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HEALTHY LIFE YEARS AS A SCREENING INDICATOR IN THE MANAGEMENT OF OLDER PEOPLE'S LIVING ENVIRONMENTS

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Population ageing makes the management of older people's living conditions increasingly important. This article assesses Healthy Life Years (HLY) as a policy-analytic screening indicator for needs relating to housing, transport, local services, information and assistive technologies. The study analyses Eurostat HLY estimates produced using the Sullivan method for Poland, Czechia, Germany and the European Union and derives expected years lived with activity limitations (LOA) and their share in remaining life expectancy (PLOA). Values for 2015 and 2023 are juxtaposed, with observation flags used to distinguish comparable differences from breaks in series. In 2023, women in Czechia had the highest PLOA among the countries and sex groups analysed; in all three countries, women also had higher LOA values than men. HLY, LOA and PLOA do not identify a specific barrier or intervention. Their management value emerges through four stages: recognising a population-health signal, establishing a functional profile, auditing the age-friendly environment, and selecting and monitoring action. The original contribution is a translational framework and decision matrix linking the indicator system to housing, transport, local services, information and assistive technologies. The indicators initiate further assessment and priority setting but do not replace local data, environmental audits or user research.

Keywords: healthy life years, activity limitations, older people, age-friendly environment, housing, transport, local services, assistive technologies

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1. INTRODUCTION

A longer life does not automatically mean a longer life without limitations in everyday functioning. Healthy ageing emphasises functional ability arising from the interaction between intrinsic capacity and the physical and social environment (World Health Organization [WHO], 2015b; Beard et al., 2016). This approach is consistent with the concepts of active ageing and quality of life, which extend beyond health to include participation, security, autonomy and social relationships (WHO, 2002; Power et al., 2005). The ‘silver economy’ perspective further highlights the design of housing, mobility, care, communication and technologies in response to changes in the age structure (European Commission, 2018).

The International Classification of Functioning, Disability and Health likewise treats activity limitations as interactions between health conditions and environmental factors (WHO, 2001). The person-environment fit model indicates that the same functional characteristic may lead to different levels of independence depending on environmental demands (Lawton, Nahemow, 1973; Wahl et al., 2012). The absence of a lift, an inaccessible stop, unclear information or a digital-only service channel may intensify a limitation, while appropriate design may partly compensate.

The Healthy Life Years (HLY) indicator describes the expected number of years lived without long-term limitations in usual activities. In the European Union, it combines mortality data with the prevalence of activity limitations measured using the Global Activity Limitation Indicator (GALI) (Eurostat, 2025b). HLY is used to monitor health and public policies, yet a knowledge gap remains between a population-level result and a decision concerning housing, transport or a service (Bogaert et al., 2018). As this indicator identifies neither the type nor the source of a difficulty, it should be treated as a screening signal that initiates functional and environmental assessment rather than as a direct measure of demand for a specific investment (Berger et al., 2015; Van Oyen et al., 2018). Screening is used here in a policy-analytic rather than clinical sense: the indicator flags populations or periods requiring further assessment, but it is not a validated diagnostic test and does not provide a universal cut-off.

In this article, management of the living environment means planning, coordinating and evaluating solutions concerning housing, public space, transport, health and social services, information and technologies. This scope corresponds to the domains of age-friendly environments (WHO, 2007, 2023). The analysis covers Poland, Czechia and Germany: neighbouring EU Member States subject to a common HLY methodology and shared accessibility regulations, but differing in resources and the organisation of care. The comparison is exploratory and is not intended as a ranking.

For public organisations and service providers, the issue also has a temporal dimension. Expanding the stock of accessible housing, redesigning transport

networks, developing home care or creating multichannel information systems requires forward-looking decisions. LOA and PLOA are not forecasts of the number of users of a particular service, but they help to assess the possible population-level duration of life with limitations. Such a signal may justify the earlier development of organisational capacity, accessibility standards and coordination mechanisms before an environmental mismatch translates into unmet needs or premature institutionalisation (WHO, 2023; European Commission, 2018).

The article develops and empirically illustrates a framework using HLY at age 65, expected years lived with activity limitations (Life with Activity Limitations, LOA), and their share in remaining life expectancy (Proportion of Life with Activity Limitations, PLOA) as screening indicators. Four questions are posed: (1) What information do LOA and PLOA add? (2) How can researchers move from the indicators to selecting domains for assessment? (3) What configurations of the measures occur in the countries studied? (4) Which macro-environmental factors should constrain interpretation? The thesis is that the management value of the HLY-LOA-PLOA system emerges only in the following sequence: signal, functional profile, environmental audit, and intervention selection and monitoring. The study's original contribution is not a new health-expectancy measure, but a translational framework that separates population screening, functional profiling, environmental auditing and intervention monitoring and applies this sequence to five domains of the living environment.

2. METHODOLOGY

2.1. The health expectancy concept

Health expectancy combines a period life table with the prevalence of a defined health state. Depending on operationalisation, one can calculate years without activity limitations, without disability, without disease or in good self-rated health. These measures are not equivalent. The European HLY indicator based on GALI describes years without self-reported, long-term limitations in usual activities rather than years without disease (Sullivan, 1971; Jagger et al., 2007; Saito et al., 2014).

Changes are interpreted through the hypotheses of the compression and expansion of morbidity. Compression means shortening the period of life with limitations, whereas expansion means extending it as longevity increases (Fries, 1980). However, as European studies find no single HLY pattern after age 65, the direction of the indicator must be considered together with total remaining life expectancy (Straka et al., 2024). HLY also remains only one component of active ageing and quality of life because it does not directly measure autonomy, participation or satisfaction (Power et al., 2005).

For management interpretation, the distinction between absolute and relative quantities is important. A higher HLY may coexist with a higher LOA if total remaining life expectancy is also greater. Conversely, a similar LOA may account for a smaller share of life when HLY is higher. While PLOA captures this relationship, it does not replace absolute values: a similar proportion of years with limitations may represent a different number of years during which an accessible environment is required. LOA and PLOA are algebraically derived interpretive measures used in this study. They are not statistically independent of HLY and remaining life expectancy, and they are not official Eurostat indicators. Their value lies in expressing the same health-expectancy relationship in absolute and relative terms relevant to planning.

2.2. European context of HLY, GALI, EU-SILC and EHIS

GALI asks whether, because of a health problem, respondents have been limited for at least six months in activities people usually perform. Responses divide the population into people without limitations and those with moderate or severe limitations. The advantage of this question is comparability and a low respondent burden; its disadvantage is the lack of information on the type of activity and the role of the environment. Validation studies confirm an association between GALI and difficulties in mobility, Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL), but they also show sensitivity to question wording and country context (Berger et al., 2015; Cambois et al., 2016; Van Oyen et al., 2018).

A reported limitation does not describe the individual's biological condition alone. The answer also depends on which activities the respondent regards as usual, what capabilities they expect at their age, and the environment in which they function. A person using a lift, accessible transport and assistive devices may assess the consequences of the same impairment differently from a person facing stairs, a long distance to a stop, and no alternative service channel. In international comparisons, GALI should therefore be interpreted as a result of the health-activity-environment relationship, additionally shaped by response norms and survey organisation (Cambois et al., 2016; Berger et al., 2015; Van Oyen et al., 2018).

The activity-limitation prevalence component used in HLY calculations comes primarily from European Union Statistics on Income and Living Conditions (EU-SILC). The survey covers private households and therefore does not fully represent the institutional population (Eurostat, 2025b). The European Health Interview Survey (EHIS) plays a complementary role by providing detailed data on mobility, sensory functions, ADL and IADL. In the proposed procedure, EU-SILC provides the population-level signal, EHIS helps establish the profile of limitations, and local data and audits identify the specific barrier.

2.3. The Sullivan method and life-table logic

Let nL_a denote person-years lived between ages a and $a + n$, l_x the life-table number surviving to age x , and h_a the proportion of people with an activity limitation. The expected remaining healthy life years of a person who has survived to age x are:

$$\text{HLY}_x = \frac{\sum_{a=x}^{\omega} nL_a (1 - h_a)}{l_x} \quad (1)$$

The denominator l_x conditions the result on survival to age x and remains necessary in abridged life tables (Jagger et al., 2007; Saito et al., 2014). If e_x denotes total remaining life expectancy, then:

$$\text{LOA}_x = e_x - \text{HLY}_x \quad (2)$$

$$\text{PLOA}_x = \frac{\text{LOA}_x}{e_x} \times 100\% \quad (3)$$

HLY indicates time without limitations, LOA the absolute duration of life with limitations, and PLOA the share of remaining life expectancy represented by that period.

Equations (1)-(3) describe the life-table logic underlying the indicator. The study did not reconstruct HLY from age-specific prevalence and person-years; it analysed the HLY estimates published by Eurostat and derived LOA and PLOA from those estimates and remaining life expectancy. Data were accessed on 12 July 2026 from the hlth_hlye and demo_mlexpec tables. The filters were: EU27_2020, Czechia (CZ), Germany (DE) and Poland (PL); women and men; age 65; unit: years; 2015 and 2023 for HLY and 2023 for remaining life expectancy. Published inputs were retained at one decimal place; LOA and PLOA were rounded to one decimal place. Observation flags were preserved. The 2023 HLY observations for the EU and Poland carry a break in series and are estimated and provisional, while the German observations carry a break in series. Consequently, only the Czech 2015-2023 difference is treated as a comparable temporal change; the other endpoints are juxtaposed without interpreting them as trends. Countries were not ranked because an ordinal position does not identify an environmental need and is sensitive to data breaks, missing values and small differences.

Age 65 was chosen analytically because it is widely used in European HLY reporting and focuses attention on later life, when environmental accessibility becomes increasingly important. Period life-table results are not forecasts for a particular cohort. They describe expected years under the assumption that the observed mortality schedule and cross-sectional prevalence of limitations remain in force. A change in HLY between years may reflect changes in mortality and functioning as well as changes in measurement. Quality flags and methodological consistency

are therefore part of interpretation, not a technical addendum (Jagger et al., 2007; Saito et al., 2014; Eurostat, 2025b).

2.4. Multistate approaches and global measures of healthy life expectancy

The Sullivan method is cross-sectional and does not follow transitions of the same individuals between health, limitation and death. Multistate life tables use longitudinal data and describe transitions and trajectories more directly, but they are more difficult to apply routinely (Saito et al., 2014). Healthy Life Expectancy (HALE) adjusts years lived in less than full health by severity weights for diseases and injuries and is therefore not equivalent to European GALI-based HLY (WHO, 2024). Eurostat's published HLY estimates are produced using the Sullivan method. This study uses those estimates for population monitoring while retaining the distinction between measuring scale and diagnosing causes.

2.5. Data sources and operationalisation of health

The operationalisation of health determines the scope of the conclusions. GALI measures a global activity limitation, ADL and IADL identify difficulties in specific activities, and an environmental audit identifies barriers and facilitators. National data cannot be mechanically transferred to the municipal level; stable regional estimates or a local assessment are required (Statistics Poland, 2020).

A layered information system should distinguish five functions: measuring mortality, identifying a global limitation signal, describing the functional profile, characterising social conditions, and measuring the environment and services. User experience forms an additional layer because formal compliance with a standard does not determine the practical usability of a solution. At local level, particularly important data concern walking and travel times, building accessibility, service opening hours, costs, waiting times, information channels and reasons for non-use or withdrawal from services. Linking such data with the limitation profile makes it possible to locate a gap that is hidden by the national average (WHO, 2015a, 2023).

The macro-environment was described through a PEST-informed contextual profile rather than a formal weighted PEST analysis. The indicators were selected to represent five mechanisms relevant to interpretation: formal entitlement to care, general health-system resources, formal long-term-care capacity, the availability of informal care, and digital inclusion. The countries share EU frameworks for digital, product and service accessibility and long-term care, but differ in financing, the allocation of responsibilities and the availability of formal support (European Parliament & Council of the European Union, 2016, 2019; Council of the European Union, 2022). The profile frames questions for interpretation; it is neither a causal model nor a comprehensive assessment of national systems. Table 1 anchors the synthesis in selected comparable indicators.

Table 1. Selected indicators in a PEST-informed contextual profile of Czechia, Germany and Poland

Dimension	Indicator and reference period	Czechia	Germany	Poland
Political-legal	Population covered for a core set of health services, 2024 or nearest year (%)	100	100	97
Economic	Current health expenditure, 2023 (% of GDP)	8.4	11.7	7.1
Economic	Long-term-care expenditure, 2023 or nearest year (% of GDP)	1.9	2.5	0.6
Socio-cultural	People aged 50+ providing informal care at least weekly, latest value reported for 2021-2022 or nearest year (%)	16.9	19.5	9.6
Technological	People aged 16-74 with at least basic digital skills, 2023 (%; system-level proxy)	69.1	52.2	44.3

Note. The source years are not fully synchronised across countries, reporting coverage for long-term care and definitions of informal care are not fully uniform, and the digital-skills indicator is a system-level proxy rather than an older-population measure. The indicators are unweighted and are used only to frame interpretation.

Source: author's own elaboration based on Eurostat (2024, 2025a) and OECD (2025).

The expenditure indicators are highest in Germany, intermediate in Czechia, and lowest in Poland among the three countries. Nearly universal formal coverage does not imply similar expenditure levels or service capacity. Informal-care data are not a simple measure of a system's reliance on the family, and the general digital-skills indicator masks the age gap. These factors frame questions about compensating for limitations; they do not explain HLY levels post factum (OECD & European Commission, 2024; OECD/European Observatory on Health Systems and Policies, 2025a, 2025b, 2025c).

Each contextual dimension indicates a different mechanism relevant to interpretation. The political-legal dimension determines entitlements, accessibility standards and the distribution of responsibilities. The economic dimension affects the capacity to maintain the supply of rehabilitation, home care, transport and housing adaptations. The socio-cultural dimension covers co-residence patterns, access to informal support, inequalities and norms for reporting limitations. The technological dimension concerns not only infrastructure but also skills, trust, support and the availability of an equivalent non-digital channel. A similar PLOA may therefore represent a different operational gap depending on the institutional capacity to compensate for limitations (European Parliament & Council of the European Union, 2016, 2019; Council of the European Union, 2022; OECD & European Commission, 2024).

The procedure comprised five main stages: first, clarifying the construction and status of the measures; second, comparing HLY(65) in 2015 and 2023 while

classifying temporal comparability from Eurostat flags; third, deriving LOA(65) and PLOA(65) for 2023; fourth, interpreting the three countries in relation to the EU and the PEST-informed contextual profile; and fifth, constructing a model for moving from signal to action. The criterion of usefulness was whether the analysis identified the additional data and questions required for planning housing, transport, services, information and technologies.

3. RESULTS

3.1. HLY(65), LOA(65) and PLOA(65) as a system of management indicators

Table 2 juxtaposes HLY(65) in 2015 and 2023. Czechia is the only analysed country without a break-in-series flag for these observations: HLY fell by 0.8 years for women and 0.6 years for men. The EU, Germany and Poland are shown as end-points, but their differences are not interpreted as comparable temporal changes because the 2023 HLY observations carry a break in series.

Table 2. HLY(65) in 2015 and 2023 by sex, in years

Sex	Country/area	2015	2023	Difference (years)
Women	EU ^{a, b}	9.3	9.6	n.c.
	Czechia	8.6	7.8	-0.8
	Germany ^a	12.3	9.0	n.c.
	Poland ^{a, b}	8.4	9.1	n.c.
Men	EU ^{a, b}	9.2	9.2	n.c.
	Czechia	8.0	7.4	-0.6
	Germany ^a	11.4	8.4	n.c.
	Poland ^{a, b}	7.6	8.2	n.c.

a Break in series, b The 2023 value is estimated and provisional. n.c. = not treated as a comparable temporal change.

Source: author's calculations based on Eurostat, hlth_hlye (Eurostat, 2025b).

Table 3 shows that HLY alone is insufficient. Women lived longer after age 65 than men, but in all three countries they also had a longer LOA. Among the countries and sex groups analysed, the highest PLOA occurred among women in Czechia: 12.7 out of 20.5 remaining years, or approximately 62%, were lived with limitations. In Poland, the 2023 cross-section comprised 11.3 years of LOA for women and 8.0 years for men. In Germany, the combination of a relatively long remaining

life expectancy and HLY of 9.0 years yielded a high absolute LOA despite higher health and long-term-care expenditure ratios than in the other two countries. These 2023 values are interpretable as cross-sectional configurations even where the corresponding HLY series is not temporally comparable.

The Czech configuration combines a comparable decline in HLY for both sexes with the highest female LOA and PLOA among the three countries. While this does not identify a cause, it supports prioritising the simultaneous examination of mobility and ADL/IADL profiles, social inequalities, and access to care, prevention, transport and housing. German and Polish HLY endpoints must not be read as trends because of the break in series. Their 2023 LOA values nevertheless show a substantial population-level horizon of life with limitations. In Germany, this supports examining service coordination, information accessibility and regional variation; in Poland, where LOA accounted for more than half of women's remaining life expectancy and formal long-term-care expenditure was lower, it supports examining community services, housing adaptations and support for carers (OECD/European Observatory on Health Systems and Policies, 2025a, 2025b, 2025c).

Table 3. Remaining life expectancy, HLY(65), LOA(65) and PLOA(65) in 2023

Sex	Country/area	e(65)	HLY(65)	LOA(65)	PLOA(65), %
Women	EU ^{a,b}	21.8	9.6	12.2	56.0
	Czechia	20.5	7.8	12.7	62.0
	Germany ^a	21.2	9.0	12.2	57.5
	Poland ^{a,b}	20.4	9.1	11.3	55.4
Men	EU ^{a,b}	18.3	9.2	9.1	49.7
	Czechia	16.7	7.4	9.3	55.7
	Germany ^a	17.9	8.4	9.5	53.1
	Poland ^{a,b}	16.2	8.2	8.0	49.4

a HLY affected by a break in series, b The 2023 HLY value is estimated and provisional. Flags refer to HLY; LOA and PLOA inherit the corresponding uncertainty because they are derived from HLY.

Source: author's calculations based on Eurostat, hlth_hlye and demo_mlexpec (Eurostat, 2025b, 2026).

The derived measures prompt different management questions. At a given time, lower HLY signals fewer expected years without limitations, a larger LOA indicates a longer potential period in which compensation may be needed, and a larger PLOA means that this period accounts for a greater share of remaining life. When a methodologically comparable series is available, changes in the measures may

additionally inform monitoring. This does not mean that everyone requires care throughout LOA. The measures are population-level values covering limitations of varying severity, but they identify the time horizon within which the accessibility of housing, transport, information or a service may determine independence.

3.2. From a demographic measure to identifying environmental needs

The results and literature support four stages (tab. 4). The first stage is policy-analytic screening; the actual identification of the type of need occurs only after establishing the functional profile and auditing the environment.

Table 4. Model for moving from indicators to management action

Stage	Information base	Analytical product	Decision
1	HLY, LOA, PLOA; comparable change and group differences	List of populations and periods requiring attention	Initiate further assessment without an automatic investment
2	GALI, EHIS, ADL, IADL, mobility, sensory functions and social situation	Profile of dominant limitations and inequalities	Select environmental domains for examination
3	Audits, GIS, service registers, operator data and user research	Map of barriers, resources and accessibility gaps	Set priorities, locations and target groups
4	Indicators of implementation, accessibility, use, experience and outcomes	Assessment of effect and equity of access	Continue, modify or discontinue the intervention

Source: author's own elaboration based on WHO (2015a, 2023).

No universal PLOA cut-off should automatically trigger a particular investment. Instead, triggers for further assessment may include adverse changes in a methodologically comparable series, large differences between groups, or the coexistence of a high LOA with service shortages. The matrix in table 5 shows how, after confirming the limitation profile, the analysis can move to the five areas specified in the article's aim.

A decision rule for initiating further assessment should reflect the policy objective, data distribution, estimation uncertainty and local resources. It may use change from a locality's own comparable baseline, a persistent deviation from an agreed benchmark, differences between neighbourhoods or groups, or convergence between a health signal and information on unmet needs. The trigger for assessment must be separated from the investment threshold: the former initiates additional data collection, while the latter requires confirmation of the barrier, assessment of alternatives and identification of the responsible organisation.

Table 5. Matrix for moving from the HLY-LOA-PLOA signal to living-environment planning

Domain	Data confirming the profile	Audit questions	Examples of action	Monitoring indicators
Housing	Mobility, stair use, ADL, falls and living alone	Do the entrance, lift, bathroom, lighting and possibility of adaptation match user profiles?	Housing adaptations, ramps, safe bathrooms and supported housing (WHO, 2018; Wahl et al., 2012; Butlewski, 2018)	Number of adaptations; waiting time; falls; ability to remain at home
Transport	Difficulties outside the home, forgone trips, use of aids, GIS and operator data	Are the route to the stop, the stop, vehicle, timetable and passenger information accessible for journeys to services?	Accessible stops and vehicles, demand-responsive transport, seating and links to facilities (WHO, 2007; Musselwhite et al., 2015)	Time-based coverage; forgone or cancelled trips; journey reliability; satisfaction
Local services	IADL, unmet needs, cost, waiting time and carer burden	Are care, rehabilitation, meals and home help available, coordinated and affordable?	Home care and rehabilitation, neighbourhood services, day centres and carer support (Council of the European Union, 2022; WHO, 2023)	Waiting time; service hours; unmet needs; continuity and coordination
Information	Limitations in vision, hearing and comprehension, and preferred contact channel	Is the message readable and available in different formats, and can human assistance be obtained?	Plain language, large print, contrast, voice messages and multichannel service (WHO, 2007; European Parliament & Council of the European Union, 2016)	Successful completion; complaints; message comprehension; use of human assistance
Technologies	Access to devices, digital skills, errors and withdrawal from e-services	Is the interface accessible and usable, and does the user have training, support and a non-digital alternative?	Accessible e-services, telecare, simple interfaces and telephone support (Chen, Schulz, 2016; Friemel, 2016; Marston, van Hoof, 2019; European Parliament & Council of the European Union, 2019)	Task completion; errors; use of support; perceived security; use of the non-digital channel

Source: author's own elaboration based on the sources cited in the table.

The framework yields different priorities for further assessment. In Czechia, the comparable decline in HLY and high PLOA strengthen the case for analysing mobility, ADL/IADL, and access to care, housing and transport. For Germany and Poland, the 2015 and 2023 endpoints are not treated as trends; instead, the 2023 LOA configurations direct attention to service coordination and regional inequalities in Germany, and to home services, support for carers, housing adaptations, local transport and digital exclusion in Poland (OECD/European Observatory on Health Systems and Policies, 2025a, 2025b, 2025c). These are hypotheses for further assessment, not conclusions about the causes of HLY values.

The model may use a three-layer regional or local dashboard. The strategic layer contains HLY, LOA and PLOA and, where methodologically comparable, their changes over time. The diagnostic layer contains the structure of limitations, the social situation and unmet needs. The operational layer describes the stock of accessible housing, transport reachability, service supply, information standards and technology usability. The dashboard should record not only implementation, such as the number of adaptations or applications launched, but also accessibility, actual use, user experience and outcomes. A solution is effective only when it improves the ability to perform a task or maintain independence, not merely when it increases the number of administrative outputs (WHO, 2015a; Greenfield et al., 2015).

4. DISCUSSION

The principal contribution is a sharper definition of HLY's management role and a translational framework, not a new demographic measure. HLY measures neither service demand nor the inaccessibility of a specific domain. LOA and PLOA re-express the same health-expectancy relationship in absolute and relative terms; they do not provide independent statistical evidence. Used together, however, these measures help assess whether the scale of life with activity limitations warrants further assessment. The four-stage procedure bridges the gap between population measurement and action because it requires functional data, an environmental audit and outcome monitoring instead of automatically assigning an indicator value to an investment.

This approach is consistent with the age-friendly framework, in which indicators establish a baseline and support progress assessment but must be adapted to the local context (WHO, 2015a, 2023). Incorporating literature on active ageing, quality of life and the silver economy prevents years with limitations from being reduced to years of dependency. Accessible housing, transport, information and technology may further sustain participation even in the presence of persistent impairments. At the same time, an increase in HLY does not necessarily imply improvements in loneliness, security or autonomy; monitoring should therefore combine population measures with user experience (Power et al., 2005; Greenfield et al., 2015).

The link with quality of life has another consequence. An environmental intervention may improve autonomy and participation without an immediate change in HLY because the indicator responds to self-reported limitations at population level rather than to all benefits of an individual service. Policy evaluation should therefore not be reduced to the question of whether HLY increased after an investment. A set of more proximal outcomes is needed: the ability to reach a service, perform an activity, remain in one's dwelling, obtain information and maintain relationships. HLY then remains a strategic measure, while domain-specific indicators show the mechanism of change (Power et al., 2005; WHO, 2015a).

The PEST-informed contextual profile shows why a similar PLOA may have different operational meanings. High expenditure does not guarantee high HLY, nor can lower expenditure alone explain lower HLY. Mortality, disease structure, inequalities, health behaviours, reporting and access to compensation all play a role. Country profiles should therefore be used to formulate questions and select data, rather than to provide a causal explanation of the HLY table. Technology requires particular caution: it can reduce the need to travel and support telecare, but digital-only provision creates new barriers, especially where skills and support are limited (Chen, Schulz, 2016; Friemel, 2016).

The sex-specific results show a longer absolute period of life with limitations among women. This does not imply homogeneous demand because sex interacts with income, education, region, living alone and support networks. The national average should be a starting point for disaggregation, not a substitute for it.

An equity perspective should cover both average differences and the ability to use the proposed solution. A housing adaptation may be inaccessible because of cost or tenure status, demand-responsive transport because of its service area, and an e-service because of a lack of equipment or trust. Monitoring should therefore examine the distribution of benefits by sex, age, income, disability and place of residence. Without such monitoring, a solution that improves the average may simultaneously deepen inequalities (WHO, 2015a, 2023).

Limitations include the Sullivan method's cross-sectional character, GALI's self-reported nature, exclusion of part of the institutional population from EU-SILC, and data-quality flags (Saito et al., 2014; Eurostat, 2025b). Three purposively selected countries and two time points were examined; the point estimates are not accompanied by confidence intervals. Breaks in series prevent the EU, German and Polish endpoint differences from being interpreted as trends. In addition, LOA and PLOA are algebraically dependent on HLY and remaining life expectancy. National data cannot determine municipal actions without regional estimation and an audit. Further research should combine HLY with EHIS or EU-SILC microdata, social inequalities and the spatial accessibility of services. It would therefore be valuable to test whether high PLOA coexists with greater unmet need in areas with weak transport, limited home care or a small stock of accessible housing.

A further limitation is the lack of direct evaluation of implemented interventions. The proposed matrix is a translational structuring tool; it does not demonstrate that a particular adaptation, service or technology will change HLY. Such an evaluation would require a quasi-experimental or longitudinal design, comparison groups and intermediate indicators describing the mechanism of action. Future research could test the entire chain: from the HLY-LOA-PLOA configuration, through the identified barrier and use of an intervention, to changes in independence, participation and unmet needs. This would make it possible to assess empirically the conditions under which a screening indicator improves the targeting of resource allocation.

5. CONCLUSIONS

Although HLY(65) can support management of older people's living environments as a policy-analytic screening signal, it is neither a clinical screening test nor a direct measure of needs relating to housing, transport, services, information or technologies. LOA shows the absolute duration of life with limitations, while PLOA shows its share in remaining life expectancy. Both are derived interpretive measures rather than statistically independent measures or official Eurostat indicators. Joint interpretation is useful because it presents the same health-expectancy relationship in forms relevant to planning.

In the countries studied, women had a longer LOA than men in 2023, and the highest PLOA among the countries and sex groups analysed occurred among women in Czechia. Only the Czech 2015-2023 difference is interpreted as a comparable temporal change. The EU, German and Polish endpoints do not provide evidence of a trend because the 2023 HLY observations carry a break in series. The results do not form a ranking of policy quality; instead, they indicate different configurations of questions for further assessment.

Moving to a decision requires four stages: the HLY-LOA-PLOA signal, a functional profile, an environmental audit, and the selection and monitoring of an intervention. A local or regional dashboard combining strategic, diagnostic and operational layers is recommended. Ultimately, an investment decision should be made only after confirming the relationship between the limitation profile and a specific barrier and after incorporating users' perspectives.

Data availability and reproducibility

The Eurostat source tables are publicly available under the codes hlth_hlye and demo_mlexpec. Section 1.3 reports the extraction date, filters, observation flags and rounding rules; Tables 2 and 3 reproduce all inputs and derived results used in the analysis. No restricted microdata were used.



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LITERATURE

- Beard, J.R., Officer, A., de Carvalho, I.A., Sadana, R., Pot, A.M., Michel, J.-P., Lloyd-Sherlock, P., Epping-Jordan, J.E., Peeters, G.M.E.E.G., Mahanani, W.R., Thiagarajan, J.A., Chatterji, S. (2016). The World report on ageing and health: A policy framework for healthy ageing. *The Lancet*, 387(10033), 2145-2154, [https://doi.org/10.1016/S0140-6736\(15\)00516-4](https://doi.org/10.1016/S0140-6736(15)00516-4).
- Berger, N., Van Oyen, H., Cambois, E., Fouweather, T., Jagger, C., Nusselder, W., Robine, J.-M. (2015). Assessing the validity of the Global Activity Limitation Indicator in fourteen European countries. *BMC Medical Research Methodology*, 15, <https://doi.org/10.1186/1471-2288-15-1>.
- 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, <https://doi.org/10.1186/s13690-018-0279-z>.
- Butlewski, M. (2018). *Projektowanie ergonomiczne wobec dynamiki deficytu zasobów ludzkich*. Poznań: Wydawnictwo Politechniki Poznańskiej.
- Cambois, E., Grobon, S., Van Oyen, H., Robine, J.-M. (2016). Impact of question wording on the measurement of activity limitation. *Journal of Aging and Health*, 28(7), 1315-1338, <https://doi.org/10.1177/0898264316656504>.
- Chen, Y.-R.R., Schulz, P.J. (2016). The effect of information communication technology interventions on reducing social isolation in the elderly: A systematic review. *Journal of Medical Internet Research*, 18(1), e18, <https://doi.org/10.2196/jmir.4596>.
- Council of the European Union (2022). Council recommendation on access to affordable high-quality long-term care (2022/C 476/01). *Official Journal of the European Union*, C 476, 1-11.
- European Commission (2018). *The silver economy: Final report*. Publications Office of the European Union, <https://doi.org/10.2759/685036>.
- European Parliament & Council of the European Union (2016). Directive (EU) 2016/2102 on the accessibility of the websites and mobile applications of public sector bodies. *Official Journal of the European Union*, L 327, 1-15.
- European Parliament & Council of the European Union (2019). Directive (EU) 2019/882 on the accessibility requirements for products and services. *Official Journal of the European Union*, L 151, 70-115.
- Eurostat (2024). *Digital skills in 2023: Impact of education and age* (dataset isoc_sk_dskl_i21). Retrieved from <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240222-1>.
- Eurostat (2025a). *Healthcare expenditure statistics – overview* (dataset hlth_sha11_hf). Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Healthcare_expenditure_statistics_-_overview.

- Eurostat (2025b). *Healthy life years statistics* (dataset hlth_hlye). Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Healthy_lifeyearsstatistics.
- Eurostat (2026). *Mortality and life expectancy statistics* (dataset demo_mlexpec). Retrieved from <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Mortality-andlifeexpectancystatistics>.
- Friemel, T.N. (2016). The digital divide has grown old: Determinants of a digital divide among seniors. *New Media & Society*, 18(2), 313-331, <https://doi.org/10.1177/1461444814538648>.
- Fries, J.F. (1980). Aging, natural death, and the compression of morbidity. *New England Journal of Medicine*, 303(3), 130-135, <https://doi.org/10.1056/NEJM198007173030304>.
- Greenfield, E.A., Oberlink, M., Scharlach, A.E., Neal, M.B., Stafford, P.B. (2015). Age-friendly community initiatives: Conceptual issues and key questions. *The Gerontologist*, 55(2), 191-198, <https://doi.org/10.1093/geront/gnv005>.
- Jagger, C., Cox, B., Le Roy, S., EHEMU (2007). *Health expectancy calculation by the Sullivan method: A practical guide*. European Health Expectancy Monitoring Unit.
- Lawton, M.P., Nahemow, L. (1973). Ecology and the aging process. In: C. Eisdorfer, M.P. Lawton (eds.). *The psychology of adult development and aging*. American Psychological Association, 619-674.
- Marston, H.R., van Hoof, J. (2019). Who does not think about technology when designing urban environments for older people? A case study approach to a proposed extension of the WHO age-friendly cities model. *International Journal of Environmental Research and Public Health*, 16(19), <https://doi.org/10.3390/ijerph16193525>.
- Musselwhite, C., Holland, C., Walker, I. (2015). The role of transport and mobility in the health of older people. *Journal of Transport & Health*, 2(1), 1-4, <https://doi.org/10.1016/j.jth.2015.02.001>.
- OECD (2025). *Health at a glance 2025: OECD indicators*. OECD Publishing, <https://doi.org/10.1787/8f9e3f98-en>.
- OECD & European Commission (2024). *Health at a glance: Europe 2024*. OECD Publishing, <https://doi.org/10.1787/b3704e14-en>.
- OECD/European Observatory on Health Systems and Policies (2025a). *Country health profile 2025: Czechia*. OECD Publishing.
- OECD/European Observatory on Health Systems and Policies (2025b). *Country health profile 2025: Germany*. OECD Publishing.
- OECD/European Observatory on Health Systems and Policies (2025c). *Country health profile 2025: Poland*. OECD Publishing.
- Power, M., Quinn, K., Schmidt, S., WHOQOL-OLD Group (2005). Development of the WHOQOL-OLD module. *Quality of Life Research*, 14(10), 2197-2214, <https://doi.org/10.1007/s11136-005-7380-9>.
- Saito, Y., Robine, J.-M., Crimmins, E.M. (2014). The methods and materials of health expectancy. *Statistical Journal of the IAOS*, 30(3), 209-223, <https://doi.org/10.3233/SJI-140840>.
- Statistics Poland (2020). *Trwanie życia w zdrowiu w Polsce w latach 2009-2019*. Główny Urząd Statystyczny.
- Straka, J., Šídlo, L., Kulhánová, I. (2024). Trends in Healthy Life Years between 2005 and 2019 in 31 European countries: The compression or expansion of morbidity? *International Journal of Public Health*, 69, <https://doi.org/10.3389/ijph.2024.1607574>.

- Sullivan, D.F. (1971). A single index of mortality and morbidity. *HSMHA Health Reports*, 86(4), 347-354.
- Van Oyen, H., Bogaert, P., Yokota, R.T.C., Berger, N. (2018). Measuring disability: A systematic review of the validity and reliability of the Global Activity Limitations Indicator. *Archives of Public Health*, 76, <https://doi.org/10.1186/s13690-018-0270-8>.
- Wahl, H.-W., Iwarsson, S., Oswald, F. (2012). Aging well and the environment: Toward an integrative model and research agenda. *The Gerontologist*, 52(3), 306-316, <https://doi.org/10.1093/geront/gnr154>.
- World Health Organization (2001). *International classification of functioning, disability and health: ICF*. WHO.
- World Health Organization (2002). *Active ageing: A policy framework*. WHO.
- World Health Organization (2007). *Global age-friendly cities: A guide*. WHO.
- World Health Organization (2015a). *Measuring the age-friendliness of cities: A guide to using core indicators*. WHO.
- World Health Organization (2015b). *World report on ageing and health*. WHO.
- World Health Organization (2018). *WHO housing and health guidelines*. WHO.
- World Health Organization (2023). *National programmes for age-friendly cities and communities: A guide*. WHO.
- World Health Organization (2024). *Healthy life expectancy (HALE): Indicator metadata and methods*. WHO.
- Yüksel, I. (2012). Developing a multi-criteria decision-making model for PESTEL analysis. *International Journal of Business and Management*, 7(24), 52-66, <https://doi.org/10.5539/ijbm.v7n24p52>.

TRWANIE ŻYCIA W ZDROWIU JAKO WSKAŹNIK PRZESIEWOWY W ZARZĄDZANIU ŚRODOWISKIEM ŻYCIA OSÓB STARSZYCH

Streszczenie

Starzenie się populacji zwiększa znaczenie zarządzania warunkami funkcjonowania osób starszych. Celem artykułu jest ocena trwania życia w zdrowiu (Healthy Life Years, HLY) jako wskaźnika przesiewowego w analityce polityk publicznych dotyczących mieszkalnictwa, transportu, usług lokalnych, informacji i technologii wspierających. W badaniu przeanalizowano oszacowania HLY publikowane przez Eurostat, wyznaczone metodą Sullivana dla Polski, Czech, Niemiec i Unii Europejskiej, oraz obliczono oczekiwane lata życia z ograniczeniami aktywności (LOA) i ich udział w dalszym trwaniu życia (PLOA). Wartości dla lat 2015 i 2023 zestawiono z uwzględnieniem flag jakości, aby odróżnić porównywalne różnice od przerw w szeregu. W 2023 r. najwyższe PLOA spośród analizowanych państw i grup płci wystąpiło wśród kobiet w Czechach; we wszystkich trzech państwach wartość LOA była również wyższa u kobiet niż u mężczyzn. HLY, LOA i PLOA nie identyfikują konkretnej bariery ani interwencji. Ich wartość zarządcza ujawnia się na czterech etapach: w rozpoznaniu sygnału demograficzno-zdrowotnego, ustaleniu profilu funkcjonalnego, audycie środowiska przyjaznego starzeniu oraz wyborze i monitorowaniu działania.

Oryginalny wkład artykułu stanowią ramy translacyjne i macierz decyzyjna, które łączą układ wskaźników z obszarami mieszkalnictwa, transportu, usług lokalnych, informacji i technologii wspierających. Wskaźniki inicjują pogłębioną ocenę i ustalanie priorytetów, lecz nie zastępują danych lokalnych, audytów środowiska ani badań użytkowników.

Słowa kluczowe: trwanie życia w zdrowiu, ograniczenia aktywności, osoby starsze, środowisko przyjazne starzeniu, mieszkalnictwo, transport, usługi lokalne, technologie wspierające