Next generation brain health: transforming global research and public health to promote prevention of dementia and reduce its risk in young adult populations

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Efforts to prevent dementia can benefit from precision interventions delivered to the right population at the right time; that is, when the potential to reduce risk is the highest. Young adults (aged 18–39 years) are a neglected population in dementia research and policy making despite being highly exposed to several known modifiable risk factors. The risk and protective factors that have the biggest effect on dementia outcomes in young adulthood, and how these associations differ across regions and groups, still remain unclear. To address these uncertainties, the Next Generation Brain Health team convened a multidisciplinary expert group representing 15 nations across six continents. We identified several high-priority modifiable factors in young adulthood and devised five key recommendations for promoting brain health, ranging from individual to policy levels. Increasing research and policy focus on brain health across the life course, inclusive of younger populations, is the next crucial step in the efforts to prevent dementia at the global level.

Introduction

Prevention of Alzheimer's disease and related dementias (ADRD) is a global health priority. Modifiable factors related to lifestyle and environment account for 45–60% of variability in the risk for ADRD, with stronger effects in under-researched and underserved groups.[1,2] Interventions that target modifiable factors could reduce future disease burden by a great extent. Positive trends are already emerging in high-income countries, where higher education levels and better treatment of cardiovascular risk could be contributing to reduced incidence of ADRD.[3] Randomised controlled trials testing causal effects of modifiable factors are already ongoing. The extant findings are mixed,[4,5] highlighting the complexities involved in participant selection and intervention delivery windows.

An important focus of ADRD prevention efforts is precision interventions that can be delivered to the right population at the right time.[6] However, this approach suffers from crucial knowledge gaps around modifiable factors across the life course.[7] ADRD research focuses heavily on mid-life to late life (>40 years), and to some extent on childhood (<18 years).[7] Less attention has been given to the life period in between: young adulthood.[8] Young adulthood, which ranges from age 18 years (ie, end of adolescence) to 39 years (ie, before mid-life),[9,10] is neglected in ADRD prevention models–a missed opportunity because exposure to many recognised modifiable factors begins or peaks during this period of life.[11]

Young adulthood is a unique, transitional life stage during which individuals develop new skills and values in the context of growing independence. Young adulthood should be considered as distinct to early life and mid-life in ADRD prevention models for two key reasons. First, young adulthood is characterised by notable shifts in the prevalence and patterns of health behaviours.[12] Behaviours such as smoking and alcohol use peak in the ages from the early-to-mid-20s.[13,14] Young adulthood is also marked by increased experimentation and risk-taking behaviours such as drug use.[15] Second, behaviours established during young adulthood can have long-term implications on health.[16] For example, lower physical activity in people aged 18 years is associated with higher odds of premature cardiovascular disease.[17] Health trajectories set during young adulthood could also influence broader social and economic outcomes, such as further education, occupation, and income.[16]

Accordingly, young adulthood can be viewed as a window of opportunity for early intervention, which could help to mitigate the risk of late life conditions such as ADRD. Unfortunately, public health messaging around ADRD prevention does not target young adults, and their knowledge of lifestyle factors associated with dementia risk is poor.[18] The concept of brain health has gained increasing attention in public campaigns. Brain health can be defined as a continuous state of maintaining optimal brain function that best supports a person's health and wellbeing throughout life.[19] As with ADRD prevention, brain health messaging is yet to target young adults.

To address the crucial knowledge gaps around modifiable ADRD risk exposure in young adults, the Next Generation Brain Health team convened a diverse, multidisciplinary group to identify high-priority modifiable factors for ADRD in global young adult populations and evolve strategies to promote prevention in this age group through individual-level intervention and policy-level intervention(s).

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Modifiable ADRD factors in young adulthood

The methodological details are provided in appendix pp 2–3. We took into consideration the recognised factors[2] and emerging factors identified by the group (figure, table 1). The methodological details are provided in the appenidx (pp 2–3).

Education

Globally, one in five adults (19%) have no formal schooling.[20] Although the gaps are narrowing, young women have less education than young men in most regions,[20] and minoritised communities continue to face barriers to high-quality education and university participation.[21] In the USA, as per data from 2014, 35% of young Hispanic adults (aged >25 years) did not complete high school, and college enrolment was higher for young White adults than for young Black and Hispanic adults.[22] Similarly, in Australia, as per data from 2021, 32% of young Aboriginal and Torres Strait Islanders (aged 20–24 years) did not complete high school.[23] Specific data linking tertiary education and ADRD risk are insufficient. However, educational attainment is a key driver of socioeconomic resources throughout life, such as occupation, economic outcomes, social status, and access to health care.[24] Thus, promoting continued education through early adulthood could confer benefits that contribute to lower ADRD risk directly (ie, cognitive or brain reserve, or both) and indirectly (ie, upward mobility).[24]

Hearing loss

Up to one billion young adults (aged 18–34 years) globally are estimated to be at risk of permanent, avoidable hearing loss caused by exposure to loud noise and unsafe listening practices.[25] Young adults face multiple noise exposure sources (eg, bars, sporting events, and personal devices). Exposure to loud noise is the highest among young men.[26] In high-income countries, young adults are more likely to engage in risky listening behaviours, such as listening to music at high volumes, than other age groups.[27] In low-income countries, the leading causes of noise-induced hearing loss are occupational exposure and ear infections.[28] Hearing loss could increase the risk for ADRD directly through changes in the brain caused by less stimulating environments or indirectly through the knock-on effects of social isolation. Hearing loss in young adulthood could contribute to both pathways. Moreover, because of accumulation of hearing damage, young adults might be susceptible to long-term harms with respect to ADRD.

Traumatic brain injury (TBI)

Young adults are among the population at the highest risk for TBI, with leading causes being motor accidents, sports-related injuries, and intimate partner violence (IPV).[29,30] Men are more likely to be injured due to sports or motor vehicle accidents, whereas women are disproportionately affected by TBI associated with IPV.[31] Rates of TBI caused by IPV are estimated to be 11–12 times higher than those caused by sports or military service.[32] However, IPV and ADRD are highly under-researched. Young women (aged 18–29 years) are most at risk of IPV, with a lifetime prevalence of 19–66%.[33] Prevalence of IPV is even higher for young women who are socially and structurally vulnerable (eg, sex workers).[34] Latin America and the Caribbean faces an epidemic of gender-specific violence; over half of the countries (56%) with the highest femicide rates are in this region.[35]

Repetitive TBI is associated with chronic traumatic encephalopathy in young contact sport athletes (aged >18 years).[36] Because IPV is typically long term,[37] the affected individuals could face a similar risk for chronic traumatic encephalopathy.[38] Repetitive subconcussive injuries (ie, brain damage that does not present observable symptoms) are an area of growing concern. Studies with young athletes (aged 18–23 years) indicate detectable brain changes, even after one season of play.[39,40] Military service members are another group at high risk of TBI. Military recruitment strategies intentionally target young adults, including recent school graduates.[41] In the USA, the average age of members enlisted for active duty is 27·3 years.[41]

Hypertension

Hypertension is estimated to affect one in 12 young adults (aged 18–39 years) globally.[42] Prevalence estimates are higher in men and in low-income and middle-income countries (LMICs).[42] Although data on racial and ethnic disparities in younger groups are scarce, one study of Black Americans aged 18–44 years reported prevalence rates of nearly one in three.[43] Hypertension in young adulthood is associated with numerous brain abnormalities,[44] which could heighten the long-term risk of ADRD. These abnormalities notwithstanding, early-onset hypertension is a major risk factor for mid-life health conditions, including cardiovascular disease.[42] The fact that prehypertension is common in younger adults (estimated 38–77% for individuals aged <44 years) is especially worrying.[45]

Alcohol use

An estimated 41% of young adults (aged 20–24 years) worldwide drink alcohol.[46] Although global data by race and ethnicity are scarce, problematic drinking behaviours have been found to peak in individuals aged in their early 20s.[14] Both alcohol use and binge drinking are higher in young men than in young women and in Europe than in the rest of the world.[46] In the USA, alcohol consumption is the highest in young White adults (aged 18–34 years).[47] Drinking heavily in young adulthood is a risk factor for alcohol use disorder and most people who develop this condition do so by age 40 years.[48] Young adult heavy drinkers show changes in the brain that could be related to neurotoxic effects.[49] For emerging adults (ie, aged 18–25 years) who are undergoing an important period of neurodevelopment, these alcohol-related changes in the brain could have long-term effects on health.

Obesity

Global estimates indicate that nearly one in four (23·8%) people aged 15–40 years meet the criteria for obesity.[50]

Obesity is rising the fastest in adolescent and young adult populations.[50] Prevalence estimates are the highest in women, individuals who identify as White, and those from high-income countries.[50] Obesity is thought to increase the risk for ADRD through chronic inflammation and cardiovascular factors, which can start to accumulate before mid-life. Evidence in young adults is mixed, with some studies supporting an association between higher BMI and an increased risk for ADRD.[51] At a minimum, obesity in young adulthood can negatively affect health and lifestyle outcomes later,[52] and being overweight in young adulthood predicts mid-life obesity.[53]

Smoking

An estimated 90% of people who smoke cigarettes every day start the habit before 26 years of age, and smoking peaks in young adulthood (aged 18–25 years).[13] Smoking is more common in young men than in young women (20% *vs* 5%).[54] Evidence suggests no clear smoking patterns across racial and ethnic groups globally.[55] Regionally, high rates of smoking exist in LMICs, upwards of 46% in some countries.[56] High disparities in prevalence also exist between countries, although socioeconomic deprivation remains a consistent risk factor.[57] Prevalence estimates within Europe range from 7·2% in Sweden to 36·6% in Greece.[57]

Evidence supports a dose-dependent relationship between early smoking trajectories (aged >18 years) and poor cognitive performance in mid-life.[58] Young adults who smoke are more likely to report subjective cognitive complaints than non-smokers.[59] Use of e-cigarettes (vaping) is rising among younger generations in high-income countries,[60] which has potential for both positive and negative effects on health. On the one hand, vaping is associated with cessation of cigarette smoking.[61] On the other, people who vape are exposed to tobacco-related toxicants, the long-term health effects of which are unknown.[62]

Depression

Onset of depression is estimated to peak in the early 20s.[63] Although its prevalence in young adults was on the rise before the COVID-19 pandemic, the risk of depression tripled during the pandemic, with women being disproportionally affected.[64] One in three Americans with depression are young adults (aged 18–39 years).[65] Growing evidence indicates that individuals who identify as Black, Hispanic, or Asian experience more depressive symptoms than do those who identify as White.[66]

Some mechanisms linking depression and ADRD have been proposed in younger generations. Specifically, children and young adults (aged 10–24 years) with depression show subtle evidence of inflammatory dysregulation and hyperactivity of the hypothalamic–pituitary–adrenal axis.[67] Additionally, having a mental health condition early in life predicts future mental health issues.[68] Thus, young adults with depression have higher vulnerability to depression in later life, which has been linked to ADRD, both as a risk factor and a prodrome.

Social isolation

As many as one in five people aged 25–44 years could be socially isolated.[69] Data on the prevalence of social isolation across sex, gender, and racial and ethnic groups are poor. Bullying is a key cause of social isolation; an estimated 25% of adults experience bullying at work.[70] For younger generations who have grown up as digital natives, social media plays an important role in social isolation. As a group, young adults are heavy social media users, averaging more than 3 h per day (aged 18–24 years).[71] Heavy social media users report feeling lonelier and more isolated than light users.[72] Loneliness (ie, perceived social isolation) in young adults is linked to poor mental and physical health.[73] Over time, chronic isolation could increase the risk of ADRD through mechanisms similar to those described above (eg, inflammation, dysregulation of the hypothalamic–pituitary–adrenal axis, and changes in the brain).

Physical inactivity

Consistent with obesity, the rates of physical inactivity are estimated to be higher in women than in men and in high-income countries than in others.[74] Being physically active in early-to-mid-life (aged >30 years) has been associated with reduced risk for ADRD.[75] Younger generations can be more likely to lead inactive lifestyles than previous generations due to increased sedentary behaviours (eg, occupational) and recreational activities (eg, watching television). Concurrently, workout culture and wellness trends are becoming increasingly popular,[76] which on the one hand, can encourage active lifestyles, promoting cardiovascular health, increasing neuroplasticity and neurotrophic factors, and reducing oxidative stress;[77] and on the other, lead to exercise addiction, appearance-related depression, and excessive diet control.[78]

Diabetes

An estimated 4% of young adults (aged 20–39 years) worldwide have type 2 diabetes as per data from 2021.[79] Women have increased risk of young-onset diabetes (aged <40 years), which has a more rapid course.[79] Youth with the highest prevalence of type 2 diabetes include Canadian First Nations, American Indian and Navajo Nation, Australian Aboriginal and Torres Strait Islander, and African American individuals. One in four young adults (aged 19–34 years) have prediabetes.[79] Chronically elevated blood glucose triggers broad vascular changes that can accelerate ageing of the brain. Longer duration of diabetes most likely exacerbates these effects. Furthermore, gestational diabetes is increasing, with an estimated 16% of livebirths being affected.[80] Gestational diabetes also has wide-ranging downstream effects on both the mother and the offspring, leading to potentially multigenerational increases in the risk for ADRD.

Air pollution

WHO estimates that 99% of people breathe air that is polluted beyond recommended limits.[81] Exposure to air

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See **Online** for appendix

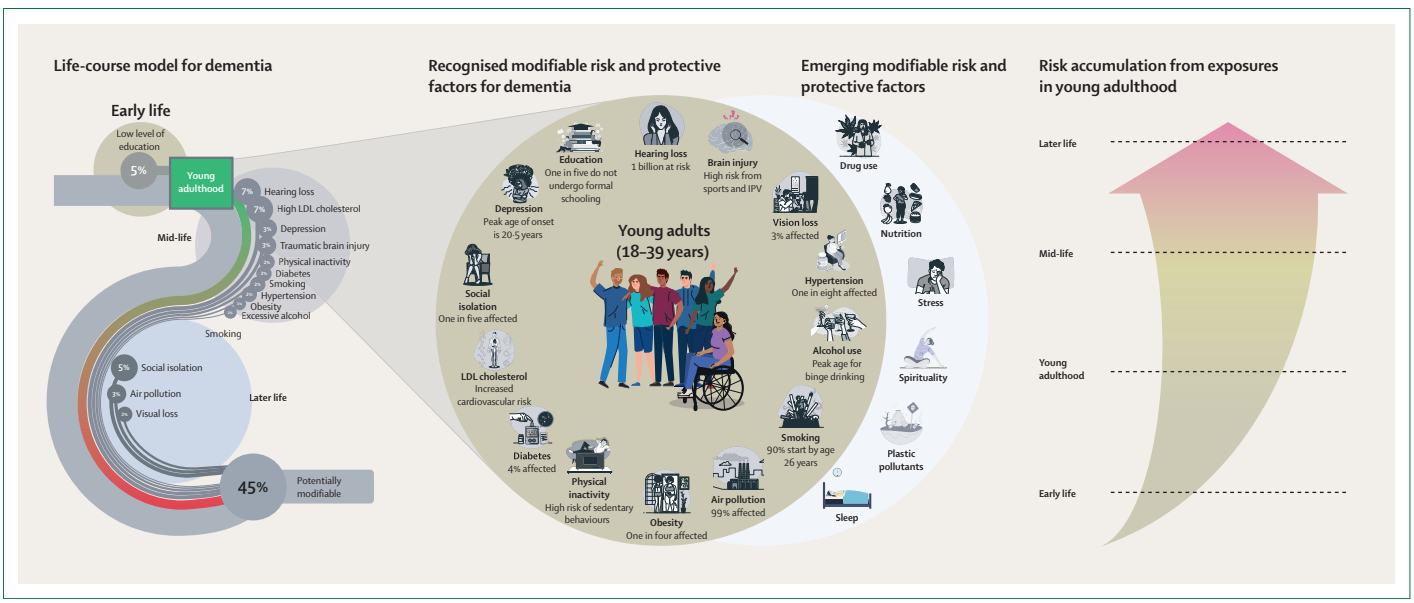

Figure: **The life-course model of dementia.**
Section modified Livingston and colleagues[2]. IPV=intimate partner violence.

pollution is closely linked to poverty. Over 716 million of the world's poorest people live in areas with unsafe levels of air pollution.[82] Evidence from Mexico City, Mexico, indicates that chronic exposure to air pollution results in ADRD-related pathology, even in early adulthood. Studies have consistently reported neuropathology in the brains of young adults (aged ≤30 years) due to exposure to air pollution.[83] Indoor air pollutants, such as household fuels used for cooking, have also been associated with worse cognitive outcomes in individuals as young as 30 years.[84]

Vision loss

A 2021 systematic review found insufficient data sources on avoidable vision loss in young adults.[85] Diabetic retinopathy is one type of vision loss that is common in younger people.[86] Findings from a longitudinal study on type 2 diabetes treatment in young people found that despite having an average age of only 25 years, half of the participants (49%) developed diabetic retinopathy.[87] Cataracts are another major cause of vision loss that is preventable, especially in LMICs.[88] The estimated global prevalence of cataracts in young adults (aged 20–39 years) is 3%;[89] however, considerable regional heterogeneity exists in this context. One study in rural Indonesia reported a 9% prevalence among young adults (aged 21–39 years).[90]

High LDL cholesterol

Global data on LDL cholesterol in young adults are insufficient. The estimated prevalence of high LDL cholesterol in US adults aged 20–45 years is 7%, with men being disproportionately affected,[91] which increases to 12% for individuals with one additional exposure to recognised factors (eg, smoking, hypertension), and 26% for those with two or more exposures.[91] Cumulative LDL cholesterol from young adulthood (aged 18–39 years) has been linked to poor memory performance.[92] However, the most likely mechanisms for the association between LDL cholesterol and ADRD-related outcomes are yet to be investigated in young adults.

Emerging factors

Multiple diets (eg, Mediterranean, Dietary Approaches to Stop Hypertension, and Mediterranean-Dietary Approaches to Stop Hypertension Intervention for Neurodegenerative Delay) reduce cardiovascular risk.[93] Evidence is also building around the positive effects of traditional Latin American, Asian, and African heritage diets. A study among Nigerians from Yoruba descent linked lower ADRD risk to traditional diets comprising low levels of saturated fat and high fibre content, including yam tubers, grains, vegetables, and fish.[94] In contrast, ultra-processed foods negatively affect health and the risk for ADRD.[95] The consumption of ultra-processed foods is rising, making up 50–60% of daily energy intake in some high-income countries,[96] raising concerns for younger generations.

Similar to alcohol and smoking, drug use has the potential to disrupt key brain development phases during emerging adulthood, and chronic exposure could impair cognition.[97] Young adulthood (age 18–24 years) is the peak life stage for drug use, with higher rates among young men.[15] However, the long-term effects of drug use on ADRD are unclear, as many studies of ADRD do not include metrics of drug substance use.

Sleep problems are common in young people. One review estimated the prevalence of insomnia in 20–26-year-olds to be 18·5%.[98] Insomnia, shorter sleep duration, sleep irregularity, and sleep apnoea have all been linked to the risk of ADRD.[99,100] Irregular sleep patterns also disrupt circadian

	Specific relevance in young adulthood
Low level of education	Young women and minoritised communities continue to face barriers against college participation and access to high-quality education
Hearing loss	One billion young adults worldwide are estimated to be at risk of hearing loss due to exposure to loud noises and unsafe listening practices Young adults are more likely to engage in risky listening behaviours than other age groups
Traumatic brain injury	Young adults are at the highest risk for traumatic brain injury Repetitive traumatic brain injuries are common due to sports-related injuries and intimate partner violence Young women face the highest risk of intimate partner violence
Hypertension	Hypertension is estimated to affect one in eight young adults globally, and one in three young Black Americans Rates of prevalence of prehypertension are high and increasing in young adults Early hypertension increases the risk of hypertension and cardiovascular disease in mid-life
Excessive alcohol use	An estimated 40% of young adults worldwide drink alcohol Heavy drinking peaks in young adulthood Young adult drinkers, particularly men, are more likely to present problematic drinking behaviours than other age groups Being a heavy drinker in young adulthood increases the risk of alcohol use disorder
Obesity	Nearly one in four young adults worldwide are estimated to be living with obesity Obesity is rising rapidly in young adults and in low-income and middle-income countries Being overweight in young adulthood increases the risk of obesity in mid-life
Smoking	An estimated 90% of people who smoke cigarettes every day start before the age of 26 years Global estimates of prevalence of smoking are higher in young men than in young women (20% *vs* 5%) E-cigarette use (vaping) is high and rising among young adults and could predict initiation of smoking in later life
Depression	Onset of depression peaks in young adulthood Prevalence of depression in young adults is increasing in many countries, particularly among women Having a mental health condition in young adulthood increases the risk of mental health conditions in later life
Social isolation	Young adults are at high risk of social isolation; as many as one in five young adults could be socially isolated Young adults are growing up in an era of social media saturation, which affects how they interact and form relationships Young adults with high social media use and who report negative online experiences (eg, cyberstalking) report feeling more socially isolated
Physical inactivity	Young adults could be more prone to inactivity due to increased sedentary behaviours and pervasiveness of television and entertainment devices Workout culture and wellness trends are rising among some young adult populations, which can have positive and negative effects (eg, eating disorders)
Diabetes	An estimated 4% of young adults have type 2 diabetes and the prevalence of this condition is rising in this population Approximately one in four young adults is estimated to have prediabetes, a risk factor for diabetes and cardiovascular disease Early-onset diabetes is associated with more rapid disease course and increased risk of chronic complications
Pollution	Pathological changes due to chronic exposure to airborne pollutants are already observable in young adulthood Exposure to air pollution is linked to poor cognitive outcomes in young adults Young adults are at greater risk of long-term exposure to air and other pollutants; they will spend more of their lives breathing unclean air than older individuals
Vision loss	Diabetic retinopathy and cataracts are common sources of preventable vision loss in young adults The estimated global prevalence of cataracts is 3% in young adults
LDL cholesterol	Cumulative LDL cholesterol from young adulthood is linked with poor cognition and increased cardiovascular risk Screening rates for LDL cholesterol concentrations among young adults are particularly low

Table 1: **Relevance of the recognised modifiable factors for dementia in young adulthood**

rhythms. One cause of irregular sleep is shift work. Young adults (aged 18–30 years) are more likely to work night shifts than other age groups.[101] Screen time at night is another driver of circadian disruption and smartphone addiction in young adults could exacerbate these effects.[102] Excessive screen time causes sensory overstimulation and can mimic symptoms of mild cognitive impairment.[103] Reducing screen time has been shown to have benefits for memory, concentration, sleep, and mental health,[104] all of which are crucial components of brain health.

Some evidence suggests that spirituality is associated with a sense of meaning and purpose in life, which could confer protection against ADRD (eg, via stress reduction or by promoting healthy behaviours).[105] However, this aspect is yet to be explored in young adults. Stress has consistently been associated with the risk for ADRD.[106] In young adults, stress can increase maladaptive behaviours such as smoking and alcohol use.[107] Minority stress due to sexism, racism, homophobia, transphobia, or xenophobia is another key consideration that warrants further attention. One final exposure is microplastics, which are detected in air, drinking water, salt, milk, and beer,[108] and have been linked to neuroinflammation in animals.[109] At the current rate, younger generations will spend more of their lives drinking and eating plastic, inevitably affecting their health.

ADRD prevention in young adulthood

Identify the most salient factors in young adulthood

Substantial knowledge gaps remain about how exposure to modifiable factors in young adulthood affect ADRD outcomes. A 2020 data mapping of recognised factors found little to no ADRD research on hearing loss, depression, obesity, inactivity, alcohol, and social isolation in young populations (aged <30 years).[7] Some factors, such as smoking, diabetes, and pollution, have a stronger evidence base. However, data in terms of diversity (ie, across populations) and measurements (eg, inclusion of biological sex but not gender identity) are insufficient. Inevitably, exposure to some factors in young adulthood will be less important than exposure later in life. Applying life-course models to longitudinal data can inform how the timing of exposure to risk factors correlates to disease development;

	Micro (individual) level	Meso (community) level	Macro (national) level
Low level of education	Promote and support the completion of secondary education among young adults in social and family networks	Increase access to high-quality education at primary, secondary, and tertiary levels Invest in educational infrastructure to ensure that schools have adequate facilities to support effective learning and teaching Understand and implement adequate supplementary support for those with barriers that prevent their access to education (eg, respite services for those with caring duties, support for accessibility needs and learning challenges)	Make education (including post-secondary education) free and compulsory Ensure completion of secondary education for all young people Conduct regular evaluation to assess who is receiving education and who is not
Hearing loss	Practise safe listening habits to prevent hearing loss (eg, applying limits on volume control when listening to audio, wearing ear protection such as earplugs or earmuffs in noisy environments or during noisy activities) Promote and support safe listening habits among young adults in social and family networks	Encourage hearing tests to pick up subtle changes in hearing loss that are potentially reversible Ensure engagement of people living with hearing loss and people from the deaf community in policy decision making Provide ear protection at community events that are most likely to exceed safe noise levels	Promote healthy ear and hearing care (eg, public health messaging campaigns about safe listening habits, engage in World HEARing Day on March 3) Engage with advocacy and lived-experience groups for hearing loss Work with the entertainment industry to introduce technological solutions to minimise risks to hearing health
Traumatic brain injury	Wear a helmet or other relevant safety equipment when necessary and comply with relevant legal or workplace safety requirements, or both Ensure understanding of concussions and the ability to recognise the risk of concussions Promote wearing of helmets (or other relevant safety equipment) and concussion education among young adults in social and family networks	Promote awareness and monitoring of brain health at professional and community sports levels (eg, helmets) Increase awareness of intimate partner violence Training in recognising intimate partner violence and better screening and support services	Create expert-consensus national guidelines for identifying traumatic brain injuries and recovery from the same Promote awareness about traumatic brain injury through participation in World Head Injury Day (March 20)
Hypertension	Reduce prehypertension and hypertension rates through lifestyle modification(s) Receive regular checks for high blood pressure by health-care professionals	Establish guidelines for regular blood pressure screening for all adults older than the age of 20 years or for individuals who are overweight or living with obesity	Promote awareness through participation in World Hypertension Day (May 17)
Excessive alcohol use	Reduce alcohol misuse Ensure understanding of safe use of alcohol	Improve early detection of risky drinking behaviours and treatment of alcohol use disorder Increase awareness of alcohol use in relation to brain health	Establish healthy national guidelines on safe alcohol use Create nationally identified clear labelling for consumable products that contain alcohol
Obesity	Reduce obesity rates through lifestyle intervention(s)	Increase accessibility to nutritious, affordable foods, especially for those living in food deserts and at risk of food poverty or insecurity Reduce consumption of ultra-processed foods (eg, through sugar tax)	Cocreate a national obesity strategy with advocacy groups of people living with obesity, governments, industry, and community partners, to change the factors that promote unhealthy weight gain and support those living with obesity Reduce the stigma associated with living with obesity
Smoking	Avoid uptake of smoking and support cessation of smoking, including interventions for cessation of vaping	Increase access to treatments that promote cessation of smoking Reduce access to tobacco products through public health policies (eg, increasing the minimum age for purchase)	Ban the access of younger generations to tobacco products
Depression	Seek support for depression	Improve access to early detection and treatment of depression Increase awareness of depression in relation to brain health Promote the development of established mental health advocacy and lived-experience groups	Promote awareness through participation in World Mental Health Day (October 10) Reduce the stigma associated with depression and accessing support for depression
Social isolation	Promote social engagement through lifestyle intervention(s)	Provide education and support around use and safety of social media Reduce bullying at school and workplace	Develop a national roadmap for social engagement, working with representatives from the voluntary sector, industry, and the government, to ensure development of clear targets, implementation of evaluation procedures, and identification and creation of interventions for social isolation
Physical inactivity	Promote safe exercise habits through lifestyle intervention(s)	Increase access to green spaces Provide incentives to exercise through school or workplace schemes	Develop clear guidelines for physical activity for young adults and work with key government-based, industry-based, and community-based groups to ensure that these guidelines are disseminated to young adults
Diabetes	Reduce prediabetes and diabetes rates through lifestyle modification(s)	Promote regular screening for diabetes and prediabetes in young adults Increase awareness about diabetes in relation to brain health	Cocreate a national diabetes strategy with people living with diabetes, government representatives, industry partners, and community organisations Promote awareness through participation in the global campaign of diabetes awareness (November 14)

(Table 2 continues on next page)

	Micro (individual) level	Meso (community) level	Macro (national) level
(Continued from previous page)			
Pollution	Restrict outdoor physical activity during times of exposure to elevated air pollution Improve indoor air quality (eg, ventilation and elimination of indoor air pollutants) in home settings	Reduce exposure to air and plastic pollution Increase awareness of exposure (eg, monitoring and alert systems) Improve indoor air quality (eg, ventilation and elimination of indoor air pollutants) in community settings (eg, workplaces) and phase out perfluoroalkyl and polyfluoroalkyl substances, also known as forever chemicals (eg, in textiles and single-use plastics)	Promote awareness through participation in International Clean Air Day (September 7)
Vision loss	Seek support for vision changes Use protective eyewear (eg, glasses or eye shields)	Encourage regular eye examinations to identify and treat early vision loss Ensure engagement of people living with vision loss in policy decision making Provide protective eyewear in environments (eg, workplace) with a safety risk	Promote awareness through participation in World Sight Day (October 10) Engage with advocacy and lived-experience groups for vision loss
LDL cholesterol	Reduce LDL cholesterol concentrations through lifestyle modification(s) Attend screenings for cholesterol by health-care professionals	Increase access to regular screening for cholesterol in young adults Increase awareness of links between LDL cholesterol and lifestyle factors (eg, diet, physical activity, smoking)	Promote awareness through participation in World Heart Day (September 29)

Table 2: **Recommended strategies for prevention of dementia and reduction of its risk in young adults**

that is, whether these effects weigh on the crucial period, set health trajectories, or have cumulative effects.[110] More research is also needed to address clustering and accumulation of factors already occurring in young adulthood (appendix p 4).

Increased research focus on young adults will most likely identify previously overlooked targets. For example, with IPV, individuals are at risk not only of TBI but also anoxic or hypoxic brain injuries via strangulation.[111] Indeed, much of the existing evidence comes from cohorts born approximately 100 years ago, which underscores the need to update how factors are conceptualised and measured, by including newer exposures (eg, vaping and ultra-processed foods) and community-level or subclinical-level exposures (eg, mild TBIs among student athletes through contact sports).[112] Accurately capturing these data in diverse and representative younger samples will require new prospective epidemiological studies. Retrospective studies will also be an important tool to inform the development of new cohorts. Similarly, researchers can leverage analytical approaches that better align with life-course perspectives and address potential biases, such as age-period-cohort models.[113]

Increase awareness among young adults

Young adults are unfamiliar with the term brain health and feel that they have inadequate access to personally actionable evidence,[114] which can be addressed by imparting the current best knowledge to them. Such an approach is already under way in other age groups (eg, MijnBreinCoach for middle-aged adults).[115] Similar initiatives could be implemented at school, university, or in the workplace through standalone brain health courses or by incorporating messaging into existing frameworks for mental and physical health. Appropriate settings will depend on the target age range–ie, someone aged 18 years versus 38 years.

Messaging about specific risk and protective factors could be offered via special interest groups. Approaches will differ, but examples include promoting awareness of TBI at community sports events (eg, Center for Disease Control's HEADS UP campaign), or hearing loss at music festivals. Another avenue is youth-led climate advocacy initiatives, which could be coupled with messaging around air pollution and ADRD. Adding messaging to topics young adults are already passionate about will enhance the effect. Messaging can be deployed across multiple mediums, including online learning platforms (eg, Massive Open Online Courses) and social media (eg, TikTok). Working with influencers on social media platforms could be a promising new engagement strategy.[116]

Develop interventions for young adults

Lifestyle interventions, including aerobic exercise, adherence to healthy diet, social and cognitive training, and health counselling based on guidelines to control cardiometabolic risk factors, are becoming realistic for ADRD prevention in older populations.[117] Such interventions are not yet feasible in young adults, in whom the interventions should focus on targeting modifiable factors as main outcomes (table 2). New multidomain interventions could be tested using Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability-type trials,[118] using harmonised procedures to allow for age comparisons. Prodromal or subthreshold stages such as prediabetes, prehypertension, and temporary hearing loss can also be targeted. For example, acute changes in hearing often precede permanent damage, which can be cured when identified early.[25] Possible access points for interventions include primary care, sexual and reproductive health, mental health and substance abuse disorder, or wellness services.

Some encouraging evidence suggests that younger generations are adopting healthier behaviours. The prevalence of cigarette smoking decreased among young Americans (aged 22–23 years) between 2002 and 2018.[119] Similarly, alcohol abstinence is becoming more popular in some

Panel: **Key policy recommendations to support brain health in young adults**

Micro (individual) level

Education and awareness:

- Increase brain health awareness, including knowledge of risk factors and lifestyle interventions to promote healthy brain choices (eg, education within school curriculums and through public health campaigns targeted at young adults)
- Lifestyle interventions could be funded through taxation of substances that affect the brain health of young adults (eg, alcohol, vapes, cigarettes)

Meso (community) level

Young adult brain health advisory council:

- Develop an advisory council of young adults with representation from diverse communities (either as groups representing one community or as a caucus depending on regional size and need) that function as a liaison with local governments to provide contextual knowledge around brain health in the community
- Development should be led by local governments or the community, or both

Macro (national) level

Brain health charter for young adults:

- Cocreate and obtain national commitment to a brain health charter, which will outline key contextual issues for brain health in young adults and subsequent policy solutions to remedy these issues with a clear timeline and budgetary commitments for implementation after adoption of the charter

young populations (eg, in high-income countries).[120] The reasons for these generational shifts are multifaceted but could also be that the young adults of this generation are more conscious of links between lifestyle and health outcomes. Dementia is also increasingly being discussed in the public domain,[121] and is frequently among the top feared conditions.[122] Exposure to such information, coupled with personal experience from family history, could be a particularly strong motivator.

More work is needed to encourage young adults to engage in preventive lifestyle behaviours using culturally relevant mechanisms. For example, moving beyond the Mediterranean diet to promote culturally appropriate alternative diets.[123] One approach could be to train local community leaders as brain health champions, which has been an effective strategy for general health promotion,[124] and could include local sports coaches, teachers, or traditional healers. Consistent with this, social context and connectedness with peers and trusted professionals have been identified as important drivers of youth engagement.[125] In LMICs, studies emphasise the importance of providing better access to health literacy training and peer education programmes to build the capacity of young people to be agents of change in their health promotion.[126]

As with older age groups, interventions also need to be tailored to the individual risk profiles of young adults. High-risk groups should be prioritised. One example is those with Down syndrome. Despite having genetically determined Alzheimer's disease, people with Down syndrome are often excluded from strategies to reduce risk.[127] By integrating people with Down syndrome, we can promote inclusion and gain crucial insights into the effectiveness of risk reduction for those with a genetic predisposition to Alzheimer's disease.

Advocate for policy change

Some factors are more modifiable than others. Thus, changes must also be implemented at the population level. Brain health diplomacy is an emerging framework that aims to place brain health at the forefront of policy decisions.[128] Reducing exposure to pollutants and increasing access to education have long been recognised as high-level priorities. TBI risk is individually modifiable to some extent, but policy-level reforms are more likely to have a positive effect.[129] At the same time, unintended policy consequences also need to be considered. For young adults, enhanced feelings of safety (eg, wearing helmets) could lead to increased risk-taking behaviours. More broadly, other types of brain injuries could be considered as potential targets. These brain injuries include injuries secondary to preventable infections,[130] which could be addressed through promotion of better vaccine uptake, hygiene, and management plans in schools and universities.

Other government reforms include raising the minimum age for purchasing harmful substances. Increasing the legal age for tobacco would substantially reduce the prevalence of smoking among young adults.[131] As of October, 2024, Ireland is planning to raise the minimum age for tobacco from 18 years to 21 years, constituting the highest age limit in the EU. Regarding e-cigarettes, governments are faced with the more complex regulatory challenge of incentivising their use so as to maximise health outcomes.[132] For physical activity, governments can improve access to safe and accessible environments to exercise and offer school-based or work-based incentives for young people. Similarly, governments can increase accessibility to nutritious, affordable foods and reduce the consumption of ultra-processed foods. Because the diet of young adults is heavily influenced by whether they can access health food stores,[133] these changes could have a sustained effect on health (panel).

Tackle multilevel risk factor interactions

In societies marked by structural inequalities, the interplay of risk factors has a compounded and devastating effect on the brain health of young adults. In poorer regions, individuals face a combination of social stressors such as poverty, violence, and isolation, which are further exacerbated by exposure to physical risk factors such as poor air quality, inadequate nutrition, untreated vision loss, and poor access to health care.[134] Internal factors such as chronic stress and depression can result from or be aggravated by adverse social and physical environments. Taken together, these clusters create a vicious cycle that affects the most vulnerable populations from a young age.

Under-representation of vulnerable populations in research magnifies the issue, potentially leading to inappropriate generalisations and interventions. Models

and recommendations often reflect data from high-income countries, neglecting the diverse experiences of those in LMICs. This observation calls for a concerted effort to understand the interactions between risk and resilience factors within structurally unequal societies. Tailored interventions and prevention strategies need to be developed to address the unique needs of these populations. Developing such strategies will require overcoming substantial structural barriers, including the shortage of health-care professionals, budget constraints and poor availability of services, negative attitudes and beliefs about prevention, and stigma.[135]

Discussion

This Personal View outlines the importance of young adulthood as a crucial life stage in ADRD prevention models and provides research and policy recommendations for the field. Failing to address the risk of ADRD in young adult populations will most likely lead to a cascading effect on brain health that persists through mid-life to late life. Better characterisation of exposures in young adulthood is needed to pinpoint when factors become harmful or protective, and to identify new intervention targets. In the meantime, efforts can focus on reducing population-level exposure to high-target risk factors and improving resilience.

Building evidence around ADRD prevention in diverse young adult populations also provides an opportunity to address social and structural health determinants early, including racism and discrimination, and major threats such as natural disasters, wars, and genocide. Sex-specific and gender-specific factors warrant further attention; examples include menstrual cycle dysfunctions, early menopause, oophorectomy,[136] and IPV in women, in addition to many others.[137] Addressing these factors will require substantial investment in women's health.

Current research with young adults is dominated by risk rather than resilience. As the narrative shifts towards brain health over the life course, we need to amplify health-promoting factors such as continued education, physical activity, and diet. Refocusing on health-promoting factors can also help to address the pervasive stigma surrounding ADRD and encourage younger generations to become part of the brain health movement. In this context, more research is needed on cultural beliefs about dementia in young adult populations and how these could be changing across generations.

Another important consideration is competing health priorities. For young adults, ADRD could be perceived as less of a threat, compared with other health concerns such as mental and sexual health issues. Similarly, policy makers need to make decisions around resource allocation, and other health issues often take precedence over ADRD in young adults. One way to achieve prioritisation of ADRD in young adults is to align ADRD prevention strategies with other chronic conditions or within the broader concept of successful ageing.[138] Aligning strategies around brain and mental health is one approach that could have relevance to younger generations, especially in the wake of the COVID-19 pandemic. At the same time, researchers have cautioned against lifestyle stigma,[139] calling for a balance between promoting prevention knowledge and reducing structural barriers to change.

Other important questions include how and where brain health interventions for young adults should be implemented, by whom, and what the incentives should be. Dementia is a disease of old age, thus falling within the remit of geriatric psychiatry. However, the perception of ADRD is changing with the advent of new biomarkers and brain health services. Alongside this are considerations of inclusion and retention, especially from under-represented groups. Long-term recruitment strategies need to be developed to ensure that equity and inclusion issues, as well as science, are at the forefront of decisions.

Limitations and future directions

The main limitation of the study is that we did not conduct a systematic review, possibly resulting in the exclusion of other important factors. A systematic review is needed to identify the full range of modifiable factors relevant in young adulthood. This work is underway by our group. Regional reviews are also needed to provide a deeper understanding of context-specific factors. Although we focused on young adulthood, many of the recommendations discussed also apply to younger age groups. Therefore, we advocate for greater focus on ADRD prevention before mid-life, from pre-birth through childhood or adolescence to young adulthood. We also acknowledge that this Personal View provides recommendations from professionals working in ADRD and needs to be triangulated with public perspectives. Younger generations will be key beneficiaries of brain health policies, so they need to be key partners in research and decision making. Such an involvement will require time to build relationships and money to ensure that the individuals involved are appropriately compensated, along with recognition of the autonomy and agency of young adults. Together, these efforts are a crucial next step in the prevention of ADRD globally.

Contributors

FRF and LB conceptualised the paper. FRF, LB, KB, IFF, LIM, TT, LC, LK, O-EIJ, and K-HN summarised the meeting discussion. FRF and LB conducted the literature search and drafted the manuscript. AI provided the figure. All authors reviewed and edited the manuscript.

Declaration of interests

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