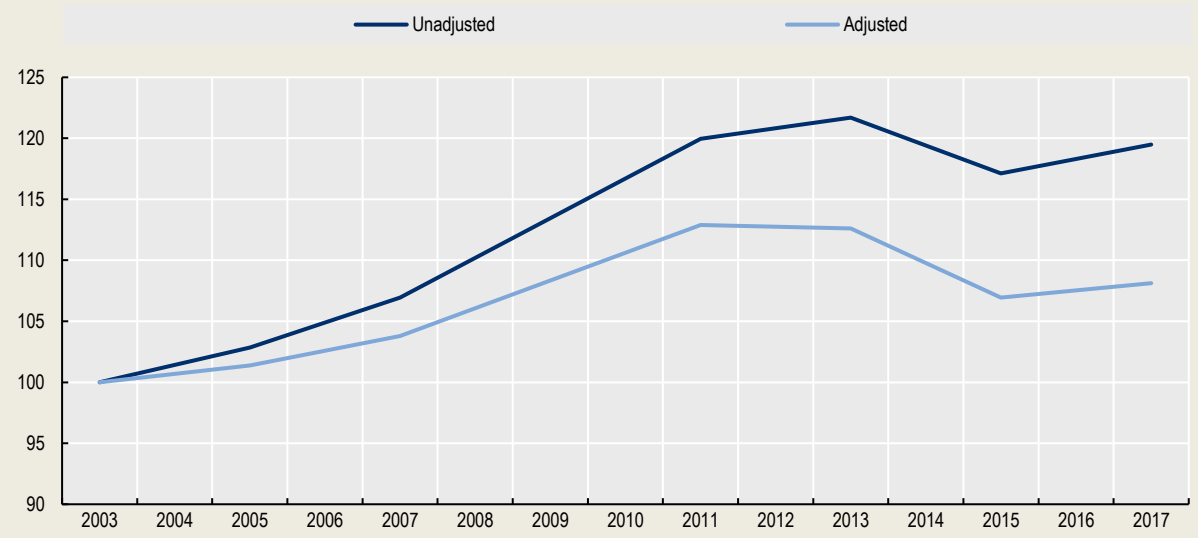
spending within a country over time. The availability of a time series of consistent health spending data disaggregated by age can allow such an assessment and is a useful insight into measures of efficiency (Box 4.1).

Box 4.1. Direct standardisation of health expenditure over time

79. In addition to cross country spatial comparisons, a key motivation for standardising health expenditures by age is to assess the impact of changes in population structure *within* a country over time, and thus as an input into measuring gains in efficiency.

80. The Netherlands regularly publishes health spending by age categories using a consistent methodology. RIVM, the Dutch National Institute for Public Health and the Environment, produces estimates of cost of disease, including by age and gender for 2003 to 2017. Aggregating using the same six broad age categories and standardising using the OECD 2015 standard population produces expected per capita estimates for each of the reference years. Using the standard AIC (Actual Individual Consumption) deflator shows the impact of both accounting for inflation and the change in population in the 'adjusted' line below (Figure 4.6). That is, when taking account population change, per capita spending in 2017 grew by just 8%, in real terms, compared to 2003, compared with almost 20% when unadjusted.

Figure 4.6. Per capita health spending in the Netherlands, 2003 to 2017 (2003=100)



Note: RIVM estimates for 2003, 2005, 2007, 2011, 2013, 2015 and 2017. Estimates are also available for 2019, but the methodology is not consistent with the other years. Both adjusted and unadjusted spending are delated using the AIC (Actual Individual Consumption) implicit price deflator from OECD National Accounts. 'Adjusted' estimates are directly standardised using the 2018 OECD Standard Population.
Source: (RIVM, 2020[31])

5. Conclusion

81. While the allocation of other health-related events (e.g., deaths or hospital admissions) by age is relatively clear-cut, the allocation by age of a whole range of financial transactions related to healthcare is more problematic. In some cases, e.g., administrative data linking patient age with reimbursement can provide a direct allocation mechanism. However, for the most part and for many health systems, it is necessary to use secondary data or broad assumptions to allocate health spending. The variation in how far countries go in allocating the various components leaves the resulting shares by age less comparable and impacts the ability to produce robust results. This study has shown that from a technical perspective, several approaches exist to adjust health spending to account for population differences. Each approach varies in the level of sophistication and data requirements:

82. First, an adjustment of health spending based on e.g., the proportion of the population over 65, requires no disaggregation of health spending by age. However, the assumption of a constant ratio of spending between the two age groups for all countries is considered over-simplistic in its interpretation and policy conclusions.

83. The second method, indirect standardisation, uses a standard age-spending profile which is applied to each study population (country) to calculate a ratio of expected spending compared to observed spending. While this method has the advantage of being applicable to all countries, with only the population age structure required, the main drawback is the loss of country-specific variation in spending by age and in the interpretation of results. The use of a standard age-spending profile also imports some of the limitations in allocating health spending to age and the choice of standard remains somewhat arbitrary. Albeit sensitivity analysis applying different profiles suggests that the general alignment of spending rates (at least up to the oldest age group(s)) results in relatively stable ratios. However, for countries with higher shares of their populations in the older age groups, the impact of different profiles is more significant.

84. Another main constraint is the limitation in making valid comparisons between populations. The indirect approach results in a ratio of expected to observed levels which can only legitimately be compared against the standard and not with each other. Moreover, the validity of adjusting per capita spending according to the ratio and comparing the resulting per capita spending not only to the average but also across all countries remains questionable.

85. The third - and preferred - approach is for direct standardisation with the country-specific age spending profile applied to a standard OECD population structure. This has the advantage of considering the observed differences in relative spending by age in each country, which is what is required, for example, in any efficiency analysis. On the other hand, one could argue that the observed differences in age-spending profiles are a function of the age structure themselves. For example, higher spending in higher age groups in an ‘older’ country could reflect priorities and the development of more formal structures to respond to the needs of older age groups.

86. The main drawback of the direct standardisation remains the data requirements – the need for a breakdown of health spending by age using consistent and robust methodologies. It is suggested that modelling of age-spending profiles based on comparator countries could fill the gaps in case of missing countries. In such a way, direct age standardisation could be applied to all countries, albeit with some inherent assumptions.

87. In the study, both standardisation approaches produced similar and expected results with adjustment leading, for example, to higher per capita health spending for “younger” countries compared

to non-adjusted expenditures. It should be borne in mind that such comparisons do not automatically lead to a recommendation of spending levels since alone they do not show whether money is spent efficiently or not. They could, however, provide an entry point to a more informed discussion on spending needs and thus age-adjusted health spending indicators could complement non-adjusted indicators in analyses of health system efficiency and the impact of ageing.

Bibliography

Ahmad O.B., B. (2009), *Age standardization of rates: a new WHO standard*, World Health Organization. [26]

Australian Institute of Health and Welfare (2011), *Australian health expenditure by remoteness: a comparison of remote, regional and city health expenditure*. [24]

Australian Institute of Health and Welfare (2011), *Principles on the use of direct age-standardisation in administrative data collections*. [27]

Barua, B. and D. Jacques (2018), *Comparing Performance of Universal Health Care Countries*, Fraser Institute, https://www.fraserinstitute.org/sites/default/files/comparing-performance-of-universal-health-care-countries-2018.pdf. [22]

Breyer, F. and N. Lorenz (2021), "The "red herring" after 20 years: ageing and health care expenditures", *The European Journal of Health Economics*, Vol. 22, pp. 661–667, https://doi.org/10.1007/s10198-020-01203-x. [19]

Canadian Institute for Health Information (2013), *National Health Expenditure Trends, 1975 to 2013*. [25]

CBS (2022), *StatLine - Health and health care; personal characteristics*, https://opendata.cbs.nl/#/CBS/en/dataset/83005ENG/table?searchKeywords=medical%20contact%20gp (accessed on 27 April 2022). [7]

Chernew, M. (2012), *Health Care Spending Growth. In: Handbook of Health Economics*, Elsevier. [11]

Destatis (2017), "Diagnosedaten der Patienten und Patientinnen in Krankenhäusern (einschl. Sterbe- und Stundenfälle)", *Fachserie 12 Reihe 6.2.1*, https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Gesundheit/Krankenhaeuser/_inhalt.html#sprg234206 (accessed on 27 April 2022). [8]

Dormont, B., M. Grignon and H. Huber (2006), "Health expenditure growth: reassessing the threat of ageing", *Health economics*, Vol. 15/9, pp. 947-963, https://doi.org/10.1002/hec.1165. [14]

Esmail, N. and M. Walker (2008), *How Good Is Canadian Health Care? 2008 Report An International Comparison of Health Care Systems*, Fraser Institute, https://www.fraserinstitute.org/sites/default/files/HowGoodisCanadianHealthCare2008.pdf. [21]

Eurostat (2016), "HEDIC - Health Expenditures by Diseases and Conditions", *Statistical Working Paper*, https://ec.europa.eu/eurostat/documents/3888793/7605571/KS-TC-16-008-EN-N.pdf/6cb33aa4-2e65-4df7-9b2b-1ff171eb1fba?t=1473156921000 (accessed on 8 March 2022). [30]

Habicht, T. et al. (2018), *Estonia: Health system review. Health Systems in Transition*, WHO Regional Office for Europe, https://apps.who.int/iris/bitstream/handle/10665/330201/HiT-20-1-2018-eng.pdf. [33]

Hagist, C. and L. Kotlikoff (2009), "Who's going broke? Comparing growth in Public Healthcare Expenditure in ten OECD countries", *Hacienda Publica Espanola/Revista de Economia Publica*, Vol. 188/5, pp. 55-72, https://doi.org/10.3386/w11833. [15]

Hungarian Central Statistical Office (2022), *Self-perceived health: Suffer from any chronic (long-standing) illness or condition by sex and age group*, https://www.ksh.hu/stadat_files/ege/en/ege0035.html (accessed on 27 April 2022). [6]

Kaminski Rotenberg, D. et al. (2022), "Similarities and diferences between two well-performing healthcare systems: a comparison between the Israeli and the Danish healthcare systems", *Israel Journal of Health Policy Research*, Vol. 11(1):14, https://doi.org/10.1186/s13584-022-00524-x. [23]

Lassman, D. (2014), *US Health Spending Trends By Age And Gender: Selected Years 2002–10*, https://doi.org/10.1377/hlthaff.2013.1224. [18]

Lorenzoni, L. et al. (2019), *Health Spending Projections to 2030: New results based on a revised OECD methodology*, OECD Health Working Papers, https://doi.org/10.1787/5667f23d-en. [12]

Marino, A. (2017), *Future trends in health care expenditure: A modelling framework for cross-country forecasts*, OECD Publishing, https://doi.org/10.1787/247995bb-en. [13]

McPherson, K., G. Gon and M. Scott (2013), *International Variations in a Selected Number of Surgical Procedures*, OECD Health Working Papers, https://doi.org/10.1787/5k49h4p5g9mw-en. [4]

Meaney, K., V. Oyewole and J. Bedogni (2018), *Comparative Levels and Efficiency of Irish Public Spending*, https://assets.gov.ie/7322/262f606010344ca3adeba2c88087add6.pdf. [5]

Meara, E. (2004), *Trends In Medical Spending By Age, 1963-2000*, https://doi.org/10.1377/hlthaff.23.4.176. [17]

OECD (2021), *Health at a Glance 2021: OECD Indicators*, OECD Publishing, https://doi.org/10.1787/ae3016b9-en. [1]

OECD (2021), *OECD Health Statistics 2021*, https://stats.oecd.org/?lang=en (accessed on 8 March 2022). [3]

OECD (2016), "Expenditure by disease, age and gender", *Focus on Health Spending*, https://www.oecd.org/els/health-systems/Expenditure-by-disease-age-and-gender-FOCUS-April2016.pdf (accessed on 23 February 2023). [29]

OECD (2015), *Cardiovascular Disease and Diabetes: Policies for Better Health and Quality of Care*, https://doi.org/10.1787/9789264233010. [2]

Papanicolas, I. et al. (2020), "Comparison of Health Care Spending by Age in 8 High-Income Countries", *JAMA Netw Open.*, Vol. 3/8, https://doi.org/10.1001/jamanetworkopen.2020.14688. [10]

Rice, N. (1999), "Approaches to Capitation and Risk Adjustment in Health Care: An International Survey", *York: University of York, Centre for Health Economics*. [32]

RIVM (2020), *Kosten van ziekten trend 2003-2017*, https://statline.rivm.nl/#/RIVM/nl/dataset/50065NED/table?ts=1697546769919. [31]

Rotermann, M. et al. (2014), "Prescription medication use by Canadians aged 6 to 79", *Statistics Canada - Health Reports*, Vol. 25/6, pp. 3-9, https://www150.statcan.gc.ca/n1/en/pub/82-003-x/2014006/article/14032-eng.pdf?st=ZAphm-Xz. [9]

Seshamani, M. (2002), *The impact of ageing on expenditures in the National Health Service*, https://doi.org/10.1093/ageing/31.4.287. [16]

WHO (2001), *AGE STANDARDIZATION OF RATES: A NEW WHO STANDARD*. [28]

Zweifel, P. (2004), *Population Ageing and Health Care Expenditure: New Evidence on the "Red Herring*, pp. 29(4), 652–666, http://www.jstor.org/stable/41952787. [20]

Annex A. Data Sources

Table A A.1. Data Sources and coverage by country

Countries	Coverage	Financing	Period	Sources
Australia	Allied health and other services, GP services, medical imaging, pathology, pharmaceutical benefit scheme, private hospital services, public hospital admitted patient, public hospital emergency department, public hospital outpatient, specialist services, dental expenditures	Public	2015-2016	AIHW
Austria	Personal healthcare services (Inpatient services, day care services, outpatient services, home care), ancillary services, medical goods (pharmaceuticals and other med non-durable, therapeutic appliances and other medical goods)	Public	2014	Statistics Austria
Canada	Hospital, drug, physician, other professionals, public health, administration	Private and Public	2018	Canadian Institute for Health Information (CIHI)
Colombia	Current health expenditure	Public (HF.1.2.1)	2020	Ministry of Health
Estonia	Personal healthcare services (curative care, rehabilitative care, LTC, Ancillary services) and prescribed medicines.	Public (HF.1.2.1)	2019	TAI - National Institute for Health Development
Finland	Curative care, rehabilitative care, LT care, Ancillary services, medical goods, preventive care, governance and health system and financing administration, other healthcare services.	Public	2013	Eurostat/HEDIC
Germany	Health protection, Dental practices, Practices of other medical professions, Pharmacies, Outpatient care, Hospitals, Preventive care , Rehabilitation facilities, Inpatient care, Emergency services, Administration, Other facilities, Abroad	Public and Private	2015	Federal Statistical Office
Hungary	Curative care, rehabilitative care, LT care, Ancillary services, medical goods, preventive care, governance and health system and financing administration, other healthcare services.	Public	2016	Eurostat/HEDIC
Israel	Range on medical services and goods covered by HMOs in the Healthcare Basket https://www.kolzchut.org.il/en/The_Healthcare_Basket	Public (HMO)	2008-09	Ministry of Finance
Italy	Hospitalization, Outpatient ambulatory, pharmaceutical expenditures	Public and Private	2019	Ministry of Health
Japan	Medical care, Dental care, Pharmaceutical expenditures	Not specified	2014	MHLW
Korea	Current health expenditure - inpatient/hospital, outpatient/ambulatory, medical goods spending	Public and Private	2018	Yonsei University/MOHW
Latvia	Public expenditures on health services administered by the National Health Service and medicines	Public	2016	National Health Service
Luxembourg	Current health expenditure - Outpatient/ Inpatient care, pharmaceutical expenditures, Day-care, Other care	Public and Private	2015	IGSS

Netherlands	Inpatient/hospital, outpatient/ambulatory, medical goods spending	Public and Private	2017	RIVM
Slovak Republic	Curative care, rehabilitative care, LT care, Ancillary services, medical goods, preventive care, governance and health system and financing administration, other healthcare services.	Public	2016	Government
Sweden	Curative care, rehabilitative care, LT care, Ancillary services, medical goods, preventive care, governance and health system and financing administration, other healthcare services.	Public	2016	Eurostat/HEDIC
Switzerland	Inpatient curative treatment, Outpatient curative treatment, Rehabilitation, LT care, Support services, Health goods, prevention, administration	Public and Private	2019	Federal Statistical Office
United States	Hospital care, physician and clinical services, dental care, other professional services, home healthcare, nursing and facilities and continuing care retirement communities, other health residential and personal care, and retail sales of medical product.	Private and Public	2014	Centers for Medicare and Medicaid Services: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Age-and-Gender

Source: OECD Secretariat.

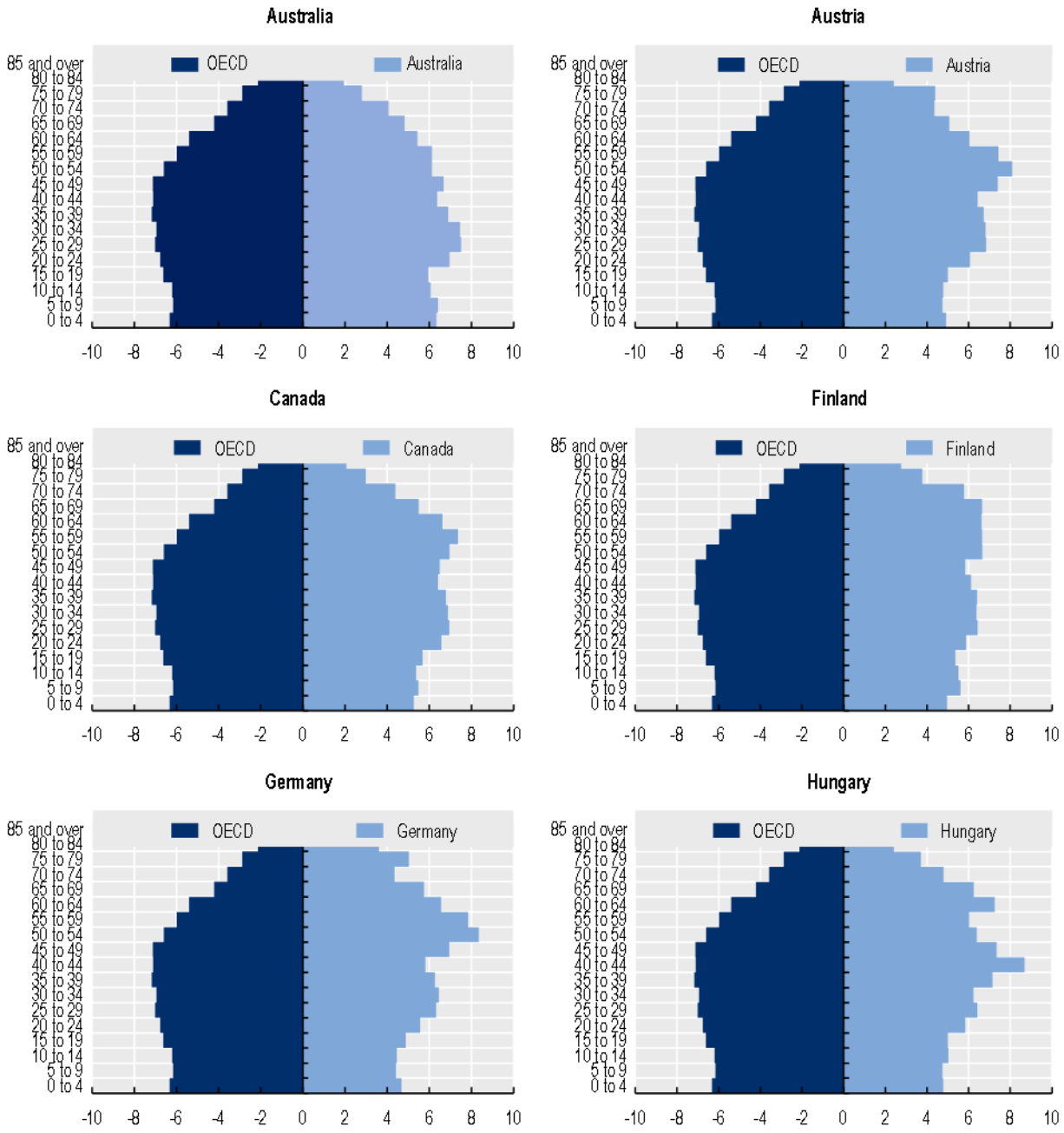
Annex B. OECD standard population and population pyramids for selected countries

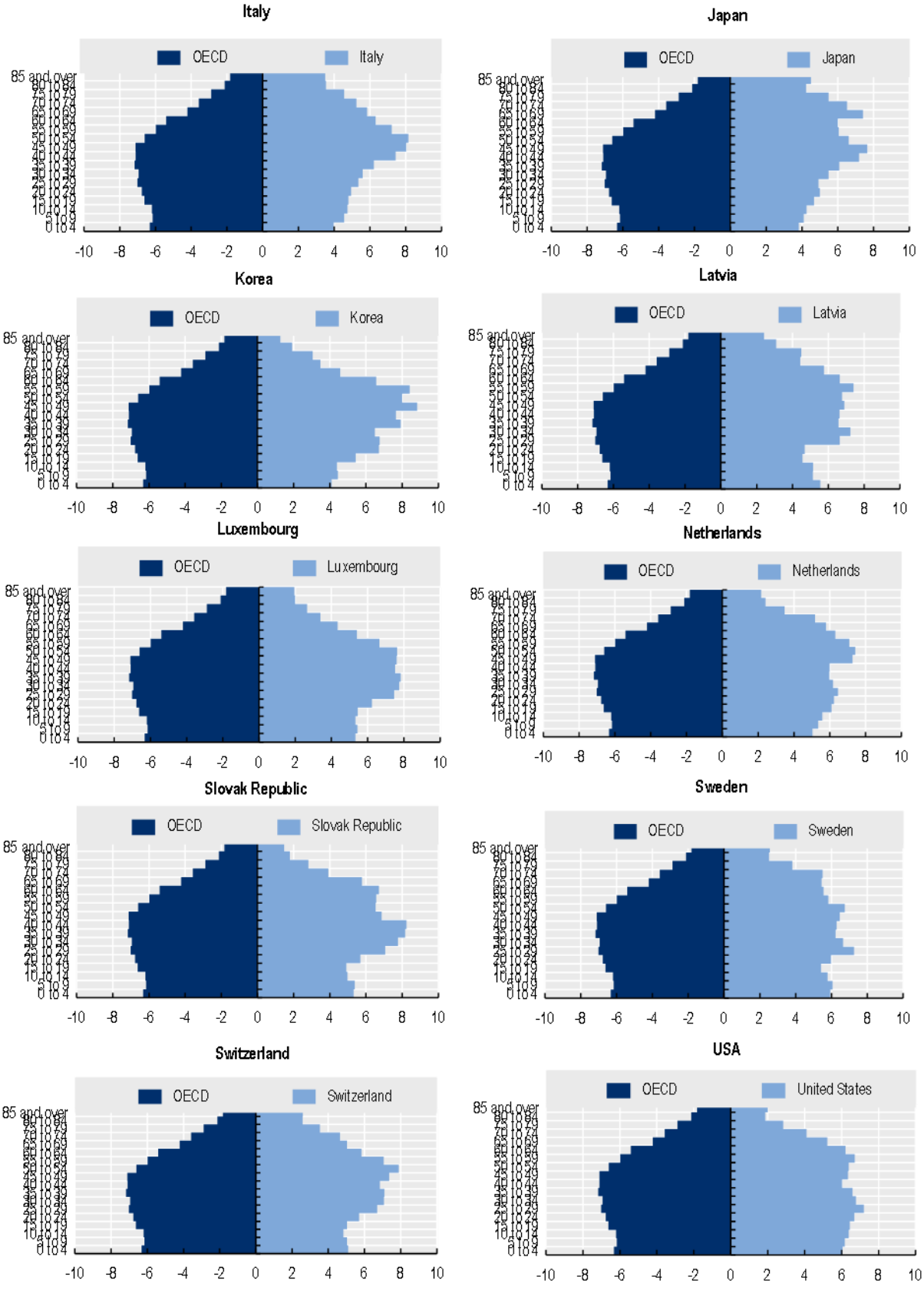
Table A B.1. OECD standard population, 2015

Age (years)	Share of total population
0- 4	5.8556
5-9	5.9688
10-14	5.7458
15-19	5.9803
20-24	6.536
25-29	6.8008
30-34	6.9247
35-39	6.9704
40-44	7.0394
45-49	6.9554
50-54	6.859
55-59	6.3507
60-64	5.6845
65-69	5.0384
70-74	3.8759
75-79	3.1256
80-84	2.2627
85+	2.026
Total	100.000

Note: This is effectively an internal standard population in that it is derived from the pooled populations. However, the number of countries in the OECD has increased from the 34 (used to calculate the 2010 population) to 38.
Source: OECD Health Statistics, 2022.

Figure A B.1. Population pyramids for Israel and selected OECD countries, 2018





Note: OECD.Stat extracted February 2020.

Annex C. Per capita spending by age group, 2018

Table A C.1. Per capita spending by age group in USD 2018 PPP

	Spending	0-14	15-29	30-44	45-64	65-84	85+
AUS	4793	2009	2451	3653	5286	11142	17327
AUT	5545	2367	2575	3212	5092	11772	28191
CAN	5331	2823	2623	3229	4706	11539	31956
COL	1195	548	732	921	1666	3942	8730
EST	2366	1318	1199	1498	2331	5073	6010
FIN	4380	2302	2362	2432	3773	8100	23520
DEU	6291	2782	2595	3382	5792	12450	29241
HUN	2103	1179	983	1312	2601	3963	4527
ITA	3522	1202	1087	1761	3106	8272	9144
KOR	3092	1978	1314	2059	3216	7480	10735
LVA	1867	1148	885	1134	1993	3728	4103
LUX	5221	1961	2327	3127	5046	12888	38984
NLD	5538	2581	3127	4233	5315	9569	30706
SWE	5457	3105	3731	3599	5122	11139	14791
CHE	6978	2238	3968	4558	6609	14103	34966

	Spending	0-14	15-29	30-44	45-64	65-69	70-74	75-79	80+
SVK	2049	1007	1031	1197	2485	4038	4787	5582	5467

	Spending	0-14	15-44	45-64	65-70	70-75	75+
JPN	4559	2275	1749	3903	6678	8639	11348

	Spending	0-18	19-44	45-64	65-84	85+
USA	10528	4776	6655	13632	19896	41540

	Spending	0	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
ISR	2836	4396	2723	1333	1135	1617	1929	3035	4793	8112	10097	11515

Note: "Spending" refers to healthcare expenditures per capita in USD PPP in 2018. Health expenditures for Israel, Japan, Slovak Republic and the United States are not broken down according to the same age categories.

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