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Cost-Effectiveness and Value of Information Analysis of Brief Interventions to Promote Physical Activity in Primary Care

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ABSTRACT

Background: Brief interventions (BIs) delivered in primary care have shown potential to increase physical activity levels and may be cost-effective, at least in the short-term, when compared with usual care. Nevertheless, there is limited evidence on their longer term costs and health benefits. **Objectives:** To estimate the cost-effectiveness of BIs to promote physical activity in primary care and to guide future research priorities using value of information analysis. **Methods:** A decision model was used to compare the cost-effectiveness of three classes of BIs that have been used, or could be used, to promote physical activity in primary care: 1) pedometer interventions, 2) advice/counseling on physical activity, and (3) action planning interventions. Published risk equations and data from the available literature or routine data sources were used to inform model parameters. Uncertainty was investigated with probabilistic sensitivity analysis, and value of information analysis was conducted to estimate the value of undertaking further research. **Results:** In the base-case, pedometer interventions yielded the highest expected net benefit at a willingness to pay of £20,000 per quality-adjusted life-year. There was, however, a great deal of decision uncertainty: the expected value of perfect information surrounding the decision problem for the National Health Service Health Check population was estimated at £1.85 billion. **Conclusions:** Our analysis suggests that the use of pedometer BIs is the most cost-effective strategy to promote physical activity in primary care, and that there is potential value in further research into the cost-effectiveness of brief (i.e., <30 minutes) and very brief (i.e., <5 minutes) pedometer interventions in this setting.

Keywords: brief intervention, cost-effectiveness, Health Check, physical activity, primary care, value of information.

Introduction

Physical inactivity is a major public health problem associated with a significant burden of chronic disease, including type 2 diabetes, cardiovascular disease, some cancers, and mental health problems [1–3]. Despite the well-documented health benefits of physical activity [4–7], in 2010, 33% of adults aged 18 years and older in high-income countries were insufficiently active, that is, they did not meet the current World Health Organization recommendations [8]. In England, using self-reported measures in 2012, 61% of adults aged 19 years and older met the current UK guideline [9] for moderate/vigorous physical activity [10], a figure virtually unchanged since the 2008 Health Survey for England (HSE), reporting 59%. Nevertheless, when physical activity was measured objectively using accelerometers, in 2008 only 6% of men and 4% of women aged 16 years and older met the recommended physical activity level [11].

Physical inactivity is also associated with a considerable economic burden, accounting for 1.5% to 3% of total direct health care costs in high-income countries [12]. The annual societal cost of physical inactivity in England (comprising the National Health Service [NHS] costs plus the value of morbidity/premature mortality-related lost productivity) is estimated at £8.2 billion per year, with an additional £2.5 billion for the contribution of physical inactivity to obesity-related costs [1].

Intensive face-to-face physical activity interventions delivered in primary care or community settings targeting sedentary adults can be effective at increasing activity levels [13]. They have been found to represent good "value for money" because they can increase self-reported physical activity at reasonable cost [14,15]. In recent years, there has been interest in brief interventions

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(BIs), defined as having a maximum duration of 30 minutes [16,17], to promote physical activity in a primary care setting [18–20]. Systematic reviews and meta-analyses of randomized controlled trials (RCTs) showed that BIs, for example, brief exercise advice/counseling delivered in primary care, increase physical activity [20,21] and are cost-effective [15,22] over the short-term (12 months or less). Nevertheless, the evidence on the longer term costs and consequences of BIs has been sparse to date.

Findings from published RCTs of physical activity interventions are not sufficient on their own to inform decision makers about the cost-effectiveness of intervention strategies [23]. Evidence on the long-term cost-effectiveness of health interventions is essential to inform resource allocation decisions aimed at maximizing health gains to the population from limited available resources [14]. Using a discrete event simulation model, we aim to evaluate the long-term cost-effectiveness of BIs to promote physical activity in adults eligible for an NHS Health Check in primary care.

If BIs are cost-effective, this raises the question of whether "very brief interventions" (VBIs) could also be cost-effective. VBIs, defined as lasting no more than 5 minutes [18], are of interest as they can be delivered as part of a primary care consultation such as the NHS Health Check [24]. This is offered every 5 years to all adults in England aged 40 to 74 years without known pre-existing vascular disease and is intended to assess the risk of certain conditions, including type 2 diabetes and heart disease, and provide preventative advice and interventions when indicated [25].

In this article, we present an economic evaluation of three classes of BIs (plus no intervention), reporting the incremental cost per quality-adjusted life-year (QALY) gained over 10 years. We also report a value of information analysis, a method to predict the return on investment in further research [26–28]. This information will inform the design of further research into the effectiveness and cost-effectiveness of VBIs delivered as part of the NHS Health Check.

Methods

Study Population

We used data from the 2011 HSE to generate a simulated cohort of 10,000 adults aged 40 to 74 years who do not have an existing diagnosis of diabetes, hypertension, cardiovascular disease, or renal disease, representing the NHS Health Check population [25].

The Physical Activity Cost-Effectiveness Model

We developed a discrete event simulation model, the Physical Activity Cost-Effectiveness model, using the R software (R Foundation for Statistical Computing, Vienna, Austria) [29] to estimate the cost-effectiveness of BIs. The model first generates a cohort of 10,000 representative individuals of the English population. It then follows each individual, predicting the incidence of chronic disease, mortality, and associated costs and outcomes over 10 years, specified with risk equations and data derived from the literature [30–38]. The model includes type 2 diabetes and associated complications, heart disease, stroke, and cancers related to physical inactivity and obesity (breast, colorectal, lung, or kidney cancer). Increased physical activity is assumed to influence risk factors such as reduced blood pressure, cholesterol level, and glycated hemoglobin. Modification of these risk factors leads to changes in the risk of chronic disease and comorbidities, such as reduced risk of cardiovascular disease. A decrease in chronic disease and comorbidities leads to a reduction in costs

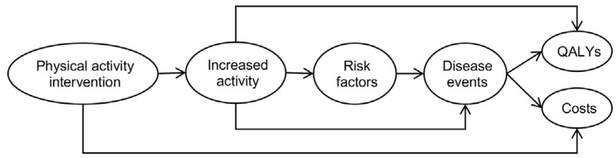

Fig. 1 – A schematic of the Physical Activity Cost-Effectiveness model. QALY, quality-adjusted life-year.

and to the prevention of a decrease in quality of life (Fig. 1). Effectiveness data for each comparator are entered in the model as an increase in metabolic equivalent (MET)-hours per week compared with no intervention, which, in turn, influences the risk of chronic disease. The random search method [39] was used to calibrate the model against seven calibration targets. Weighted mean deviation was used to assess the goodness of fit of calibration results [40]. Full details of the model and calibration are provided in Appendix 1 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2017.07.005.

Data Inputs and Sources

Model Inputs

Data on demographic characteristics of individual participants (age, sex, and ethnicity) were derived from the UK Office for National Statistics [41,42]. The risk factor profile (systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, body mass index, smoking status, and glycated hemoglobin) and prevalence of type 2 diabetes and cardiovascular events (ischemic heart disease, myocardial infarction, stroke, and heart failure) for individual participants in the cohort were generated using data from the 2011 HSE [43]. The severity of breast cancer was classified according to the Nottingham Prognostic Index prognostic groups—ductal carcinoma in situ, excellent, good, moderate, and poor [44]—and age-specific prevalence data for breast cancer were taken from the estimates for 2008 in the United Kingdom [45]. The baseline parameter values for colorectal cancer were derived from Frazier et al. [35] and applied to the baseline population to generate prevalence data for colorectal cancer. The baseline prevalence data of lung and kidney cancers were based on estimates from Cancer Research UK [37,46].

Interventions

We selected three classes of BIs: pedometer interventions, advice/counseling in primary care, and action planning interventions. Evidence of effectiveness was extracted from published meta-analyses of RCTs [47–49]. The three classes are somewhat heterogeneous, and therefore descriptions of the classes (and associated costings) hereafter reflect the scope of interventions included in the respective meta-analyses. This selection of BIs was based on the strength of evidence of effectiveness and their relevance in a primary care setting. Full details are provided in Appendix 2 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2017.07.005. We also included current practice in which no physical activity intervention is delivered.

Pedometer Interventions. Participants were given a pedometer to wear and were encouraged to view and record their daily step counts. They were also asked to set a physical activity goal such as to walk 20 minutes on all or most days of the week, or walk 10,000 steps on 5 days of the week. In some interventions, participants received individualized exercise feedback or additional "behavioral counseling" from a nurse or physiotherapist.