Years of Healthy Life among Older Adults in Brazil: An Analysis Based on the Global Activity Limitation Indicator, 1998 and 2008[*]

Años de vida saludable entre adultos mayores en Brasil: un análisis basado en el Indicador Global de Limitación de Actividad, 1998 y 2008

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Abstract

The study aimed to calculate life expectancy and Healthy Life Expectancy (HLY) using the Global Activity Limitation Indicator (GALI) among Brazilian older adults stratified by sex for the years 1998 and 2008. We use data from the Brazilian National Household Sample Survey (PNAD) and Abbreviated Life Tables in 2000 and 2010 from the Brazilian Institute of Demographic Geography and Statistics (IBGE). Activity limitation-free life expectancy was estimated using the Sullivan method. The

Keywords

Health Expectancy

Healthy Life Years

Global Activity Limitation Indicator

Participation Restriction

Older Adults

Brazil

results indicated an overall increase in life expectancy for both sexes over the period. However, men experienced a decrease in activity limitation-free years in 2008, while women showed a reduction in the percentage of time lived without activity limitation. A slight advantage in men's health compared to women was observed. When comparing the two periods, the proportion of years expected to be lived without activity limitation was higher in 1998 than in 2008 for both sexes.

Resumen

Este estudio propone calcular la esperanza de vida y la Esperanza de Vida Saludable utilizando el Indicador Global de Limitación de Actividad (GALI) en adultos mayores brasileños, estratificados por género para los años 1998 y 2008. Se utilizaron datos de la Encuesta Nacional por Muestreo de Hogares de Brasil (PNAD) y Tablas de Vida Abreviadas en 2000 y 2010 del Instituto Brasileño de Geografía y Estadística Demográfica (IBGE). Se estimó la esperanza de vida sin limitación de actividad utilizando el método Sullivan. Los resultados indicaron un aumento en la esperanza de vida para ambos géneros durante el periodo. Los hombres experimentaron una disminución en los años sin limitación de actividad en 2008, mientras las mujeres mostraron una reducción en el porcentaje de tiempo vivido sin limitación de actividad. Se observó una ligera ventaja en la salud de los hombres en comparación con las mujeres. Al comparar los dos periodos, la proporción de años esperados para vivir sin limitación de actividad fue mayor en 1998 que en 2008 para ambos géneros.

Introduction

Health expectancies, or Healthy Life Expectancies, have gained widespread usage globally and are currently considered one of the key indicators for summarizing the health conditions of populations and the performance of public health actions, particularly among older adults. Health Life Expectancy denotes the average number of years that individuals of a certain age are expected to live healthy, considering a specific prevalence of morbidity and mortality within their age group. By combining information on both mortality and morbidity into a singular index, these measures have evolved into valuable tools for assessing trends and changes in the health status and lifespan of actual populations, with a particular focus on the health of aging populations (Alves and Arruda, 2017; Imai and Soneji, 2007; Jagger, Hauet & Brouard, 2001).

Health Life Years (HLY) indicators serve as a valuable tool for assessing and evaluating the factors contributing to the extended lifespan. These metrics help disentangle whether the additional years of life can be attributed to advancements in medical technology, diagnostic methods, and treatment approaches. The evolution of diagnostic tools and enhanced medical technologies enables the early detection of severe health issues, thereby extending the period individuals can live with morbidity. Consequently, as the onset of more serious health conditions is consistently delayed, morbidity is compressed (Jagger et al., 2013).

Since 2005, the European Union (EU) has employed Health Life Years (HLY) as a metric to gauge advancements aligned with strategic European policies, notably the 2000 Lisbon strategy and the European strategy on Active and Healthy Ageing. HLY relies on the Global Activity Limitation Indicator (GALI), which is collected through surveys. Developed alongside other indicators to comprehensively monitor health across Europe (Robine, Jagger & the Euro-Reves Group, 2003), GALI functions as a condensed measure of functional status, amalgamating diverse information into a singular item (Van Oyen et al., 2006). Recognized as a pivotal gauge for evaluating health and functional status in population surveys, as emphasized by Berger, Van der Heyden and Van Oyen in 2015, GALI serves as a crucial component within the broader framework of health assessment in population surveys.

GALI was initially utilized to estimate the European indicator 'Healthy Life Years' in 2004 (Jagger et al., 2008). While subsequent studies demonstrated its construct validity, it has been noted that the index exhibits consistent correlations with instruments measuring functioning and disability across the European Union (Jagger et al., 2010; Van Oyen et al., 2006). Rooted in the language of the International Classification of Functioning, Disability, and Health (ICF), GALI measures disability in relation to participation restrictions (WHO, 2001). Indeed, GALI stands out as the sole internationally recognized and standardized measure for assessing participation restrictions (Cabrero-Garcia, Rico-Juan & Oliver-Roig, 2022). Its emphasis lies in assessing limitations in fulfilling social roles and engaging in activities such as independence, work, and social participation (Berger et al., 2016). The GALI question posed is: 'For at least the past six months, to what extent have you been limited because of a health problem in activities people usually do? Would you say you have been: severely limited? Limited but not severely? Not limited at all?' (Bogaert et al., 2018).

During the Sixty-Ninth World Health Assembly in 2016, the World Health Organization (WHO), in collaboration with Member States and Partners for the Sustainable Development Goals, formulated a comprehensive Global Strategy and Plan of Action for Aging and Health covering the 2016-2020 period. This initiative was further extended with the inception of the WHO program titled "The Decade of Healthy Aging 2020-2030". Emphasizing the need for enhanced measurement, monitoring, and research on aging, the established strategic objectives set forth a crucial agenda for addressing the challenges related to aging (PAHO, 2021)

Brazil has undergone a swift demographic transition characterized by a marked aging process and an increase in the longevity of its population. The life expectancy at birth witnessed a remarkable surge of 30 years from the 1940s to the 2000s, culminating in a figure of 73.8 years by 2010 (IBGE, 2022). Specifically, the male life expectancy at age 60 exhibited a noteworthy progression, escalating from 15.2 years in 1980 to 19.3 years in 2010. A parallel trend was observed among women, with life expectancy rising from 17.6 years in 1980 to 22.6 years in 2010. Notably, the projections for individuals aged 80 in 1980 suggested an anticipated average lifespan of 6.4 years for women. In contrast, by 2010, the life expectancy at this age reached 9.1 years, surpassing the corresponding figures of 5.7 and 8.0 years for men (IBGE, 2022). This demographic shift underscores the pressing need to focus on the themes of longevity and active, healthy aging within the Brazilian context.

Several prior surveys have been conducted to assess healthy life expectancy in Brazil, utilizing diverse indicators such as self-perception of health, disability, frailty, chronic diseases, and cognitive capacity (Alves & Arruda, 2017; Alves & Pereira, 2018; Alves et al., 2019; Andrade et al., 2014; Camargos & Gonzaga, 2015; Camargos et al., 2019; Campolina et al., 2013; Nepomuceno & Turra, 2015; Romero, Leite & Szwarcwald, 2005). The predominant method employed across most of these studies is the Sullivan method (Sullivan, 1971), recognized as the principal approach for decomposing life expectancy based on specific health dimensions in cross-sectional studies (Imai & Soneji, 2007). Notably, applying the Sullivan method has been a consistent trend in these investigations. It is essential to note that, at the total population level, only a limited number of longitudinal studies are currently underway in the country.

To the best of our knowledge, no studies in Brazil utilize the GALI indicator. Therefore, the present study is innovative and contributes to the

country's research on aging and health. It explores an indicator that integrates information on functional capacity and participation in social activities, providing a new perspective on the actual impact of functional disability among older adults. Functional limitations have significant repercussions on the quality of life and well-being of older adults, especially when they constrain interactions among individuals in society or hinder the performance of social roles. GALI essentially measures this aspect.

While Brazil has numerous cross-sectional studies that assess various health aspects at the national level, the collection of GALI data is not consistently standardized across these studies. Specifically, the Brazilian National Household Sample Survey (PNAD) conducted in 1998, 2003, and 2008 included the GALI question. However, it is noteworthy that the GALI question in Brazil, referring to the last two weeks, differs from European surveys, but only in this temporal aspect. Another crucial point to emphasize is that nationally representative surveys in Brazil often lack the uniformity needed for comparisons between them and across different periods within the same survey. The PNAD stands out in this regard, as it offers a framework for ensuring comparability.

To provide a more in-depth assessment of healthy aging in Brazil, estimating healthy life expectancies using GALI is essential. This effort is critical in scrutinizing trends in active and healthy aging within the country. Furthermore, it substantially contributes to the current academic literature by introducing GALI-based assessments, facilitating cross-country comparisons with regions undergoing advanced aging processes, notably in Europe. Hence, the objective of the present study is to compute life expectancy and Healthy Life Years (HLY) using the Global Activity Limitations Indicator (GALI) among older adults in Brazil, categorized by sex, for the years 1998 and 2008.

Methods

The research utilized data sourced from the Brazilian Institute of Geography and Statistics (IBGE), specifically from the National Household Sample Survey (PNAD) and the Abbreviated Life Tables (Tábuas de Mortalidade) for the years 2000 and 2010. These years correspond to the periods of the Demographic Census in Brazil.

The PNAD is a nationally representative cross-sectional household survey conducted annually and serves as a comprehensive tool for cap-

turing information about various demographic aspects. Commencing in 1967, the PNAD's primary focus includes gathering data on the Brazilian population's education, employment, income, and housing character-istics. Notably, in 1998 and 2008, the PNAD featured a health special supplement, enabling the acquisition of data on the Global Activity Lim-itations Indicator (GALI).

GALI was evaluated based on the answers to the following question: 'For at least the past two weeks, have you been limited to performing because of a health problem in activities people usually do?' The GALI question was answered by the interviewee and not by a respondent. A dichotomized nominal variable was then created with the yes or no responses. Thereafter, the GALI prevalence and age-specific GALI rates were estimated. The demographic variables considered were age (60-64, 65-69, 70-74, 75-79, 80-84, and 85 years or older) and sex.

Estimates of total life expectancy and activity limitation-free life expec-tancy (HE) for Brazilian older adults in 1998 and 2008 were obtained using the life table method, which combines mortality information and prevalence of activity limitations by age and sex, as proposed by the Sul-livan method (1971).

Decomposing the life table and applying the prevalence of individuals without activity limitations in the age group x to $x+n$, to the person-years lived (nLx) derived from the life table allowed the calculation of the per-son-years lived in a specific age interval free of activity limitations. Finally, HE was estimated by dividing this result by lx, representing the proba-bility of surviving to age x. This value could be interpreted as the average number of years lived without activity limitations, as follows:

$$HE_x = \frac{\sum\left[1 - {}_n\pi_x\right] \times {}_nL_x}{l_x}$$

HEx represents the average number of years an individual is expected to live without activity limitations. The terms $n\pi x$ and $1 - n\pi x$ denote, respectively, the proportion of individuals with activity limitations in the age group x to $x+n$ (prevalence obtained from PNAD each year) and the proportion without activity limitations in the same age group. The number of person-years lived in the age interval is denoted as nLx, and lx represents the number of individuals surviving to age x. Both values are derived from the abbreviated life table provided by IBGE. The Total

Life Expectancy (TLE) at each age, *ex*, is calculated by dividing the total years lived beyond that age by the total number of individuals who have survived to age *x*. For further details on the methodology, refer to Jagger, Hauet, and Brouard (2001). All statistical analyses were conducted using R Statistical Software (version 4.1.3).

Results

Figure 1 shows the prevalence of activity limitations among Brazilian older adults in 1998 and 2008. The findings indicate an increase in prevalence for both sexes during this period. Women consistently exhibited a higher frequency than men across all years, with respective percentages of 5.4 and 6.1 % for women and 2.5 and 3.1 % for men.

Figure 1. Prevalence of activity limitation among older adults in Brazil, 1998 and 2008.
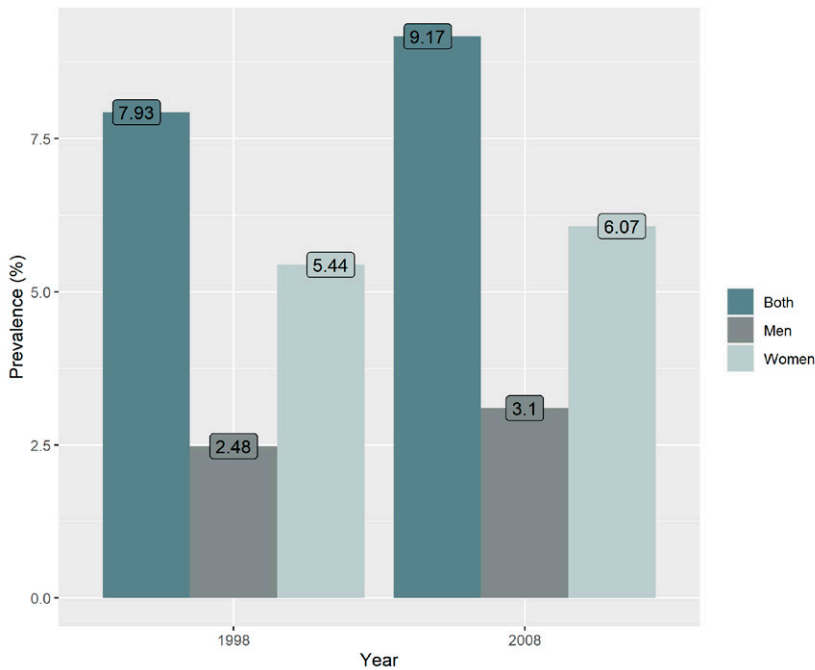
Source: PNAD (1998 and 2008).

Based on the results presented in Table 1, among men, age-specific prevalence ranged from 10.6 % (age 85 and above in 1998) to 15.4 % (age 85 and above in 2008). In 1998, there was an increase in prevalence up to the age of 80 years (from 11.1 to 15.0 %), followed by a decrease at the age of 85 years and above (10.6 %). In 2008, the proportion with activity limitations increased with advancing age, starting at age 70. Regarding differences

within each age group for males, the highest positive percent change was observed in the oldest age group (45.3 %), while the highest negative percent change occurred at ages 70-74 (-9.7 %).

In 1998 and 2008, the prevalence of activity limitation increased until age 75 and decreased thereafter for women. Differences by age group across the years were less pronounced compared to men. The highest positive difference was observed in ages 80 to 84 (6.1 %), while the greatest negative percent change was found in ages 65 to 69 (-7.2 %).

Sex differences reveal that, in 1998 and 2008, women generally exhibited higher prevalence levels, except for the 80-84 age group in 1998 and the 85 plus age group in 2008, where men surpassed women in prevalence (15.0 % for men as compared to 14.8 % for women).

Table 1. Prevalence (%) of activity limitation among older adults by sex and age. Brazil, 1998 and 2008.

	Prevalence (%)		
Sex and age	1998	2008	Change (%)
Men			
60-64	11.1	11.9	7.2
65-69	11.1	12.3	10.8
70-74	12.3	11.1	-9.7
75-79	14.0	13.2	-5.7
80-84	15.0	15.0	0
85+	10.6	15.4	45.3
Women			
60-64	12.1	12.1	0
65-69	13.8	12.8	-7.2
70-74	13.5	13.3	-1.5
75-79	16.4	15.8	-3.6
80-84	14.8	15.7	6.1
85+	14.8	14.7	0.7

Source: PNAD (1998 and 2008).

Table 2 presents the total life expectancy (TLE), activity limitation-free life expectancy (HE), and the percentage of years with activity limitation-free (%HE/TLE) for selected ages for both men and women. During the analyzed period, there was an overall increase in life expectancy for both genders, with a more substantial increase in both years and percentage change observed among women. In 1998, women aged 60 could expect to live, on average, 3.5 years longer than their male counterparts. By

2008, women of the same age group had an average life expectancy of 3.3 years greater than men. Additionally, there was an observed increase in the average survival of women compared to men at the age of 80, though the difference was less pronounced at age 85.

When analyzing TLE decomposition, we observed a decline in the average time lived without activity limitation with increasing age for both genders and across the two examined periods. The data from Table 2 indicate that women, compared to men, are more prone to experiencing activity limitations at any given age in both years.

In each year under examination, the years expected to be lived without activity limitations deteriorate notably beyond the age of 80 for both genders, with a more pronounced decrease seen at 85 years and above. Women, in particular, exhibit more unfavorable outcomes – as measured by the percentage of years without activity limitation – compared to men. When comparing the two time periods, the proportion of years expected to be lived without activity limitation is higher in 1998 than in 2008 for both sexes. However, the variation between the two periods is higher among men. Notably, older adult men spent more of their lives dealing with activity limitations in 2008 compared to 1998, as outlined in Table 2.

Overall, the proportion of years expected to be lived without activity limitation can be considered low (Table 2).

Table 2. Total life expectancy (TLE), activity limitation-free life expectancy (HE), and percentage of years with activity limitation-free years by age and sex among older adults. Brazil, 1998 and 2008.

Sex and age	1998			2008		
	TLE	HE	%	TLE	HE	%
Men						
60	17.4	15.0	86.0	19.3	16.3	84.1
70	11.4	9.5	83.0	12.9	10.4	80.8
80	6.9	5.1	74.7	8.0	5.5	68.5
85	5.2	3.2	60.9	6.2	3.2	51.4
Women						
60	20.9	17.2	82.4	22.6	18.4	81.4
70	13.8	10.8	78.7	15.1	11.6	77.1
80	8.2	5.6	68.5	9.1	6.0	65.7
85	6.2	3.2	51.4	6.8	3.3	49.0

Source: PNAD (1998 and 2008). IBGE (2000 and 2010).

Discussion

This study aimed to calculate healthy life years using GALI among Brazilian older adults based on gender for the years 1998 and 2008. Our findings revealed an increase in years lived with activity limitations in Brazil, with a more negative scenario for women, especially among those aged above 80 in both years. The year 2008 showed a longer average lifespan lived with activity restrictions for both men and women, with men experiencing the greatest declines in time lived without activity restrictions between 1998 and 2008.

The study also aimed to investigate whether life expectancy improvements in the country are linked to healthy or active aging. Various European cross-national studies have utilized GALI to compute 'Healthy Life Years' (Van Oyen et al., 2006). To the best of our knowledge, this current study contributes to the Brazilian literature as it is the first conducted in the country using the GALI indicator to assess and monitor health trends among older adults. Since disability-free life expectancies have already been studied and explored in research conducted in Brazil (Camargos & Gonzaga, 2015; Camargos et al., 2019), another noteworthy aspect of this research is the assessment of how population aging manifests in Brazil through a distinct indicator for measuring disability.

While GALI has been widely acknowledged as a reliable indicator of disability, its association with disability measures exhibits variation across different countries (Berger, Van der Heyden & Van Oyen, 2015; Cambois, Robine & Mormiche, 2007; Tubeuf et al., 2008;). Nonetheless, in the majority of cases, the results remain comparable. In a cross-national study conducted in several European countries, Jagger et al. (2010) found a consistent association between GALI and other disability and functional limitation indicators among the older population. Furthermore, GALI offers consistent information across diverse population subgroups (Berger, Van der Heyden & Van Oyen, 2015), emphasizing the significance of global health measures in evaluating health and functioning. Notably, GALI demonstrates substantial efficacy against various health indicators (Van Oyen et al., 2006). Therefore, our study adds to the literature by providing supplementary information and enhancing the comparability and interpretation of the reality of older adults in Brazil, given that GALI represents activity limitation-free life expectancy associated with disability and functional limitations.

Disparities in prevalence become apparent when comparing disability and GALI indicators. Limitations in activities of daily living (ADL) and instrumental activities of daily living (IADL) significantly impact personal autonomy and self-care. Consequently, the prevalence of individuals with disabilities in these areas is notably lower than observed in other life domains (Altman, 2014). As a measure of participation restrictions, GALI encompasses limitations in social roles, independence, work, and engagement in social activities (Berger et al., 2016).

In the study by Camargos and Gonzaga (2015), the prevalence of disability for women steadily increased from 10.3 % (60-64 years) to 36.7 % (80 years and over) in 1998, and from 9.2 to 38.8 % in 2008. Correspondingly, GALI prevalence was more concentrated, ranging from 12.1 % (60-64 years) to 16.4 % (75-79 years) in 1998, and 12.1 % (60-64 years) to 15.8 % (75-79 years) in 2008. For men, disability prevalence ranged from 8.4 % (60-64 years) to 31.8 % (80 years and over) in 1998, and from 7.0 to 30.9 % in 2008 (same age groups). GALI prevalence figures were more concentrated, varying from 11.1 % (60-64 years) to 15.0 % (80-84 years) in 1998, and 11.1 % (70-74 years) to 15.4 % (85+ years) in 2008. Hence, our findings suggest that, in Brazil, the prevalence of activity restriction is not as pronounced as disability. Moreover, our studies may be valuable for further comparisons and developing effective public health policies.

Concerning sex differences in prevalence within our study, it is crucial to highlight a marked increase in prevalence among males aged 85 and above. Specifically, from 1998 to 2008, the percentage change for this age group was notably high at 45.3 %, contrasting with the range of -9.7 to 10.8 % for all other age groups in men. This substantial shift in the older age group correlates with higher disability prevalences in younger cohorts, as indicated by Fors et al. (2022), where sex differences in functional limitations tended to decrease with age within birth cohorts. Interestingly, our findings align with a gradual reduction in sex differences in disability prevalences in some European countries, as observed in the studies by Fors et al. (2022) and Bloomberg et al. (2021).

Indeed, our findings slightly differ from those of Camargos and Gonzaga (2015) as we compared the percentage of healthy years lived, as measured by the disability or activity-limitation indicator. Our results indicate that the percentages of Healthy Years measured by GALI markedly decreased between 1998 and 2008 across all ages, for each gender separately. In

the case of the findings from Camargos and Gonzaga (2015), among men, this consistent decline was not identified in life expectancy up to age 75; there was a decline only from age 80 onwards. This could suggest that men may not experience more years with disability but may be more affected than women in their activities. Therefore, this opens a path for further investigation, given the difference found between the two indicators.

According to Berger, Van der Heyden, and Van Oyen (2015), GALI is influenced by social and cultural variations in reporting, including factors such as age, sex, culture, education, income, employment, and health. Given Brazil's vast cultural diversity and significant socioeconomic inequality, it is reasonable to consider that these factors may influence our results and the GALI indicator. Older adults attribute personal meanings to life habits within a culture of self-care, encompassing aspects like food, hygiene, comfort, leisure, spirituality, and rest (Faller & Marcon, 2013). In Brazil, a study on the care of older adults revealed diverse forms of caregiving practices among ethnic groups. This included the influence of faith and religiosity in the Lebanese community, the use of beliefs and teas among Paraguayans, a belief in conventional medicine among the French, and a reliance on tea and traditional medicine among Brazilians (Faller & Marcon, 2013). This indeed highlights the fact that cultural variations are prevalent in the population and can impact individuals' activities and perceptions of limitations. Despite this, our study represents the inaugural use of GALI in Brazil, acknowledging the need to broaden discussions on active and healthy aging in the country.

When combining the indicator with life expectancy, this study suggests that despite the overall increase in longevity between 1998 and 2008 in Brazil, there was a simultaneous increase in the years lived with activity limitation. Unfortunately, these results imply that the rise in unhealthy years aligns with the general increase in total years lived. Moreover, the percentage of years expected to be lived with activity limitation has increased across all groups. These findings support the expansion of morbidity hypotheses, which present a pessimistic perspective asserting that gains in life expectancy are mainly driven by technological advances prolonging the lives of individuals with diseases and limitations (Gurenberg, 1977; Kingston et al., 2017). In addition to the 'sick survivors' hypothesis (Gruenberg 1977; Kingston et al. 2017), the expansion of morbidity could be linked to changes in behavioral patterns and living conditions in

recent cohorts, making them more susceptible to disabilities (e.g., obesity, sedentary lifestyles, labor market conditions). Lastly, there may be cohort differences in the perception and likelihood of reporting disabilities influenced by cognitive 'benchmarks' established throughout life (Fors et al., 2022).

The information collected by PNAD is self-reported by the interviewees, introducing various types of measurement errors that may pose a limitation to the present study. However, self-reported information has been utilized in several previous studies, and evidence suggests that these indicators are valid and reliable for measuring health among older adults (OCampo, 2010). A second limitation of this study is the discrepancy in the questions investigated by the PNAD survey in comparison to other countries. In Europe, individuals are asked: "For at least the past 6 months, to what extent have you been limited because of a health problem in activities people usually do?" In Brazil, the question pertains to the last two weeks. Furthermore, the methods are not standardized across European countries. Despite these variations, GALI has not been used in Brazil before, offering potentially more accurate targets for public policies.

An advantage of this study is the control over the respondent. The older individuals who participated in the study answered the GALI question, reducing potential bias. It is important to note that future studies in Brazil should prioritize comparisons of life expectancy free of limitations in Instrumental Activities of Daily Living (IADL), Basic Activities of Daily Living (BADL), and limitations of activities. Studies of this nature can more effectively contribute to the discussion on healthy aging in the country.

Finally, summary measures of population health that combine life expectancy and global health measures in a single indicator, such as GALI, are essential for assessing the health of older adults in the country and other sectors, including social and economic factors that also influence health. A deeper understanding of GALI is crucial in developing countries, especially in Brazil, where many uncertainties about the aging process still exist. Given this context, an ongoing effort to monitor health consistently through various indicators like GALI is essential. Simultaneously, strengthening local and regional policies is crucial to establishing robust pathways and mechanisms for promoting active and healthy aging in the population.

References

Altman, B. M. (2014). Definitions, concepts, and measures of disability. *Annals of Epidemiology*, *24*, 2-7. https://doi.org/10.1016/j.annepidem.2013.05.018

Alves, L. C., & Arruda, N. M. (2017). Socioeconomic differentials and disease-free life expectancy of the elderly in Brazil. *International Journal of Populations Studies*, *3*(1), 64-78. https://doi.org/10.18063/ijps.2017.01.001

Alves, L. C., & Pereira, C. C. (2018). Race, sex and depression-free life expectancy in Brazil, 1998-2013. *International Journal of Population Studies*, *4*(1), 1-9. https://doi.org/10.18063/ijps.v4i1.412

Alves, L. C., Andrade, F. C. D., Corona, L. P., Santos, J. L. F., & Duarte, Y. A. O. (2019). Inequalities in life expectancy with frailty among brazilian older adults: a multistate approach. *Innovation in Aging*, *3*(4), 1-9. https://doi.org/10.1093/geroni/igz032

Andrade, F., Corona, L., Lebrão, M., & Duarte, Y. A. O. (2014). Life expectancy with and without cognitive impairment among Brazilian older adults. *Archives of Gerontology and Geriatrics*, *58*(2), 219-225. https://doi.org/10.1016/j.archger.2013.10.007

Berger, N., Van der Heyden, J., & Van Oyen, H. (2015). The global activity limitation indicator and self-rated health: two complementary predictors of mortality. *Archives of Public Health*, *73*(25), 1-7. https://doi.org/10.1186/s13690-015-0073-0

Berger, N., Robine, J. M., Ojima, T., Madans, J., & Van Oyen, H. (2016). Harmonising summary measures of population health using global survey instruments. *J Epidemiol Community Health*, *70*(10), 1039-1044. doi:10.1136/jech-2015-206870

Bloomberg, M., Dugravot, A., Landré, B., Britton, A., Steptoe, A., Singh-Manoux, A., & Sabia, S. (2021). Sex differences in functional limitations and the role of socioeconomic factors: a multi-cohort analysis. *The Lancet. Healthy Longevity*, *2*(12), e780–e790. https://doi.org/10.1016/S2666-7568(21)00249-X

Bogaert, P., Van Oyen, H., Beluche, I., Cambois, E., & Robine, J. M. (2018). The use of the global activity limitation Indicator and healthy life years by member states and the European Commission. *Archives of Public Health*, *76*(30), 1-7. https://doi.org/10.1186/s13690-018-0279-z

Cabrero-García, J., Rico-Juan, J. R., & Oliver-Roig, A. (2022). Does the global activity limitation indicator measure participation restriction? Data from the European health and social integration survey in Spain. *Quality of Life Research*, *31*(5), 1335-1344. https://doi.org/10.1007/s11136-021-03057-z

Camargos, M. C. S., & Gonzaga, M. R. (2015). Viver mais e melhor? Estimativas de expectativa de vida saudável para a população brasileira. *Cadernos de Saúde Pública*, *31*(7), 1460-1472. https://doi.org/10.1590/0102-311X00128914

Camargos, M. C. S., Gonzaga, M. R., Costa, J. V., & Bomfim, W. C. (2019). Estimativas de expectativa de vida livre de incapacidade funcional para Brasil e Grandes Regiões, 1998 e 2013. *Ciência e Saúde Coletiva*, *24*(3), 737-747. https://doi.org/10.1590/1413-81232018243.07612017

Cambois, E., Robine, J. M., & Mormiche, P. (2007). Did the prevalence of disability in France really fall sharply in the 1990s? *Population*, *62*(2), 313-337. https://www.jstor.org/stable/27645309

Campolina, A. G., Adami, F., Santos, J. L. F., & Lebrão, M. L. (2013). A transição de saúde e as mudanças na expectativa de vida saudável da população idosa: possíveis impactos da prevenção de doenças crônicas. *Cadernos de Saúde Pública*, *29*(6), 1217-1229. https://doi.org/10.1590/S0102-311X2013000600018

Gurenberg, E. M. (1977). The failure of success. *The Milbank Memorial Fund Quarterly*, *55*(1), 3-24. https://www.milbank.org/wp-content/uploads/mq/volume-55/issue-01/55-1-The-Failures-of-Success.pdf

Faller, J. W., & Marcon, S. S. (2013). Práticas socioculturais e de cuidado à saúde de idosos em diferentes etnias. *Escola Anna Nery*, *17*(3), 512-519. https://doi.org/10.1590/S1414-81452013000300015

Fors, S., Illinca, S., Jull, J., Kadi, S., Philips, S. P., Rodrigues, R., Vafaei, A., Zolyomi, E., & Rehnberg, J. (2022). Cohort-specific disability trajectories among older women and men in Europe 2004-2017. *European Journal of Ageing* 19, 1111-1119. https://doi.org/10.1007/s10433-022-00684-4

IBGE. Instituto Brasileiro de Geografia e Estatística. (2020). *Projeção da população do Brasil por sexo e idade para o período: 1910-2050: Revisão 2008*. https://biblioteca.ibge.gov.br/index.php/bibliotecacatalogo?view=detalhes&id=28477

IBGE. Instituto Brasileiro de Geografia e Estatística. (2022). *Tábuas Abreviadas de Mortalidade*. https://www.ibge.gov.br/busca.html?searchword=t%C3%A1bua+mortalidade+abreviada

Imai, K., & Soneji, S. (2007). On the estimation of disability-free life expectancy. *Journal of the American Statistical Association*, *102*(480), 1199-1211. https://doi.org/10.1198/016214507000000040

Jagger, C., Hauet, E., & Brouard, N. (2001). *Health expectancy calculation by the Sullivan method: A practical guide*. França: EHEMU. https://reves.site.ined.fr/fichier/s_rubrique/20184/rp408.en.pdf

Jagger, C., Gillies, C., Moscone, F., Cambois, E., Van Oyen, H., Nusselder, W.,... (2008). Inequalities in healthy life years in the 25 countries

of the European Union in 2005: a cross-national meta-regression analysis. *Lancet*, *372*(9656), 2124-2131. https://doi.org/10.1016/S0140-6736(08)61594-9

Jagger, C., Gillies, C., Cambois, E., Van Oyen, H., Nusselder, W., & Robine, J. M. (2010). The Global Activity Limitation Index measured function and disability similarly across European countries. *Journal of Clinical Epidemiology, 63*(8), 892-899. https://doi.org/10.1016/j.jclinepi.2009.11.002

Jagger, C., McKee, M., Christensen, K., Lagiewka, K., Nusselder, W., Van Oyen, H.,... (2013). Mind the gap – reaching the European target of a 2-year increase in healthy life years in the next decade. *European Journal of Public Health*, *23*(5), 829-833. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3784798/

Kingston, A., Wohland, P., Wittenberg, R., Robinson, L., Brayne, C., Matthews, F. E., Jagger, C., & Cognitive Function and Ageing Studies collaboration (2017). Is late-life dependency increasing or not? A comparison of the Cognitive Function and Ageing Studies (CFAS). *Lancet* (London, England), 390(10103), 1676-1684. https://doi.org/10.1016/S0140-6736(17)31575-1

Nepomuceno, M. R., & Turra, C. M. (2015). Tendências da expectativa de vida saudável de idosas brasileiras, 1998-2008. *Revista de Saúde Pública*, *49*(1), 1-8. https://doi.org/10.1590/S0034-8910.2015049005472

OCampo, J. M. (2010). Self-rated health: Importance of use in elderly adults. *Colombia Médica*, *41*(3), 275-289. https://www.redalyc.org/articulo.oa?id=28315220011

PAHO. Panamerican Health Organization. (2021). *Década do Envelhecimento Saudável nas Américas (2021-2030)*. https://www.paho.org/pt/decada-do-envelhecimento-saudavel-nas-americas-2021-2030

Robine, J., Jagger, C., & Euro-Reves Group. (2003). Creating a coherent set of indicators to monitor health across Europe. The Euro-REVES 2 project. *European Journal of Public Health*, *13*(Suppl. 3), 6-14. https://doi.org/10.1093/eurpub/13.suppl_1.6

Romero, D. E., Leite, I. C., & Szwarcwald, C. L. (2005). Healthy life expectancy in Brazil: applying the Sullivan method. *Cadernos de Saúde Pública*, *21*(Suppl. 1), S7-S18. https://doi.org/10.1590/S0102-311X2005000700002

Sullivan, D. F. (1971). A single index of mortality and morbidity. *HSMHA Health Reports*, *86*(4), 347-354. https://doi.org/10.2307/4594169

Tubeuf, S., Jusot, F., Devaux, M., & Sermet, C. (2008). *Social heterogeneity in self-reported health status and measurement of inequalities in health*. Irdes.

Van Oyen, H., Van der Heyden, J., Perenboom, R., & Jagger, C. (2006). Monitoring population disability: Evaluation of a new Global Activity Limitation Indicator (GALI). *Soz Praventivmed*, *51*, 153-161. https://doi.org/10.1007/s00038-006-0035-y

WHO. World Health Organization. (2001). *International classification of functioning, disability and health*. Geneva (Switzerland): ICF. http://www.who.int/classifications/icf/en/