Next Generation Brain Health: Reducing risk and building resilience in young adults

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Early detection and management of risk factors is the best way to reduce the incidence or prevent neurodegenerative diseases that cause dementia. Despite this, research on risks to brain health continues to focus on middle aged and older adults. Lifecourse models of dementia highlight only one early risk factor, education, with the remaining factors focused on mid-life onwards[1]. As a result, we are faced with a knowledge gap about brain health in young adults spanning over twenty years.

Brain health is a state of optimal cognitive, sensory, social-emotional, and behavioural functioning[2]. Understanding brain health in young adults is critical as they have the opportunity to make early and long-term changes to minimise risk. This is particularly important given the widespread and serious consequences of the pandemic on young peoples' mental health[3].

Young adults (born between 1981 and 2004) account for over 30% of the world's population[4] and are distinguished by unique characteristics and contexts. Young adults are often more technologically enabled than older adults, for example, so are particularly amenable to health-promoting technologies. They have also lived through a global recession and face unemployment rates 2-3 times higher than the population average[5].

Quantifying the prevalence of risk factors for dementia among young adults is important but neglected. These factors have been studied almost exclusively in children and people over 40. More data is needed on adults between the ages of 18 and 39. This will require researchers across multiple disciplines to add measures of brain health (such as cognitive and mental health outcomes) to existing studies, along with relevant lifestyle and environmental exposures. Sustained investment in large interventional trials is also required, potentially lasting decades. As much of our current knowledge comes from cohorts born nearly 100 years ago[6], a clearer focus on younger adults may lead to the discovey of new risk and protective factors.

Characterising cumulative risks to brain health from an early age will inform both primary and secondary prevention of dementia. Many risk factors, including obesity[7], smoking[8] and head injuries[9], begin accumulating in young adulthood. Associations between oestrogen and risk of Azheimer's disease[10] suggest a need for observational data in young adults to explore the effects of older age at childbirth, increasing use of vitro fertilisation, and early menopause. Evidence for a positive association between the APOE ε2 allele and cognitive performance in adults as young as 23 years also raises the possibility of protective genetic factors[11].

Optimising brain health from young adulthood demands a precision public health approach, which considers individual variability in genes, environment, and lifestyle to deliver the right intervention at the right time[12]. Young adults are digitally literate and broadly health conscious, and so can be active agents in monitoring their own brain health risks. Mobile phone applications, sensors, and big data analytics enable health monitoring in ways not previously possible[13]. For example, physical health indices like blood pressure and levels of air pollutants such as nitrogen oxides are amenable to monitoring via wearable devices.

Community-based services for managing brain health also provide new opportunities for early risk profiling and communication[14]. For example, in Scotland, such services are open to

anyone interested in their brain health and include light-touch lifestyle assessments and interventions such as dietary advice. This broad based approach will generate large amounts of data to help advance our understanding of the epidemiology of neurodegenerative diseases, and the efficacy of interventions.

Interventions to change behaviour must happen at individual and societal levels. Although no studies explicitly target brain health in young adults, evidence is growing from broader health fields that can inform this work[15-16]. Promising targets for protective interventions include parent-child and peer-to-peer groups to promote mental health, as well as physical activity programs to increase brain plasticity[17-18]. The recently published WHO position paper on optimizing brain health provides several suggestions for policy level change including strengthening road safety legislation, limiting population exposure to neurotoxic chemicals, policies to protect survivors of intimate partner violence, and increasing access to green spaces[2].

Rather than focusing solely on risk reduction, public health messaging should promote brain health as a valuable goal to aspire to, like physical fitness. Mobile phone applications are being developed allowing people to monitor, and potentially protect or improve their own brain health[19]. Such applications could simultaneously track multiple factors for brain health, like diet, use of substances such as alcohol, tobacco, and illicit drugs, physical fitness, mood, and engagement in social activities. Connecting brain health with issues that young adults value, such as climate sustainability, will amplify the brain health message.

Young adults are well placed to lead the global movement towards optimising brain health across the lifecourse. In so doing, they can help secure benefits that extend beyond neurodegenerative diseases to better mental and physical health, reduced healthcare costs, higher productivity, and enhanced well-being of societies more broadly[2].

References

1. Livingston, G., Huntley, J., Sommerlad, A., Ames, D., Ballard, C., Banerjee, S., ... & Mukadam, N. (2020). Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *The Lancet*, *396*(10248), 413-446.
2. Organization, W. H. Optimizing brain health across the life course: WHO position paper. (2022).
3. Xie, Y., Xu, E., & Al-Aly, Z. (2022). Risks of mental health outcomes in people with covid-19: cohort study. *bmj*, *376*.
4. United Nations, Department of Economic and Social Affairs, Population Division (2022). *World Population Prospects 2022, Online Edition*.
5. Marelli, E., & Signorelli, M. (2022). Young People and the Labor Market—Challenges and Opportunities: An Introduction. *Merits*, *2*(1), 59-61.
6. Deary, I. J., Gow, A. J., Taylor, M. D., Corley, J., Brett, C., Wilson, V., ... & Starr, J. M. (2007). The Lothian Birth Cohort 1936: a study to examine influences on cognitive ageing from age 11 to age 70 and beyond. *BMC geriatrics*, *7*(1), 1-12.
7. Gallus, S., Lugo, A., Murisic, B., Bosetti, C., Boffetta, P., & La Vecchia, C. (2015). Overweight and obesity in 16 European countries. *European journal of nutrition*, *54*(5), 679-689.
8. Zatonski, W., Przewozniak, K., Sulkowska, U., West, R., & Wojtyla, A. (2012). Tobacco smoking in countries of the European Union. *Annals of Agricultural and Environmental Medicine*, *19*(2).
9. Bruns Jr, J., & Hauser, W. A. (2003). The epidemiology of traumatic brain injury: a review. *Epilepsia*, *44*, 2-10.
10. Ratnakumar, A., Zimmerman, S. E., Jordan, B. A., & Mar, J. C. (2019). Estrogen activates Alzheimer's disease genes. *Alzheimer's & Dementia: Translational Research & Clinical Interventions*, *5*, 906-917.
11. Sinclair, L. I., Pleydell-Pearce, C. W., & Day, I. N. (2017). Possible positive effect of the APOE ε2 allele on cognition in early to mid-adult life. *Neurobiology of learning and memory, 146,* 37-46.
12. Solomon, A., Stephen, R., Altomare, D., Carrera, E., Frisoni, G. B., Kulmala, J., ... & Kivipelto, M. (2021). Multidomain interventions: state-of-the-art and future directions for protocols to implement precision dementia risk reduction. A user manual for Brain Health Services—part 4 of 6. *Alzheimer's Research & Therapy*, *13*(1), 1-15.
13. Alkire, L., O'Connor, G. E., Myrden, S., & Köcher, S. (2020). Patient experience in the digital age: An investigation into the effect of generational cohorts. *Journal of Retailing and Consumer Services*, *57*, 102221.
14. Ritchie, C. W., Waymont, J. M., Pennington, C., Draper, K., Borthwick, A., Fullerton, N., ... & Kilgour, A. (2021). The Scottish Brain Health Service Model: Rationale and Scientific Basis for a National Care Pathway of Brain Health Services in Scotland. *The Journal of Prevention of Alzheimer's Disease*, 1-11.
15. Partridge, S. R., McGeechan, K., Bauman, A., Phongsavan, P., & Allman-Farinelli, M. (2017). Improved confidence in performing nutrition and physical activity behaviours mediates behavioural change in young adults: mediation results of a randomised controlled mHealth intervention. *Appetite*, *108*, 425-433.
16. Brinn, M. P., Carson, K. V., Esterman, A. J., Chang, A. B., & Smith, B. J. (2012). Cochrane review: Mass media interventions for preventing smoking in young people. *Evidence-Based Child Health: A Cochrane Review Journal*, *7*(1), 86-144.

17. Grummitt, L., Kelly, E., Barrett, E., Keyes, K., & Newton, N. (2021). Targets for intervention to prevent substance use in young people exposed to childhood adversity: A systematic review. *PloS one, 16*(6), e0252815.
18. de Sousa Fernandes, M. S., Ordônio, T. F., Santos, G. C. J., Santos, L. E. R., Calazans, C. T., Gomes, D. A., & Santos, T. M. (2020). Effects of physical exercise on neuroplasticity and brain function: a systematic review in human and animal studies. *Neural Plasticity*, 2020.
19. Cattaneo, G., Bartrés-Faz, D., Morris, T. P., Sánchez, J. S., Macià, D., Tarrero, C., ... & Pascual-Leone, A. (2018). The Barcelona brain health initiative: a cohort study to define and promote determinants of brain health. *Frontiers in aging neuroscience, 10,* 321.