Different attitudes towards estimating indirect costs of disease: The example of cancer

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Abstract

Goal: Cost estimations in healthcare are crucial to make sound and adequate economic evaluations and assessments. The concept of indirect costs' estimation seems to be still not very well developed and systematized. This article is dedicated to the problem of indirect costs estimation of different types of cancer. The main aim of the article is to analyse the frequency of usage of different methods used for estimating indirect costs in economic analysis.

Methods: There are discussed various methods used for indirect costs' estimations. Among them, in details, there are described: human capital approach (HCA), friction cost method (FCM) and health state valuation (HSV). There is included a systematic review of the articles dedicated to the problem of cancer costs'estimation.

Principal findings: Analysing the results of our analysis it turns out that the most frequently used method of estimating indirect costs is the human capital approach (HCA). It makes more than 53% of the analysed studies. The second most frequently used method is the health state valuation (HSV) which constitutes less than 17%.

Practical applications: Calculating indirect costs in the proper way is of a great importance to adequate overall costs' evaluation of disease. It is very important to be aware of different attitudes towards estimating indirect costs of diseases as it may allow for much more accurate assessments which will be beneficial for healthcare systems and proper allocation of limited resources. The deliberations presented in this paper might be very useful for the health technology assessment institutions.

Introduction

Development of healthcare systems needs to be based on sound and reliable economic evaluations and assessments. That is why adequate cost estimations are crucial to make such analyses. It is necessary to run many economic evaluations aimed, first, at calculating real costs of the diseases to societies and then to carefully analyse how these costs may be reduced. Each disease is associated with both direct as well as indirect costs. The reduction of indirect costs is of great importance due to the linkage between disease and the condition of each country's economy presented in Abegunde and Stanciole's[1] research (see Figure 1).

The most common groups of diseases worldwide include heart disease, lung disease and cancer. Different types of cancer make one of the most important causes of death all over the world and are a very important burden to the worldwide healthcare systems. Quite often authors analysing costs of many diseases, including cancer, use in

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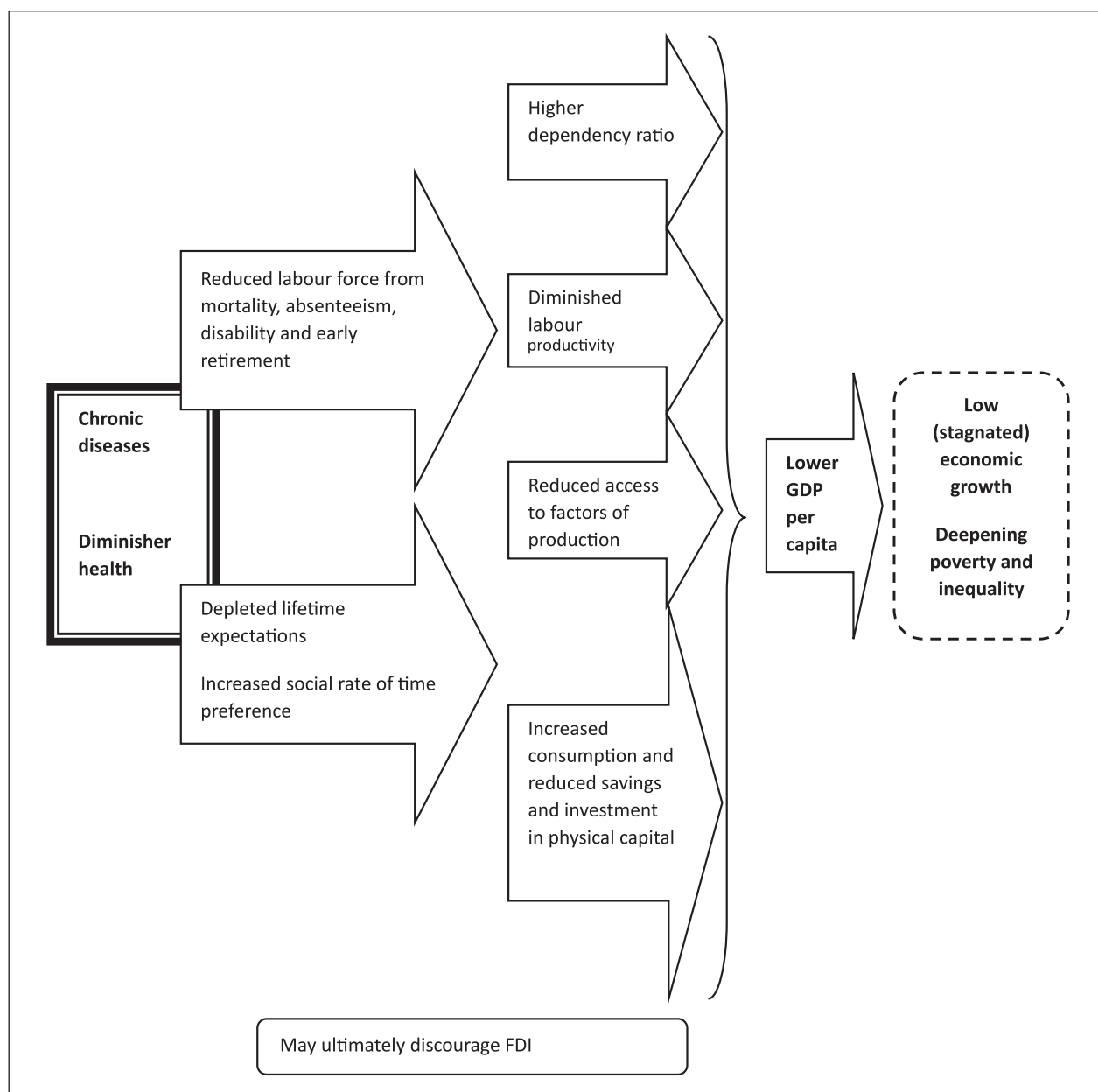Email: katarzyna.miszczynska@uni.lodz.pl

Figure 1. Linkages between diseases and the economy.
Source: Abegunde and Stanciole.[1]

their calculations only direct costs. However, for societies, so-called indirect costs of diseases, seem to be equally important (see Figure 1). Indirect costs may have a significant influence on efficiency ratios.[2]

The deliberations in this article are dedicated to the problems and costs that different types of cancers might cause to societies. The main aim of this article is to analyse the frequency of usage of different methods of estimating indirect costs of cancer in economic analysis. On the one hand, literature review suggests that the most frequently used method to estimate indirect costs is so-called human capital approach[3,4] but on the other hand so-called health

state valuation method is widely recommended as a method of estimating indirect costs.[5–7] What is more, due to the fact that higher level of education in the area of indirect costs can significantly reduce many doubts about the use of this relatively new tool in healthcare analyses.[8] The term 'indirect costs' itself is sometimes quite ambiguous. It can be interpreted in different ways, both more broadly (like change in the use of time caused by illness or injury, both for the sufferer and the affective environment including leisure time value, informal care cost, etc.) and more narrowly (like loss of work productivity). Hence, it is necessary to present some theoretical background in the
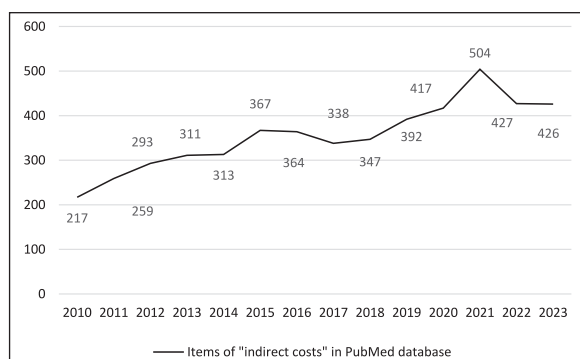
Figure 2. Items of 'indirect costs' in PubMed database in years 2010–2022.
Source: Own elaboration based on PubMed[9] database.

matter and the different methods that are used to estimate indirect costs of disease. In our article there are discussed different methods of calculating indirect costs and some advantages and disadvantages of each of them.

The importance of indirect costs in economic analysis in healthcare can be observed by analysing searches of the phrase 'indirect costs' in PubMed database (see Figure 2).

As it is presented in Figure 2 the number of articles including the phrase 'indirect costs' is generally on growth, which is probably mainly due to the tips for conducting Health Technology Assessment (HTA) analyses suggesting incorporating into such analyses not only direct costs but also indirect ones.[10] It is very important as HTA analyses are more and more often being linked to the serious decision-making processes.[11]

To conclude, after an initial analysis of the literature, we noted that there is a research gap in analyses focussing on literature reviews of the prevalence of methods used to estimate the social costs of diseases in the last 5 years in Europe. The added value of our study will be to conduct such an analysis and extend it to the type of cancer analysed and the country in which the study was conducted.

Indirect costs – General idea

In terms of economic evaluations the problem of indirect costs estimation is still under discussion and quite often indirect costs are understood and defined in many different ways.[12] Władysiuk[8] emphasize, that the costs of medical technology can be divided into: direct (expenditure related to illness and treatment), indirect (generally speaking – resources lost due to illness and its consequences) and intangible costs (non-financial and hardly measurable consequences of illness such as e.g. pain and suffering). Indirect costs are a broad and multidimensional term. They can be analysed in terms of accounting and medical technology. They express the value of all burdens resulting from illness and its treatment. According to Krol et al.,[13] these are 'costs associated with loss of production and

replacement costs due to illness, incapacity (temporary or permanent) and premature death'. Different attitudes towards indirect costs understanding were presented by Calhoun et al.,[14] Severens et al.,[15] Koopmanschap et al.,[16] Hartmann et al.[17] or Gutierrez-Delgado.[18] In terms of indirect costs of cancer Doran et al.,[19] Lidgren et al.,[20] Kim et al.[21] and Gutierrez-Delgado[18] presented their general understanding. Knowing that there are different methods of literature review, such as systematic review, umbrella review or others, in this article we apply the method of systematic review.

Methods of indirect costs measurement

According to latest research of Hubens et al.[22] there are many different method and instruments that could be used for indirect costs estimation (productivity loss estimation). However, according to authors, most were not suitable for capturing productivity changes for economic evaluations from a societal perspective.[22] In the literature, though, three main different methods of indirect cost measurement are pointed out: human capital approach (HCA), friction cost approach (FCA) and health state valuation (HSV). Hermanowski[23] also pointed out some methods designed only for evaluation of indirect costs in terms of presentism connected with a single company or professional groups for example, a firm or introspective method (FIM), Murphy's model (MM), team production method (TPM) but they will not be widely described and used in our study due to the fact they are not very prevalent in the subject literature. Instead we focus on the first three methods that is, HCA, FCM and HSV.

Human capital approach (abbr. HCA). Literature analysis indicates that the human capital approach is the most widely used and the most commonly used method of estimating indirect costs.[3] According to Koopmanschap, Rutten[3] the human capital approach estimates the value of potentially lost production (or the potentially lost income) as a consequence of disease. According to the authors the word potentially is used because in case of permanent disablement or premature death at a specific age, the total productive value from that age until the age of retirement is counted as indirect costs. In other words, the indirect cost calculated on the basis of HCA includes the loss of productivity associated with reduced employee's productivity (presenteeism), absenteeism, permanent incapacity or death.

The HCA method has both advantages and disadvantages, which are pointed out by many authors (see Table 1).

It is worth to point out that most of the attributes concerning the disadvantages of human capital approach are not focussed on the criticism of the HCA method itself but rather on some imperfections of measures of lost productivity. It seems that using possibly objective data and taking care of due diligence while making estimations will

Table 1. Pros and cons of human capital approach.

+	Easily applicable and embedded in theory of economics.[4]
	HCA may be more appropriate for comparing sub-groups (e.g. by gender, age or education).[24,25]
	The HCA incorporates a broader view of lost productivity than FCA including lost non-work time and informal carers` time, in addition to lost production in paid employment. HCA method includes the cost of lost productivity due to disability, early retirement and presenteeism when FC method does not consider these types of non-work-related productivity costs.[26]
−	The human capital approach over-estimates the value of lost production as a result of the inclusion of indirect costs related to permanent incapacity for work or death.[27]
	It attributes different productivity and thus discriminates against people according to their age or gender.[4]
	Does not take into account the occurrence of different phases of the business.[28]

Source: Own elaboration.

Table 2. Pros and cons of friction cost method.

+	Leads to more reliable calculations, since it assumes that employees can be replaced by unused labour resources.[29]
	The FCA may provide more generalizable results.[24]
	The friction cost method reflects the true cost of productivity loss for employers (and in over a long-term perspective the FCA estimates lower indirect costs compared with HCA,[30] which is favourable for employers – they better reflect the economic impact of illness.[27]
−	The necessity of heaving detailed data describing the labour market in a given country emphasizes the impact of country's economic conditions on the estimated costs – the costs estimated for the same disease unit can vary between countries.[29]
	Difficult to be carried out in practice.[4]
	The friction cost method is based on implausible assumptions not supported by neoclassical economic theory.[31]
	It refers only to microeconomic analysis, and thus does not provide information that should be crucial for policy makers at macroeconomic level.[4]
	This approach rests on very strong assumptions about the individual's valuation of leisure and about the labour market and that should be assessed negatively.[32]

Source: Own elaboration.

allow repelling the criticism to some extent and to obtain reliable results of the analysis.[4]

Friction cost approach (abbr. FCA). This approach was introduced by Koopmanschap et al.[27] as a response to the shortcomings of the human capital approach. In contrast to the human capital approach, the friction cost method takes into account more economic factors which reduce the estimated production losses substantially as compared with those based on HCA.

In the friction cost method, the indirect cost of the disease is analysed from an enterprise perspective. According to Koopmanschap et al.[27] in the case of short-term absences, some of the duties of the ill worker may be taken over by the others, while less urgent duties may be fulfilled by the employee after their healing, or sometimes they may be abandoned altogether. Therefore the friction cost method accepts the following assumption: in the situation of incomplete use of workforce in economy, the indirect costs will constitute this part of the capital, which will not be worked out by the co-worker or ill person after his/her return to full recovery. Adopting an enterprise perspective means that in the case of long-term absenteeism or death, the indirect costs are incurred only for the time necessary to replace the lost employee by a new one, that is, until the company returns to the initial production level – so-called fricative period.[4]

The use of the friction cost method meets with some criticism of its implementation. However, it also has its followers (see Table 2).

Health state valuation (abbr. HSV). The health state valuation, based on questionnaires,[8] assumes that the productivity loss can be classified as a health effect. Drummond and McGuire[33] outlines that in this method quality of life already takes into an account indirect costs and their independent analysis results in an error of their double counting. Bebrysz et al.[34] conclude, that the cost of job loss is already included in the quality of life of the patient along with non-measurable costs. These costs are estimated, for example, by the willingness to pay (WTP) method – mainly used to measure goods and services that do not have their market price. Authors of Ernst & Young[4] report assume that the production loss, in case of this method, is expressed by the monetary value that a person would be able to pay for lowering the probability of illness or premature death. According to the report this value can be estimated by stated or revealed preferences methods.

Table 3. Pros and cons of health state valuation.

+	It takes into account the aspect of quality of life.[8]
	It is widely recommended as a method of estimating indirect costs.[5–7]
	This method reflects the 'real world' nature of the oncology day ward. Thanks to this method there could be reported some details of complementary therapy costs, dietary changes, and religious or spiritual trips taken during cancer treatment, which have often been omitted in the other methods.[35]
−	The indirect cost of productivity loss is only a health-side burden and its economic value is not presented in monetary unit.[8]
	It interferes the relationship between disability and loss of income, resulting from the social security system.[33]
	It does not reflect the impact of the disease on the economic potential of society.[35]
	It is mainly based on questionnaires which is always associated with subjectivity and low credibility of respondents' answers.[4]

Source: Own elaboration.

The health state valuation method has both, supporters and opponents of its use (see Table 3).

It is worth to emphasize that the method by which productivity costs should be measured also differs between countries. Lensberg et al.[26] note that in Sweden more recommended is the traditional human capital method which values lost productivity in terms of gross earnings. In Canada, Netherlands and Australia authorities recommend the friction cost method where the FC approach is focussed on the time required to restore the lost productivity due to the absent worker.

General assessment of different methods used for indirect costs analyses

The human capital method is above all a well-understood method by the public, commonly used in practice, well embedded in economic theory and relatively easy to apply. The main complaint regarding the use of the HCA method is the overestimation of the value of lost production as a result of the inclusion of indirect costs related to permanent incapacity or death. This objection can be repelled by applying in the calculations the occupational activity ratios, lifetime tables as well as making the corrections in terms of decreasing productivity. As we have mentioned, the vast majority of reservations do not refer to the concept of the method itself, but to the imperfection of applied measures of lost production which can be eliminated or mitigated by using as objective data as possible and due diligence in the process of estimation.

Methods

Study design

To analyse the frequency of various methods of indirect costs estimations in economic analyses of different types of cancer a systematic literature review was conducted. The literature review was conducted based on three databases: Web of Science, Scopus and PubMed.

The literature search was performed on 19 February 2024, on the following databases: SCOPUS, Web of Science, PubMed and MEDLINE (Medical Literature Analysis and Retrieval System Online; via PubMed). The search was conducted based on an analysis of abstracts, titles and keywords. The systematic literature review was conducted based on selected Prisma guidelines, however the review was not registered. The search term was constructed as a combination of domains related to 'indirect cost' and 'cancer' and 'indirect costs estimation methods (such as: HCA, FCA, WTP and HSV)' (see Tables 1–3). The study design is presented in Figure 3.

As an example the search strategy for PubMed is presented below:

('Indirect cost' [TIAB] OR 'Productivity loss' [TIAB] OR 'Lost Productivity' [TIAB] OR 'Cost of Absenteeism' [TIAB] OR 'Presenteeism cost' [TIAB] OR 'Cost of Presenteeism' [TIAB] OR 'Cost of illness' [TIAB] OR 'Sickness Cost' [TIAB] OR 'Cost of Sickness' [TIAB] OR 'Burden of Disease' [TIAB] OR 'Economic Burden of Disease' [TIAB] OR 'Illness Burden' [TIAB] OR 'Cost of Disease' [TIAB] OR 'Disease Cost' [TIAB] OR 'Disease costs' [TIAB] OR 'Costs of Disease' [TIAB] OR 'Productivity costs' [TIAB] OR 'Human capital' [TIAB] OR 'Economic burden' [TIAB]) AND ('Cancer' [TIAB]) AND ('human capital approach' [TIAB] OR 'human capital method' [TIAB] OR 'friction cost method' [TIAB] OR 'friction cost approach' [TIAB] OR 'willingness to pay' [TIAB] OR 'health state valuation' [TIAB]).

After the first step (databases search) the amount of articles were limited on the basis of the exclusion criteria. Articles that met the following criteria were taken for further analysis:

1. Language: English
2. Years: 2019–2024
3. Document type: article
4. Publication stage: final
5. Source type: journal
6. Country/territory: Europe

The literature was limited to English language articles published after 2019. We have decided to concentrate on up-to-date articles in accordance with guidelines presented
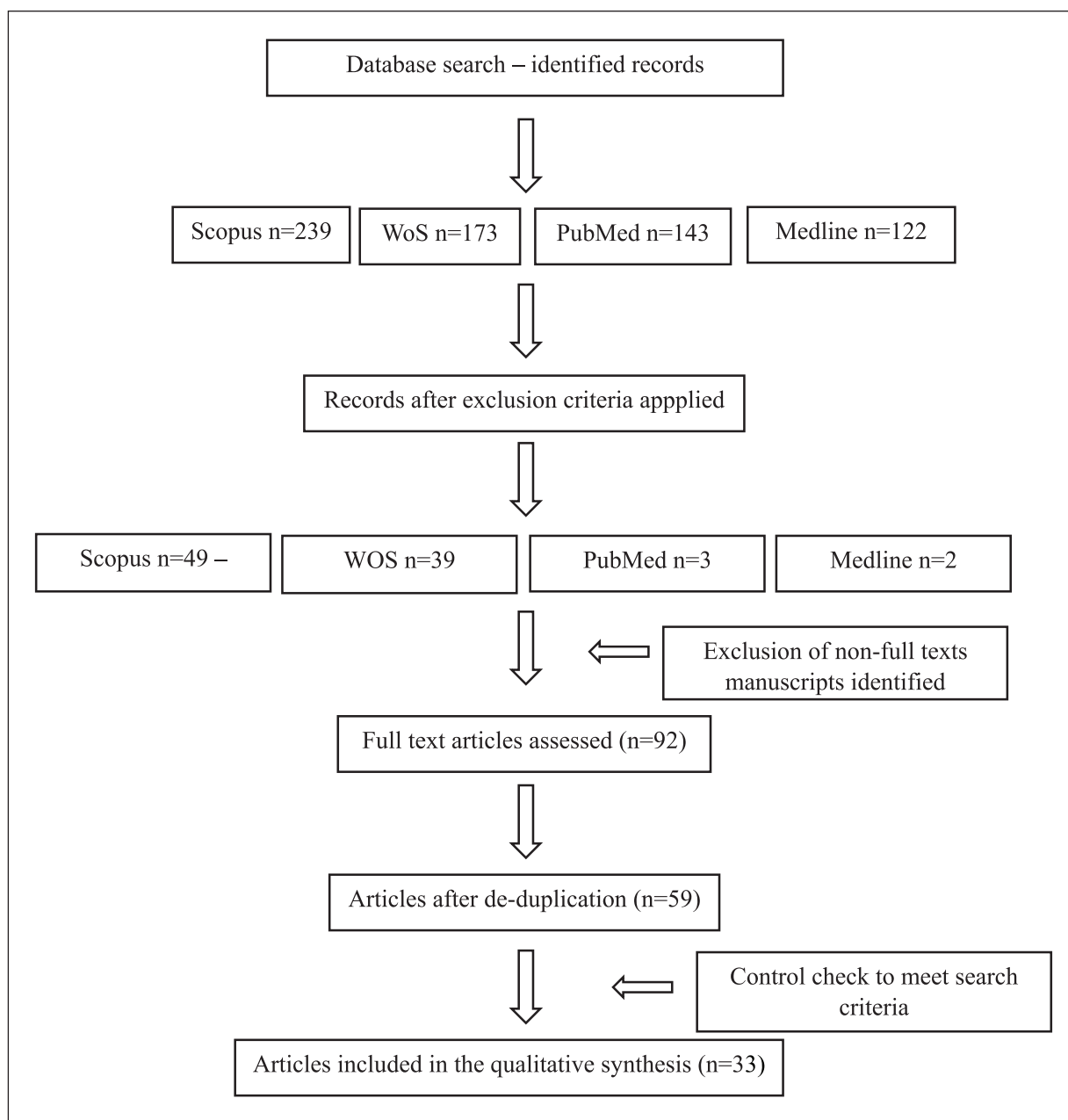
Figure 3. Study design.
Source: Own elaboration.

in Fasseeh et al.[36] study. According to which articles selected in the process should be up-to date in order to balance between the requirements of HTA and sufficient information to draw a conclusion.[36] In our sample, we included only original articles removing literature and systematic reviews, medical trials etc. All the documents that did not meet all criteria were excluded from further analysis. Due to the overlap of the databases the process of de-duplication was conducted with a help of Mendeley embedded feature. After the de-duplication procedure control check of the selected articles was made. The step-by-step procedure is shown in the figure below. Thus, of the initial 675 articles searched (in four databases), 36 were finally analysed.

Results and discussion

In accordance with the proposed study design we analysed 34 articles fulfilling the assumed criteria. The results of our analysis are presented in Table 4.

Analysing the results of our analysis it turns out that the most frequently used method of estimating indirect costs is

Table 4. Different methods used for estimating indirect costs of cancer.

| Study/Method	HCA	FCA	HSV (WTP)
Bencina et al.[37]	+		
Bencina et al.[38–40]	+		
Bencina et al.[40]	+		
Bencina et al.[39]	+		
Bullement et al.[41]			+
Casal et al.[42]	+		+
Castor et al.[43]	+		
Chen-Xu et al.[44]	+		+
Compen et al.[45]			+
Darbà and Marsà[46]	+		
Darbà and Marsà[46]	+		
Darbà and Marsà[47]	+		
De Castro et al.[48]	+		
Draus et al.[49]			+
Draus et al.[50]			+
Ferrier et al.[51]	+	+	
Hanly et al.[52]		+	
Hanly et al.[53]		+	
Hanly et al.[54]	+	+	
Hanly et al.[55]	+	+	
Hao et al.[56]	+		
Hughes et al.[57]	+		
Jackson et al.[58]	+	+	
Jansen et al.[59]		+	
Lebanova et al.[60]	+		
Łyszczarz[61]	+		
Marchetti and Visco[62]			+
Michels et al.[63]			+
O'Brien et al.[64]	+		
O'Mahony et al.[65]	+		
Ortega-Ortega et al.[66]	+		
Ortega-Ortega et al.[67]	+		
Racine et al.[68]		+	
Rumgay et al.[69]	+		

Source: Own elaboration.

the human capital approach (HCA). It makes more than 53% of the analysed studies. The exact percentage values are presented at Figure 4.

The second most frequently used method is the health state valuation (HSV) which constitutes less than 17%. The least popular method of estimating indirect costs according to our analysis is the friction cost method (FCA). It was used just in two studies incorporated into our analysis together with the human capital approach method.

The results for the countries in which the surveys were conducted are also interesting. In addition to surveys based on EU countries, more frequent surveys have been carried out in Spain and Sweden in the last just over 5 years (see Table 5).

From the perspective of health policy making, the analysis of productivity losses (indirect costs) due to illness plays a very important role.[71] The choice as to the method used is dedicated by government recommendations. These
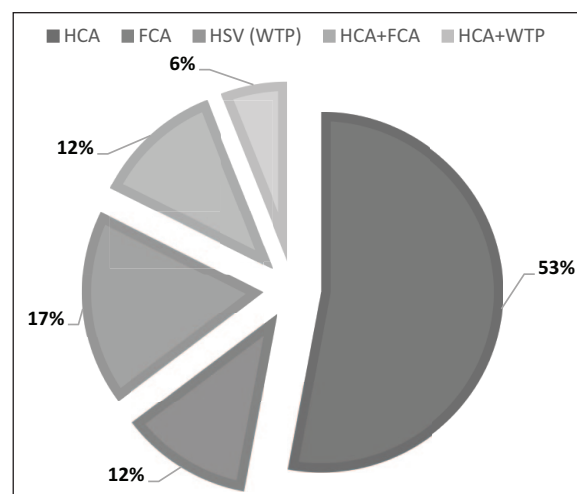
Figure 4. The proportion of HCA, FCM and HSV methods in estimating indirect costs of cancer.
Source: Own elaboration

recommendations relate not only to the method itself, but also to the perspective applied to their calculation.[71] As the study conducted by SBU stated, most countries recommend societal perspective in costs calculation. However, our analysis brought the results that in general indirect costs estimation process in case of cancer is still not very well developed. Only less than half of the articles from our initial sample included such costs' estimation. On the other hand, the systematic review presented by Hubens et al.[22] pointed out the existence of many other productivity loss estimation, that unfortunately are not applicable in indirect costs estimation.

According to our analysis the HCA method of estimating indirect costs is the most frequent one. It is consistent with the earlier literature studies concerning indirect costs estimation,[3,4] however, stays somehow opposite to the recommendations towards the usage of health state valuation method for estimating indirect costs in economic analyses.[5–7] The reasons for HCA frequency probably results from the fact that it is soundly embedded in the theory of economics and is also easily applicable. The frequency of occurrence of this method over the others is evident. According to the authors' assessment the HCA method, despite some drawbacks (which can be mitigated at least to some extent), can be portrayed as the best method to estimate indirect costs in economic evaluations. This practice is also in line with country-specific HTA guidelines.

In the analysed countries, the most frequently chosen method for estimating indirect costs is the HCA method. An interesting phenomenon of the use of indirect cost estimation methods occurs in the system - Universal Health Insurance - traditionally shaped systems - where in countries such as Austria, Belgium, France, Germany, both cost estimation methods, namely HCA and FCA, are used. In other systems, dual methods, that is, HCA and FCA, are still used only in Denmark, Norway, Sweden, Poland and

Table 5. Different scopes of analysed studies.

Author	Country	Type of cancer	Method
Bencina et al.[37]	Hungary, Poland, and Romania	Head and neck cancer	HCA
Bencina et al.[38–40]	Belgium, Poland, the Netherlands	Lung cancer	HCA
Bencina et al.[39]	Portugal, Greece	Kidney cancer	HCA
Bencina et al.[40]	Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Serbia, Slovakia, Slovenia	Breast cancer	HCA
Bullement et al.[41]	UK	Skin cancer (mMCC)	WTP
Casal et al.[42]	Spain	Lung cancer	WTP, HCA
Castor et al.[43]	Sweden	Cancer	HCA
Chen-Xu et al.[44]	EU	Lung cancer	WTP
Compen et al.[45]	The Netherlands	Heterogenous cancer	WTP
Darbà and Marsà[46]	Spain	Hodgkin and non-Hodgkin lymphoma	HCA
Darbà and Marsà[70]	Spain	Colorectal cancer	HCA
Darbà and Marsà[47]	Spain	Lung cancer	HCA
De Castro et al.[48]	Spain	Lung cancer	HCA
Draus et al.[49]	Sweden	Pancreatic cancer	WTP
Draus et al.[50]	Sweden	Pancreatic cancer	WTP
Ferrier et al.[51]	France	Breast cancer	HCA, CFA
Hanly et al.[52]	OECD	All cancers	FCA
Hanly et al.[53]	EU + Norway, UK and Switzerland	All cancers	FCA
Hanly et al.[54]	Europe	All cancers	FCA, HCA
Hanly et al.[55]	Ireland	Prostate cancer	FCA, HCA
Hao et al.[56]	Sweden	Prostate cancer	HCA
Hughes et al.[57]	England, Wales	All cancers	HCA
Jackson et al.[58]	UK, Germany, France, Spain, Italy	Multiple myeloma	HCA, FCA
Jansen et al.[59]	The Netherlands	Head and neck cancer	FCA
Lebanova et al.[60]	Bulgaria	Cervical cancer	HCA
Łyszczarz[61]	Poland	Neoplasms	HCA
Marchetti and Visco[62]	Italy	Mantle cell lymphoma	WTP
Michels et al.[63]	Denmark	TRK fusion positive cancer	WTP
O'Mahony et al.[65]	Ireland	All cancers	HCA
Ortega-Ortega et al.[66]	Europe	Cancer	HCA
Ortega-Ortega et al.[67]	Europe	Cancer	HCA
Racine et al.[68]	France	Colon cancer, breast cancer	FCA
Rumgay et al.[69]	EU, Iceland, Norway, UK and Switzerland	Cancer attributable to alcohol	HCA

Source: Own elaboration.

Hungary. Details of the application of the guidelines in each country are shown in Table 6.

Despite the fact that HSV was suggested as the most approved method to incorporate indirect costs into economic evaluations of diseases, its frequency of usage is rather poor. It is probably due to its subjectivity and high costs necessary to conduct the estimation of indirect costs using the health state valuation. The friction cost approach is also quite rare probably due to the problems of its implementation and the fact that it has no sound background in the theory of economics. Hence, the authors would probably prefer to apply the method which rather overestimates the costs of health technologies like HCA because of prudent inference to be inconsistent with the economic theory and to avoid excessive costs of studies. It should be underlined that Hanly et al.[53] made lately an attempt to generate two alternative estimates of the friction period for European

countries and to apply the FCA to illustrate the impact on cancer-related lost productivity costs. The author stated that the newly presented approaches will enable researchers to apply the FCA to estimate the productivity cost of diseases across Europe from an employer's perspective.[53]

It could also be observed that in many articles the methods that were used for estimating indirect costs are directly presented. Very often there is no clear information if the FCA, HCA or HSV method was applied. Instead, there are presented some assumptions describing just the way the indirect costs were calculated whereas there exists a sound theory explaining how to calculate indirect costs. Therefore, in most cases we were forced to make assignments of particular methods of indirect costs calculation on our own. This sort of subjective judgement may constitute a sort of limitation to this study. Though, it also shows that the topic of indirect costs' estimation, which may have

Table 6. Recommened method for indirect cost estimation.

Country	HCA	FCA	WTP	Other method	Type of the healthcare system
Austria	X	X			Universal Health Insurance – traditionally shaped systems
Belgium	X	X			
France	X	X			
Germany	X	X (in sensitivity analysis)			
Luxembourg	No guidelines available				
Netherlands		X			
Switzerland			X		
Finland				X	National Healthcare – traditionally shaped systems
England	X				
Ireland				X	
Bulgaria	No guidelines available				Universal Health Insurance – transformed systems
Czech Republic	X				
Croatia	X				
Estonia	X				
Hungary	X	X (for sensitivity analysis)			
Lithuania	X				
Poland	X	X (for sensitivity analysis)			
Slovak Republic	X				
Slovenia	X				
Romania	No guidelines available				
Cyprus	No guidelines available				National Healthcare – transformed systems
Denmark	X	X			
Latvia	X				
Greece	No guidelines available				
Italy	X				
Malta	No guidelines available				
Norway	X	X			
Portugal			X (CVM)		
Spain				X	
Sweden	X	X			

Source: Miszczyńska, Antczak, Rupel after: Cleemput et al.,[72] Jiang et al.,[73] Lotric Dolinar,[74] Lubloy.[75]

significant meaning for overall costs of diseases calculations, is not well structured and systemized.

Moreover, it is worth to point out that some analyses also include into indirect costs such elements as travel expenses, extra costs of treatment or the costs related to sending invitations or reminders to patients which should be rather classified as direct non-medical costs.[10,76] It shows the vagueness concerning the analysed matter and also supports the thesis that the problem of indirect costs estimation should be explored, popularized and described in a more precise way.

In the article, we tried to systematize and describe in details indirect costs estimation methods and make their assessment. What is more, we also tried to rank the methods according to their frequency of usage. As a proxy we restricted our deliberations just to different types of cancers which is obviously a sort of limitation of our study. The other limitation might be the number of studies included into our sample. However, we believe that the distribution of different methods according to their frequency of usage among other diseases as well as conducted on a bigger sample would be probably similar. Moreover, we have confidence that cancer is one of the most serious and wide-spread diseases of current times. Hence, it needs careful and in-depth attention.

Conclusions

Analysing the problem of different methods used for estimating indirect costs in case of different types of cancers it is clearly visible that the problem is evolving. Due to the fact that each of the methods used for estimating indirect costs is not free of drawbacks, it seems quite reasonable to incorporate into such economic evaluations of costs of cancers as well as other diseases more than one method of indirect costs' estimation, describing in details research assumptions. Then the readers would have definitely a greater chance to figure out a more accurate point of view after reading such a study.

As it was mentioned earlier in the article the problem of indirect costs estimation in economic evaluations is still under many debates and the higher level of discussion in the area of indirect costs can significantly reduce many doubts about the use of this relatively new tool in healthcare analyses. Calculating indirect costs in the proper way is of a great importance to adequate overall costs' evaluation of disease. Moreover, thanks to incurring indirect costs into HTA analysis it is possible to choose between two medical technologies with identical health effects and identical costs of treatment. In such a case the use of indirect costs might be crucial to absorbing the technology featured by the lower costs from the societal perspective, which is particularly important for limited medical resources. However, the ongoing debate about the appropriateness of the two main methods suggested in HTA recommendations - HCA and FCA - has continued unabated for several decades. Thus, it is difficult to disagree with the view put forward by Pike and Grosse that the lack of standardization of the HCA and FCA methods makes productivity cost estimates difficult to compare across studies. And, crucially, the demand for the use of indirect costs in healthcare analysis is particularly evident in developed countries.

What is more, the discussion about different methods in the matter might be also beneficial for improving them or even creating the new methods of which potential drawbacks might be mitigated at the very first start.

High level of awareness among researchers in the area of indirect costs' estimations in health and medicine will allow definitely for much more accurate assessments which will be beneficial for healthcare systems' financing and proper allocation of limited resources.

In the nearest future it seems necessary to fully systemize the subject of indirect costs' estimation and highly promote associated theory among researchers incorporating this kind of costs into their analyses.

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Author contributions

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References

1. Abegunde D and Stanciole A. An estimation of the economic impact of chronic noncommunicable diseases in selected countries. Working paper, WHO Department of Chronic Diseases and Health Promotion (CHP), 2006.
2. Jacobs P and Fassbender K. The measurement of indirect costs in the health economics evaluation literature: a review. *Int J Technol Assess Health Care* 1998; 14(4): 799–808.
3. Koopmanschap MA and Rutten FF. Indirect costs in economic studies: confronting the confusion. *Pharmacoeconomics* 1993; 4(6): 446–454.
4. Ernst & Young. *The methodology of measuring indirect costs in the Polish health care system*. Warsaw: Ernst &Young, 2013.
5. Weinstein MC, Siegel JE, Gold MR, et al. Recommendations of the panel on cost-effectiveness in health and medicine. *JAMA* 1996; 276(15): 1253–1258.
6. Gold MR. *Cost-effectiveness in health and medicine*. New York, NY: Oxford University Press, 1996.
7. Brouwer WBF, Koopmanschap MA and Rutten FFH. Productivity costs measurement through quality of life? A response to the recommendation of the Washington panel. *Health Econ* 1997; 6(3): 253–259.
8. Władysiuk M. *Indirect costs in medical technology assessment*. Warsaw: INFARMA, 2014.
9. PubMed. US National Library of Medicine National Institutions of Health [Internet], https://www.ncbi.nlm.nih.gov/pubmed/ (2023, accessed 25 January 2023).
10. HTA. *Wytyczne oceny technologii medycznych [Health technology assessment guidelines]*. Warsaw: The Agency For Health Technology Assessment And Tariff System in Poland, 2016.
11. Pichon-Riviere A, Soto NC, Augustovski FA, et al. Health technology assessment for decision making in Latin America: good practice principles. *Int J Technol Assess Health Care* 2018; 34(3): 241–247.
12. Oliva J, Lobo F, Lopez-Bastida J, et al. Indirect costs of cervical and breast cancers in Spain. *Eur J Health Econ* 2005; 6: 309–331.
13. Krol M, Brouwer W and Rutten F. Productivity costs in economic evaluations: past, present, future. *Pharmacoeconomics* 2013; 31(7): 537–554.
14. Calhoun EA, Chang CH, Welshman EE, et al. Evaluating the total costs of chemotherapy-induced toxicity: results from a pilot study with ovarian cancer patients. *Oncologist* 2001; 6(5): 441–445.
15. Severens JL, Laheij RJ, Jansen JB, et al. Estimating the cost of lost productivity in dyspepsia. *Aliment Pharmacol Ther* 1998; 12(9): 919–923.

16. Koopmanschap M, Burdorf A, Jacob K, et al. Measuring productivity changes in economic evaluation: setting the research agenda. *Pharmacoeconomics* 2005; 23(1): 47–54.

17. Hartmann KE, Birnbaum H, Ben-Hamadi R, et al. Annual costs associated with diagnosis of uterine Leiomyomata. *Obstet Gynecol* 2006; 108(4): 930–937.

18. Gutiérrez-Delgado C, Armas-Texta D, Reynoso-Noverón N, et al. Estimating the indirect costs associated with the expected number of cancer cases in Mexico by 2020. *Salud Publica de Mexico* 2016; 58(2): 228–236. DOI: 10.21149/spm.v58i2.7792.

19. Doran CM, Ling R, Byrnes J, et al. Estimating the economic costs of skin cancer in New South Wales, Australia. *BMC Public Health* 2015; 15: 952.

20. Lidgren M, Wilking N, Jönsson B, et al. Resource use and costs associated with different states of breast cancer. *Int J Technol Assess Health Care* 2007; 23(2): 223–231.

21. Kim YA, Oh IH, Yoon SJ, et al. The economic burden of breast cancer in Korea from 2007-2010. *Cancer Res Treat* 2015; 47(4): 583–590.

22. Hubens K, Krol M, Coast J, et al. Measurement Instruments of productivity loss of paid and unpaid work: a systematic review and assessment of suitability for health economic evaluations from a societal perspective. *Value Health* 2021; 24(11): 1686–1699.

23. Hermanowski T. *Szacowanie kosztów społecznych choroby i wpływu stanu zdrowia na aktywność zawodową i wydajność pracy [Estimation of social costs of illness and health effects on occupational activity and labor productivity]*. Warsaw: ABC Wolters Kluwer, 2013.

24. Pearce A, Timmons A, Hanly P, et al. *A comparison of the human capital and friction cost approached to estimating the productivity costs associated with head and neck cancer*. Dublin: National Cancer Registry of Ireland, 2014.

25. Władysiuk M, Bebrysz M and Fedyna MEA. Calculating indirect costs – differences caused by various approaches to unit costs. Results of move to work study (M2W). In: *ISPOR 6th Asia-Pacific conference*, 6–9 September 2014, China.

26. Lensberg BR, Drummond MF, Danchenko N, et al. Challenges in measuring and valuing productivity costs, and their relevance in mood disorders. *Clinicoecon Outcomes Res* 2013; 5: 565–573.

27. Koopmanschap MA, Rutten FF, van Ineveld BM, et al. The friction cost method for measuring indirect costs of disease. *J Health Econ* 1995; 14(2): 171–189.

28. Glied S. Estimating the indirect costs of illness: an assessment of foregone earnings approach. *Am J Public Health* 1996; 86(12): 1723–1728.

29. Hutubessy RCW, van Tulder MW, Vondeling H, et al. Indirect costs of back pain in the Netherlands: a comparison of the human capital method with the friction cost method. *Pain* 1999; 80(1–2): 201–207.

30. Kirch W. (ed.) *Encyclopedia of Public Health*. Berlin: Springer, 2008.

31. Johannesson M and Karlsson G. The friction cost method: a comment. *J Health Econ* 1997; 16(2): 249–255.

32. Liljas B. How to calculate indirect costs in economic evaluations. *Pharmacoeconomics* 1998; 13(1): 1–7.

33. Drummond MF and McGuire A. *Economic evaluation in health care, merging theory with practice*. New York, NY: Oxford University Press, 2001.

34. Bebrysz M, Fedyna M, Rutkowski J, et al. *Przewlekłe choroby zapalne mediowane immunologicznie-ocena kosztów pośrednich w Polsce [Indirect costs of immune-mediated inflammatory diseases in Poland]*. Cracow: Central and Eastern European Society of Technology Assessment in Health Care, 2014.

35. Jakubczyk M. Koszty pośrednie w ocenie technologii medycznych [Indirect costs in medical technology assessment]. *Pol Merkur Lekarski* 2010; 163(2): 42–45.

36. Fasseeh, A, Nemeth B, Molnar A, et al. A systematic review of the indirect costs of schizophrenia in Europe. *Eur J Public Health* 2018; 28(6): 1043–1049.

37. Bencina G, Chami N, Hughes R, et al. Lost productivity due to head and neck cancer mortality in Hungary, Poland, and Romania. *J Cancer Policy* 2022; 34: 100366.

38. Bencina G, Chami N, Hughes R, et al. Indirect costs due to lung cancer-related premature mortality in four European countries. *Adv Ther* 2023; 40(7): 3056–3069.

39. Bencina G, Chami N, Hughes R, et al. Assessing the impact of kidney cancer-related premature mortality and productivity loss in Greece and Portugal. *Expert Rev Pharmacoecon Outcomes Res* 2023; 23(4): 391–398.

40. Bencina G, Chami N, Hughes R, et al. Breast cancer-related mortality in central and Eastern Europe: years of life lost and productivity costs. *J Med Econ* 2023; 26(1): 254–261.

41. Bullement A, Nathan P, Willis A, et al. Cost effectiveness of avelumab for metastatic Merkel cell carcinoma. *Pharmacoecon Open* 2019; 3(3): 377–390.

42. Casal B, Rivera B and Currais L. Evidence of the adverse effects of air pollution on the population's health in Spain: analysis of the economic costs of premature deaths [Evidências sobre os efeitos adversos da poluição do ar sobre a saúde da população na Espanha: análise dos custos eco]. *Cadernos de Saude Publica* 2023; 39(7): e00145922. DOI: 10.1590/0102-311XEN145922.

43. Castor C, Bolin K, Hansson H, et al. Healthcare costs and productivity losses associated with county-based home-care service for sick children in Sweden. *Scand J Caring Sci* 2020; 34(4): 1054–1062.

44. Chen-Xu J, Jakobsen LS, Pires SM, et al. Burden of lung cancer and predicted costs of occupational exposure to hexavalent chromium in the EU – the impact of different occupational exposure limits. *Environ Res* 2023; 228: 115797.

45. Compen F, Adang E, Bisseling E, et al. Cost-utility of individual internet-based and face-to-face mindfulness-based cognitive therapy compared with treatment as usual in reducing psychological distress in cancer patients. *Psychooncology* 2020; 29(2): 294–303.

46. Darbà J and Marsà A. Burden of Hodgkin and non-Hodgkin lymphoma in Spain over a 10-year period: productivity losses due to premature mortality. *Expert Rev Pharmacoecon Outcomes Res* 2021; 21(1): 87–92.

47. Darbà J and Marsà A. The cost of lost productivity due to premature lung cancer-related mortality: results from Spain

over a 10-year period. *BMC Cancer* 2019; 19(1): 992. DOI: 10.1186/s12885-019-6243-7.

48. De Castro J, Insa A, Collado-Borrell R, et al. Economic burden of locoregional and metastatic relapses in resectable early-stage non-small cell lung cancer in Spain. *BMC Pulm Med* 2023; 23(1): 69.

49. Draus T, Ansari D and Andersson R. Model-based screening for pancreatic cancer in Sweden. *Scand J Gastroenterol* 2023; 58(5): 534–541.

50. Draus T, Ansari D, Wikström F, et al. Projected economic burden of pancreatic cancer in Sweden in 2030. *Acta Oncol* 2021; 60(7): 866–871.

51. Ferrier C, Thebaut C, Levy P, et al. Absenteeism and indirect costs during the year following the diagnosis of an operable breast cancer: a prospective multicentric cohort study. *J Gynecol Obstet Hum Reprod* 2021; 50(6): 101871.

52. Hanly P, Ortega Ortega M, Pearce A, et al. Estimating global friction periods for economic evaluation: a case study of selected OECD member countries. *Pharmacoeconomics* 2023; 41(9): 1093–1101.

53. Hanly P, Ortega Ortega M, Pearce A, et al. Advances in the methodological approach to friction period estimation: a European perspective. *Soc Sci Med* 2020; 264: 113289.

54. Hanly P, Ortega-Ortega M and Soerjomataram I. Cancer premature mortality costs in Europe in 2020: a comparison of the human capital approach and the friction cost approach. *Curr Oncol* 2022; 29(5): 3552–3564.

55. Hanly P, Maguire R, Drummond F, et al. Variation in the methodological approach to productivity cost valuation: the case of prostate cancer. *Eur J Health Econ* 2019; 20(9): 1399–1408.

56. Hao S, Östensson E, Eklund M, et al. The economic burden of prostate cancer- a Swedish prevalence-based register study. *BMC Health Serv Res* 2020; 20(1): 448.

57. Hughes K, Ford K, Kadel R, et al. Health and financial burden of adverse childhood experiences in England and Wales: a combined primary data study of five surveys. *BMJ Open* 2020; 10(6): e036374.

58. Jackson G, Galinsky J, Alderson DEC, et al. Productivity losses in patients with newly diagnosed multiple myeloma following stem cell transplantation and the impact of maintenance therapy. *Eur J Haematol* 2019; 103(4): 393–401.

59. Jansen F, Coupé VMH, Eerenstein SEJ, et al. Cost-utility and cost-effectiveness of a guided self-help head and neck exercise program for patients treated with total laryngectomy: results of a multi-center randomized controlled trial. *Oral Oncol* 2021; 117: 105306.

60. Lebanova H, Stoev S, Naseva E, et al. Economic burden of cervical cancer in Bulgaria. *Int J Environ Res Public Health* 2023; 20(3): 2746. DOI: 10.3390/ijerph20032746.

61. Łyszczarz B. Productivity losses from short-term work absence due to neoplasms in Poland. *Sci Rep* 2024; 14(1): 3289.

62. Marchetti M and Visco C. Cost-effectiveness of brexucabtagene autoleucel for relapsed/refractory mantle cell lymphoma. *Leuk Lymphoma* 2023; 64(8): 1442–1450.

63. Michels RE, Arteaga CH, Peters ML, et al. Economic evaluation of a tumour-agnostic therapy: Dutch economic value of larotrectinib in TRK fusion-positive cancers. *Appl Health Econ Health Policy* 2022; 20(5): 717–729.

64. O'Brien GL, O'Mahony C, Cooke K, et al. Cost minimization analysis of intravenous or subcutaneous trastuzumab treatment in patients with HER2-Positive breast cancer in Ireland. *Clin Breast Cancer* 2019; 19(3): e440–e451.

65. O'Mahony C, Murphy KD, O'Brien GL, et al. A cost comparison study to review community versus acute hospital models of nursing care delivered to oncology patients. *Eur J Oncol Nurs* 2020; 49: 101842.

66. Ortega-Ortega M, Hanly P, Pearce A, et al. Projected impact on labour productivity costs of cancer-related premature mortality in Europe 2018–2040. *Appl Health Econ Health Policy* 2023; 21(6): 877–889.

67. Ortega-Ortega M, Hanly P, Pearce A, et al. Paid and unpaid productivity losses due to premature mortality from cancer in Europe in 2018. *Int J Cancer* 2022; 150(4): 580–593.

68. Racine AN, Margaritis I, Duclos M, et al. Costing the economic burden of prolonged sedentary behaviours in France. *Eur J Public Health* 2022; 32(Suppl 1): I3–I7.

69. Rumgay H, Ortega-Ortega M, Sharp L, et al. The cost of premature death from cancer attributable to alcohol: productivity losses in Europe in 2018. *Cancer Epidemiol* 2023; 84: 102365.

70. Darbà J and Marsà A. Evaluation of productivity losses due to premature mortality from colorectal cancer. *PLoS One* 2021; 15(12): e0244375.

71. Miszczyńska KM, Antczak E and Prevolnik Rupel V. Estimating the share of sickness absence costs in Europe's GDP – a country, gender and time perspective. *J Fin Law* 2023; 1: 9–27. DOI: 10.18778/2391-6478.S1.2023.01.

72. Cleemput I, Neyt M, Van de Sande S, et al. *Belgian guidelines for economic evaluations and budget impact analyses: second edition*. Brussels: KCE REPORT 183C, Belgian Health Care Knowledge Centre(KCE).

73. Jiang S, Wang Y, Si L, et al. Incorporating productivity loss in health economic evaluations: a review of guidelines and practices worldwide for research agenda in China. *BMJ Glob Health* 2022; 7(8): 1–14. DOI: 10.1136/bmjgh-2022-009777.

74. Lotrič Dolinar A, Zvan B and Došenović Bonča P. Productivity losses due to migraine in slovenia: an analysis of absenteeism and presenteeism costs based on administrative and self-reported data. *Zdr Varst* 2020; 59(2): 75–82. DOI: 10.2478/sjph-2020-0010.

75. Lublóy Á. Economic burden of migraine in Latvia and Lithuania: direct and indirect costs. *BMC Public Health* 2019; 19(1): 1–26. DOI: 10.1186/s12889-019-7461-2.

76. Yabroff KR, Lund J, Kepka D, et al. Economic burden of cancer in the United States: estimates, projections, and future research. *Cancer Epidemiol Biomarkers Prev* 2011; 20(10): 2006–2014.