ESCOLA NACIONAL DE SAÚDE PÚBLICA

Health Inequality in Portugal: A four-decade endurance test?

Evolution of income-related inequalities in morbidity and health-related behaviours (1987–2019)

Master of Health Management

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Dissertation submitted to fulfil the requirements for the Master's Degree in Health Management developed under the scientific supervision of Professor João Pereira, PhD.

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ABSTRACT

Introduction: Equity is a core principle of Portuguese NHS, yet income-related health inequalities persist and have been reported to be among the highest in Europe. To date, however, no comprehensive analysis has systematically examined trends in health inequalities across socioeconomic groups. This study aims to assess the evolution of income-related health inequalities in Portugal (1987-2019), covering indicators of morbidity and health-related behaviours.

Methods: Repeated cross-sectional analysis of Portuguese National Health Interview Survey waves (1987, 1995, 1999, 2005/06, 2014, 2019) among adults aged 18-64; a harmonised set of indicators consistently measured across waves was grouped into four domains - subjective (self-assessed health), sociofunctional (functional limitations), medical (diabetes, asthma, chronic bronchitis, hypertension), and behavioural (obesity, tobacco use, physical activity). Household income was equivalised and ranked into wave-specific quintiles; income-related inequalities were estimated using concentration curves and indices with age-sex standardisation.

Results: Data analysis shows a persistent and widening gradient, detrimental to poorer income groups, for all outcomes, particularly for self-assessed health and mobility limitations. Over time, inequalities were more stable for medical indicators (diabetes, asthma, chronic bronchitis and hypertension) but tended to increase after 2005. Health-related behaviours diverged in their overall patterns - obesity was concentrated among the poor in all periods with inequality increasing, tobacco use shifted from concentration among the better-off to concentration among the less well-off, and physical activity showed an uneven trend over time concentrated among the better-off.

Conclusions: Income-related health inequalities have persisted - and in most domains increased - over the last four decades (1987-2019). Progress to improve this situation requires intersectoral action on social determinants of health and multivariate analyses to identify policy-relevant drivers.

Keywords: Health inequities; Health status disparities; Socioeconomic factors; Health surveys; Portugal.

RESUMO

Introdução: A equidade é um princípio estruturante do SNS português, contudo, as desigualdades em saúde relacionadas com o rendimento persistem em Portugal, tendo sido já identificadas entre as mais elevadas da Europa. Até ao momento, não está disponível uma análise abrangente e sistemática das tendências nas desigualdades em saúde entre grupos socioeconómicos. Este estudo visa avaliar a evolução das desigualdades em saúde relacionadas com o rendimento, através de indicadores de morbilidade e de comportamentos de saúde (1987–2019).

Métodos: Este estudo utilizou os dados das diferentes vagas do Inquérito Nacional de Saúde (INS) - 1987, 1995, 1999, 2005/06, 2014, 2019-, incluindo os adultos entre 18-64 anos. Foram selecionadas variáveis de saúde, equiparáveis entre vagas do INS, e agrupadas em quatro domínios de saúde: subjetivo (saúde autoavaliada), sociofuncional (limitações funcionais), médico (diabetes, asma, bronquite crónica e hipertensão) e comportamental (obesidade, consumo de tabaco e atividade física). A variável socioeconómica usada foi o rendimento familiar equivalente, ordenado em quintis. As desigualdades relacionadas com o rendimento foram estimadas por curvas e índices de concentração com padronização por idade e sexo.

Resultados: A análise dos dados evidencia um gradiente persistente e crescente, desfavorável aos grupos de menor rendimento, em todos os indicadores, particularmente na autoavaliação de saúde e nas limitações de mobilidade. As desigualdades demonstraram uma maior estabilidade nos indicadores médicos (diabetes, asma, bronquite crónica e hipertensão), embora tendam a aumentar após 2005. Os comportamentos relacionados com a saúde revelaram padrões distintos: a obesidade permaneceu concentrada entre os mais pobres, com agravamento da desigualdade; o consumo de tabaco passou de uma concentração entre os mais favorecidos para uma concentração entre os menos favorecidos; e a atividade física apresentou uma evolução irregular ao longo do tempo, mantendo-se concentrada nos grupos de maior rendimento.

Conclusões: As desigualdades em saúde relacionadas com o rendimento persistiram - e, na maioria dos domínios, intensificaram-se – ao longo das últimas quatro décadas. A reversão do paradigma requer uma ação intersectorial sobre os determinantes sociais da saúde, recomendando-se uma análise multivariável que permita identificar os potenciais fatores suscetíveis de intervenção.

Palavras-chave: Iniquidades em saúde; Desigualdades em saúde; Fatores socioeconómicos; Inquéritos de Saúde; Portugal.

INDEX

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BMI – Body mass index

CI / CIs – Concentration Index / Indices

COPD – Chronic obstructive pulmonary disease

EHIS – European Health Interview Survey

EU-SILC – European Union Statistics on Income and Living Conditions

EUROSTAT – Statistical Office of the European Union

HBP – High blood pressure

HCP – Health Care Professional

INS – *Inquérito Nacional de Saúde* (Portuguese National Health Interview Survey)

INE – *Instituto Nacional de Estatística* (Statistics Portugal)

INSA – *Instituto Nacional de Saúde Doutor Ricardo Jorge*

NCD – Noncommunicable disease

NHIS – U.S. National Health Interview Survey

OECD – Organisation for Economic Co-operation and Development

SAH – Self-assessed health

SDGs – Sustainable Development Goals

SES – Socioeconomic status

SPSS – IBM SPSS Statistics

WHO – World Health Organization

CHAPTER I

GENERAL INTRODUCTION

Health in Portugal is at the frontline of public debate. The organisation and performance of the health system - particularly the National Health Service - have come under sustained scrutiny, with some questioning whether it delivers equity and largely free-at-the-point-of-use care to all citizens. At the same time, contemporary debate has brought health inequity to the forefront of policy agendas after identification of persistent inequalities in many countries.[1-3] Among these, the World Health Organization (WHO) frames health as a "fundamental human right",[4] further stating that "pursuing health equity means minimizing inequalities in health and in the major determinants of health".[5] In Portugal, the Constitution enshrines the guarantee of "access for all citizens, regardless of their economic situation, to health care",[6] subsequently reinforced by additional legislation.[7,8] Yet, while the reduction of health inequalities has been advanced in theory and law, it remains far from fully realized.[9,10,11] Broadly, there are substantial inequalities in health outcomes to the advantage of higher-income groups.[9,10,11] International evidence shows that those in higher-income brackets also have access to higher-quality care,[12] tend to adhere more rigorously to providers' instructions,[13] and more readily adopt healthy lifestyles.[14]

Beyond the perception of civil society, a central empirical question remains: how have health inequalities evolved in Portugal over the past four decades, and to what extent are socioeconomic disparities associated with inequalities in morbidity and health-related behaviours? This study addresses this question by examining income-related health inequalities in Portugal from 1987 to 2019, using repeated cross-sectional waves of the National Health Interview Survey. We focus on a broad set of outcomes - self-assessed health, functional limitations, major chronic conditions, and health behaviours - to characterise inequalities across income groups and how these have changed over time. The research objective is to assess the evolution of income-related inequalities in morbidity and related behaviours, over time.

The study's novelty and relevance lie in its scope and methodological consistency. First, it offers a long-run perspective spanning four decades rather than a single survey year. Second, it integrates multiple health domains, thereby providing a more comprehensive picture of population health. Third, it applies equity-sensitive metrics (concentration curves and indices) with careful harmonisation of indicators across waves, enhancing comparability. These features make the work directly pertinent to the scientific domain of the master's programme - health management - by linking socioeconomic position to

measurable differences in health outcomes and by generating actionable evidence for policy.

Finally, the study contributes to the Sustainable Development Goals (SDGs) by strengthening the evidence base for SDG 3 “Good Health and Well-Being” and SDG 10 “Reduced Inequalities”.[15] By identifying where and how income-related gradients persist or widen, the analysis informs targeted prevention, equity-oriented service delivery and upstream social policies. In doing so, it supports monitoring and accountability frameworks central to progress.

This thesis follows the article model type, being divided into two chapters: **Chapter I** presents this introduction, outlining the study’s rationale. **Chapter II** presents the manuscript, which will be subsequently submitted to a peer-reviewed journal in the field.

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CHAPTER II

MANUSCRIPT

Health Inequality in Portugal: A four-decade endurance test? Evolution of income-related inequalities in morbidity and health-related behaviours (1987–2019)

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Keywords: Health inequities; Health status disparities; Socioeconomic factors; Health surveys; Portugal.

INTRODUCTION

The Portuguese National Health Service (NHS: *SNS, Serviço Nacional de Saúde*) was established in 1979 with the mission of promoting individual and public health, preventing disease, and providing adequate and high-quality medical care.[1] The Portuguese NHS is a universal health service covering all residents, regardless of their socioeconomic, employment or legal status,[2] following a Beveridge-style model.

The right to health is enshrined as a fundamental right, and over the past four and a half decades – despite various shortages and ongoing challenges – the NHS has gradually reinforced its vital role in protecting the health of the Portuguese population with key achievements such as universalization of access to healthcare, improvements in health indicators, expansion of the care network (e.g., public hospitals, primary care centres, and long-term care units), professionalization and training of health professionals, reforms in primary healthcare, effective public health programs (e.g., vaccination campaigns and maternal-child health initiatives), or the reduction in regional health disparities.[1]

Although legal frameworks identify “equity” as a core pillar of the Portuguese NHS, there is robust evidence that socioeconomic health inequalities exist in Portugal. Comparative analyses suggest that these inequalities may be among the highest in Europe, highlighting the lack of a coherent strategy to address this issue.[3] Due to a limited research base, there is also limited guidance on how to manage and reduce health inequities (and inequalities) in the country.[3]

Universality, equity, and free access are values well-established in Portuguese legislation as fundamental principles of the Portuguese NHS. However, health remains a topic which is at the forefront of public debate, and these values are frequently challenged. Almost five decades after its establishment, it is both timely and necessary to assess if and to what extent health inequalities have diminished. To date, however, no comprehensive analysis has systematically examined trends in morbidity across socioeconomic groups in Portugal. To the best of our knowledge, although several analyses have focused on specific years, no longitudinal (or repeated cross-sectional) comparative analysis of such breadth has ever been conducted. At the core of the matter, how have health inequalities evolved in Portugal over the past 40 years? Are socioeconomic disparities within the population associated with inequalities in morbidity? How extensively might inequalities impact on the health of the resident population in Portugal?

Arising from these considerations, this study seeks to answer the following questions: How have health inequalities evolved in Portugal over the past 40 years? Are socioeconomic inequalities associated with disparities in population morbidity?

This study aims to assess the evolution of income-related inequalities in health, in Portugal, drawing on various waves of the National Health Interview Survey between 1987 and 2019, seeking to add new evidence for the relationship between socioeconomic status and health in Portugal, over the years.

Health, Health inequality and Income-related inequalities in health

Health inequality is a generic and non-moral and non-judgmental term used to designate differences, variations, and disparities in the health achievements of individuals and groups.[4] Measuring health inequalities is essential for the implementation and the monitoring of health policies.[5] Regardless of socioeconomic circumstances, it is essential that the entire population has access to the health system.[6] In fact, the literature shows that health is related to more socially cohesive societies with developed welfare states, reflecting a long and sustained period of social, economic and health development,[7] which makes sense given that, according to WHO, "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".[8]

In a bidirectional relationship, inequalities in income and wealth have been associated with health inequities and gradients,[9] having long been a serious health policy concern.[10,11] Income is a key factor affecting health inequality, in that a country's degree of (income-related) health inequality appears to be closely associated with its degree of income inequality.[10,12,13] This circumstance has a clear impact on the population, and people in higher socioeconomic groups tend to have lower rates of mortality and better health than those in lower socioeconomic groups.[13–15] Its unequal impact among lower socioeconomic strata further aggravates the issue leading to increased differences in the health of different socioeconomic groups.[16]

Despite decades of research and policy efforts targeting the reduction of health inequalities, individuals in more advantaged socioeconomic positions continue to experience longer life expectancy and better health outcomes compared to those in less privileged circumstances.[14] Socioeconomic inequalities in health are mainly caused by the effect that socioeconomic factors such as income, education and occupation status have on health status.[17] It is essential to recognize that lower socioeconomic status and lacking income resources are associated with less healthy lifestyles, higher health risks,

poor living conditions, a faster decline of health status and higher mortality rates.[14,17,18] On the other hand, growing up in favourable socioeconomic circumstances leads to higher levels of education, which is associated not only with higher income but also with comparatively better health in later stages of life.[6] People who have higher socioeconomic status tend to better understand and follow the instructions given by their health care providers, as well as easily adopt healthier lifestyles and also tend to live in a less stressful psychosocial environments.[19]

An unequal Globe: when health depends on wealth

For many years now, across the globe, several studies have consistently confirmed the relationship of income inequality or socioeconomic status and health outcomes.[20–23] In a study developed in 57 countries (from all regions of the world) which used data from the World Health Surveys, research has shown that inequalities in health, favouring the rich and the educated, were evident in overall health as well as in every health domain.[24] As examples, in Tehran, a population-based cross-sectional study showed substantial socioeconomic inequalities in different health domains in favour of groups of higher socioeconomic status.[25] In Brazil, the poor reported worse health status, even though income-related inequality in health care utilization has been declining.[26] Likewise in Chile, people in lower-income quintiles report worse health status and more physical limitations than people in higher quintiles.[27] As for the USA, self-reported health deteriorates more rapidly among individuals with lower socioeconomic status, particularly those in manual occupations, whose physically demanding work contributes to their poorer health outcomes.[28] In the UK, an analysis based on data from Health Survey for England 1998-2006 found that better health is significantly concentrated among the rich in every period, even though income-related inequality increased slightly over the period.[17]

Most European governments have recognised the need to tackle income-related health inequalities:[14] Although reducing inequalities in health became a priority for policy-makers in some European countries, health inequalities widened over the period from 1980 to the late 2000s.[11] Despite considerable improvements in average health status, significant income-related inequalities in health have persisted, and even increased, in some western countries.[14] In 2017, Pasqualini *et al.* highlighted a strong inverse relationship between wealth and health, with a higher concentration of chronic diseases and poor perceived health corresponding to a lower level of income.[7]

Portugal: a well-unknown inequality?

Like many others around the world, the Portuguese health system currently faces the challenge of consolidating and improving the population's health, reducing inequalities between groups and meeting people's expectations, while dealing with the problems of risk behaviours and the financial sustainability of the health system.[29,30] In 2004, van Doorslaer and Koolman, while explaining differences in income-related health inequalities across European countries, identified Portugal as the country with the highest income-related health inequality.[10] In 2010, according to the World Health Organization (WHO), in spite of the progress made, there were still significant differences in the health status of Portuguese citizens according to gender, geographical region and SES and argued that health inequalities were an "important policy gap".[31]

Portuguese research on this topic consistently shows that illness and the prevalence of several health conditions are disproportionately concentrated among individuals with lower socioeconomic status.[3,29,30,32–40] This pattern was also confirmed by the most recent OECD report about health inequalities, which highlighted some important health-related inequalities in Portugal: disparities in access to timely care are particularly pronounced, and significantly exceeding the EU and OECD averages; it is one of the countries that display the largest concentration of unmet needs for financial reasons among lower income groups, and the highest income-related inequalities for unmet needs[6] In 2023, official data confirmed the trend in access to medical care: the Portuguese population reported a slightly higher rate than the EU citizens on unmet needs for medical care, and those from the poorest households reported six times greater unmet needs than the richest.[2] Beyond the foregoing, a report published by the European Commission on Health Inequalities has also identified persistent challenges in measuring and analysing these disparities.[3,29]

Despite the available data, the literature has largely offered time-bound snapshots; although a continuum of inequalities is often inferred, no study has, to date, systematically traced this trajectory across years. In light of this evidence, it becomes crucial to develop a systematic and long-term assessment of income-related health inequalities in Portugal. This study seeks to contribute to filling this gap by providing a comprehensive analysis of trends in morbidity and health-related behaviours across socioeconomic groups, using more than three decades of data from successive waves of the National Health Interview Survey (1987–2019). By examining the evolution of these inequalities, the study aims not only to document their persistence or potential change over time, but also to generate new evidence to inform policies directed at promoting greater equity in health.

METHODS

Study Design

This quantitative, observational, and analytical study evaluates changes over time using repeated cross-sectional data from the Portuguese National Health Interview Survey (*Inquérito Nacional de Saúde*, INS), carried out in 1987, 1995, 1999, 2005/2006, 2014 and 2019, and focuses on the population aged between 18 and 64 years (working-age adult population). This timeframe was determined by the availability of data, as these are the only national surveys so far carried out. In addition, variables were chosen based on their availability in various waves of the INS. The data under study are intended to analyse the socioeconomic distribution of health. The methodological approach applied concentration curves and indices to evaluate the socioeconomic dimension of inequalities in health.[41]

Data Sources/ Study Population

Household survey data, regularly implemented in many countries, represent one of the most important and promising sources for assessing and analysing health equity.[41] In Portugal, the first INS was launched in 1987 by the Ministry of Health, in response to the increasing need for planning and evaluation following the establishment of the National Health Service (SNS).[42] Currently, it is the standard tool for health observation in Portugal.

The data collected - via household interviews - for these cross-sectional surveys ensure national and regional representativeness of the non-institutionalised Portuguese population. A multistage probabilistic sampling design, stratified and clustered, is followed. The resulting indicators describe the population's health status, healthcare utilization, and health determinants among individuals living in private households.[42]

Data analysed in this study come from all available 6 waves of the INS: 1987, 1996, 1999, 2005/2006, 2014 and 2019. Developed by INE (Portuguese National Institute of Statistics aka Statistics Portugal), in collaboration with INSA (*Instituto Nacional de Saúde Doutor Ricardo Jorge*, National Health Institute) and EUROSTAT, the questionnaires used in INS have consistently followed the recommendations of international organizations, namely the World Health Organization (WHO), the Organisation for Economic Co-operation and Development (OECD) and EUROSTAT.[42] Until 2014, the INS was based on the methodological framework of the U.S. National Health Interview Survey (NHIS). Since that date, it has been integrated into the European Health Interview Survey (EHIS), aligning with the harmonised standards adopted across EU member

states. Table 1 (full table in supplementary material) represents the evolution of INS in terms of population and number of variables covered.

Table 1 – Evolution of INS 1987-2019: population sample and no. of variables

	1987	1995	1999	2005	2014	2019
Population Sample	41 585	49 718	48 606	41 193	18 204	14 617
Number of Variables	170	180	200	233	256	277

All the INS were developed as representative population samples: INS 1987, 1995 and 1999 covered the resident population of mainland Portugal; and since 2005 the studied samples also include Azores and Madeira islands.[42] As such, the various INS identify changes over time in the Portuguese population with new probability samples from that population for each year studied.[41]

Study Variables

Health is often captured by at least three types of variables in surveys: self-assessed health, limitations in daily activity and the presence of chronic diseases.[6] However, lifestyle also plays an important role in explaining population health,[6] given that inequalities can be exacerbated by lifestyles adopted by individuals.[43] This approach aligns with Blaxter's classification, which distinguishes between three conceptual models of health and disease: subjective, social functioning and medical.[44] The subjective model reflects an individual's own perception and self-assessment of their health status,[30,44] such as "self-assessed health". The social functioning model suggests that poor health is characterised by limitations in performing everyday tasks and fulfilling social roles.[30,44] It incorporates indicators of difficulty or inability to carry out activities of daily living, like "dressing/undressing", "walking", "stair climbing/descending" and "getting in/ out of bed". The medical model views ill-health as defined by the presence of clinically diagnosed diseases or deviations from physiological and psychological norms.[30,44] This might mean, indicators such as the prevalence of "diabetes", "asthma", "chronic bronchitis" or "high blood pressure (HBP)". Given the growing importance of health behaviours in the pursuit of improved health, this study also examined indicators such as "physical activity", "tobacco use" and "obesity".

In this study, we cover all the dimensions established above, in order to provide a comprehensive picture of the evolution of income-related health inequalities. Considering the evolution of INS over the years, each domain was analysed separately using variables common to, or present in, most survey waves.

Education, income, occupation and wealth are the main markers of socioeconomic status which can be used as the dimension along which inequalities in each domain are captured.[6] While education is widely used in health inequality research due to its stability, ease of measurement, and high response rates, it reflects more distal determinants of health.[45] Income was therefore selected as the main indicator in this study, as it captures material living standards and access to resources, accumulates effects over the life course, and may itself be influenced by health status through reverse causality.[45]

The income measure used was disposable household income i.e. total income after taxes and other deductions, adjusted for household composition,[46] per equivalent adult, applying the OECD equivalence scale valid at the time for each year analysed. The "OECD-modified equivalence scale" has been in use by INE since the late 1990s; prior to that, the "OECD equivalence scale" was applied.[47] Accordingly, in this study, the original OECD scale was applied to INS 1987, while the modified OECD equivalence scale was used for all subsequent surveys. The equivalised income is calculated by dividing the household's total income from all sources by its equivalent size. The OECD-modified equivalence scale attributes a weight to all members of the household: 1.0 to the first adult; 0.5 to the second and each subsequent person aged 14 and over; and 0.3 to each child aged under 14. The equivalent factor is the sum of the weights of all the members of a given household.[48] The previous scale - the "OECD equivalence scale" - assigns a value of 1 to the first household member, of 0.7 to each additional adult, and of 0.5 to each child.[47] After this procedure, household income was divided into quintiles, where quintile one represented the poorest income quintile and quintile five the richest.[24]

The INS actually collects income data through a survey question format that displays income in 10 defined ranges rather than exact figures. Interpolation of the interval ranges was made using the respective midpoints, which were then equivalized, thereby producing hundreds of data points in each sample. These were then transformed into equivalent income quintiles. In the 1987 sample gross income was transformed into disposable income based on Portuguese budget survey data.[49] In the 2014 and 2019 samples, the same procedure was followed by INE.

Table 2 presents a compilation of all variables employed in the analysis. As required for the calculation of concentration curves and indices, most categorical variables were

recoded into binary form by aggregating multiple response categories. As shown in table 2, many questions vary only marginally across surveys. However, other variables differed across survey waves despite capturing the same underlying goal and were therefore integrated accordingly. This was the case for physical activity, a domain in which the questions varied slightly over the years but were considered comparable as they all aimed to assess whether or not individuals engaged in regular physical activity.

Self-assessed health (SAH), a subjective measure, has proven highly relevant in health research, as its predictive value does not appear to vary substantially across socioeconomic status.[10] SAH responses derive from the question: "In general, how would you describe your health status?" rated in 5 categories ((1) very good, (2) good, (3) fair, (4) poor, (5) very poor), which provide an ordinal ranking of individuals' self-perception of their health status.[10] Because of that, and to develop the concentration index approach, we dichotomize it into two categories: individuals reporting to be in good, very good or fair health versus those in poor or very poor health.

The same rationale was applied to the selection of chronic diseases, without disregarding their clinical relevance and public health significance, as they represent some of the most prevalent health conditions in Portugal:[50–53] diabetes, asthma, chronic bronchitis (later, identified as COPD) and high blood pression (HBP). In addition, diabetes and HBP are important risk factor for cardiovascular diseases (among others),[54,55] the principal causes of morbidity, mortality and disability in Portugal.[29]

Regarding variables addressing lifestyle factors, we selected obesity, smoking and physical activity. Lifestyle factors, such as smoking and obesity, have been shown to contribute to inequalities in health-related to socioeconomic status.[11,43] Although smoking rates have been decreasing over the past decades, tobacco consumption remains a major public health issue worldwide.[6] Overweight and obesity, which are known risk factors for numerous health problems, have increased in many European and OECD countries over the past decades.[6] It is important to highlight that obesity was defined based on body mass index (BMI), calculated from self-reported weight and height, using a threshold of BMI ≥30, without consideration of clinical diagnosis.

Data Analysis: Methods for the measurement of inequality

Concentration Index

Health concentration curves and indices can be summarized as tools that are able to provide measures of relative income-related health inequality.[56] Wagstaff *et al.* (1991) suggest that minimal requirements for an inequality measure are: (i) that it reflects the

socioeconomic dimension to inequalities in health; (ii) that it reflects the experiences of the entire population; and (iii) that it is sensitive to changes in the distribution of the population across socio-economic groups.[22,57] Indeed, the Concentration Index (CI) satisfies all three requirements,[57] and in recent years, it has become a well-established measure of income-related health inequalities.[14,30,57]

CIs are bivariate measures of inequality, measuring inequality in one variable (in this case, health status or risk factors) related to the ranking of another (independent) variable (in our case income).[14,17,49] In this study, the CI is measured as a function of the share of total health status accounted for, by individuals in different parts of the income distribution.[17]

Once individuals are ranked by their income, and not by their health, CI reflects the socioeconomic dimension to inequalities in health.[14] Indeed, the concentration index is a rank-dependent measure of inequality, which is defined as twice the area between the concentration curve and the line of equality (the 45-degree line),[14,22,41] that is, how far the observed income-related distribution of health deviates from a scenario of perfect equality.[14] So, in the case in which there is no socioeconomic-related inequality, the concentration index is zero.[14,41] The index is theoretically bounded in the (−1; 1) interval and is negative or positive, if the health outcome is concentrated among the poor or the rich, respectively.[14] In practice, the bounds of binary health variables are constrained by the mean, so that the interval is smaller.[58] For example, if the prevalence of a binary outcome is 0.4, the minimum and maximum values of CI are effectively (-0.6, 0.6). The magnitude of CI reflects both the strength of the relationship and the degree of variability in the health variable.[41]

Concentration Curve

The Concentration Index is based on the Concentration Curve, which provides a visual representation of health inequality,[59] being derived from the Lorenz curve. Despite the concentration curve not providing a measure of the magnitude of inequality, it can be used to examine inequality in any health sector variable of interest.[14]

The two key variables underlying the concentration curve are the health variable, the distribution of which is the subject of interest, and income (the variable which capture living standards) against which the distribution is to be assessed. Income is used to rank individuals from poorest to richest.[41] In this study, the data was grouped, and for each income quintile, the mean value of the health variable is observed.

The concentration curve lies below or above the 45 degree line of equality if the health variable is concentrated among the better-off or the worse-off,[14] and it plots the cumulative percentage of the health variable (y-axis) against the cumulative percentage of the population, ranked by income, beginning with the poorest, and ending with the richest (x-axis). In other words, the concentration curve plots shares of the health variable against quintiles of the income variable.[41,49]

Statistical Analyses

The statistical analysis was conducted using IBM SPSS Statistics 29 to calculate the parameters required for the development of the study, specifically those necessary for computing the concentration index. Microsoft Excel was used to calculate the concentration curves and indices.

As listed in table 2, the variables were transformed to meet the specific aims of the study, given that a concentration index cannot be computed directly from categorical data.[41] While not without limitations,[60] dichotomising the categorical health variables represented a solution to this problem.[41]

Descriptive statistics were used to characterise the sample: for categorical variables, absolute (n) and relative frequencies (n) were calculated; for numerical variables, means were computed as measures of central tendency.

The computation of concentration indices and curves was performed using income as the independent variable and the various health variables (described above) as dependent variables. Presenting the distribution of health variables by income quintiles is a convenient way of understanding the gradient in the distribution.

Health inequality was calculated by adjusting (or standardizing) the health status and health behaviours variables by age and sex (age-sex standardized health distribution). Standardization is important to assure that, while measuring socioeconomic related inequality in health and health behaviours, the confounding effect of demographics is controlled.[22,41] The process used was that of direct standardization, often used in Epidemiology, with the total population in each wave of the INS serving as the standard population.[61,62]

It should also be noted that both “non-response data” and data categorized as “not applicable” were treated as “missing data”.

Table 2 – Survey questions and corresponding variables considered in the study: 1987-2019

Health Outcome		Questions/ year						Observations
		1987	1995	1999	2005	2014	2019	
Subjective Model	**Self-assessed health**		In general, how would you describe your health status? (Very good; Good; Fair; Poor; Very poor)	In general, how would you describe your health status? (Very good; Good; Fair; Poor; Very poor)	In general, how would you describe your health status? (Very good; Good; Fair; Poor; Very poor)	In general, how would you describe your health status? (Very good; Good; Fair; Poor; Very poor)	In general, how would you describe your health status? (Very good; Good; Fair; Poor; Very poor)	Categorised as 'Unhealthy' (poor; very poor) and 'Healthy' (very good; good; fair)
Social Functioning Model	**Walking**		What distance are you able to walk without stopping and without significant discomfort? (≥200m; <200m; Only a few steps; Does not walk but uses a wheelchair; Unable to walk)	What distance are you able to walk without stopping and without significant discomfort? (≥200m; <200m; Only a few steps; Does not walk but uses a wheelchair; Unable to walk)	What distance are you able to walk without stopping and without significant discomfort? (≥200m; <200m; Only a few steps; Does not Walk but uses a wheelchair; Unable to walk)	Do you have difficulty walking 200 metres on level ground without assistance? (Yes; No)	Do you have difficulty walking 200 metres on level ground without assistance? (Yes; No)	Classified as 'no difficulty' (0) versus 'some or severe difficulty / unable to perform' (1)
	Stair climbing/ descending		Are you able to climb up and down a flight of 12 stairs? (Without stopping to rest; Stopping to rest; Unable to do it)	Are you able to climb up and down a flight of 12 stairs? (Without stopping to rest; Stopping to rest; Unable to do it)	Are you able to climb up and down a flight of 12 stairs? (Without stopping to rest; Stopping to rest; Unable to do it)	Do you have difficulty climbing or descending 12 steps without assistance? (Yes; No)	Do you have difficulty climbing or descending 12 steps without assistance? (Yes; No)	Classified as 'no difficulty' (0) versus 'some or severe difficulty / unable to perform' (1)
	Getting in/ out of bed		Are you able to lie down and get out of bed? (Alone, without difficulty; Alone, with difficulty; Only with assistance)	Are you able to lie down and get out of bed? (Alone, without difficulty; Alone, with difficulty; Only with assistance)	Are you able to lie down and get out of bed? (Alone, without difficulty; Alone, with difficulty; Only with assistance)	*Data were limited to age ≥65 years*	*Data were limited to age ≥55 years*	Classified as 'no difficulty' (0) versus 'some or severe difficulty / unable to perform' (1)
	Dressing/ undressing		Are you able to dress and undress yourself? (Alone, without difficulty; Alone, with difficulty; Only with assistance)	Are you able to dress and undress yourself? (Alone, without difficulty; Alone, with difficulty; Only with assistance)	Are you able to dress and undress yourself? (Alone, without difficulty; Alone, with difficulty; Only with assistance)	*Data were limited to age ≥65 years*	*Data were limited to age ≥55 years*	Classified as 'no difficulty' (0) versus 'some or severe difficulty / unable to perform' (1)

Medical Model	**Diabetes**	Do you suffer from diabetes? (Yes; No)	Do you suffer from diabetes? (Yes; No)	Do you suffer from diabetes? (Yes; No)	Do you have, or have you ever had, diabetes? (Yes; No)	During the past 12 months, have you suffered from diabetes? (Yes; No)	During the past 12 months, have you suffered from diabetes? (Yes; No)	"Yes" was interpreted as the presence of the condition
	Asthma		Do you suffer from asthma? (Yes; No)	Do you suffer from asthma? (Yes; No)	Do you have, or have you ever had, asthma? (Yes; No)	During the past 12 months, have you suffered from asthma? (Yes; No)	During the past 12 months, have you suffered from asthma? (Yes; No)	"Yes" was interpreted as the presence of the condition
	Chronic bronchitis		Do you suffer from chronic bronchitis? (Yes; No)	Do you suffer from chronic bronchitis? (Yes; No)	Do you have, or have you ever had, chronic bronchitis? (Yes; No)	During the past 12 months, have you suffered from chronic bronchitis? (Yes; No)	During the past 12 months, have you suffered from chronic bronchitis? (Yes; No)	"Yes" was interpreted as the presence of the condition
	High blood pressure (HBP)	Do you suffer from HBP? (Yes; No)	Do you suffer from HBP? (Yes; No)	Do you suffer from HBP? (Yes; No)	Do you have, or have you ever had, HBP? (Yes; No)	During the past 12 months, have you suffered from HBP? (Yes; No)	During the past 12 months, have you suffered from HBP? (Yes; No)	"Yes" was interpreted as the presence of the condition
Health behaviours	**Obesity**		Obesity was defined based on body mass index (BMI), calculated from self-reported weight and height, and considering a threshold of BMI ≥30. This definition did not consider clinical diagnosis of the condition.					BMI ≥30
	Tobacco use	In the past two weeks, have you smoked regularly? (Yes; No)	In the past two weeks, did you smoke? (Daily; Occasionally; Do not smoke)	Do you smoke? (Daily; Occasionally; Do not smoke)	Do you smoke? (Daily; Occasionally; Do not smoke)	Do you smoke? (Yes; No)	Do you smoke? (Yes; No)	Tobacco use was determined based on the act of smoking, regardless of consumption level.
	Physical activity		Do you usually engage in regular physical exercise to maintain good health? (Yes; No)	*Data not available in the provided database*	*The question was considered non-equivalent for comparison*	In a typical week, on how many days do you engage in physical exercise for at least 10 consecutive minutes?	In a typical week, on how many days do you engage in physical exercise for at least 10 consecutive minutes?	Physical exercise engagement (≥1 day)

Note: A blank cell indicates that no question was available.

RESULTS

Sample characteristics

Table 3 shows summary statistics for demographic and socioeconomic characteristics of the six INS samples examined. The sample size ranged from 30 356 in 1995 to 8 997 in 2019, with all samples being representative of the non-institutionalized civilian population in Portugal in the respective years.

Table 3. Demographic and Socioeconomic characteristics of the samples

Variables	Categories	Year					
		1987	1995	1999	2005	2014	2019
Respondents#, n		24632	30356	29840	24964	12068	8997
Sex, n(%)	Male	11835 (48.0%)	14705 (48.4%)	14470 (48.5%)	12247 (49.1%)	5516 (45.7%)	4023 (44.7%)
	Female	12797 (52.0%)	15651 (51.6%)	15370 (51.5%)	12717 (50.9%)	6552 (54.3%)	4972 (55.3%)
Age group, n(%)	18-19 years	1409 (5.7%)	1649 (5.4%)	1415 (4.7%)	1018 (4.1%)	289 (2.4%)	229 (2.5%)
	20-29 years	5204 (21.1%)	6133 (20.2%)	6273 (21.0%)	4780 (19.1%)	1409 (11.7%)	1034 (11.5%)
	30-39 years	4729 (19.2%)	6195 (20.4%)	6100 (20.4%)	5157 (20.7%)	2645 (21.9%)	1461 (16.2%)
	40-49 years	5061 (20.5%)	6613 (21.8%)	6560 (22.0%)	6006 (24.1%)	3152 (26.1%)	2296 (25.5%)
	50-59 years	5626 (22.8%)	6454 (21.3%)	6232 (20.9%)	5521 (22.1%)	3015 (25.0%)	2559 (28.4%)
	60-64 years	2603 (10.6%)	3312 (10.9%)	3260 (10.9%)	2482 (9.9%)	1558 (12.9%)	1416 (15.7%)
Legal marital status, n(%)	Single	5846 (23.7%)	7674 (25.3%)	7798 (26.1%)	7234 (29.0%)	3672 (30.5%)	3095 (34.5%)
	Married	17428 (70.8%)	20962 (69.1%)	20254 (67.9%)	15607 (62.5%)	6486 (53.8%)	4418 (49.3%)
	Widowed	879 (3.6%)	977 (3.2%)	890 (3.0%)	1335 (5.3%)	483 (4.0%)	330 (3.7%)
	Divorced	479 (1.9%)	743 (2.4%)	898 (3.0%)	788 (3.2%)	1415 (11.7%)	1118 (12.5%)
Mean household size		3.57	3.50	3.38	3.42	2.80*	2.61*
Work status, n(%)	Employed	17158 (69.7%)	19396 (65.5%)	19764 (67.9%)	16722 (67.2%)	7592 (63.0%)	6234 (69.5%)
	Unemployed	970 (3.9%)	1620 (5.5%)	1384 (4.8%)	1613 (6.5%)	2045 (17.0%)	976 (10.9%)
	Retired	1891 (7.7%)	2474 (8.4%)	2154 (7.4%)	1852 (7.4%)	859 (7.1%)	593 (6.6%)
	Student/ Disabled/ Homemaker/ Others	4592 (18.7%)	6112 (20.6%)	5812 (20.0%)	4687 (18.8%)	1559 (12.9%)	1169 (13.0%)
Education, n(%)	No formal education	4548 (18.6%)	3350 (11.0%)	2258 (7.6%)	1548 (6.2%)	407 (3.4%)	236 (2.6%)
	Basic education	15144 (62.0%)	21042 (69.4%)	20580 (69.0%)	16451 (65.9%)	6596 (54.7%)	4447 (49.4%)
	Secondary education	4178 (17.1%)	3048 (10.0%)	3627 (12.2%)	3814 (15.3%)	2682 (22.2%)	2319 (25.8%)
	Higher education	551 (2.3%)	2896 (9.5%)	3350 (11.2%)	3136 (12.6%)	2383 (19.7%)	1993 (22.2%)

Income quintiles (equivalised per adult equivalent), n(%)	1st Quintile	3986 (18.4%)	5013 (17.1%)	4631 (16.7%)	4285 (17.5%)	2510 (20.8%)	2086 (23.2%)
	2nd Quintile	2855 (13.2%)	4924 (16.8%)	4770 (17.2%)	4039 (16.5%)	2122 (17.6%)	1352 (15.0%)
	3rd Quintile	4864 (22.4%)	5931 (20.2%)	5256 (19.0%)	4618 (18.9%)	2343 (19.4%)	1726 (19.2%)
	4th Quintile	4807 (22.2%)	6506 (22.2%)	6527 (23.5%)	5981 (24.4%)	2505 (20.8%)	1974 (21.9%)
	5th Quintile	5187 (23.9%)	6952 (23.7%)	6551 (23.6%)	5557 (22.7%)	2588 (21.4%)	1857 (20.6%)

Legend: #18-64y; *households with >=7, not differentiated in the data bases, are counted as an average of 8, based on the distribution in the 2005 data base; Basic education, 1st-3rd Cycle (equivalent to 9 years of schooling).

Women consistently comprised most of the samples, representing 52.0% in 1987 and increasing slightly to 55.3% in 2019. In the final two survey years (2014 and 2019), there was a notable aging of the samples: the proportion of individuals aged 50–64 years increased from 33.4% in 1987 to 44.1% in 2019, while younger age groups (18–29 years) declined accordingly.

Changes were also observed in marital status. While the proportion of married individuals decreased from 70.8% in 1987 to 49.3% in 2019, the share of single and divorced individuals increased significantly, reflecting broader social and demographic shifts. Mean household size declined steadily from a mean of 3.57 members in 1987 to 2.61 in 2019.

In terms of employment status, most respondents were employed in all samples, although fluctuations were observed: 69.7% in 1987, 63.0% in 2014, and 69.5% in 2019. Unemployment saw a substantial increase to 17.0% in the 2014 sample, coinciding with the severe economic crisis, before declining to 10.9% in 2019.

Educational attainment improved considerably over the decades. The proportion of individuals with no formal education dropped significantly from 18.6% in 1987 to 2.6% in 2019, while those with higher education increased from 2.3% to 22.2% in the same period. Despite this progress, almost half of the respondents (49.4%) in 2019 reported only basic (1^{st}, 2^{nd} or 3^{rd} cycles) education level, accounting for 75.2% if individuals with secondary level are considered.

Regarding quintiles of equivalised household income (per adult equivalent), it should be highlighted that these are approximate (given the income data collection approach, as described in the Methods). Up to 2005, the 1st and 2nd quintiles contained the fewest respondents; in 2014 and 2019 this shifted to the 2nd and 3rd quintiles. Whereas up to

1999 (and 2014) the 5th quintile was the most populated, in 2019 the 1st quintile comprised the largest share of respondents.

Table 4 displays the health-related variables included in the analysis and their respective descriptive statistics.

Table 4. Characterisation of the sample's health condition

Health Outcome		1987	1995	1999	2005	2014	2019
Respondents (18-64y), n		24632	30356	29840	24964	12068	8997
Subjective							
Self-assessed health	Bad/very bad		3516 (21.4%)	2845 (17.6%)	1999 (12.2%)	1009 (8.4%)	707 (7.9%)
Social Functioning							
Walking	Limitation in		1029 (3.4%)	1299 (4.4%)	204 (3.1%)	427 (3.5%)	357 (4.0%)
Stair climbing/ descending	Limitation in		2390 (7.9%)	2491 (8.4%)	417 (6.4%)	777 (6.4%)	659 (7.3%)
Getting in/ out of bed	Limitation in		1191 (3.9%)	1374 (4.6%)	260 (4.0%)		
Dressing/ undressing	Limitation in		1090 (3.6%)	1290 (4.3%)	225 (3.5%)		
Medical							
Diabetes	Yes (disease)	1176 (4.8%)	1232 (4.1%)	1238 (4.2%)	1453 (5.8%)	733 (6.1%)	614 (6.9%)
Asthma	Yes (disease)		809 (2.7%)	1414 (4.7%)	1141 (4.6%)	563 (4.7%)	500 (5.6%)
Chronic bronchitis	Yes (disease)		1288 (4.2%)	621 (2.1%)	591 (2.4%)	514 (4.3%)	369 (4.1%)
HBP	Yes (disease)	4146 (17.2%)	4182 (13.8%)	4320 (14.5%)	4551 (18.2%)	2285 (19.0%)	1917 (21.5%)
Health Behaviours							
Obesity	BMI >= 30		3259 (11.1%)	3935 (13.5%)	3787 (15.2%)	2026 (17.0%)	1545 (17.7%)
Tobacco use	Smoker	5409 (22.1%)	7348 (24.2%)	7765 (26.0%)	6332 (25.5%)	3233 (26.8%)	2089 (23.3%)
Physical activity	Physical Act. >= 1/ week		2834 (9.4%)			4269 (35.5%)	2881 (32.6%)

Survey data suggest a gradual and notable decline in self-assessed poor health over the study period. The data on functional limitations indicate overall stability in getting in/out of bed, dressing/undressing, and walking, with only minor fluctuations observed across survey waves. Climbing or descending stairs showed the most noticeable variation over time, yet the overall pattern remained broadly stable, with fluctuations not exceeding two percentage points. Data restrictions in later waves (with some variables collected only

for older age groups) limited comparability for getting in/ out of bed and dressing/ undressing.

Patterns in chronic conditions were mixed. Diabetes and asthma appeared to increase steadily, while chronic bronchitis declined initially and then stabilised. HBP also became more commonly reported. Obesity rose consistently throughout the period, reflecting a worsening trend in weight-related health risks. Tobacco use showed fluctuations over time, ranging from 22.1% to 26.8%. Physical activity increased substantially after year 1995 (although with a slight reversal in the last wave), suggesting a broadly positive evolution in health-related behaviours. These changes should be interpreted cautiously, as they may reflect both underlying population trends and fluctuations inherent to survey samples.

Evolution of income-related health inequalities

Table 5 and Figures 1, 2 and 3 present values of the concentration indices, over time, for each health outcome, previously identified as comparable across different survey waves.

Table 5. Income-related concentration indices of morbidity and health-related behaviours (1987-2019)

Health Outcome		1987	1995	1999	2005	2014	2019
Subjective	Self-assessed health		-0.172	-0.231	-0.203	-0.260	-0.303
Social Functioning	Walking		-0.171	-0.230	-0.287	-0.253	-0.329
	Stair climbing/ descending		-0.195	-0.250	-0.212	-0.207	-0.284
	Getting in/ out of bed		-0.152	-0.226	-0.184		
	Dressing/ undressing		-0.211	-0.255	-0.234		
Medical	Diabetes	-0.065	-0.038	-0.097	-0.093	-0.114	-0.117
	Asthma		-0.037	-0.077	-0.004	-0.043	-0.071
	Chronic bronchitis		-0.113	-0.087	-0.094	-0.113	-0.151
	HBP	-0.054	-0.045	-0.047	-0.026	-0.093	-0.090
Health Behaviours	Obesity		-0.045	-0.066	-0.061	-0.105	-0.085
	Tobacco use	0.069	0.036	0.042	-0.007	-0.057	-0.063
	Physical activity		0.264			0.149	0.172

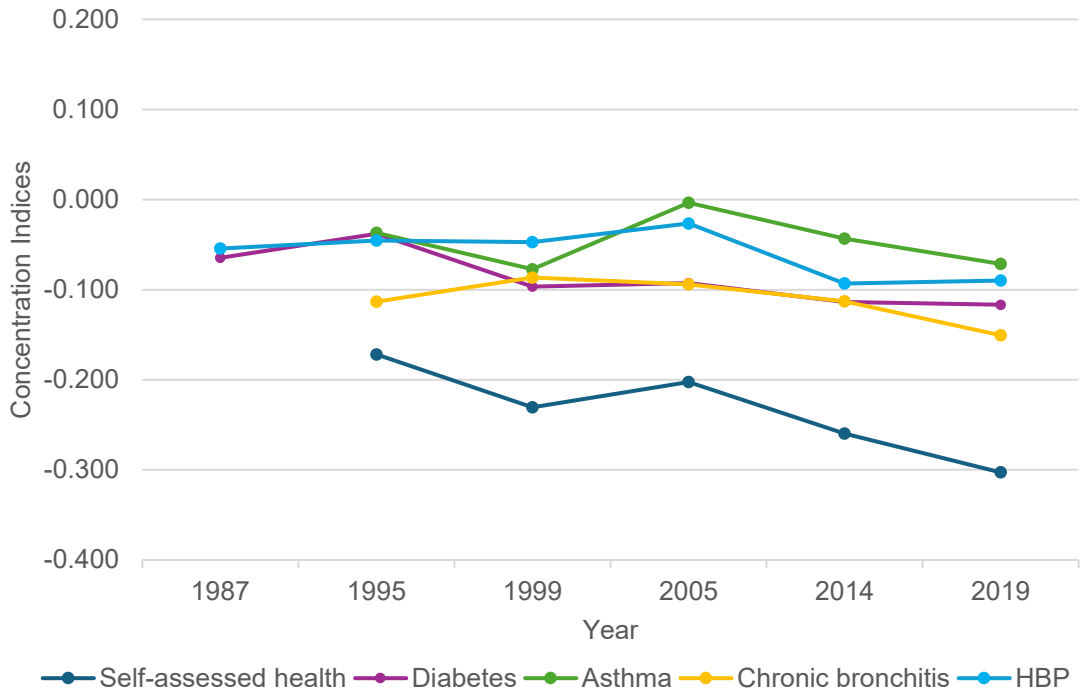

Figure 1. Income-related concentration indices of subjective and medical model outcomes (1987-2019)

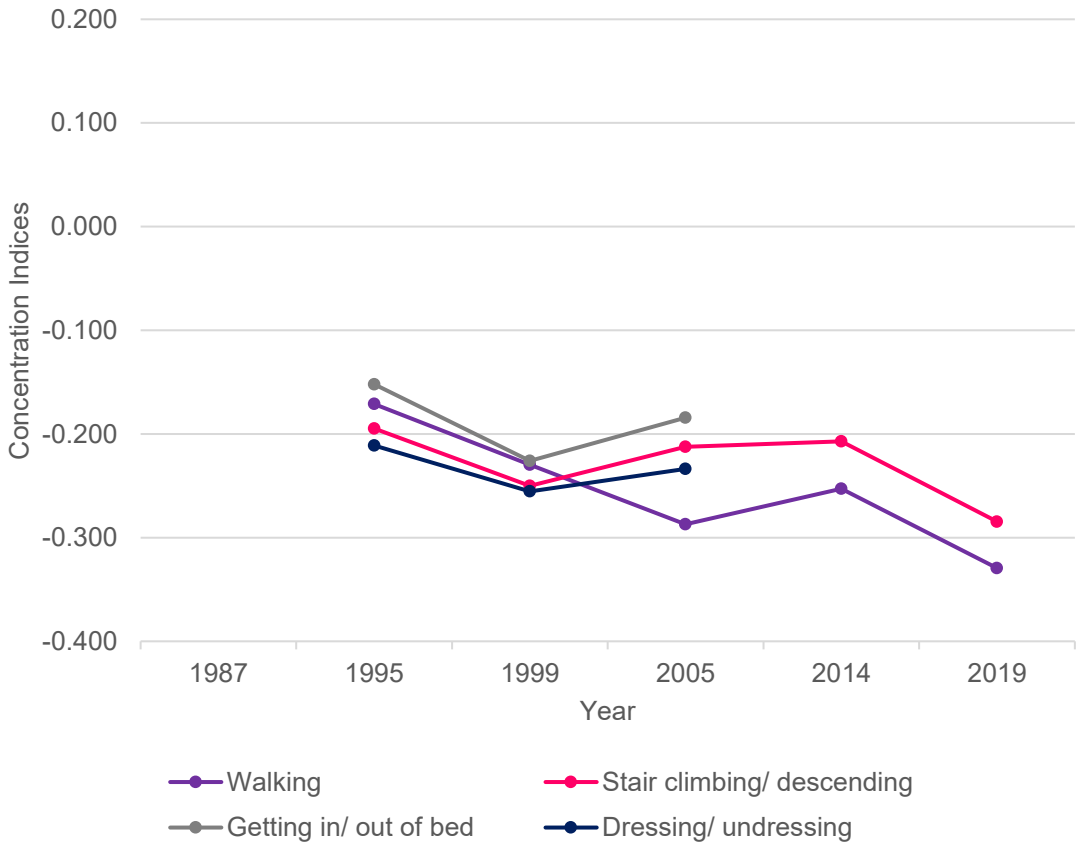

Figure 2. Income-related concentration indices of social functioning model (1987-2019)

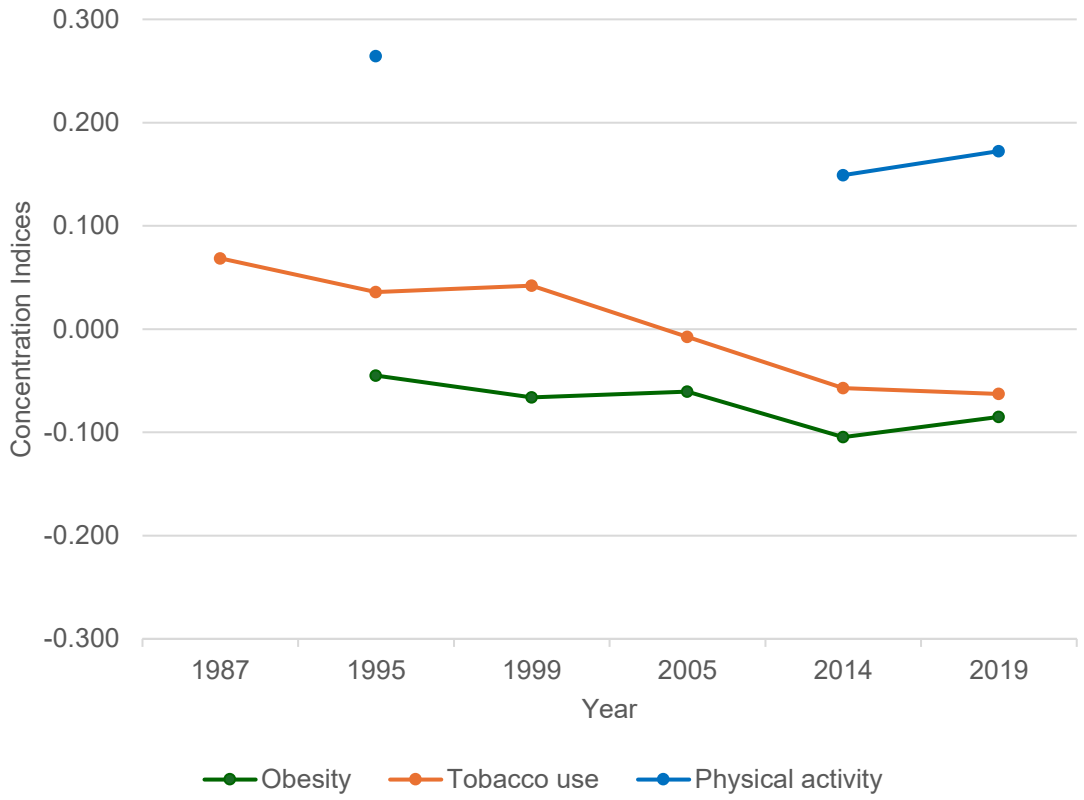

Figure 3. Income-related concentration indices of health-related behaviours outcomes (1987-2019)

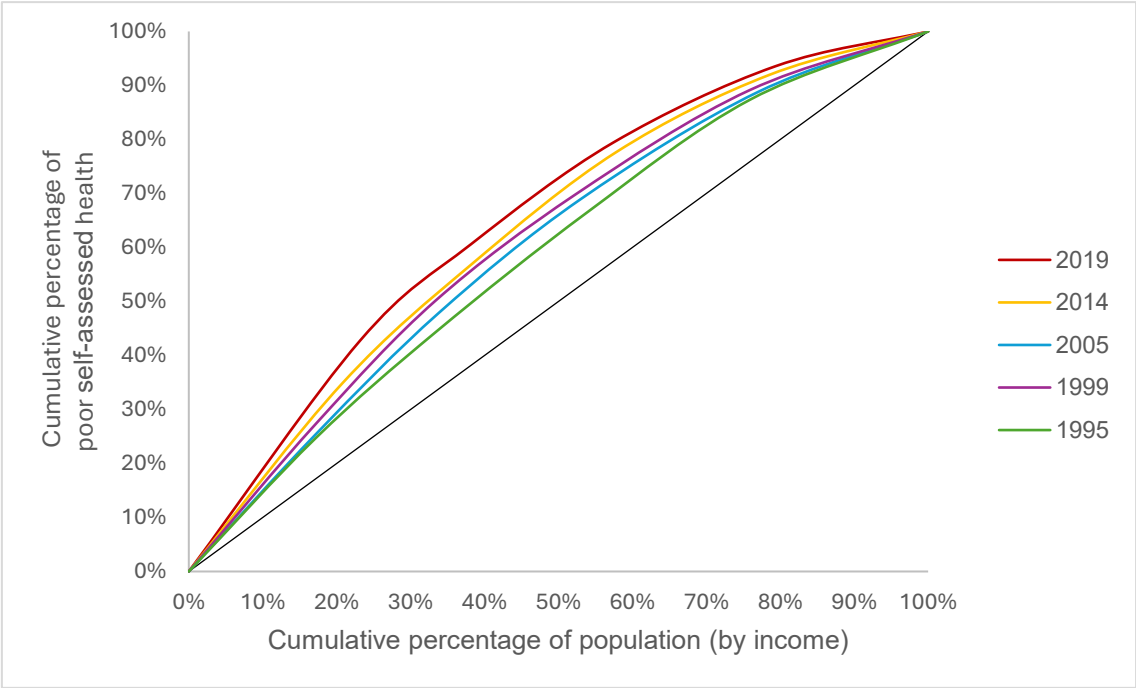

Figure 4. Income-related concentration curves of self-assessed health (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

Note 1: Additional concentration curves for other variables are available in the supplementary material.

Figure 4 presents the estimated concentration curves for the variable self-assessed health in each of the survey periods. The concentration curves for the other variables under examination are presented, for reasons of space, in the supplementary material.

The analysis of concentration indices and curves over the period 1987–2019 indicates a persistent and, in many cases, widening gradient in health outcomes associated with household equivalent income. The findings of this study are aligned with previous evidence, suggesting that individuals with higher income levels consistently report better health outcomes.

Self-assessed health, recognized as a key health indicator, consistently showed some of the highest levels of socioeconomic inequality among the outcomes analysed. While the survey estimates varied across waves, the overall pattern points to a persistent and widening gradient, detrimental to poorer income groups, with poorer health more frequently reported among individuals in lower-income groups. The most recent survey wave (2019) is particularly noteworthy, as it suggests an intensification of inequality, with the concentration index reaching -0.303 (compared with -0.172 in 1995), also reflected in the 2019 concentration curve, which departs more clearly from the line of equality than in earlier waves. Taken together, these results highlight not only the persistence but also the recent acceleration of income-related inequalities in self-assessed health, making this indicator one of the clearest examples of growing socioeconomic inequalities observed in the study period.

Survey estimates show that **functional limitations** remain persistently concentrated among lower-income groups across all indicators. The pattern of inequality has intensified over time, with a pronounced increase between 2014 and 2019, particularly in the mobility-related variables available. Walking limitations displayed one of the steepest socioeconomic gradients, with concentration indices becoming progressively more negative from -0.171 in 1995 to -0.329 in 2019. Stair climbing/descending showed a similar distribution concentrated among lower-income groups, with some fluctuation across waves but a renewed increase in inequality in the last survey (-0.284). Basic daily activities, such as getting in/out of bed and dressing/undressing, also remained concentrated among lower-income groups, although data availability limited assessment of later years.

All **disease-related outcomes** (medical model) analysed in this study displayed negative concentration indices across survey years, indicating a consistent pattern of higher prevalence in the lowest income quintiles. Survey estimates for medical indicators

- diabetes, asthma, chronic bronchitis, and hypertension - were comparatively more stable than those reported above; nevertheless, income-related inequalities tended to increase after 2005. **Diabetes** and **chronic bronchitis** exhibited the most persistent inequalities, while **asthma** and **HBP** displayed relative stability, with a brief approach to equity around 2005 - concentration indices near zero - followed by a renewed widening of inequalities in subsequent waves.

Health-related behaviours diverged in their overall patterns. Across survey years, **obesity** suggested a distribution unfavourable to lower-income groups, with concentration indices pointing to a modest but persistent socioeconomic inequality. The most pronounced inequality occurred in 2014 (CI: -0.105), corresponding to the steepest divergence from the line of equality observed across years. **Tobacco use** shifted from being more prevalent among the better-off in earlier years to becoming increasingly concentrated among the less well-off in later surveys (from 2005 onwards). Across the survey years in which **physical activity** could be assessed, the indicator showed an uneven trend and remained more prevalent among the better-off.

Taken together, these findings suggest persistent and, for some outcomes, increasing socioeconomic inequalities in health across the period studied, although the magnitude and direction of trends varied by indicator.

DISCUSSION

This study aimed to explore how income-related inequalities in health and health-related behaviours evolved over recent decades in Portugal. The present study provides compelling evidence of persistent income-related health inequalities over a four-decade period between 1987 and 2019. The analysed data indicates a steepening socioeconomic gradient across health outcomes, to the detriment of lower-income groups.

By investigating health patterns and trends within the population, the INS plays a crucial role in assessing population health, identifying major needs, supporting evidence-based decision-making, and informing health planning.[42,63] Household income was chosen as the measure of socioeconomic position in this study, given that this variable is especially important because it is instrumental in securing many of the conditions that are central to guaranteeing good health.[13] Barnes *et al.* (2023) compare the relative contributions that access to different types of resources makes to socioeconomic inequality in health, and find that income inequality matters most.[13]

To understand the relationship between health and income, it is clearly important to look at household income inequality in Portugal, over years. Portugal was the most unequal country in Western Europe for most of the 1990s and 2000s, in both income and wages.[64] Income inequality was generally increasing between 1990 and the mid-2000s, and has been decreasing since then, especially during the severe recession of 2010-2014.[64,65] Assuming the conclusion of this study, it can be inferred that the stabilisation of income inequality does not appear to translate into a reduction in income-related health inequalities.

When examining the data across the different variables and INS waves, priority was given to those variables that were both consistently available across all survey years and relevant for measuring health outcomes. Nevertheless, some indicators could not be included in certain years, either because they were not answered by the entire survey samples or were unavailable in the datasets. For example, the functional limitations variables “dressing/undressing” and “getting in/out of bed” were assessed in all survey years; however, as the populations covered in 2014 and 2019 were not comparable, these indicators were not included in the present study. It is also relevant to note that, although some questions appeared similar across surveys, detailed inspection of the datasets demonstrated that they could not be incorporated into the study: semantic changes and differences in the timeframe of reference would have prevented a scientifically rigorous and intellectually honest comparison. As a result of this aim, ‘regular physical activity’ was assessed in only three years, whereas variables such as ‘alcohol consumption’ and ‘sick leave’ were removed from the study despite prior analysis.

Self-assessed health (SAH) stood out as one of the least equitable variables across income quintiles, with concentration indices becoming increasingly negative over time. The observed trend reflects an increasing polarization in perceived health status between income strata. SAH measures the subjective perception of physical and mental health status,[66] being used in the health inequality literature,[15,25,43,66] which show that it is a good predictor with respect to objective health status (e.g. mortality)[10,15,25,66], but also morbidity, disability or disease development risks.[15,25] The results also indicate persistent inequalities in functional limitations concentrated among the poor, with walking and stair climbing/descending showing the steepest and most consistent gradients. Basic daily activities, such as dressing/undressing and getting in/out of bed, also remained more prevalent among lower-income groups, despite smaller magnitudes of change. These findings indicate that income-related inequalities in social functioning have persisted over time and, indeed, have increased, with a strengthening concentration in lower

socioeconomic strata, which aligns with the broader literature on health inequalities, emphasising the role of socioeconomic position not only in shaping disease prevalence but also in influencing the degree to which health conditions translate into functional impairment and loss of independence.

The observed patterns in functional limitations are consistent with, and may be reinforced by, the socioeconomic inequalities documented in the medical model variables: chronic disease indicators displayed mixed trajectories. Across all conditions, the distribution remained concentrated in lower socioeconomic strata; diabetes and chronic bronchitis exhibited a progressive widening of inequality, while asthma and high blood pressure displayed temporary improvements around 2005, followed by a reversal toward greater inequality concentrated among the poor by 2019. The observed cross-disease increase may be attributable to a combination of factors, including population ageing, improved screening and diagnosis, greater awareness among both health professionals and the public, as well as lifestyle-related risk factors.

In this study, obesity was approached as a health behaviour rather than a medically diagnosed condition, being derived from self-reported height and weight and defined as BMI ≥30. Despite some fluctuation over time, obesity remained disproportionately concentrated among lower-income groups, reflecting structural barriers to healthy diets and physical activity and highlighting the persistence of socioeconomic inequalities in this domain. Concerning tobacco use, it showed a distinct trend compared with the other variables, shifting from being more prevalent among higher-income groups to more heavily affecting lower-income populations. While smoking was slightly more common among the better-off in the 1980s–1990s, this pattern reversed after 2005. This trend mirrors international findings showing that anti-smoking measures were more effective among wealthier individuals.[67,68] In contrast, physical activity demonstrated clear pro-rich gradients, particularly after 2014. Physical activity, while consistently concentrated among wealthier individuals, displayed the highest positive inequality indices, reinforcing the notion that health-promoting behaviours are unequally distributed. These findings simultaneously underscore the complex and multifaceted nature of health inequality and reveal that most health indicators have not progressed towards greater equity - in fact, many have evolved in the opposite direction.

Although it might be expected that the SNS (National Health Service), being universal and almost free of charge at the point of use, would contribute to reducing health inequalities among lower-income groups, contrary to expectations, the evidence from this study does not reflect such an outcome. Taken together with the existing literature, the findings are consistent with the possibility that rising inequality reflects the impact of

social determinants of health. Counterfactually, in the absence of the SNS, inequalities would likely have increased even further; accordingly, the SNS appears to have attenuated - although not fully eliminate - inequalities in health. Even so, it can further be concluded that these trends raise concerns about the effectiveness of existing public health strategies in addressing the root causes of socioeconomic inequalities in health and underscore the need for more targeted interventions that address the structural determinants of health across income groups.

Evidence from the Literature: Support or contradiction?

Comparability with previous research is limited due to heterogeneity in variables definitions and methodologies - particularly in Portugal, where evidence is scarce and no directly comparable study exists. However, validation is possible at the level of individual health variables through a need-adjusted analysis incorporating socioeconomic dimensions beyond income.

Our findings were consistent with international evidence, which has consistently shown that health inequalities are strongly patterned by socioeconomic status. Classic findings by Wagstaff *et al.* (1991) demonstrated that health outcomes such as 'chronic sickness' and 'self-assessed health' tend to be disproportionately concentrated among lower-income individuals, as reflected by negative concentration indices across countries.[22] This pattern was reinforced by van Doorslaer *et al*. (1997), who confirmed that the burden of ill-health (via self-assessed health) is significantly more concentrated among the poor.[23] Mackenbach *et al.* (2008) further emphasized the persistence of these inequalities across Europe, attributing them largely to socioeconomic disparities, particularly among lower-income and less-educated populations.[21]

While self-assessed health and chronic diseases are arguably the most frequently studied variables in the context of income-related health inequalities, the other health outcomes included in this study are also supported by substantial evidence in both national and international literature.

A cross-country comparison (33 countries) of income-related inequality in physical functional disability among middle-aged and older adults showed that the lower-income groups tended to have higher disability prevalence than higher-income groups, and this inequality was consistent across countries.[69] Most studies examining the relationship between functional limitations and income-related inequalities understandably focus on older populations. However, findings across different countries consistently indicate a

growing inequality, with functional limitations increasingly concentrated among individuals with lower income levels.

Regarding obesity, it is important to highlight its significance as a public health challenge. Also, obesity is recognised as being influenced by individuals' socioeconomic position, which shapes exposure to risk factors associated with its development.[70] A Portuguese study analysing socioeconomic inequalities in obesity from 2005 to 2019, based on INS data, reported a peak in income-related inequalities in 2014, followed by a decline through 2019, although individuals living with obesity remained more likely to belong to lower income groups.[38]

Physical inactivity is a global public health challenge associated with negative physical and mental health outcomes like cardiovascular diseases, type 2 diabetes, obesity or depression.[71] A global study across 84 countries concluded that significantly higher levels of inactivity were found in countries with higher income inequality in high and middle income countries irrespective of a country wealth and spend on health care.[71]

The harmful effects of tobacco are well established and extend across multiple dimensions of health: namely, pulmonary and cardiovascular diseases, lung cancer or premature mortality, among other adverse effects on both health and quality of life.[72] Several studies conducted in different countries indicate that lower-income groups tend to have higher levels of tobacco consumption.[73,74] A German study further found a significant concentration of current and ever-smoking among worse-off adolescents and young adults, whereas smoking cessation was more prevalent among better-off ever-smokers.[72] Evidence from Portugal-based studies also corroborates these findings, emphasizing that inequalities in smoking are reflected in inequalities in health:[35,75] Smoking inequalities have increasingly disadvantaged lower-income groups over time,[75] and a higher prevalence of tobacco-related diseases was identified in areas with lower socioeconomic status.[35]

Portugal stands out as one of the most unequal countries across EU, regarding income-related inequalities in health. In a study developed by van Doorslaer *et al.* (2004): poor self-assessed health is markedly concentrated among lower-income individuals. The main drivers of these inequalities were found to be education and income.[10] Also the 2019 OECD report compares poor self-assessed health between the highest and lowest education groups, and Portugal was shown to have a significant disparity, with a gap of approximately 30 percentage points between those reporting poor health and holding lower versus tertiary education.[6] Portugal has also been identified as one of the countries with the highest income-related inequalities for unmet needs to the detriment of the poor,[6]

and likewise among the countries with the largest income-related differences in self-rated health.[76]

Regarding Portuguese studies on this topic, previous research has reported similar conclusions: The previous evidence based in INS data (1987 and 1999) indicates that illness is generally unfavourable to poorer income groups among the Portuguese population.[30,37,39] Pereira (2000), using data from the 1987 INS and a concentration curve and index approach, provided early evidence that morbidity was disproportionately concentrated among low-income groups: while milder illnesses appeared more evenly distributed, more serious conditions were clearly clustered within disadvantaged populations, reflecting structural inequities.[30] Building on this, Veiga (2005), analysing data from the 1999 INS with an approach also based on concentration curves and indices, confirmed a CI lower than zero, which indicate that income-related inequalities exist and favour the higher income groups.[37]

Based on available evidence, only Martins Teixeira *et al.* (2023) conducted a comparable analysis, using data from six National Health Surveys and applying both income and education as socioeconomic indicators. Their study – only available as an abstract - focused on the evolution of socioeconomic inequalities in the prevalence of Non-Communicable Diseases (NCDs) in Portugal, with a less comprehensive set of indicators and methodological approaches distinct from the present study. Nevertheless, their findings similarly pointed to persisting inequalities in NCDs, with an increasing trend after 2005.[77]

Also, a study which compares the results of EU-SILC survey in 2014 vs. 2005/2006, concluded that persistent health inequalities are observed to the disadvantage of individuals with lower educational attainment across all three health indicators considered in both periods: chronic disease, self-reported health, and functional limitation.[78] Other studies conducted in Portugal that aimed to examine the prevalence of particular diseases have reached similar conclusions, reinforcing the evidence that these conditions are more prevalent among individuals with lower socioeconomic status. Diabetes was found to be concentrated not only among people with lower educational levels, but also in the lower income quintiles.[33,36] The same conclusion was reached with regard to cardiovascular diseases with a higher prevalence associated with individuals of lower socioeconomic status,[29,35] and which also identified a greater propensity for the presence of risk factors for hypertension or diabetes within this socioeconomic group.[29] The higher prevalence of hypertension among individuals with lower socioeconomic status has been confirmed in other studies of the Portuguese population.[33,34] Alves *et al.* concluded that upper-social-class areas were associated with a lower prevalence of

respiratory diseases, such as bronchitis.[35] Although it is not the focus of this study, it can also be inferred that, in Portugal, equity in access to health care has not yet been achieved for the majority of services.[79,80] In the case of specialized care, individuals with higher incomes exhibit greater utilization of services for the same level of need.[79]

Why does income play such a critical role in shaping health outcomes? Income plays a fundamental role providing access to a broad range of factors that are central to maintaining good health, such as adequate housing, nutrient-rich food, and high-quality health care.[13] People in lower socioeconomic groups are more exposed to adverse working conditions (as physically demanding work, shift work, and precarious employment).[81] However, poor health may also lead to lower income, when this results in unemployment, less access to higher paid jobs, fewer hours worked or lower productivity (reverse causality).[82] Some authors also point out that it is not just material and psychosocial factors that are relevant, but also behavioural aspects.[15,83,84] For example, low sense of control, coping or social support are unequally concentrated in disadvantaged people of lower socioeconomic status, thereby contributing to social inequalities in health.[15] Lynch *et al.* (1998) argue that the loss of life from income inequality "is comparable to the combined loss of life from lung cancer, diabetes, motor vehicle crashes, HIV infection, suicide, and homicide in 1995.", saying that "if even a fraction of this effect were real or if, more broadly, income distribution affects population health even indirectly, economic and fiscal policy has effects on well-being that are typically ignored by economists or policy makers".[85]

The findings of the present study emphasize the persistent and systemic nature of income-related health inequalities in Portugal and points to the need for sustained, equity-oriented health and social policies that tackle the structural determinants of health.

Strengths and Limitations

This study aimed to conduct a repeated cross-section analysis encompassing a wide range of health variables, rather than focusing solely on the most common indicators such as self-assessed health or specific diseases. In doing so, it intended to address an existing gap, as most previous studies have been limited to analysing a single wave of the National Health Interview Survey. Nevertheless, one of the main limitations of this study lies in the fact that it uses repeated cross-sectional data, rather than longitudinal data, and as such cannot follow individual trajectories over time, capturing instead only group-level trends whose composition may shift across survey waves.[14] Cross sectional data describe associations between socioeconomic factors and health, but do not explain

casual relationships or health change over time,[24] potentially leading to misleading conclusions.[86] However, it is important to highlight the value of repeated cross-sectional analyses as these are simpler to implement than longitudinal cohort studies, while still enabling the assessment of multiple health outcomes. There is a risk that methodological heterogeneity across different INS waves may compromise the analysis. Nevertheless, this risk was mitigated through a careful selection process, whereby only those variables deemed strictly comparable across survey years were retained for analysis.

Regarding the study population, a potential bias arises from the exclusion of institutionalised individuals, as the sample only includes non-institutionalised residents. It also omits certain vulnerable groups that are disproportionately affected by health inequalities, such as the homeless and undocumented migrants. Despite these limitations, it is important to emphasise the major advantage of using the National Health Survey, as it is representative of Portugal as a whole rather than of a specific subpopulation, enabling a robust monitoring of temporal trends.

A further limitation is that health perceptions may be shaped by individual expectations. This can complicate meaningful comparisons and heterogeneity in health reporting can arise.[41] People with higher income report better health:[86] if lower socioeconomic groups consistently underreport their health status, self-reported measures may underestimate true health inequalities.[41] In general, there is a risk of less valid responses and potential recall bias. For instance, the use of self-assessed health reflects a subjective assessment of an individual's overall health status rather than an objective clinical measure[43] (no clinical examinations were conducted which may limit the robustness of certain analyses[25]).

Also, the reliance on self-reported income – common in health surveys – has known disadvantages. Income tends to be underreported by certain population groups, particularly those that obtain non-wage income, leading to an underestimation of true income inequality compared to figures derived from administrative data.[87] The fact that the calculation of the concentration index requires the health variable to be either dichotomous or continuous may also represent a limitation, resulting in information loss and requires the choice of an arbitrary cut-off point. [60,88]

A further limitation of this study is that the most recent data available are from 2019, with no post-pandemic wave of the National Health Interview Survey yet accessible. It is due for field work from October 2025 onwards.

Beyond replicating the present study once the new INS wave is available, future research should address the issue of statistical error of sample surveys, including estimation of

confidence intervals for the concentration coefficients, which would enhance the robustness of conclusions. It should also explore the underlying drivers of inequality, for example through decomposition analysis of concentration indices. Moreover, subsequent analyses could complement income with other socioeconomic indicators, such as education, occupation or multiple deprivation. Harmonisation across survey waves should address not only semantic and timeframe discrepancies but also database structure and variable coding. In addition, intersectional and sub-national analyses would help detect heterogeneous trends and inform place-based action. Taken together, these steps would materially strengthen the precision, comparability, and policy relevance of future work.

Despite these limitations, and in addition to the strengths already noted, the breadth of health indicators employed - from self-assessed health to the prevalence of major chronic conditions, functional limitations, and health-related behaviours - provides a more comprehensive picture of inequality in health of the Portuguese population over time, than was hitherto available.

Policy recommendations

The perception that the health of the population of Portugal deteriorated - whether due to “worsening health” or to a “decline in SNS performance” - was widely inferred during the COVID-19 pandemic. Whether this perception is warranted remains uncertain: what, in fact, was the pandemic’s impact on the health of the Portuguese population? The forthcoming wave of the INS will be pivotal in addressing these questions, and (as discussed above) future research should extend the analysis beyond 2019 - as soon as data become available - to capture the post-pandemic period.

The findings indicate a clear and persistent pro-poor pattern in health: over time, lower-income groups are disproportionately exposed to worse health outcomes. This is one strand of a mutually reinforcing cycle - lower income, lower educational attainment, weaker labour-market attachment, and poorer health - that operates across the life course. The least well-off and the less educated are less likely to be in good health, partly due to greater exposure to health-damaging risks and more limited access to preventive and healthcare services.[6] Accordingly, a solely health-sector response will be insufficient: effective strategies must extend beyond healthcare to the social and economic determinants of health. Reducing health inequalities yields broad social returns - through higher productivity, increased tax revenues, lower welfare expenditures, and reduced treatment costs.[6,89]

While access to healthcare has improved markedly over the last four decades, and the SNS has advanced an equity agenda, that agenda remains incomplete. In addition to ongoing access policies (beyond the scope of this study), a wider set of measures should be considered, consistent with international evidence, and may be concisely framed around two pillars:

- Act upstream across the life course: prioritise prevention that reduces risk exposure among disadvantaged groups and strengthen health literacy (school-based and community). Combine this with coordinated labour, education, housing and social policies - income boosts (tax, benefits, minimum wage, etc.), tailored employment support, and better housing/ rental assistance - to lower risk, improve access, and narrow pro-poor health gaps.[6,90,91]
- Ensure equity in delivery and accountability: rely on a strong, well-financed public sector and equity-oriented governance. Evaluate programmes for equity impact, routinely monitor inequalities, build and strength HCP workforce capacity on the social determinants of health, and raise public awareness.[6,90,91]

While research in this field remains limited, one point is clear: health inequity in Portugal is no longer a blind spot, it constitutes a central yet underacknowledged systemic challenge (the “elephant in the room”?). Although the most recent National Health Plan (2021–2030) includes the reduction of health inequalities among its strategic objectives,[86,92] it is crucial that effective, evidence-based actions are taken to ensure this goal is fully realised.

CONCLUSION

This study is, to the best of our knowledge, the first comprehensive attempt to assess the evolution of income-related health inequalities in Portugal over a four-decade period, using nationally representative data from multiple waves of the National Health Interview Survey. Providing a unique long-term analysis of income-related health disparities in Portugal, this study highlights not only persistence but also a clear intensification of inequalities across a wide range of health outcomes since the early years of the National Health Service.

The analysis confirms that inequalities remain pervasive and cut across all dimensions of health, particularly among lower socioeconomic strata. Health outcomes such as self-

assessed health, functional limitations, and chronic diseases display a persistent and increasing pro-poor concentration, underscoring the unequal distribution of adverse health outcomes among individuals with lower income. Importantly, the persistence of these inequalities suggests that income inequality alone does not fully account for the observed health gaps; rather, they are embedded in a complex interplay of structural, behavioural, and systemic factors. Although this study highlights clear income-related disparities in health outcomes, it does not uncover the specific mechanisms driving these inequalities. Future research should prioritise the decomposition of these inequalities to better understand their origins, thereby informing more effective and targeted policy interventions.

These results indicate that, although the SNS has brought considerable and well-established improvements in population health through its universal and largely cost-free access, it has not been sufficient to eradicate health inequalities. Achieving genuine health equity will require going beyond universal health coverage and implementing intersectoral public policies that tackle the social and economic determinants of health, mitigate income inequalities, and promote fairer distribution of health-promoting resources.

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SUPPLEMENTARY MATERIAL

Table 6. Evolution of INS 1987-2019: population, no. of variables and covered areas

	1987	1995	1999	2005	2014	2019
Population Sample	41 585	49 718	48 606	41 193	18 204	14 617
Number of Variables	170	180	200	233	256	277
Survey Areas Covered	Household Composition	Demographic Profile	Demographic Profile	Demographic Profile	Individual Characterization	Individual Characterization
	Chronic Diseases	General Health Information	General Health Information	General Health Information	Health Status	Health Status
	Employment Status	Temporary Disability	Temporary Disability	Temporary Disability	Chronic Diseases	Self-assessed Oral Health
	Disability	Long-term Disability	Long-term Disability	Long-term Disability	Accidents and Injuries	Chronic Diseases
	General Care	Chronic Diseases	Chronic Diseases	Chronic Diseases	Work Absence	Accidents and Injuries
	Medical Care	Medical Care	Medical Care	Health Care	Physical and Sensory Functional Lim.	Work Absence
	Expenditure and Income	Expenditure and Income	Oral Health	Medication Consumption	Personal Care	Physical and Sensory Functional Lim.
	Dependency	Tobacco Consumption	Expenditure and Income	Oral Health	Household Activities	Personal Care
	Tobacco Consumption	Food and Beverage Consumption	Tobacco Consumption	Tobacco Consumption	Pain	Household Activities
	Food and Beverage Consumption	Child Health	Food and Beverage Consumption	Food and Beverage Consumption	Mental Health	Pain
	Child Health	Physical Activity	Child Health	Reproductive Health and Family Plan.	Hospital Care	Mental Health
	Family Planning		Physical Activity	Physical Activity	Outpatient and Home Care (Oral Health)	Hospital Care
	Acute Diseases			Mental Health	Medication Consumption	Outpatient and Home Care (Oral Health)
				Preventive Care	Preventive Care	Occupational Health
				Quality of Life	Reproductive Health	Medication Consumption
				Food Insecurity	Unmet Need for Health Care	Preventive Care
					Health Determinants	Reproductive Health
					Physical Exercise/ Act.	Unmet Need for Health Care
					Food Consumption	Health Determinants
					Tobacco Consumption	Physical Exercise/ Act.
					Alcohol Consumption	Food Consumption
					Life Satisfaction	Tobacco Consumption
					Social Support	Alcohol Consumption
					Informal Care and Assistance	Life Satisfaction
					Long-term Disability	Social Support
					Income and Expenditure	Informal Care and Assistance
						Long-term Disability
						Income and Expenditure

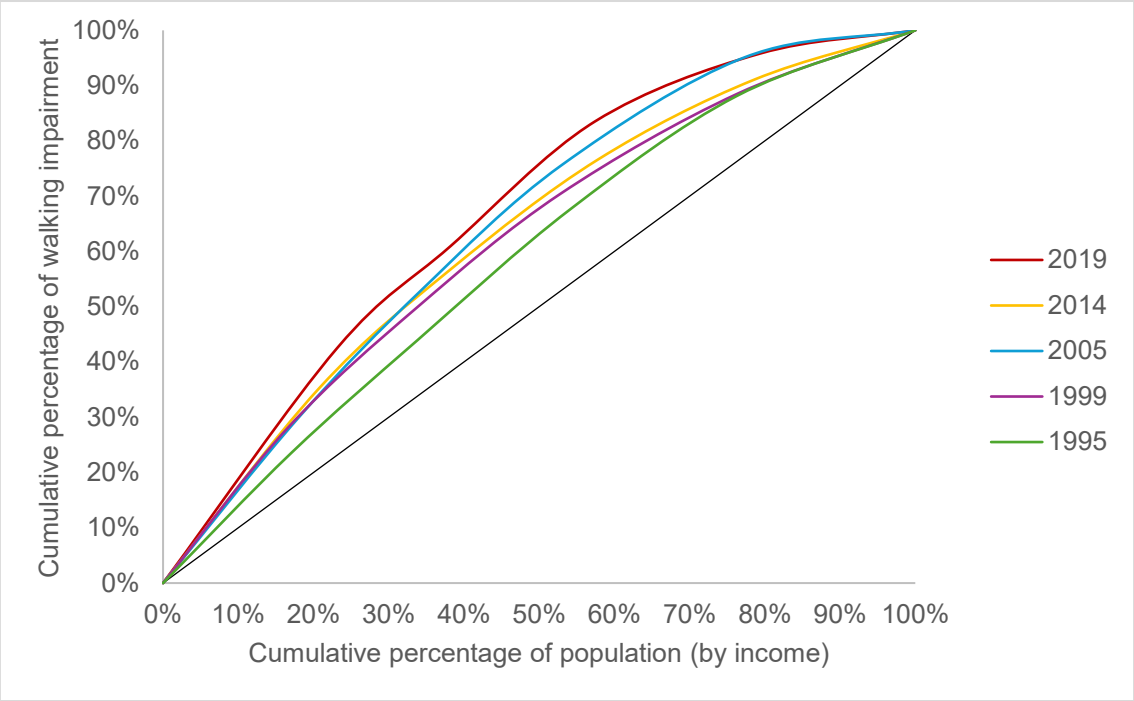

Figure 5. Income-related concentration curves of walking impairment (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

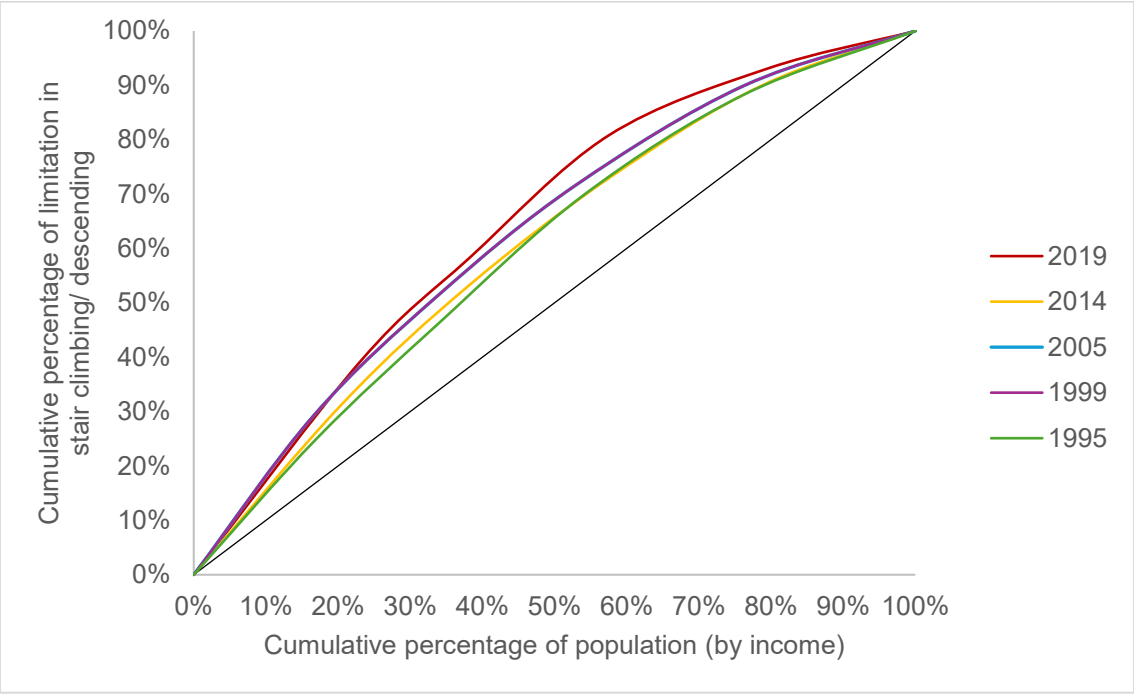

Figure 6. Income-related concentration curves of limitation in stair climbing/ descending (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

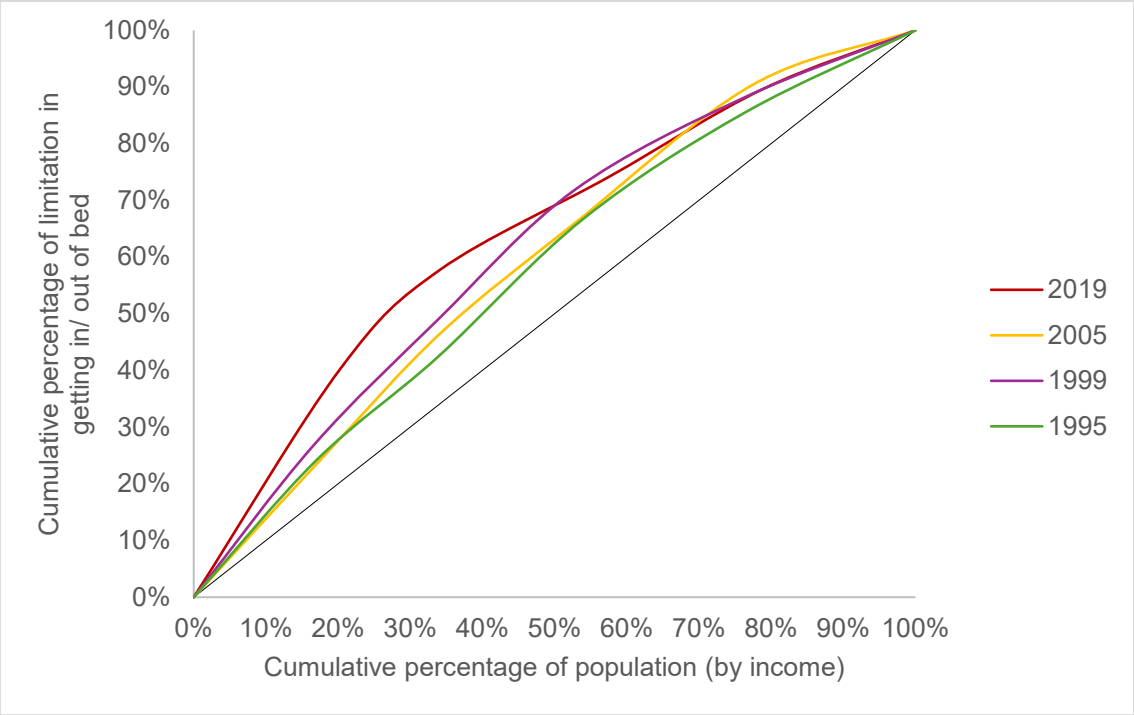

Figure 7. Income-related concentration curves of limitation in getting in/ out of bed (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

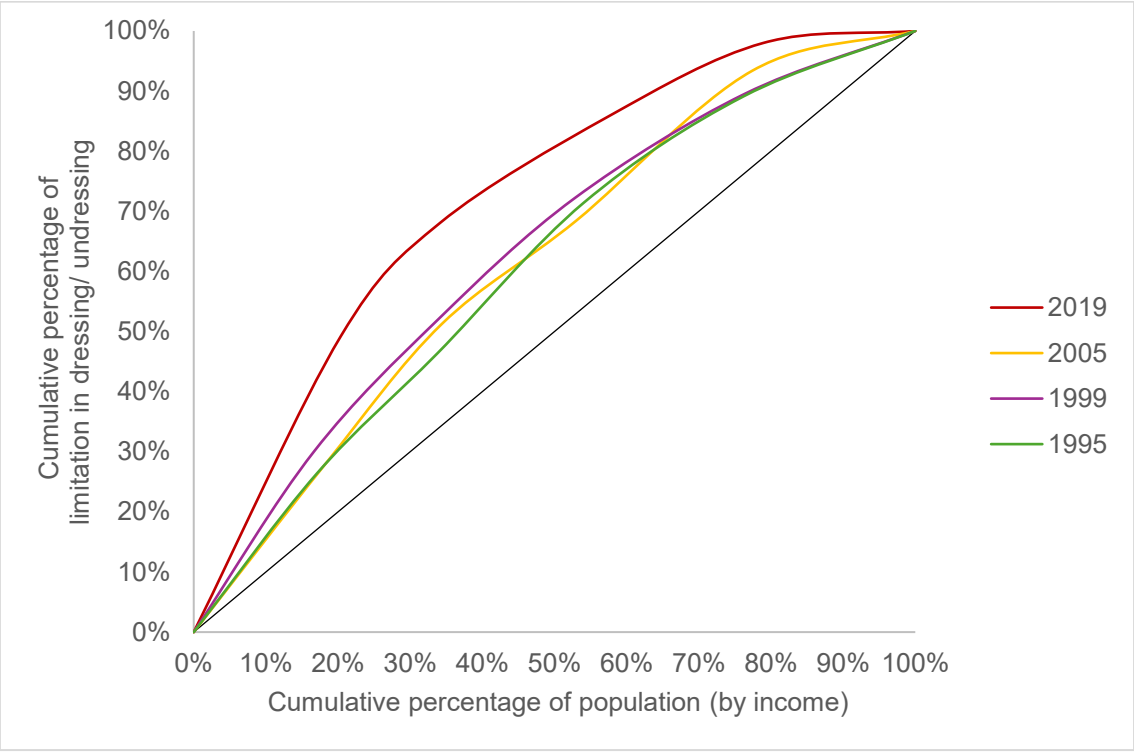

Figure 8. Income-related concentration curves of limitation in dressing/ undressing (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

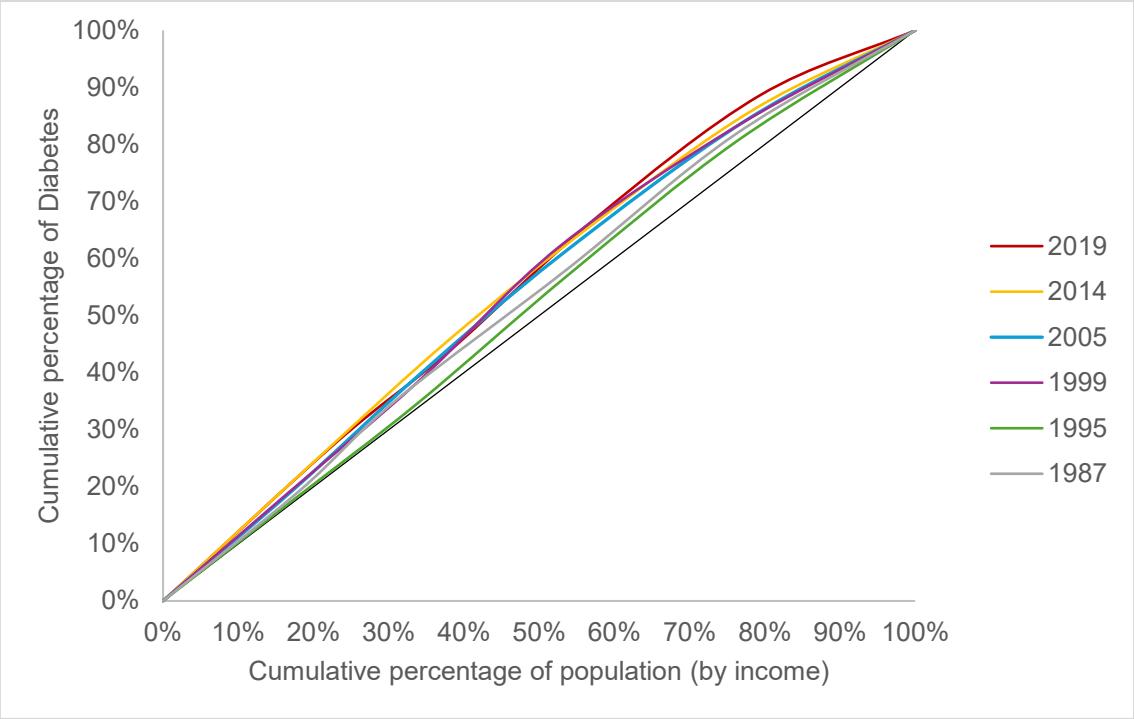

Figure 9. Income-related concentration curves of diabetes (1987-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

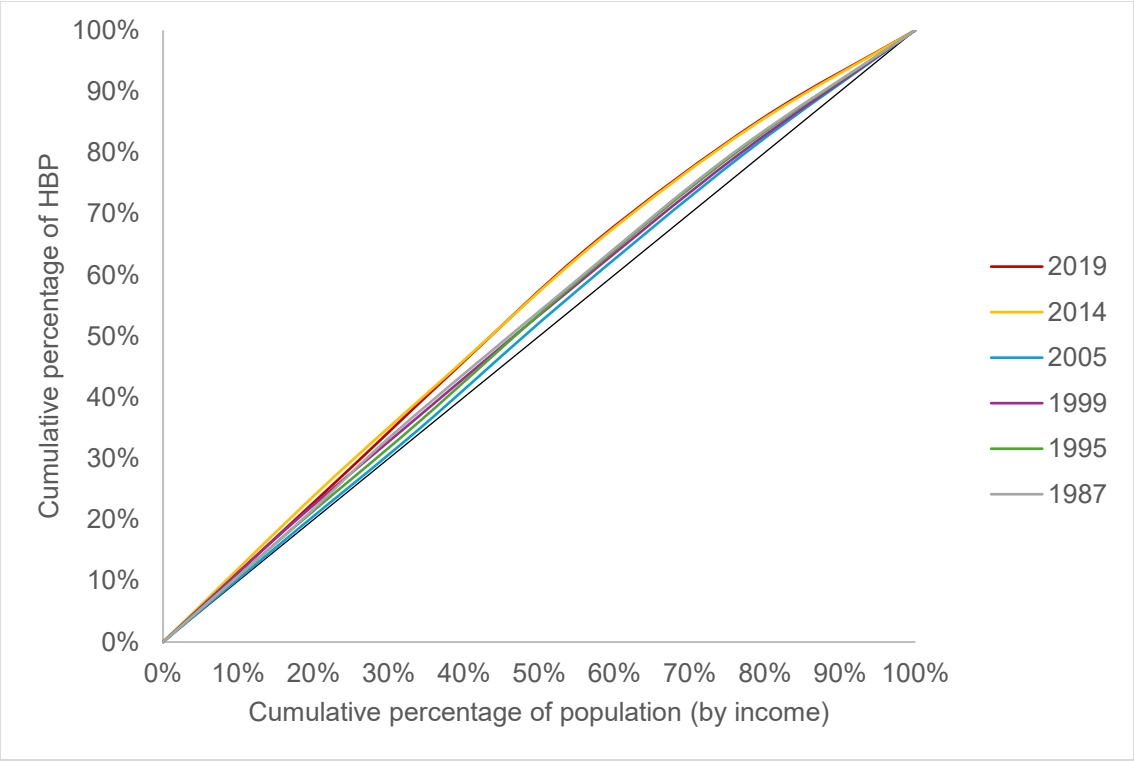

Figure 10. Income-related concentration curves of HBP (1987-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

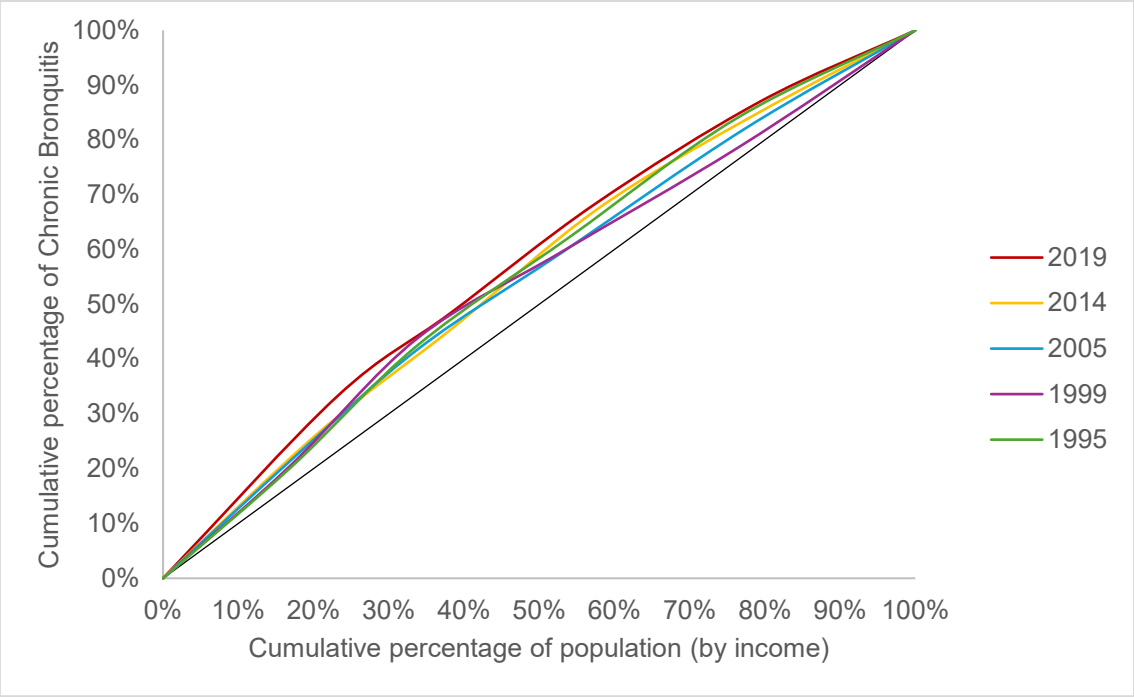

Figure 11. Income-related concentration curves of Chronic Bronchitis (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

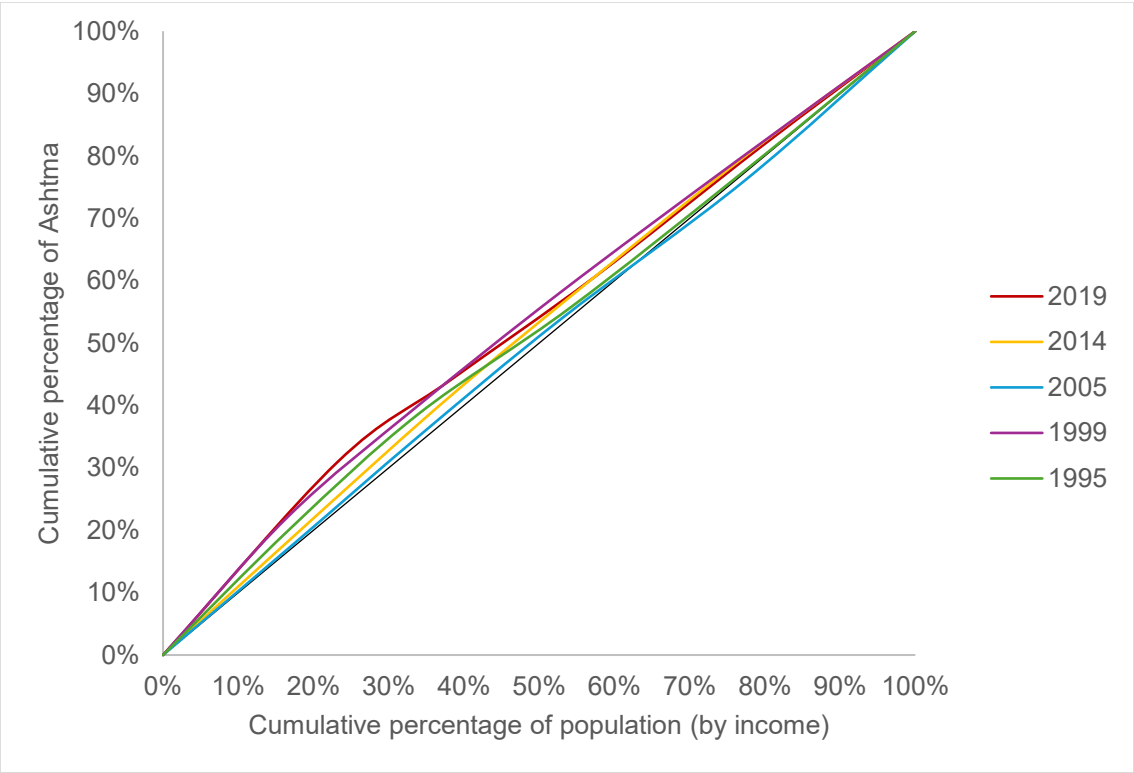

Figure 12. Income-related concentration curves of Asthma (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

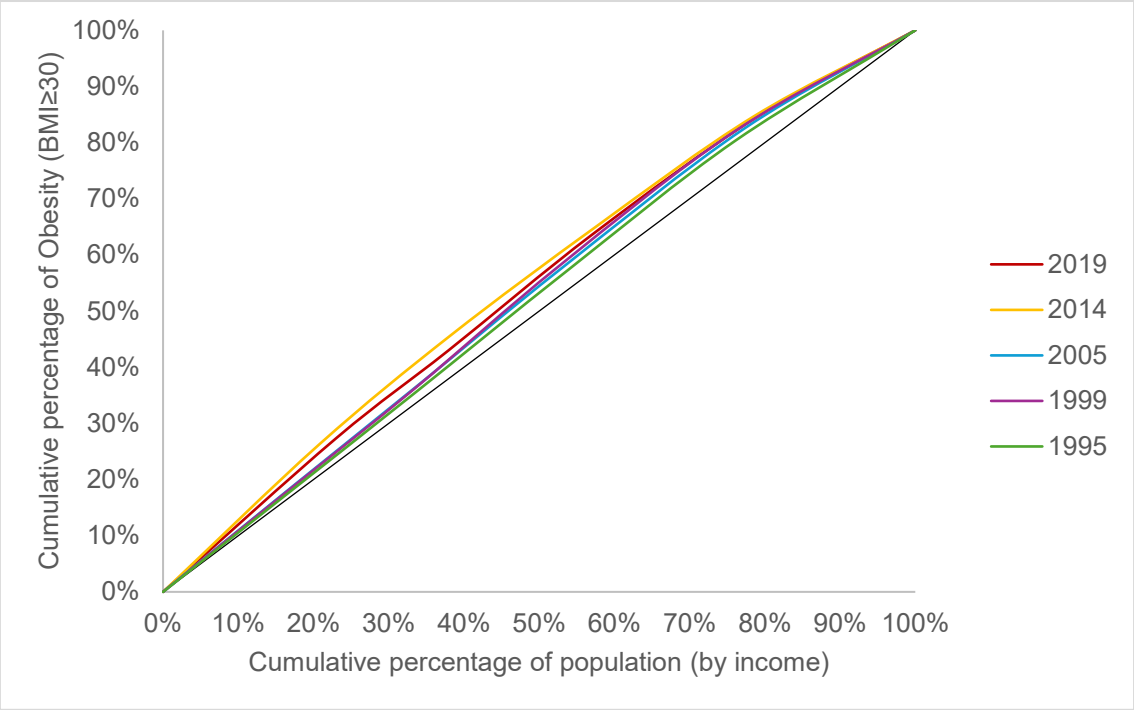

Figure 13. Income-related concentration curves of Obesity (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

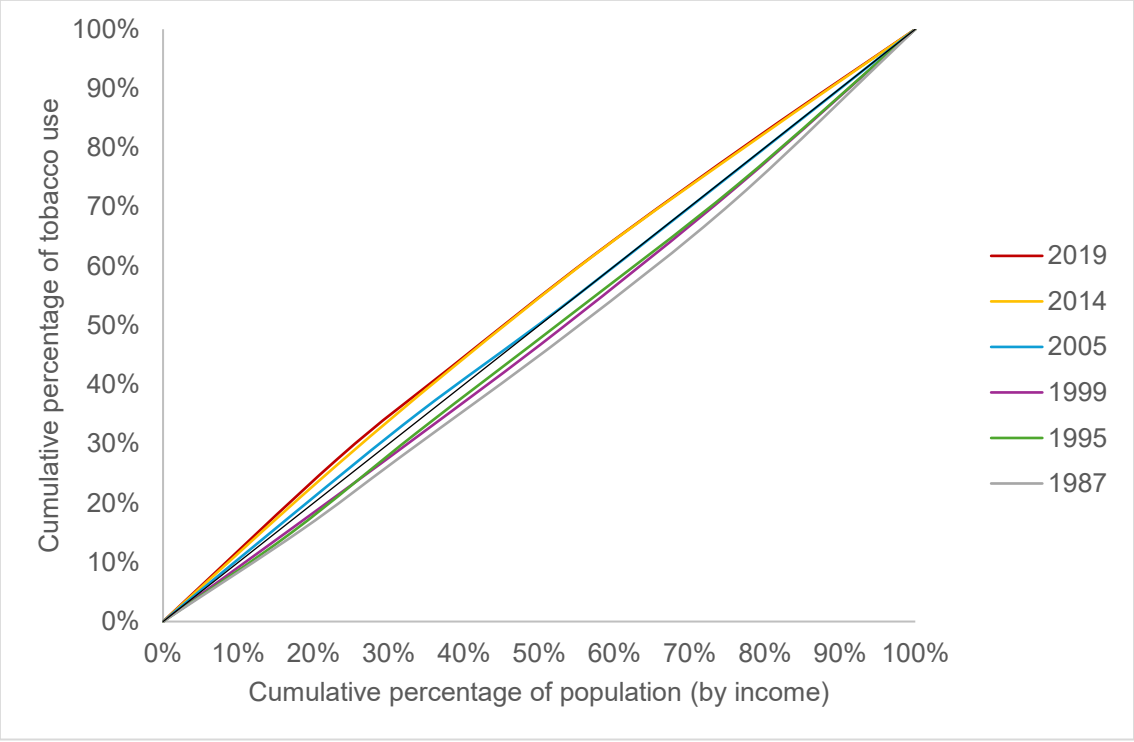

Figure 14. Income-related concentration curves of Tobacco use (1987-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.

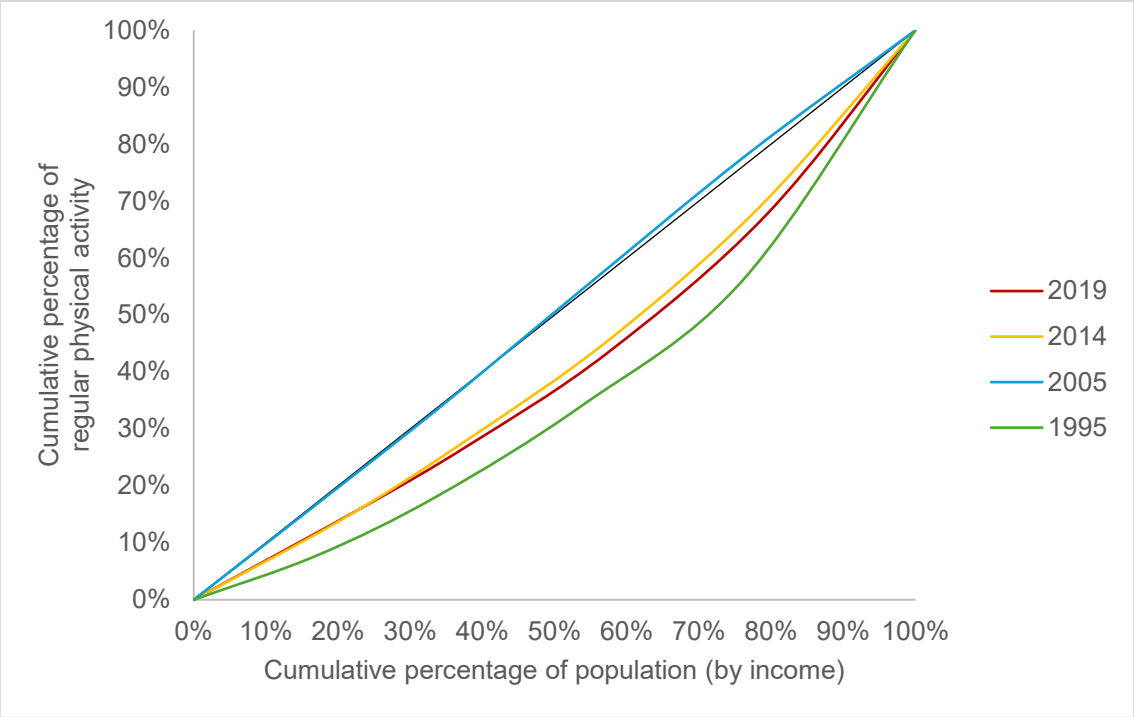

Figure 15. Income-related concentration curves of Physical activity (1995-2019)

Note: Each curve is based on a cross-sectional sample for the respective year; sample sizes and compositions differ across years.