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Role of digital health wearables in the wellbeing and quality of life of older people and carers

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Introduction to the research programme¹

Ageing population, retaining independence of older people, support to carers, and using internet-enabled technologies to transform healthcare services are some of the national concerns. We are involved in a research programme², in collaboration with Age UK Milton Keynes, Carers MK, Samsung UK and University of Oxford, to investigate whether and how wearable activity-tracking technologies can contribute towards monitoring of activity and health by people aged over 55, carers, and people they care for, and be accepted by healthcare professionals. Example technologies include off-the-shelf activity trackers such as from Fitbit, Garmin and Samsung, and smartwatches. Typically, these devices record steps/distance walked, sleep patterns, calories expended, route of walking or location via GPS navigation³, and heart rate. These devices work in conjunction with a mobile application (app) on a smartphone, or a tablet, or a desktop computer on which the app's data dashboard is displayed⁴.

With the advent of digital NHS⁵, digital health wearables and apps will play an increasingly significant role in healthcare such as managing specific medical conditions, for example, related to heart and

¹ All the web-links in this document were last accessed on 28 February 2018.

² Digital Health Wearables research programme at The Open University, UK, <http://www.shaileyminocha.info/digital-health-wearables/>

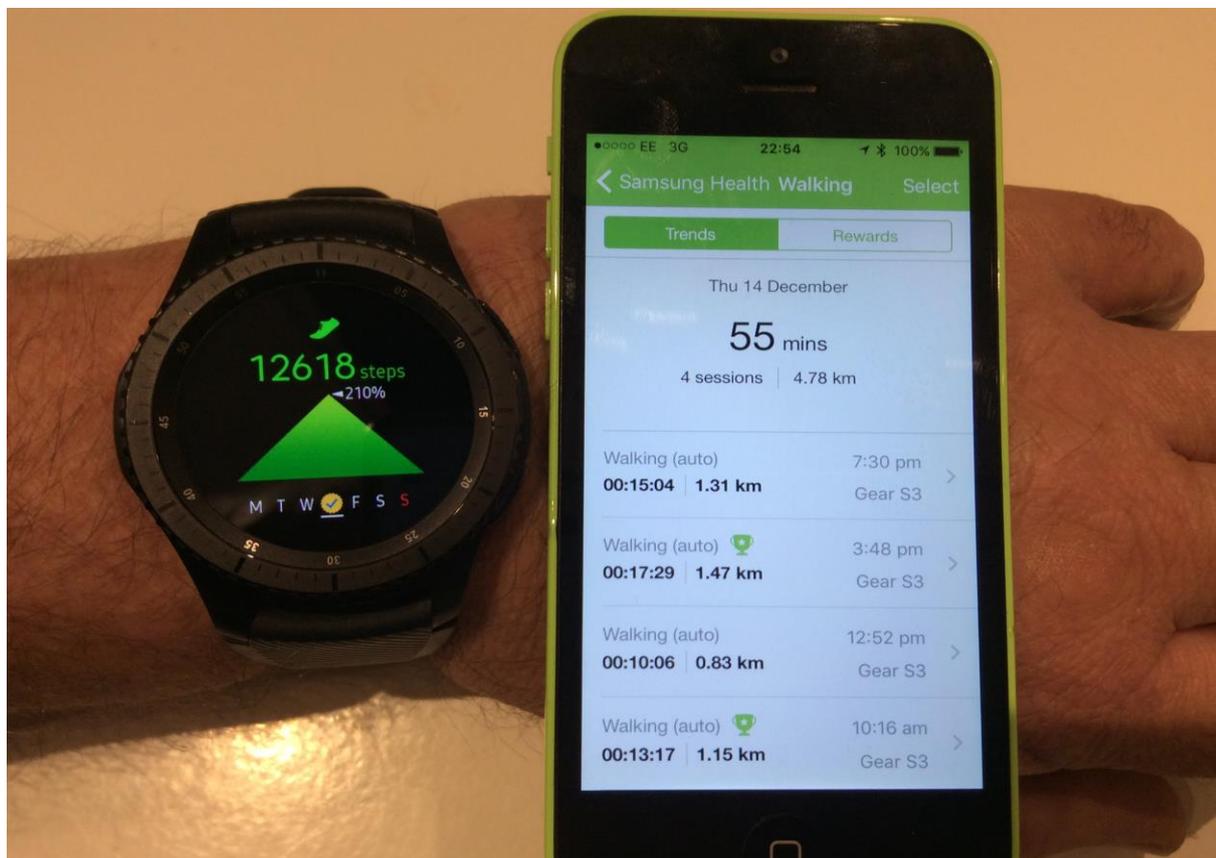
³ Global positioning system (GPS), <https://www8.garmin.com/aboutGPS/>

⁴ Example, Fitbit App and Dashboard, <https://www.fitbit.com/uk/app>

⁵ A digital NHS? An introduction to the digital agenda and plans for implementation, <https://www.kingsfund.org.uk/publications/digital-nhs>

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respiratory system, and during recuperation. Towards this, in our research programme, we have investigated the service design challenges that people aged over 55 years, carers, and people being cared for face in procuring, setting up, and using activity trackers. Among carers, our focus has been on unpaid and informal carers - anyone who cares, unpaid, for a friend or family member who due to illness, disability, a mental health problem or an addiction cannot cope without their support.



Picture: Activity monitor and the dashboard on the app on the smartphone

Our research programme on digital health wearables⁶ for older people, carers and people being cared for (2016-2018) has been funded by [Sir Halley Stewart Trust](#) (2016-2017) and the [ESRC Impact Acceleration Account](#) (2017-2018).

Rationale of the research programme

The number of adults aged 65 and over has increased by 2% across Europe in the past 15 years, and in Northern Ireland by 22% between 2003-2013. The population continues to age in Northern Ireland with the number of those aged 65 or over increasing by 2.0% in the year ending mid-2016 to reach 297,800 people (16.0% of the population). In contrast, the number of children aged 0 to 15 years increased by just 0.7% to reach 388,000 children (20.8% of the population)⁷. Projections indicate a continued ageing population in Northern Ireland, with the number of people aged 65 or over projected

⁶ Digital Health Wearables research programme at The Open University, UK, <http://www.shaileyminocha.info/digital-health-wearables/>

⁷ Northern Ireland Statistics and Research Agency 'Registrar General Annual Report', (NISRA), <https://www.nisra.gov.uk/statistics/births-deaths-and-marriages/registrar-general-annual-report>

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to grow by 25% in the 10-year period to mid-2026. Furthermore, the proportion of the population aged 65 or over is projected to overtake that of children by mid-2028 (20.1% and 19.6% respectively)⁸.

Given Northern Ireland's Active Ageing Strategy (2016-2021)⁹, which focuses on leading healthy, active and independent lives while ageing and on increasing the average healthy lifespan of citizens, there is a need to encourage physical activity as people get older to preserve mobility and motor skills. Leading an active life will enable people to enjoy the benefits of living longer, and to minimise health problems associated with ageing and lower physical activity such as frailty, high blood pressure, obesity and diabetes.

The benefits of regular physical activity for older adults and those with chronic disease and/or mobility limitations are indisputable¹⁰. Regular physical activity attenuates many of the health risks associated with obesity, cardiovascular disease, diabetes, depression and anxiety, and cognitive decline. Walking has been shown to improve cognitive performance in older people. Our previous research has shown that walking with others can help reduce social isolation and loneliness among people aged 55 and over¹¹. As physical activity levels among older adults (both with and without chronic disease) are low, facilitating an increase in activity levels is an important public health issue. Further, caring responsibilities can have an adverse impact on the physical and mental health of those who care which can affect a carer's effectiveness.

“Being fitter not only benefits the individual it reduces society's need for social care. The value to society of even modest improvements in fitness could be several billion pounds a year [in the UK], since the mean care needs of a person almost double between age 65 and 75, and triple between age 65 and 85”¹².

As a part of the digital NHS agenda, there is an increasing focus on self-monitoring of health and medical conditions. In a 2015 survey by Trustmarque and YouGov¹³, 81% of respondents said they would like wearable devices to be used in healthcare to monitor vulnerable people or patients at home; helping patients follow diet and exercise regimes or courses of medicine: *“self-monitoring devices ... could help the NHS save at least 60 per cent on the average cost per patient”*. Monitoring during and after treatment and facilitating early hospital-discharge could address long-term occupation of hospital beds.

Research programme

In our research programme, activity-tracking technologies (or activity monitors) were used by 21 participants in the 55-82 age range for a twelve-month period to track activity, exercise, food, weight and sleep. Furthermore, the two-year research programme has involved a number of surveys, workshops and interviews with (a) people aged over 55 years who were already using activity monitors; (b) carers who considered the use of these devices for themselves and for the people they care for; (c) healthcare professionals; (d) local charities who provide services and support to older people, carers and their families in the community; and (e) manufacturers of digital health wearables.

⁸ Health and Wellbeing 2026 - Delivering Together, Department of Health, Northern Ireland, <https://www.health-ni.gov.uk/publications/health-and-wellbeing-2026-delivering-together>

⁹ Active Ageing Strategy 2016-2021, Department of Communities, Northern Ireland, <https://www.communities-ni.gov.uk/publications/active-ageing-strategy-2016-2021>

¹⁰ Older males could live longer with light intensity exercise, study suggests, <http://bit.ly/2Hlm3Gg> (20 Feb 2018)

¹¹ Social isolation and loneliness in people aged 55 and over in Milton Keynes, <http://oro.open.ac.uk/43925/>

¹² Scarlett McNally, et al. Focus on physical activity can help avoid unnecessary social care, *British Medical Journal*, doi: <https://doi.org/10.1136/bmj.j4609> (17 October 2017); available from: <https://www.ageing-better.org.uk/news/physical-activity-can-help-avoid-unnecessary-social-care>

¹³ 'wearable tech' Raconteur. Healthcare/ Future of Healthcare (August 2016)

<http://www.raconteur.net/healthcare/empowering-patients-to-track-their-health-through-wearable-tech>

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One key characteristic of our research programme is that some of the participants became *co-researchers* – helping us with recruitment, data collection, in dissemination, and pointing us to similar or related research and news items in the media.

Our empirical mixed-methods research programme has shown the role activity monitors can play in the health and wellbeing of people:

- *as behaviour change interventions*: participants reported about becoming conscious of how they are not so active and in adopting newer healthier routines, such as walking for minor errands instead of using the car, adopting a regular exercise routine, joining weekend walking groups, or forming lunchtime walking groups at workplaces, and cycling to work instead of using the car. The data from these devices informs, nudges and motivates people to adopt active lifestyles and to pay emphasis on diet and regular exercise, thereby facilitating self-management of health.
- *in alleviating social isolation and loneliness in older people and carers*: people are able to maintain their active routines if they are walking with others, or comparing their activity levels with others, or setting up targets as daily or weekly competitions with others, or if they are nudging or being nudged by others to maintain their activity levels through shared dashboards of these devices and apps. Walking with others and connecting with others helps them to socialise physically and/or virtually.
- *the activity tracker to keep connected with family and friends*: as a part of our research programme, we investigated how the device influenced the lifestyles of the 21 participants to whom we gave devices. One of the woman-participants reported to us: *seeing their mother's 'new' active lifestyle as a result of using the device, her two daughters have also bought their own devices. The three set up step-targets every day and compare and rank one another at the end of the day. The father feels that he is missing out on this fun and is planning to buy a device for himself. The girls know from the dashboard when their mother is up and about and reach out to her if they want to have an early morning conversation. As a family, they are feeling better connected and have the sense of 'virtual' presence or connection by looking at each other's activity on the dashboard.*
- *sense of accomplishment by the users*: activity monitors acknowledge achievement of set targets with motivational messages. Participants reported experiencing a positive sense of achievement and accomplishment when they reached their targets – which had direct effects on their wellbeing and motivation to keep up their physical activity.
- *use of the data in diagnosis and medical interventions*: sharing of the data from these devices with healthcare professionals - such as sleep patterns, activity levels, and heart rate and their trends can help in diagnosis by healthcare professionals and in planning medical interventions. *We spoke to a physiotherapist who looks after patients with neurological disorders. She recommends activity-routines to her patients who have such devices or who have smartphones and can use apps. She advises on how many steps they should walk depending upon their condition and the activity-routine that they should maintain (such as increasing the number of steps with time) before their next appointment with her – usually after 3 or 6 or 9 months. She advises her patients to contact her in-between appointments if their activity level drops unexpectedly so that she can investigate the cause(s) and discuss suitable interventions with their medical team.*
- *in preoperative intervention*: the use of activity monitors will help in increasing and maintaining physical activity and to improve physical fitness prior to elective surgery to improve postoperative outcomes.

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“The association between physical fitness and outcome following major surgery is well described – less fit patients having a higher incidence of preoperative morbidity and mortality. This has led to the idea of physical training (exercise training) as a preoperative intervention with the aim of improving postoperative outcome”¹⁴.

“Older adults undergoing surgery are at greater risk of poor postoperative outcomes, including morbidity, mortality, increased length of stay, loss of function, and low measures of physical activity and physical fitness. However, these increased risks may be mitigated in those who engage in more physical activity and have higher levels of physical fitness prior to surgery”¹⁵.

- *in post-operative monitoring of mobility during rehabilitation:* monitoring activity levels after knee or hip replacements, or after a heart operation by patients themselves, or by their carers.
- *for self-monitoring a specific medical condition or monitoring by carers:* such as (a) with the heart or lungs; (b) sleep patterns to compare the data over a period of time; (c) extent of activity while undergoing physiotherapy for a neurological condition; (d) during recuperation after a hip or knee replacement; or (e) for maintaining activity levels when suffering from Chronic Obstructive Pulmonary Disease (COPD). *John, a 71-year old user with an untreatable lung condition has been using an activity tracker for the past two years to stay active. By being physically active, John’s lung-problems have improved enabling him to be more physically active. Based on the positive effects that the device has had on his general wellbeing (e.g. more time spent outdoors, less respiratory infections), his medical team has recommended to him to continue using the activity-tracker.*
- *usage strategies:* some benefit from using such a device or app continuously, such as having regular updates on the recorded data, motivates them to maintain their active routines; while some users form their routines based on their early interactions with these devices and don’t need the data or these devices regularly to keep them motivated. Some use these devices to keep in (virtual) touch with the family members or friends via shared dashboards of these devices or apps; and some use these devices to monitor a specific measure such as heart rate or sleep patterns to keep a track of a particular medical condition or health issue. For older users in their 80s, activity monitors help them to pace themselves, that is, guiding them not doing too much in one day so as not to tire them out, and to manage their activity levels to avoid over-doing and over-exhaustion.
- *accuracy of the devices and apps:* the majority of these activity-monitoring technologies and apps are not medically-certified devices but they are useful for monitoring trends and changes rather than the actual data-points in most cases. However, even during the course of our research programme, the technology has improved both in its user interface design (e.g. ease of wearing the straps, ‘watch-face’ of these devices, large dials, ease of readability, long battery life), sleek designs (e.g. designed as watches, bracelets), reliability, and in the ease of set up and use.

Key highlights of our research programme

These are the **five** key contributions of our research programme.

- 1 We have raised awareness of the role of activity monitors in active and healthy ageing for older people and carers.

¹⁴ S. Jack *et al.*, Perioperative exercise training in elderly subjects, *Best Practice & Research Clinical Anaesthesiology*, 2011, vol. 25, pp. 461-472.

¹⁵ S. Halloway, *et al.*, Prehabilitation Interventions for Older Adults: An Integrative Review, *Western Journal of Nursing Research*, 2015, vol. 37, no. 1, pp. 103-123.

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- 2 Our research has shown that activity monitors can serve as behaviour change interventions towards healthier lifestyles.
- 3 We have developed evidence-based strategies for older people and carers – how they can integrate activity monitors in their daily routines.
- 4 We have informed design of activity monitors and applications by involving manufacturers as one of the key stakeholders in the research programme.
- 5 Finally, we are disseminating evidence-based outcomes of our research programme to charities and policy makers for supporting active and healthy ageing in communities and for influencing social prescribing¹⁶ policies to address social isolation and loneliness.

However, there are barriers to innovation in the adoption, usage and integration of activity monitors, and digital health wearables, in general, in health and social care for people aged over 55, carers and people they care for, and healthcare professionals:

- off-the-shelf devices, such as the one in our research programme, monitor activities relevant for physically fit (typically young active people). Finding an activity-tracker that monitors activities such as gardening, or housework, or wheelchair usage was perceived as a major challenge by our participants.
- usability and accessibility concerns – the need to design activity monitors for age-related impairments such as in vision, hearing, memory and dexterity.
- data access, management and security issues of data storage: concerns of accuracy and reliability of the data from off-the-shelf devices; lack of clear guidelines on ethical aspects of data-usage by family, carers, healthcare professionals and manufacturers; lack of guidance on whether and how the data from these devices can be integrated within patient records for consideration in diagnosis and in planning interventions.
- lack of or inadequate digital health literacy skills¹⁷ – from using the device, how the data is calculated and recorded, sense-making of the data, and how to select the critical data-points for reporting to healthcare professionals.
- perceptions of healthcare professionals on non-medically certified devices.

Conclusions

Our knowledge exchange workshops in the second year of the research programme have involved diverse-stakeholder groups such as: older people, carers, manufacturers of digital health wearables and apps, local charities, healthcare professionals and medical educators. These workshops have shown that the design and use of digital health wearables will require close collaboration between manufacturers, health care services and the end-users so that the solutions developed can be easily adopted and used by communities to monitor their physical and mental wellbeing. Through participation in our research programme and based on our evidence, Samsung has changed the design of its Samsung ACTIVAGE app¹⁸. This app serves as a mobile platform for digital health

¹⁶ Social prescribing, <https://www.kingsfund.org.uk/publications/social-prescribing>

¹⁷ Digital health literacy goes global, <https://www.goodthingsfoundation.org/news-and-blogs/blog/digital-health-literacy-goes-global>

¹⁸ OU research findings into digital wearables influences design of health app, <http://www.open.ac.uk/research/news/digital-wearables-influences-design-health-app>

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wearable users to record and monitor their health and share the data with health professionals and carers.

There is a role of digital health wearables in caring and incident reporting, and for monitoring movement and locations in conditions such as dementia and Alzheimer's and use of the long-term recorded data for diagnosis and medical interventions. Such systems can also be used to help keep people healthy and improve care for those with chronic conditions. Further, the wearable activity tracking and monitoring technologies and smart watches have the potential to provide valuable research data for advances in healthcare by integrating widespread high-quality health data about the population.



Pictures from the knowledge exchange workshops at The Open University

Policy recommendations from our research programme on activity-tracking technologies

1. Support health literacy programmes: encourage local charities, local doctor practices and community groups to:
 - a. set up meetings and talks to promote active and healthy living that support people in understanding how physical activity can have positive impacts on health in later life, such as slowing down the onset of frailty and cognitive decline, and reducing the risks of diseases such as diabetes and obesity;
 - b. facilitate establishment of walking groups that support physical wellbeing and encourage socialisation; and
 - c. target unpaid (informal) family/friends' carers who are an ageing population in need of respite and strategies for self-management of health.
2. Support digital literacy and digital health literacy programmes: if people develop digital skills to access online information and services and to use digital health wearables, it will have a significant impact on improving health outcomes as people will feel more in control of their health and care. The digital skills will enable them to better manage their conditions as well as helping to relieve the burden on NHS services¹⁹.
3. Raise awareness of the role of activity monitors in active and healthy ageing, for keeping fit, and as a preventative measure for some medical conditions, for socialisation and as a possible way to alleviate social isolation and loneliness, in self-management of health, in self-monitoring of health,

¹⁹ Widening digital participation, NHS Digital, <https://digital.nhs.uk/transforming-health-and-care-through-technology/self-care-and-prevention/widening-digital-participation>

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for monitoring the person being cared for, and in social prescribing. This awareness-raising could be by the local charities such as Age NI²⁰, Northern Ireland Pensioners Parliament²¹, through local doctor practices, “show and tell” sessions of people sharing their experiences, and through Q&A sessions.

4. Build capacity in communities by organising peer-to-peer sessions where older people and carers who are already using such technologies and apps can share their experiences and stories of usage with others who are considering the use of such devices and act as “champions” within the community.
5. Raise awareness that it is not about meeting the stated standard goals for using such devices (e.g. 10,000 steps in a day); people can set up their own targets and work towards their targets as per their own context: stamina, health condition and living situation (at home, in a care home, etc.).
6. Encourage informal family and friend carers via Carers NI and Carers Trust NI to adopt activity monitors to maintain their own health and wellbeing such as activity levels, sleep patterns, and calorie and water intake.
7. Encourage carers to consider using such devices to monitor the activity and other data of the person they are caring for remotely or in-person.
8. Set up training and support within local charities or via GO ON NI²² for providing support in buying a suitable device and on the usage of such devices: e.g., to make sense of the recorded data such as number of steps, heart rate, sleep patterns, etc., depending on the health condition of the user.
9. Procurement: if local councils and/or charities can partner up with manufacturers to provide these devices at special prices to older people and carers; and if local councils can set up lower prices (than normal) for access to the internet for older people and carers who may not be able to afford internet access required for activity monitors to communicate with its app and vice versa.
10. Families and friends should be encouraged (within ethical norms and permissions of individual users) to access dashboards of older people and people that they care for, keeping an eye on the data and the wellbeing. Sharing dashboards of the devices also helps in socialisation: such as family members and friends connecting with one another to encourage them to achieve their targets, or for comparing targets across the family members and friends (who share the dashboard of their individual devices), or for keeping an eye on the activity levels of others by looking at the shared dashboard needed to use their activity monitors.
11. Introduce activity-tracking technologies as behaviour change interventions in public health programmes such as weight management programmes (for any age group) and for encouraging walking. People have different usage strategies: some people need such devices to keep them nudged and to stay motivated, while others require only an initial push and adapt their routines fairly quickly.
12. In social prescribing: primary health care professionals could encourage people to adopt activity-tracking technologies and mobile health apps as a non-clinical solution to encourage people to be active and to be out and about and as a way to alleviating social isolation and loneliness.
13. Encourage usage of mobile health apps on smart phones in case buying an activity-monitor is not feasible or affordable.

²⁰ Age NI, <https://www.ageuk.org.uk/northern-ireland/>

²¹ Northern Ireland Pensioners Parliament, <https://www.agesectorplatform.org>

²² GO ON NI, <https://www.nidirect.gov.uk/campaigns/go-on-ni>

14. People will be more attracted to use such devices and apps if the message emphasises how technology will help them proactively to take control of their lives, rather than saying that the adoption of this technology is a sign of their frailty²³.
15. Funded programmes in partnerships with local universities will help provide evidence on the impact of activity monitors, mobile health apps and other digital health wearables for a systematic adoption of such devices and apps as a part of the digital NHS.
16. Encourage the inclusion of activity-tracking technologies, digital health wearables and health apps in medical education.

While making these recommendations, we are conscious that there may be socio-economic barriers for adoption of activity-tracking technologies or similar digital health wearables or apps as they require access to the internet, access to a tablet or desktop computer or a smartphone. Further, people need to be digitally skilled to set up these devices and to use them, and even if they are digitally skilled, they may still require support from family, friends or formal support via their doctors and other healthcare professionals, and digital health literacy skills to draw out interpretations from the data from such devices and apps. Finally, their medical conditions, age, and any mobility constraints may prevent the adoption and use of these technologies.

There are ethical and privacy issues in accessing and using the data from these devices/apps, such as who has access to the data - e.g. carers, family members, friends, manufacturers, employers - and what are the consequences of data being misused and misinterpreted, and even disrupting long-standing treatment plans of people. While the prospects for improving healthcare with this technology are huge, there is a potential for abuse and privacy breaches because of the personal health data being collected. Thus, gaining public trust before these technologies are deployed is crucial and is a prerequisite for the effective use of this technology by the wider public. Healthcare professionals have ethical concerns with recommending these devices and apps because of costs involved in procuring the technology and for the internet access.

Although being active and walking are paramount for active and healthy living in older age, there could be several barriers that may prevent older people from walking in their neighbourhoods, such as damaged or uneven pavements; pavement parking; lack of benches or resting places; lack of public toilets; lack of crossing points, or inadequate crossings; and risk of slipping by ice during winter or after an excessive rainfall. Policies that encourage adoption of activity monitors should consider these infrastructural factors, irrespective of the technology and its adoption, that would enable older people to have access to locations where walking is safe and easy²⁴.

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²³ Using technology to improve the public's health: A guide for local authorities, <https://www.local.gov.uk/using-digital-technology-improve-publics-health-guide-local-authorities>

²⁴ Older people walking report, <http://content.tfl.gov.uk/older-people-walking-report.pdf>