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Dementia Prevention Requires Moving Beyond Individual Choice: The Costs of Effort and Time intersect with Social Determinants of Health

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Abstract

Social determinants of health strongly influence modifiable risk factors for dementia, yet prevention frameworks list only individual-level behaviours and conditions, overlooking the impact of social and environmental factors on the risk of dementia. In this perspective, we introduce the concept of non-monetary costs as a central mechanism through which social determinants shape modifiable risk factors by influencing individuals' ability to adopt healthy behaviours. Drawing from economic theory, we define non-monetary costs as the time and metabolic cost, perceived by individuals as physical and cognitive effort, required to engage in healthy behaviours. Under adverse social determinants of health, individuals effectively lack a choice, as the non-monetary costs required to engage in healthy behaviours become prohibitively high. We propose a framework that links social determinants of health adversity to increased dementia risk through non-monetary costs. We apply this framework to each of the fourteen modifiable risk factors for dementia identified by the Lancet Commission, demonstrating how these costs systematically elevate risk in populations facing social adversity. Finally, we explore the implications of incorporating non-monetary cost assessments across research, interventions, clinical care, and public policy. We propose that quantifying and addressing these costs is essential for designing equitable, scalable, and contextually grounded strategies for dementia prevention across socially diverse populations.

1 Introduction

Modifiable risk factors (MRFs) for dementia intersect with and are influenced by social determinants of health (SDH). Such determinants can be broadly understood as the living conditions of people, how they age, learn, work, and access resources that influence health outcomes, mediated by social gradients and inequities (World Health Organization 2025). Less education and social isolation, which are among the most burdensome MRFs for dementia (Livingston et al. 2024), are also commonly employed as indicators of SDH (Peretz Patricia, Islam, and Matiz Luz 2020). Other MRFs are downstream health outcomes influenced by SDH. Hearing loss and low-density lipoprotein (LDL) cholesterol—the two risk factors with the highest worldwide population attributable fractions for dementia (Livingston et al. 2024)—are disproportionately prevalent among ethnically minoritised and socioeconomically disadvantaged individuals (Bessen et al. 2024; Frank et al. 2014). Diabetes and hypertension follow similar patterns, with higher prevalence and poorer control in socioeconomically disadvantaged individuals (Chaturvedi et al. 2024). This is also reflected in other MRF profiles among populations facing SDH adversity, marked by elevated and variable population attributable fractions for dementia (Ma'u et al. 2021; Borelli et al. 2023; Suemoto et al. 2023). Together, these disparities highlight the need for dementia prevention frameworks that explicitly address the unequal distribution of resources and the impact of these risk factors across social gradients.

Designing population-level policies aimed to improve healthy behaviours of underserved populations represents a unique opportunity with great impact for dementia incidence reduction (Coates et al. 2025; D'Angelo and Jirsa 2022) but also presents challenges regarding its scalability and sustainability (Horstkötter, Deckers, and Köhler 2020; Daly 2024b). Individuals face barriers to improving their behaviours influenced by both a lack of economic resources and adverse SDH. The second, often shaped by factors in which individuals have little to no control, such as limited access to green spaces and healthcare infrastructure, unsafe neighbourhoods, poor walkability, food insecurity, and prolonged commuting times (Coley et al. 2021). We conceptualise non-monetary costs as a factor through which these barriers shape healthy behaviours by increasing the required time and metabolic costs, which individuals perceive as physical and cognitive effort, of engaging in healthy behaviours.

In this perspective, we examine the interplay between SDH and non-monetary costs associated with behavioural change to reduce dementia risk, emphasising how these costs shape individual health choices and ultimately determine dementia risk and brain health outcomes. We first provide an overview of how adverse SDH influences brain health, outlining the two key pathways through which SDH contributes to an increased risk of dementia. First, an environment-related pathway, involving a cumulative brain health burden caused by chronic stress exposure, and a choice-related pathway, through which SDH shapes the capacity to engage in healthy behaviours. Second, we elaborate on economic theory and the concept of monetary and non-monetary costs as central factors through which SDH exacerbates behavioural non-monetary costs to engage in healthy behaviours. We also review each of the MRFs identified by the Lancet Commission on Dementia Prevention from the perspective of monetary and non-monetary costs. Finally, we explore

the implications of this framework across research, interventions, clinical care, and public policy (Figure 1).

1.1 The Incomplete View on Social Determinants of Health and Brain Health: How Non-Monetary Costs Constrain Healthy Lifestyles Choices

SDH influence brain health and dementia risk through cumulative exposure to adversity across the lifespan (Sakowski et al. 2024; Ibanez et al. 2024). Low educational attainment (Livingston et al. 2024), financial instability (Landeiro et al. 2024), poor nutrition (Livingston et al. 2024; Kirolos et al. 2022), limited healthcare access (Mullins et al. 2021), and early-life trauma (Severs et al. 2023; Bhutta et al. 2023), are associated with worse clinical, cognitive and brain health outcomes (Moguilner et al. 2024; Gonzalez-Gomez et al. 2024; Fittipaldi et al. 2024; Gonzalez-Gomez et al. 2025; Legaz et al. 2024; Santamaria-Garcia et al. 2023; Migeot et al. 2025). Adverse SDH impacts brain health and dementia through the dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis activity, which lowers glucocorticoid sensitivity and promotes insulin resistance and endothelial dysfunction (Raymond et al. 2021). These SDH adversities also contribute to chronic inflammation, elevate peripheral inflammatory cytokine levels (Furman et al. 2019; De Felice, Gonçalves, and Ferreira 2022; Yaffe et al. 2004; Boyd et al. 2022; Muscatell, Brosso, and Humphreys 2020), elevated allostatic load (Franco-O'Byrne et al. 2024; Migeot and Ibáñez 2023; Migeot et al. 2022; Santamaría-García et al. 2025; Birba et al. 2022; De Felice, Gonçalves, and Ferreira 2022) and alter the microbiome (Shen et al. 2020)—all changes that ultimately increase the risk of developing dementia (Furman et al. 2019; Lefevre-Arbogast et al. 2024; Boyd et al. 2022; Muscatell, Brosso, and Humphreys 2020). Additionally, factors such as socioeconomic status, environmental exposures, and national inequality levels influence neurocognitive markers. This evidence underscores the structural nature of SDH effects on brain health, where individuals are subjected to cumulative and prolonged stressors that translate into biological changes underlying dementia (Lupien et al. 2009). However, there is another pathway through which SDH impacts brain health: individual choices on healthy behaviours. This second pathway is an understudied layer of inequality linked to non-monetary costs embedded in disadvantaged social and environmental contexts that elevate the cost and effort required to sustain such behaviours.

Individuals facing SDH adversity often encounter persistent difficulties that make it challenging to engage in healthy behaviours (Coley et al. 2021). In addition to facing higher financial burdens associated with healthier lifestyles, which consume a higher percentage of their total income, individuals also incur non-monetary costs due to increased effort and time requirements. Factors like the lack of safe public spaces for exercise and socialisation, limited access to nutritious food options, heightened stress from financial pressures (Mani et al. 2013), long working hours, lengthy commutes, and other factors increase the marginal non-monetary cost of engaging in healthier behaviours. These challenges result in increased efforts to adopt and sustain health-promoting behaviours, making behavioural change choices more difficult, or even impossible (Walsh et al. 2022). Thus, in theory, individuals have a choice, but in practice, they do not, unless the non-monetary costs are reduced enough.

In sum, the impact of SDH on brain health operates through two main pathways. First, through an environment-related pathway outside the individual's control, by accumulating stressor exposure across the lifespan (Lupien et al. 2009; De Felice, Goncalves, and Ferreira 2022). Second, through a choice-related pathway that makes it difficult for individuals to engage in healthier lifestyles by imposing additional barriers that increase the cost of adopting dementia risk-reducing behaviours (Coley et al. 2021; Walsh et al. 2022). To fully understand how individuals rationalise their health-related choices under SDH adversity, it is necessary to examine in depth the determinants underlying these choices. This requires understanding how individuals allocate their limited resources—including time, money, and cognitive effort—among competing demands, ultimately influencing the decision whether to engage in health-promoting behaviours or prioritise other immediate needs.

1.2 Economic theory: The lack of effort in health choices

In economic theory, individuals engage in a healthy behaviour if the marginal benefit exceeds the marginal cost. In classic economic thinking, individuals are assumed to be completely rational when evaluating the costs and benefits of their choices. More recently, behavioural economics has shown that individuals operate under bounded rationality, relying on heuristics and subject to cognitive biases, which can lead to systematic deviations from optimal choices (Kahneman 2003). Still, while incorporating the concept of bounded rationality, economic theory has not accounted for the role of metabolic cost, understood as the physical and cognitive effort required to engage in healthy behaviours, or how these vary between individuals in shaping health choices.

Among the first economic analyses of health choices was Michael Grossman's Model of Health Demand, where health is considered a lifelong investment, in which individuals allocate their income between consumption and health-related investments (Grossman 2017). These health investments increase productivity in future periods, increasing the resources available over time. In this model, individuals invest in health if the marginal benefit (in increased productivity due to better health) exceeds the marginal monetary cost, which depends on the cost of healthcare and increases as individuals age. While Grossman's model acknowledges that the marginal cost varies by individuals' age, it does not account for non-monetary costs such as effort. Grossman's model is built on Gary Becker's Human Capital Theory (Becker 2007), where, similarly, individuals decide to either consume goods or invest in their education for improved productivity.

Gary Becker's Theory of Allocation of Time, although not specifically applied to health choices, introduces the idea that households not only consume goods but also produce commodities through a combination of goods (which are purchased) and time devoted (Becker 1965; Heckman 2015). For example, households purchase ingredients and devote time to cooking to prepare meals. The model can also be applied at the individual level (i.e., unipersonal households), where health behaviours like exercise, meal preparation, or participation in social and cognitive activities all need time (and effort) to be devoted. Moreover, substitution exists between time and goods, depending on the commodity being produced, as households can buy prepared meals at a higher price, thereby reducing the time needed to prepare them. While time is not the same as effort, the framework offers a

foundation that can be adapted to account for the non-monetary costs of health choices, such as the physical and cognitive effort required, by explicitly incorporating these as additional constraints or disutility terms in individuals' decision-making processes.

A recent application of Gary Becker's Theory of the Allocation of Time to health production shows that limited individual effort, compounded by physical and cognitive effort, increases the marginal cost of engaging in healthy behaviours (Araya-Ríos and Trepél 2024). By extending Becker's Theory of Allocation of Time to include effort as integral non-monetary costs of health choices, these decisions are shaped by socioeconomic, environmental, and individual factors. For example, engaging in regular physical activity may carry a low non-monetary cost for someone living in a safe neighbourhood with nearby parks and flexible work hours. Still, for individuals in high-crime areas with poor infrastructure and rigid, burdensome work schedules, it demands more time, physical and cognitive effort, making it much costlier, if not even unfeasible.

People will engage in certain health behaviours if the marginal benefits outweigh the marginal costs. These costs include not only monetary expenses but also non-monetary costs, which individuals perceive as physical and cognitive effort. Therefore, reducing non-monetary costs is crucial to promoting healthier choices at the population level, particularly among individuals facing structural disadvantages.

Connecting this theory with the Lancet Commission's life-course framework (Livingston et al. 2024), non-monetary costs are dynamic and stage-specific. In Early life (childhood/adolescence), parents are primarily responsible for promoting healthy behaviours and education for their children. In this stage, individuals accumulate health stock that contributes to cognitive reserve in adulthood. The only MRF directly linked to early life is education, which depends largely on parental investment of time and resources, as well as the availability of public education systems that ensure access irrespective of family circumstances. Midlife concentrates the largest number of MRFs. It is therefore the stage where reducing such costs offers the greatest opportunity to promote healthier lifestyles, such as maintaining physical activity, adhering to treatments, and engaging in preventive health care. However, due to work and parenting responsibilities, it is the stage of life when individuals may be more restricted in non-monetary costs. In later life, the Lancet Commission identifies only three MRFs in this stage: social isolation, air pollution, and visual loss (Livingston et al. 2024). The latter two are largely beyond individual control. Still, social isolation is shaped by non-monetary costs such as fatigue, mobility limitations, bereavement, caregiving demands, and the effort required to initiate or sustain social ties in contexts of shrinking networks (Rozynek and Lanzendorf 2023). These barriers can reduce participation in cognitively and socially stimulating activities, accelerating risk accumulation.

2 Incorporating non-monetary costs assessment into MRF inequality

Elevated non-monetary costs for individuals from adverse SDH backgrounds are widespread across all fourteen MRFs identified by the Lancet Commission on Dementia Prevention. These include less education, hearing loss, high LDL cholesterol, hypertension, diabetes,

depression, social isolation, smoking, obesity, physical inactivity, excessive alcohol consumption, and traumatic brain injury (TBI) (Livingston et al. 2024). Each is linked with specific health-promoting behaviours that require varying amounts of time, cognitive effort, metabolic cost, and planning. These behaviours involve substantially greater non-monetary costs among populations exposed to adverse SDH. Improvements in infrastructure or public transportation that the time and effort spent on work and essential daily activities (e.g., commuting time) may have a positive impact on behaviors that are time- and effort-intensive. Such improvements may increase the engagement in health-promoting behaviors (Table 1).

2.1 Low education and cognitive activities

For the MRF of less education, we focus on engaging in cognitively stimulating activities, which is the most relevant health behaviour in dementia prevention (Kivimäki et al. 2021; Livingston et al. 2024). These behaviours require sustained cognitive effort (Virtanen et al. 2009; Cunningham et al. 2022) and are especially challenging for individuals working long or irregular hours, who often must sacrifice rest or family time to participate in mentally demanding activities (Augustine, Prickett, and Negraia 2018; Artazcoz et al. 2024), leading them to default to forms of low-effort leisure to recover (e.g., passive screen time, scrolling on social media, or watching television), which offer immediate relief but limited cognitive stimulation. These patterns of ‘fast leisure’ may reflect an adaptation to environments of chronic time scarcity and mental fatigue. Adding to these challenges are additional non-monetary costs such as the absence of adult learning opportunities, limited digital literacy, and reduced social support (Virtanen et al. 2009; Cunningham et al. 2022; Winding and Andersen 2015), which further increases the non-monetary costs of sustaining cognitively beneficial routines.

Regarding the protective effects of education, for most adults and older adults, their current level of education is not a modifiable behaviour but rather a situation shaped by opportunities and constraints encountered during their youth. Moreover, evidence has suggested that the intellectual capacity gains from education plateau in late adolescence and early adulthood, reinforcing the idea that, since mid-adulthood, education, or its protective factor, is not modifiable (Kremen et al. 2019). Nevertheless, cognitive stimulation can also arise through informal pathways such as community interactions, cultural practices, and day-to-day problem-solving (Udeh-Momoh et al. 2025). These activities can contribute meaningfully to cognitive reserve even in the absence of formal education opportunities. From a non-monetary cost perspective, barriers to both formal and informal avenues of cognitive engagement—such as limited time, fatigue from work, or lack of supportive community structures—can elevate the effort required to sustain these activities. Recognising these diverse sources of cognitive stimulation is essential to understanding the protective effects of education and cognitive engagement against dementia risk (Udeh-Momoh et al. 2025).

2.2 Hearing and visual loss

Hearing and visual loss require preventive and maintenance behaviours. For hearing loss, individuals are encouraged to avoid harmful noise levels (Cunningham Lisa and Tucci

Debara 2017), attend regular hearing screenings (Jenstad and Moon 2011; Cantuaria et al. 2024), and consistently use hearing aids when necessary (Yeo et al. 2023). For visual loss, behaviours include scheduling regular vision checks, using corrective lenses (Lee et al. 2022; Li and Zhu 2024; Ehrlich et al. 2022), and minimising prolonged screen exposure (Manwell et al. 2022; Neophytou, Manwell, and Eikelboom 2021). While these behaviours carry direct financial costs, they also involve non-monetary costs such as discomfort, cognitive adjustment, maintenance routines, and the time and effort required to attend healthcare appointments (Hong et al. 2014; Hughes, Fylan, and Elliott 2021; Manwell et al. 2022; Neophytou, Manwell, and Eikelboom 2021). These non-monetary costs are amplified in adverse SDH settings, where non-monetary costs include limited access to visual and auditory health specialists, transportation burdens, and long wait times (Tsimpida et al. 2021; Arnold et al. 2019; Scholes et al. 2018; Quimby et al. 2023; Jenstad and Moon 2011; Palmer and Zitelli 2024). These conditions increase the effort needed to engage in visual and hearing health-promoting behaviours, illustrating how non-monetary costs can vary depending on the surrounding socioeconomic and environmental conditions.

2.3 High cholesterol, hypertension, diabetes, and obesity

For chronic conditions like high LDL cholesterol, hypertension, diabetes, and obesity, healthy behaviours are essential. These include adopting a low-fat, low-sodium, or low-sugar diet, engaging in regular exercise, and following prescribed pharmacological treatment (Morris et al. 2003; Yassine et al. 2022; Jensen et al. 2015; Iso-Markku et al. 2022; Schutte et al. 2021; Hughes et al. 2020; Merrill et al. 2016; Wang et al. 2021). These behaviours involve significant non-monetary costs, such as searching for and learning about nutrition information, resisting cultural or habitual food preferences, preparing nutritious meals, fitting exercise into busy routines, and accessing healthcare to receive a proper diagnosis (Baratta, Angelico, and Del Ben 2023; Pedersen, Hansen, and Elmoose-Østerlund 2021; Hill-Briggs et al. 2020; Espinoza et al. 2020). All these behaviours require individuals to devote time, cognitive effort, and physical energy. Individuals from adverse SDH backgrounds have lower healthy food accessibility, lower health literacy about the adverse health effects of unhealthy eating, less access to healthcare, often face long commutes and working hours, caregiving burdens, and higher economic constraints, which raise the marginal cost of devoting extra effort and time to these activities, further increasing the adherence costs (Kris-Etherton et al. 2020; Anstey, Christian, and Shimbo 2019; Thomas et al. 2011; Pedersen, Hansen, and Elmoose-Østerlund 2021; Sequeira et al. 2011; Sallis et al. 2016; Hill-Briggs et al. 2020; Flood et al. 2021; Fan et al. 2016). These non-monetary costs contribute to higher fatigue levels, reduced planning capacity, and limited flexibility in time allocation, making it more challenging to adopt and sustain healthy behaviours.

Government policies can play a critical role in shaping the nutritional and behavioural environments that influence these conditions. Tobacco control provides a clear example: the WHO Framework Convention on Tobacco Control (FCTC) has contributed to substantial reductions in smoking prevalence worldwide (Paraje et al. 2024), showing how policy interventions can shift population behaviours. Comparable approaches in nutrition include sugar taxes, trans fat bans, sodium reduction strategies, and mandatory front-of-package labelling (Mostert, Milena, and Crutzen 2025; Crosbie et al. 2023). These measures

have influenced consumer choices toward healthier options and prompted producers to reformulate products to avoid warning labels, thereby reducing unhealthy content in the food supply. By lowering both the direct exposure to harmful products and increasing the monetary costs of making unhealthier choices through taxes, such policies contribute to reduced dementia risk at the population level by improving cardiometabolic health.

2.4 Depression and social isolation

Depression and social isolation are two MRFs for dementia that share overlapping behavioural and structural challenges. Recommended behaviours for managing depression include engaging in psychotherapy, maintaining social ties, and participating in physical activity (Yang et al. 2023). Similarly, mitigating social isolation involves maintaining regular social interactions (Sommerlad et al. 2023). These actions require emotional resilience, motivation, and planning—resources often depleted by the symptoms they aim to address (Jalali et al. 2023; Wang et al. 2024; Vuorilehto et al. 2016). Among individuals facing SDH adversity, these non-monetary costs are further heightened by long working hours, caregiving responsibilities, or extended travel times, all of which reduce the available time and energy to address these risk factors (Wang et al. 2024; Vuorilehto et al. 2016). Additionally, structural non-monetary costs such as a lack of mental health services, cultural stigma surrounding mental illness, limited availability of group activities, poor transportation infrastructure, and restricted access to digital tools further increase the effort needed to engage in protective behaviours (Rozynek and Lanzendorf 2023; Niemeyer and Knaevelsrud 2023). Together, these conditions make it more difficult for individuals facing SDH adversity to reduce their risk of dementia through social or psychological pathways.

2.5 Physical inactivity

Physical inactivity requires an interruption of sedentary behaviours and increased engagement in regular physical exercise to mitigate its effects (Iso-Markku et al. 2022; Jensen et al. 2015). Physical activity is any bodily movement that generates an energy expenditure greater than rest, while physical exercise is that structured and planned physical activity that aims to improve or maintain some component of physical fitness, such as strength (Adami et al. 2018). The time and metabolic cost required for regular exercise often compete with other obligations such as work shifts and caregiving duties (Brand and Cheval 2019). Individuals living in adverse contexts often experience fatigue and have limited discretionary time, which reduces their capacity to engage in physical activity. Moreover, environmental barriers—such as a lack of secure, well-lit sidewalks, parks, or recreation centres—make exercise feel unsafe or impractical, further discouraging consistent participation (Sequeira et al. 2011; Sallis et al. 2016; Reichert et al. 2007). These overlapping constraints elevate the non-monetary cost of physical activity and help explain the persistence of sedentary behaviours in populations facing SDH adversity, contributing to increased dementia risk.

2.6 Tobacco and alcohol consumption

Addressing smoking and excessive alcohol consumption requires individuals to engage in cessation efforts, attend behavioural programs, and build new coping mechanisms (Jeong et al. 2023). These behaviours require sustained emotional and psychological resilience, as

they involve overcoming physiological withdrawal symptoms, managing emotional triggers, and resisting ingrained coping mechanisms that have often become deeply embedded due to chronic stress (Chaiton et al. 2016; Kelly et al. 2018). Individuals must develop and maintain new routines and coping strategies, such as seeking social support or engaging in alternative activities, while also confronting environments and social networks where smoking or alcohol consumption is normalised (Chaiton et al. 2016; Kelly et al. 2018). In disadvantaged populations, individuals may rely on smoking or alcohol as immediate coping strategies because they are accessible, socially reinforced, and require minimal time or planning. These burdens are compounded by limited access to appropriate cessation programs, elevated monetary costs, environments where smoking and drinking are normalised, and a lack of alternatives for managing stress, reinforcing the difficulty of sustaining cessation efforts (Raggi et al. 2022; Schwarzsinger et al. 2018; Calling et al. 2019; Probst et al. 2020). This continuous need for self-regulation, particularly in settings with limited external support or high psychosocial stress, increases the psychological and emotional effort required to achieve and sustain cessation.

2.7 Air pollution and traumatic brain injury (TBI)

For air pollution and TBI, recommended behaviours include avoidance of polluted areas, use of indoor air filtration (Wilker, Osman, and Weisskopf 2023; Chen and Kan 2022), using protective gear to prevent head trauma and avoiding high-risk behaviours that increase the likelihood of injury, such as unsafe recreational or occupational practices. These actions involve non-monetary costs, such as planning, self-regulation, and both financial and time investments in acquiring, maintaining, and consistently using protective equipment. Avoiding risky environments or behaviours—whether recreational, occupational, or domestic—requires individuals to exert vigilance, adjust routines, and sometimes forgo economically necessary activities that carry injury risk (Maas et al. 2022). In underserved settings, these non-monetary costs are further increased by minimal control over environmental exposures, limited access to safety infrastructure, and a lack of education or awareness about injury prevention (Maas et al. 2022). In the case of air pollution, individuals have little to no control over exposure, making personal preventive actions mostly ineffective (Wilker, Osman, and Weisskopf 2023). By contrast, reducing TBI risk depends more directly on individual action, yet faces non-monetary costs such as the absence of safe recreational or supervised environments, and exposure to unsafe living or working conditions (Maas et al. 2022). Together, these barriers elevate the perceived and actual non-monetary cost of adopting preventive behaviours against TBI and air pollution exposure.

2.8 Toward an integrated view of MRFs and non-monetary costs

These heightened non-monetary costs across all MRFs limit the feasibility of adopting and maintaining healthy behaviours, reinforcing the elevated dementia risk in populations facing SDH adversity. Characterising and addressing these non-monetary costs—such as time constraints, cognitive demands, and metabolic cost—is essential for creating equitable dementia prevention strategies at the individual and population level (Walsh et al. 2023). This also serves a critical function in dismantling the view that treats MRF as isolated, abstract entities, divorced from the structural realities that shape them, and overemphasising

individual responsibility while obscuring the upstream social and environmental drivers of risk (Daly 2024b; Daly, Mastroleo, and Migliaccio 2022; Daly 2024a; Horstkötter, Deckers, and Köhler 2020). SDH tend to cluster with health and MRFs to predict dementia (Livingston et al. 2024), while the exact high non-monetary costs are present for several MRFs in persons with adverse SDH (e.g., fatigue from extended work hours, limited access to healthcare and safe spaces for physical activity, high-stress living environments, Table 1). By grounding MRFs in their social and environmental context through the lens of non-monetary costs, we advance toward shifting the focus away from abstract behavioural prescriptions towards the concrete, systemic barriers that shape real-world choices. This reframing enables the development of pragmatically grounded and equity-driven research designs, interventions, clinical practices, and public policies aligned with lived social and cognitive realities.

3 How to measure and incorporate non-monetary costs assessment into practice

Currently, there are no standardised or unified protocols for evaluating the non-monetary costs associated with engaging in healthy behaviours for dementia risk reduction. Their accurate quantification requires assessments of determinants such as hours worked, time spent commuting, time dedicated to caregiving or household tasks, and time available for leisure or rest. Ideally, this involves mapping an individual's weekly time use across categories (e.g., work/study, commuting, sleep, caregiving, social interaction, leisure time) to approximate a complete daily or weekly profile. This time-use data must be collected in real-life, non-laboratory settings to ensure ecological validity. Digital tools such as smartphone applications, wearable devices, and time-tracking software offer promising opportunities for both passive and active data capture. Such tools can generate valuable, ecologically grounded data to inform research, intervention, clinical practice, and public policy.

In research, incorporating non-monetary costs frameworks can enhance the ecological validity of studies examining MRFs and lifestyle interventions for dementia prevention. These costs are typically underrepresented in standard study designs, yet they fundamentally shape the feasibility and sustainability of health behaviours. Unlike monetary costs, which are measured in currency, non-monetary costs represent a latent construct that must be inferred through indirect indicators, such as hours worked, commuting time, caregiving demands, stress measures, or available leisure time (Araya-Ríos and Trepél 2024). Incorporating assessments of non-monetary costs into intervention design enhances ecological validity and ensures alignment with participants' lived constraints, thereby improving feasibility and impact. Aligning intervention delivery with individuals' actual time use and contextual limitations lowers the perceived and real burden of participation, improving feasibility, sustained engagement and reducing disparities in participation and adherence in lifestyle-based multidomain dementia prevention programs (Coley et al. 2021). For example, mobile-based interventions, flexible group formats, or integrated services delivered in community settings may reduce participation barriers and enhance intervention uptake among high-risk individuals.

In clinical care, systematically assessing individuals' time availability, caregiving burden, literacy, and access constraints enables providers to offer more realistic behaviour change plans and support systems. This approach avoids overprescribing idealised interventions that may be infeasible in the patient's social context, thereby increasing adherence and the likelihood of sustained dementia risk reduction. In the context of social prescribing—a clinical practice model that enables health professionals to refer patients to nonmedical, community-based services such as exercise programs, nutritional guidance, arts-based activities, or social support networks—(Roland, Everington, and Marshall 2020) offers a promising avenue for embedding the non-monetary costs approach into practice. Current limitations in social prescribing, such as digital exclusion, lack of public transport access, and scheduling inflexibility (Marshall et al. 2025), may be characterised as elevated non-monetary costs and addressed through individualised assessment and structural support (e.g., accessible public transport, translated materials, flexible programming). Such approaches can enhance the accessibility and equity of social prescribing initiatives, particularly for those facing the greatest social disadvantage.

From a public policy standpoint, these insights call for structural interventions that reduce the indirect burden of engaging in healthy behaviours. Policies should adopt whole-population approaches (Walsh et al. 2022) and prioritise investments in community infrastructure (e.g., walkable neighbourhoods, subsidised healthy food markets), targeted subsidies, accessible transportation to reduce commute times, labour rights to promote work-life balance and leisure activities (Su et al. 2022), and expanded access to preventive care services (Daly 2024b). Addressing non-monetary costs at a population level is essential for promoting equitable health and reducing dementia risk (Walsh et al. 2022).

4 Conclusion

The relationship between SDH and MRF for dementia operates through two interconnected pathways. First, a direct pathway, where cumulative exposure to SDH adversity leads to biological and physiological changes via dysregulation of the HPA axis activity and endothelial dysfunction, chronic inflammation, elevated peripheral inflammatory cytokine levels, and elevated allostatic load. Second, an indirect pathway, where adverse environments increase the difficulty of adopting healthy behaviours by elevating the required metabolic costs, which individuals perceive as physical and cognitive effort. We define this second pathway as non-monetary costs. This second pathway requires recognising the central role of individual choice, particularly in situations where, despite appearing to have a choice, individuals effectively lack one due to prohibitively high non-monetary costs. It is necessary to clarify that acknowledging the role of individual choice does not imply assigning responsibility to the individual. Instead, by framing the issue in terms of choice, attention can be directed toward identifying and reducing non-monetary costs at the population level, enabling individuals to exercise agency over their health behaviours. This framing enables the design of population-level policies that complement the allocation of monetary resources to healthcare systems, while also making the choice of individuals to adopt healthier behaviours more accessible and feasible.

We highlight how non-monetary costs, such as time, physical and cognitive effort, serve as critical mediators between structural disadvantage and dementia risk. By identifying and integrating these non-monetary burdens, we propose a reconceptualization of modifiable risk factors that is grounded in social context, practical feasibility, and lived experience. Without the systematic integration of non-monetary cost assessments, dementia prevention efforts risk perpetuating inequities by privileging individual agency over structural accountability.

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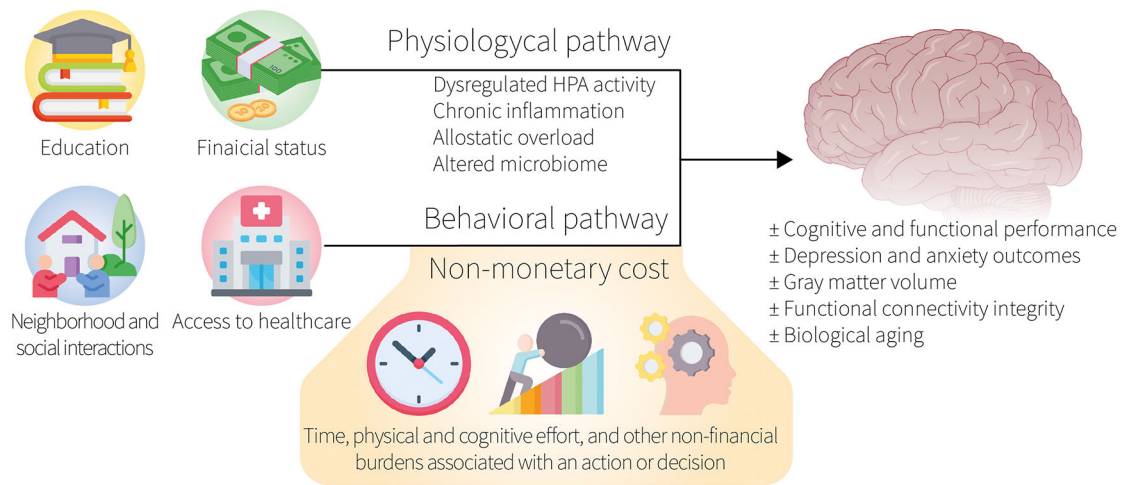
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a. Pathways linking social determinants of health to brain health



b. Non-monetary cost inequity

Favorable SDH - low non-monetary costs

Adverse SDH - high non-monetary costs

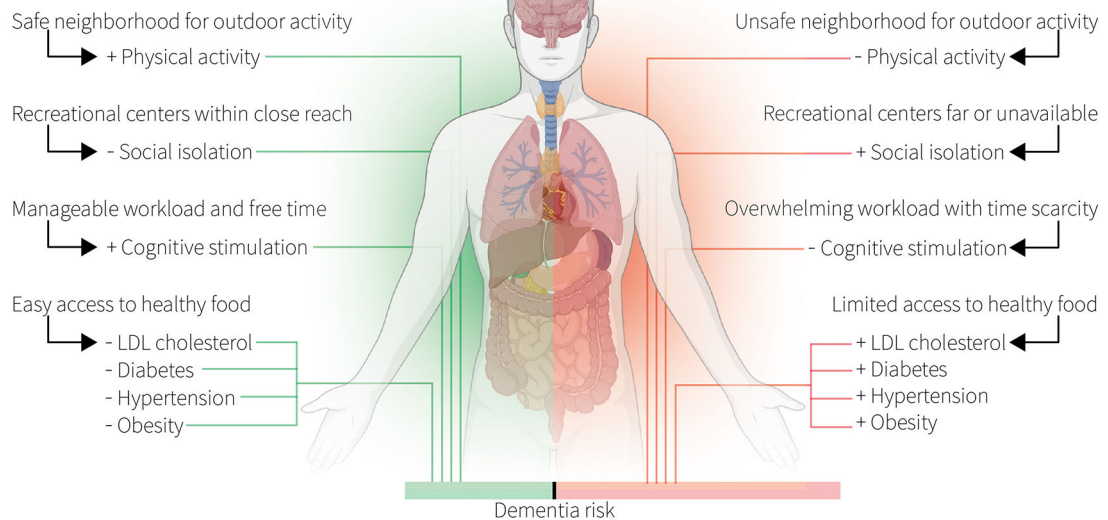


Table 1.

Non-monetary costs and barriers in contexts of social determinants of health adversity for modifiable risk factors for dementia.

Potentially modifiable risk factor	Healthy behaviours related to risk reduction	Non-monetary costs	Barriers in people with adverse SDH	Recommended actions on non-monetary costs
Less education	Engage in cognitively stimulating activities Participation in educational programs	Learning requires cognitive effort after extended work-related fatigue (Cunningham et al. 2022) Educational activities reduce limited rest time and increase mental load (Artazcoz et al. 2024)	Long work hours or informal jobs limit free time (Cunningham et al. 2022) Limited supportive social networks (Winding and Andersen 2015) No access or only low-quality access to education (Livingston et al. 2024)	Expand flexible and community-based educational programs that reduce fatigue and time demands while strengthening social support
Hearing loss	Avoidance of harmful noise exposure Routine hearing checks for early detection Consistent use of hearing aids when indicated	Adjustment period and initial discomfort (Hong et al. 2014) Ongoing maintenance of hearing aids (Hong et al. 2014) Effort required to learn effective use (Hong et al. 2014) Time, planning, and transport needed for checkups (Hong et al. 2014)	Limited audiology services delay diagnosis and intervention (Tsimpida et al. 2021) Perceived burden of time and transport, intensified by competing demands and scarce resources (Arnold et al. 2019) Hearing loss often underestimated by the individual (Jenstad and Moon 2011) Low perceived benefit reduces trust in hearing aids (Palmer and Zitelli 2024)	Increase accessibility to hearing checks through mobile services, simplify training for hearing aid use, and promote peer support to ease adaptation
High LDL cholesterol	Adoption of a diet low in saturated and trans fats Engagement in regular physical activity	Time and cognitive effort required to learn nutrition and prepare healthier meals (Baratta, Angelico, and Del Ben 2023) Need to overcome taste preferences or cultural norms favoring high-fat foods (Baratta, Angelico, and Del Ben 2023)	Limited access to preventive care or counseling delays detection and lifestyle change (Baratta, Angelico, and Del Ben 2023) Insufficient health literacy or lack of nutrition information (Baratta, Angelico, and Del Ben 2023) Dependence on low-cost, high-fat foods in areas without affordable healthy options (Kris-Etherton et al. 2020)	Provide culturally tailored cholesterol-lowering nutrition guidance, expand access to affordable heart-healthy foods, and offer simple meal-prep tools that reduce planning burden
Depression	Engagement in psychotherapy Participation in social interactions Regular physical activity	Therapy and social engagement may evoke emotional distress; depression symptoms increase perceived effort of physical activity (Vuorilehto et al. 2016) Mental health care requires time for therapy, self-guided exercises, social interaction, and routine adjustments (Vuorilehto et al. 2016)	Stigma around mental illness (Vuorilehto et al. 2016) Limited access to mental health services (Niemeyer and Knaevelsrud 2023)	Increase access to low-burden therapies and telehealth while embedding physical and social activities in supportive community settings
Traumatic brain injury	Use of protective gear Avoiding risky behavior	Physical discomfort and adjustment to equipment (Maas et al. 2022) Time and financial investment required to access adequate protective gear (Maas et al. 2022)	High perceived cost of protective gear limits acquisition (Maas et al. 2022) Limited awareness or education on injury risks (Maas et al. 2022) Fewer opportunities for safe behaviors due to unsafe environments or lack of supervision (Maas et al. 2022)	Ensure affordable protective gear and deliver injury-prevention education in schools and workplaces with safe recreational spaces
Physical inactivity	Regular physical exercise	Physical exertion required (Brand and Cheval 2019) Time investment needed (Brand and Cheval 2019) In very sedentary people, overcoming delayed onset muscle soreness (Brand and Cheval 2019)	Lack of safe, accessible spaces discourages regular physical activity (Sequeira et al. 2011) Fatigue from demanding work or multiple jobs (Sallis et al. 2016) Limited free time due to long commutes and caregiving duties (Reichert et al. 2007)	Create safe and nearby opportunities for exercise with beginner-friendly programs that integrate activity into daily routines

Potentially modifiable risk factor	Healthy behaviours related to risk reduction	Non-monetary costs	Barriers in people with adverse SDH	Recommended actions on non-monetary costs
Diabetes	Diet low in simple sugars and refined carbohydrates Regular physical activity	Preparing balanced meals while limiting culturally or personally preferred high-sugar foods (Hill-Briggs et al. 2020) Sustained planning and habit adjustments needed to select low-sugar foods, read labels, and maintain exercise routines (Espinoza et al. 2020)	Limited free time for health-promoting activities (Sallis et al. 2016) High cost and low availability of healthy food exceed budget constraints (Flood et al. 2021) Limited access to screenings and nutrition counseling delays early intervention (Hill-Briggs et al. 2020) Low health literacy hinders understanding of treatment plans and nutrition labels (Sallis et al. 2016)	Offer culturally tailored diabetes education focused on label-reading, affordable healthy food options, and community-based exercise groups adapted to daily schedules
Smoking	Smoking cessation Participation in cessation programs	Managing withdrawal, cravings, and triggers requires sustained emotional and physical resilience (Chaiton et al. 2016) Developing alternative coping strategies to replace smoking for stress or anxiety management (Chaiton et al. 2016)	Stressful life circumstances hinder cessation efforts (Raggi et al. 2022) Limited access to cessation support services (Raggi et al. 2022) Social norms and peer influence in high-smoking communities discourage quitting (Raggi et al. 2022)	Provide accessible cessation supports combined with stress-management alternatives and community campaigns
Hypertension	Diet low in sodium Regular physical activity Consistent medication use and regular blood pressure monitoring	Learning to interpret sodium content and use alternative seasonings (Schutte et al. 2021)	Limited time for meal preparation (Kris-Etherton et al. 2020) Fatigue from extended work hours (Anstey, Christian, and Shimbo 2019) Restricted access to safe spaces for physical activity (Schutte et al. 2021) High-stress living environments (Schutte et al. 2021)	Increase access to hypertension management through low-cost salt substitutes, community blood pressure monitoring stations, and accessible stress-reduction resources in high-burden settings
Obesity	Balanced, calorie-reduced diet Regular physical activity Behavioral or psychological support interventions	Researching healthy recipes and shopping for fresh produce (Merrill et al. 2016) Preparing meals at home (Pedersen, Hansen, and Elmoose-Østerlund 2021) Mental effort to resist cravings (Pedersen, Hansen, and Elmoose-Østerlund 2021) Physical exertion from regular activity (Pedersen, Hansen, and Elmoose-Østerlund 2021)	Fast food and processed items are often cheaper and more accessible than fresh produce in low-income areas (Kris-Etherton et al. 2020) Fatigue from physically demanding work reduces capacity for additional health behaviors (Sequeira et al. 2011)	Support access to affordable healthy foods and community cooking programs while encouraging low-burden physical activity with psychological support
Excessive alcohol	Abstinence from or reduction in substance use	Psychological stress and discomfort from cravings or withdrawal (Kelly et al. 2018) Effort required to redefine social relationships and manage peer pressure around alcohol use (Kelly et al. 2018)	Limited awareness of long-term alcohol-related harms and lack of alternative stress coping strategies (Schwarzinger et al. 2018) Increased susceptibility to social norms and peer pressure promoting heavy drinking (Probst et al. 2020)	Develop peer-led supports and alcohol-free social spaces alongside campaigns that increase awareness of harms and coping strategies
Social isolation	Regular social interactions	Mental fatigue from initiating new social connections after demanding workdays (Sommerlad et al. 2023) Sacrificing limited rest or personal time for social engagement (Wang et al. 2024)	Long work hours, fatigue, and limited social opportunities (Rozynek and Lanzendorf 2023) Transportation barriers to social engagement (Rozynek and Lanzendorf 2023)	Strengthen community hubs with flexible hours, affordable transport, and digital platforms that make social connections more accessible
Air pollution	Avoidance of polluted environments Use of indoor air filtration systems	Time and cognitive effort required to monitor air quality and adjust activities (Chen and Kan 2022) Reduced outdoor engagement and increased indoor time to	Close proximity to pollution sources with little control in low-income areas (Chen and Kan 2022) Insufficient resources for air purifiers, masks, or cleaner environments (Chen and Kan 2022)	Deliver clear air-quality alerts and accessible delivery of low-cost air cleaning systems

Potentially modifiable risk factor	Healthy behaviours related to risk reduction	Non-monetary costs	Barriers in people with adverse SDH	Recommended actions on non-monetary costs
		limit exposure (Chen and Kan 2022)	Limited ability to modify surroundings to reduce exposure (Wilker, Osman, and Weisskopf 2023)	
Visual loss	Routine vision checks Use of corrective measures (e.g., glasses) Reduced screen time and regular breaks from digital devices	Effort required to adapt to corrective measures (Hughes, Fylan, and Elliott 2021) Time commitment for regular healthcare visits (Hughes, Fylan, and Elliott 2021) Cognitive effort and discipline needed to reduce screen time despite digital reliance (Manwell et al. 2022)	Limited access to vision care and corrective lenses due to cost or availability (Manwell et al. 2022) Dependence on screens for affordable entertainment, education, or work limits ability to reduce exposure (Manwell et al. 2022)	Expand low-cost vision care through mobile services, promote practical screen-use adaptations, and increase accessibility through subsidized or home-delivered corrective devices

SDH: Social determinants of health; LDL: low-density lipoprotein.

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