Wearable devices: underrepresentation in the ageing society

In *The Lancet Digital Health*, Zinzuwadia and Singh commented on the bias and inequity in studies that make use of wearable devices among the general population.[1] We appreciate their efforts to widen the known issue of insufficient representation from racially minoritised people, to people from low-income or rural communities, and other populations with poorer access to digital literacy. However, they did not properly address older populations, especially those who are most likely to benefit from remote monitoring and wearable device technology—people living with age-related cognitive decline and dementia.

Wearable devices and smartphone applications could help health-care professionals gain insight into the spectrum of dementia conditions in a real-time, longitudinal, and more objective manner. Well validated devices and algorithms have the potential to assist in tracking cognitive and functional trajectories, monitoring social behaviour changes, preventing falls, and potentially relieving care-giver burden,[2] which can go far beyond the cardiovascular diseases that were described in the Comment. However, older people are underrepresented in many wearable device studies, such as the Apple Heart Study.[3] With a mean age of 41 and less than 6% of participants aged above 65, its initially claimed sensitivity in detecting atrial fibrillation dropped significantly in the validation study with a mean age of 76.[4] The issue of underrepresented populations can be further complicated with underrepresented data (ie, data loss due to suboptimal acceptance or adherence to wearables) caused by a decline in cognitive capacity in people with dementia.

Despite the potential benefits of wearables (eg, logitudinal monitoring), a 2022 systematic review showed that there were few studies with wearable sensors and artificial intelligence-enhanced technologies in older people receiving long-term care. When studies included this group, older people did not find the wearables acceptable, due to perceptions that these devices were not useful or usable.[2] Another observational study of mostly cognitively healthy older people found a generally high (95%) device-wearing adherence, but poor memory performance could decrease adherence to daily syncing and was therefore associated with data loss.[5] The influence of cognitive function on adherence appears in our own unpublished study, RADAR-AD[6] in people with preclinical, mild, and moderate Alzheimer's disease. Participants were asked to wear two activity trackers for 8 weeks. Wear time was not associated with age or sex but decreased with decreasing cognition and function. Although wearables usually function passively and therefore pose fewer cognitive challenges than interactive mobile apps, adherence might still be hampered by more complex study protocols and cognitive challenges. Prospective memory challenges that we observed included remembering to press a button at a predefined time, to charge a device before use,[7] and to change the wearable device (appendix). Unpublished data from another study recruiting older care-home participants living with moderate to severe Alzheimer's disease (the STAND trial; ISRCTN97163562), which used an actigraphy watch to explore behavioural symptoms, reports similar findings. The overall adherence was 88% during the 4-week trial, with carers reminding participants to wear the watch continuously. A sex difference was noted in this study, with an adherence of 75·5% for female residents and 96·4% for male residents in the first 2 weeks, which then improved to 82·6% and 97·4% respectively, in the last 2 weeks (unpublished; appendix). Some carers reported in their feedback that low adherence might have been influenced by the appearance and design of the device, particularly for female residents, but this could still be improved when they provided reassurance and reminders.

See **Online** for appendix

One of the two studies had a very small sample size (STAND n=29; RADAR-AD n=175) and therefore any inference should be made with caution. However, adequate reporting, exploring, and dealing with non-adherence or non-acceptance is both crucial and challenging in dementia research with wearable devices. A systematic review found many studies have potential bias due to missing data and bias in selection of the reported result.[2] Another systematic review summarised multiple barriers to adherence, including the severity of cognitive symptoms. These studies require tailored strategies to encourage people to wear the devices and secure their continuous use.[8] If adherence is affected by clinical characteristics such as cognitive capacity, high compliance data could be seen as having low

representative value, making the clinical validity and generalisability questionable. Non-adherence related data loss and systematic links between missing data and unobserved data, should not be neglected and cannot be tackled solely with advanced imputations by data scientists. Dementia researchers should report the adherence data to reduce bias and assist in finding solutions.

There is a myth that older people are unable to participate in digital studies due to a lack of digital competence. However, there is ample evidence that the participation has rapidly increased for this age group, especially during the COVID-19 pandemic. Large-scale sensor-based studies started to include older populations,[9] and our ongoing longitudinal online study also suggests that tele-research is feasible with older adults from Black, Asian, and minority ethnic communities.[10] Thordardottir and colleagues emphasised the need to reduce ageism in digital research and the importance of addressing the specific needs of older people with dementia. Key topics determining adherence and feasibility include perceived benefit, patient-centred design of the wearables, technical demand, and encouragement and assistance from carers.[8] Our feedback from carers suggests that adherence could be further improved with additional cognitive aids (eg, detailed documentation of study procedures and user manuals) and allowing enough time to build up wearing routines.

With global ageing, the number of people living with dementia worldwide is projected to exceed 150 million by 2050.[11] These individuals are at high risk for many symptoms that studies with wearable devices attempt to monitor. Acquiring sufficient representative data is the only way to reflect real-world scenarios and develop solutions accordingly. Achieving adequate representation from this population requires health-care professionals and the wider community to embrace the fact that, given age-appropriate conditions, older participants can be both willing to use and proficient with wearable devices. Once studies have sufficient representation of participants from different stages of dementia, the knowledge to optimise adherence and strategies to minimise missing data can then be further improved with quantitative and qualitative information from both participants and carers. This insight will ultimately make remote monitoring and wearable device technology truly feasible and beneficial for older people.

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