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Knowledge Exchange Seminar Series (KESS)

The empowering role of smart phones in behaviour interventions: The Gray Matters study

Abstract

Alzheimer's disease (AD) is recognised as a global health concern, however, there is currently no cure and research is focusing on identifying modifiable risk factors and prevention methods. Almost two thirds of the risk of developing AD can be attributed to one's lifestyle choices and environment. Our previous research has highlighted the potential of using a smartphone app to encourage individuals to adopt and sustain healthy lifestyle behaviours. This is achieved through facilitating the setting of achievable lifestyle goals, ranging from exercise and nutrition to stress management and brain stimulation – all of which are known to have an impact on the onset and progression of AD.

Specifically, our research targets mid aged persons (40-65) to reduce their risk of developing AD. Based on the success of our previous research we are currently focussed on translating this research knowledge and findings into practice by providing tools and resources to implement behaviour change at a population level for the public, clinicians and voluntary organisations who are conducting research into reducing the risk of developing AD.

Background Research

Research conducted by the Alzheimer's Society, shows that there will be 850,000 people living with dementia in the UK by 2015. This will cost the UK £26 billion a year. Given that there is currently no cure more systematic primary prevention, through lifestyle interventions, is critical in order to reduce the overall burden of disease in the population and maintain the financial sustainability of the NHS. AD is irreversible and results from recent

drug trials employing bapineuzumab or solanezumab have produced disappointing results. There is a growing interest in scientific investment in the development of preventive interventions as complementary to searches for a cure. Health education programs have demonstrated their effectiveness in educating individuals with targeted knowledge relating to risk factors of various diseases. With this knowledge, individuals are subsequently capable of making educated decisions regarding lifestyle choices, which may have a significant effect on their future health outcomes. Most health education programs target the leading causes of mortality, such as heart disease and stroke, cancer, diabetes and respiratory diseases. Nevertheless, only a limited number of studies have been conducted with a focus on health education for AD risk reduction, despite AD and other dementias being the third leading cause of death in the UK in the United Kingdom and 4th in Northern Ireland (1498 deaths in 2014).

Previous research by the investigators has highlighted the potential of multivariate behaviour change interventions to reduce the risk of developing AD. This work has also highlighted the utility of pervasive technologies, such as activity monitors and smart phones, in effective delivery of behaviour change interventions. These findings are in agreement with a growing body of supportive literature. Nevertheless, uptake of such interventions has been limited and it is still unclear whether or not the interventions undertaken within research will be sustainable or scalable in a free living environment. To appropriately deliver an education based behavioural intervention program, a suitable method of delivery, using proven behaviour change techniques is required. The term delivery encompasses both the psychological message of the intervention material and also the mode of distribution. This intervention is based upon the transtheoretical model (TTM) of behaviour change. The TTM is a stage theory that is often used as a guiding framework for many health-related interventions. This model posits that an individual's willingness to make behavioural changes is driven by their readiness to change. Stages of readiness are described as pre-contemplation, contemplation, preparation, action and maintenance, with relapse to prior unhealthy behaviours possible between the action and maintenance stages. Clearly, there is a wide range of potential use-cases for mobile technology for behaviour change within healthcare, nonetheless, the adoption of technology for the purpose of public health education or behavioural change interventions are extremely limited. This may be due to a number of reasons. Firstly, the surge in availability of apps in an unregulated market raises concerns as to the appropriateness of their content for different groups of end users. Recent reports have highlighted that many available apps are limited by quality, inaccurate information/absence of evidence-based content and lack of user and clinician engagement in their development. Conversely, many of the apps created for academic purposes and evidence based are not designed and built to the modern standards that users now expect from commercial grade apps. Therefore limiting the apps reach within an increasingly competitive market. Another issue is that of long-term sustained engagement. Whilst popularity of health apps is increasing and use has been associated with improved health outcomes, studies are finding that achieving sustained engagement with the technology over time is more challenging.

The Gray Matters Study

Previous work by the investigators identified distinct behavioural patterns across 6 domains (diet, exercise, social interaction, church attendance, alcohol consumption and smoking), and examined their association with dementia risk (Norton 2012). Findings from this work suggested that, persons who exhibited the least healthy behavioural patterns had nearly a two-fold higher risk for AD. This was the first study that identified distinct behavioural patterns across all six of the examined behavioural domains. The findings led to the realisation that instead of an examination of individual factors, a multivariate approach may be more effective. From this work

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it was highlighted that clinicians should target multivariate healthy behavioural patterns in their patients to encourage behavioural changes that could delay or prevent the onset of AD.

This previous research was the foundation for a successful collaboration between Utah State University (USU) and Ulster University (Ulster) through the Gray Matters Study (Figure 1) (Norton 2015, Hartin 2015). This study is an evidence-based multi-domain lifestyle intervention for middle-aged persons (40 to 64 years) with normal cognition, designed to promote brain health.

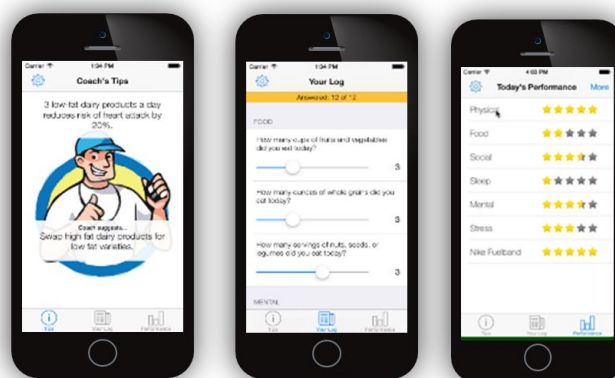


Figure 1 The Gray Matters app used during the study's RCT.

The six-month RCT of 146 residents of Cache County, Utah (treatment $n=104$; control $n=42$) tracked lifestyle behaviours across six domains: physical activity, food choices, social engagement, cognitive stimulation, sleep quality and stress management. Users tracked their physical activity using a wearable activity monitor and self-reported through a smartphone app. Evidence based daily facts, consisting of fact and suggestion pairs, highlighted the link between healthy lifestyle behaviours and improved cognitive wellbeing and were pushed to the user through the app on a daily basis. The aim of the app was to increase knowledge about AD prevention through modifiable lifestyle behaviours and increase intrinsic motivation to change.

The primary outcomes of the Gray Matters study were increases in intrinsic motivation, and actual changes in, healthy behaviours, with accompanying reductions in subjective memory complaints. Usage of the app was also shown to impact positively on clinical measures such as serum glucose ($p=0.015$), Insulin ($p=0.011$), HDL cholesterol ($p=0.037$), BMI ($p=0.048$) and CES-D depression ($p=0.085$). 92.5% reported their cognitive, physical or emotional health improved over the course of the study.

The app encouraged positive behavioural change, if maintained, these lifestyle changes may help users to realise improved vascular health in the short-term and sustained cognitive health in the long-term, which for some may translate to avoiding or delaying AD onset. Results from the RCT were presented at the Alzheimer's

Association International Conference (AAIC 2015) and subsequently poster by media outlets (Irish News, The herald Journal and Pharma times).

Additionally use of the app has been shown to be an effective tool for providing convenient, scalable and cost effective methods of delivering behavioural change interventions(Hartin 2014). 94.5% of users entered, and 91.8% reviewed, their performance daily. Over 141,800 individual behaviour logs were submitted across the six-month Gray Matters trial. Respondents rated the app's effect on their health improvement: 31% reported "a great deal of effect", 48% reported somewhat of an effect, and 3% said the app was the key factor. In Addition, presentation of the app at key conferences, including AAIC, has highlighted the potential of the app to facilitate behaviour change interventions across a number of domains including, drug therapy, primary prevention and biomarker analysis for a range of conditions including, COPD, CVD and some cancers.

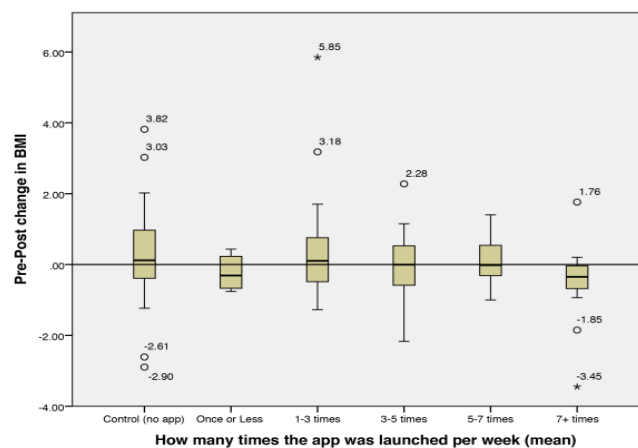


Figure 2 Boxplot showing CONTROL (no app) and TREATMENT (grouped by app launches per week) against observed changes in BMI.

Underpinning research References:

- (Norton, 2012) Norton, Maria C., et al. "Lifestyle behavior pattern is associated with different levels of risk for incident dementia and Alzheimer's disease: the Cache County study." *Journal of the American Geriatrics Society* 60.3 (2012): 405-412.
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- (Hartin, 2015) The Empowering Role of Smartphones in Behaviour Change Interventions: The Gray Matters Study. *Journal of Medical Internet Research (JMIR)*. In review.
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