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## **A cost-effectiveness evaluation of Dance to Health: a dance-based falls prevention exercise programme in England**

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Sheffield Hallam University Research Ethics Board.

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### **Competing interests**

None declared.

## **ABSTRACT**

### **Objectives**

To evaluate whether the falls prevention programme Dance to Health provides the health system with an effective and cost-effective means to address the issue of older people's falls.

### **Study design**

Pre-post design - the same assessment measures were utilised both before and after the programme.

### **Methods**

Analysis and modelling was conducted using monitoring data (frequencies including session attendance, falls, GP and hospital visits), comprehensive financial information (including all costs related to the delivery of Dance to Health), and the Public Health England economic model: "A return on investment tool for falls prevention programmes in older people based in the community".

### **Results**

Findings from the research show that under the suggested health intervention there was a 58% reduction in the number of falls. Further, results also demonstrate that Dance to Health offers a potential cost saving of over £196m over a 2-year period, of which £158m is a potential cost saving for the NHS.

### **Conclusions**

The evidence outlines that Dance to Health offers the health system a cost-effective means to address the issue of older people's falls, and most importantly a method that produces strong results in terms of falls prevention.

## KEYWORDS

Dance programmes, falls, older people, cost savings

## INTRODUCTION

In the context of existing evidence on falls amongst older people, which shows that one third of people aged 65 plus, and half of people aged 80 plus, fall at least once per year,<sup>1</sup> we evaluated a new prevention programme aiming to reduce the frequency of falls and subsequently improve both the quality of life of older people and the financial burden on the NHS. Falls are a major challenge for the health system, costing the NHS £2.3 billion per year.<sup>2</sup> They represent the most frequent and serious type of accident in people aged 65 and over.<sup>2</sup> In 2016-17, there were 316,669 hospital admissions in England of people aged 65 and over because of falling; the equivalent of more than 867 each day across the country.<sup>3</sup> Fractures from falls account for over 4 million hospital bed days each year in England alone, among people aged 65 and over.<sup>4</sup> It has been estimated that the average cost of simply being an inpatient following a fall is £2600, whilst falls that result in moderate or severe harm lead to much greater costs for hospitals.<sup>5</sup> Furthermore, cost-wise, unaddressed falls hazards at home are estimated to cost the NHS in England £435m,<sup>6</sup> whilst the total cost of fragility fractures to the UK has been estimated at £4.4bn, which includes £1.1bn for social care.<sup>7</sup> Most hip fractures (more than 95%) are caused by falling.<sup>8</sup>

In addition to being a major cause of pain and injury, falls are traumatic for older people, destroying confidence, increasing isolation, and reducing independence. One in ten people who fall become afraid to leave home in case they fall again.<sup>9</sup> After a fall an older person has a 50% probability of having his or her mobility seriously impaired, and a 10% probability of dying within a year.<sup>10</sup> However, falls are not an inevitable part of ageing.<sup>11</sup> There is evidence (including findings related to the benefits of Dance to Health detailed within this study) that exercise programmes designed to improve strength and balance can lead to a reduction in falls.

Falls are the most common cause of injury related deaths in people over the age of 75 with over 5,000 older people dying because of a fall in 2017, a 70% increase on the numbers in 2010.<sup>12</sup> This is in part because we are living longer. The number of people aged 65 and over is projected to rise by over 40% in the next 17 years to more than 16 million, meaning that the threats posed by elderly falls and the demands placed on public healthcare will only increase.<sup>13</sup> Additionally, it is imperative to acknowledge that the importance of falls prevention has been widely recognised by Public Health England (PHE) in particular. The NHS intends to focus on working on falls and fracture prevention, where we know that a 50% improvement in the delivery of evidence-based care could deliver £100 million in savings.<sup>14</sup>

Many organisations describe the benefits of staying active to reduce the risk of falling. For example, Public Health England states that "older adults at risk of falls should incorporate physical activity to improve balance and coordination on at least two days a week"<sup>15</sup>, whilst The Centre for Ageing Better calls for the government to promote the benefits of physical activity more widely for older people and support more people to maintain physical activity in order to delay frailty and reduce falls.<sup>16</sup> Age UK outlines the importance of looking after the body, emphasising not only staying active, but also eating well and staying hydrated in order to reduce the risk of falling.<sup>17</sup> In addition to the potential physical benefits of staying active, the NHS recommends that older people should "keep moving" in order to reduce the risk of mental illness and stay independent well into old age.<sup>18</sup>, whilst dance has been shown to reduce the risk of dementia by 35%.<sup>19</sup> More recently it has been emphasised that greater consideration of all psychological benefits of exercise is needed among health and exercise professionals working with the elderly.<sup>20</sup> NICE guidelines on the prevention of falls recommends muscle-strengthening and balance training programmes. Existing evidence around falls prevention exercise programmes demonstrates the potential of these programmes to improve quality of life and achieve significant cost savings.<sup>21</sup> By offering a programme of activity in order to improve their health and prevent falls, it gives individuals the capability to manage their own

health and wellbeing in order to reduce the risk of falls, rather than facing the consequences of falls once they have occurred.<sup>11</sup> The meaningful involvement of older people in falls prevention will increase its likelihood of success.<sup>11</sup>

Despite the huge potential of exercise programmes for achieving dramatic improvements in quality of life and significant cost savings, older people continue to have limited access to evidence-based falls prevention programmes, whilst evidence has demonstrated that participation in best practice exercise to prevent falls is low.<sup>22</sup> Where these programmes are available, the vast majority are altered or scaled down to an average duration of 12 weeks or less,<sup>23</sup> yet we know that a ‘dose’ of at least 50 hours is necessary to reduce falls.<sup>24</sup> Ongoing commitment to staying active (maintaining/sustaining activity) is also required, as there is evidence that suggests that any improvements from physical activity can wear off within 12 months if the activity ceases.<sup>25</sup> The crux of the matter is that ageing muscle can still be trained – it is never too late to get active. Population-based approaches and targeted strategies for high-risk group are needed.<sup>22</sup>, therefore it is essential to encourage and support the commissioning of services which reduce risk of falls and fragility fracture.

There has been a number of important projects on the topic of falls as outlined above. A recent project, noting the developing of balance through dance was developed by Merom D. et al (2013), investigating not only the link between dance classes and reduction in falls, but also the effect on social engagement.<sup>26</sup> The results of this research showed that social dancing did not prevent falls or their associated risk factors, and suggested that ‘modified dance programmes that contain training elements’ should be investigated.<sup>27</sup> Although Dance to Health can be classified within this category, for the sake of completeness we should point out a systematic review by Choi et al (2017) which highlighted exergame technology and interactive interventions for reducing falls, including using dance video games to achieve such an outcome.<sup>28</sup> Despite some positive findings, it remained inconclusive whether or not the exergame-based interventions were superior to conventional physical therapy.

Difficulties to evaluate effectiveness and cost effectiveness of health interventions have been developed by Ismail (2017).<sup>29</sup> In terms of the current project, the difficulties associated with QALYs and the community-based dimensions are particularly important and are addressed in the discussion of our results.

### **Dance to Health**

Dance to Health is a nationwide pioneering falls prevention dance programme targeting older people. The programme was designed with the intention of addressing older people's falls and problems with existing services. Dance to Health sessions combine evidence-based exercise with the creativity, energy, and sociability of dance. The sessions are led by professional dance artists who have been fully trained and qualified in falls prevention exercise methods. The programme was devised and managed by Aesop, a social enterprise and charity.

A systematic review investigating if dance can reduce falls and improve fear of falling in older adults was conducted by Veronese et al (2017). The conclusion of this review was that dance therapy does not appear to reduce falls per se, but may improve fear of falling.<sup>30</sup> However, Dance to Health differs significantly from other dance-based programmes, as the programme is comparable with two evidence-based falls prevention initiatives: the Otago Exercise Programme (Otago) and the Falls Management Exercise Programme (FaME). These programmes have been shown to be effective for both primary and secondary prevention of falls and non-vertebral fractures in older people, but with greater efficacy in those who have a history of recurrent falls or who have a balance or gait deficit.<sup>31</sup> Despite the existence of evidence-based programmes such as Otago and FaME, many current falls-prevention exercise programmes that are being delivered face challenges: patchy provision,<sup>31</sup> low take-up and adherence (maintaining their attendance at sessions),<sup>32</sup> poor fidelity in terms of delivery,<sup>33</sup> whilst only a minority are evidence-based.<sup>24</sup> Additionally, uptake to exercise programmes can be disappointing, with many programmes considered to be dull and delivered over short

periods, without consideration of sustaining activity levels or long-term ongoing programmes to maintain improvements.<sup>34</sup>

Evidence suggests that participation must be regular and frequent to have an impact, with a minimum dose of 50 hours over the duration of six months.<sup>24</sup> Dance to Health achieves this through a weekly two-hour slot (a 90-minute activity session and 30 minutes of socialising time), plus a further 30 minutes (at least) of 'homework' exercises and activities each week. Finally, programmes must be of the right intensity and be significantly challenging and progressive for individuals. NICE recommends that practitioners involved in developing falls prevention programmes should ensure that programmes are flexible enough to accommodate participants' different needs and preferences and should promote the social value of such programmes.<sup>35</sup> Dance to Health incorporates exercises from both Otago and FaME as these programmes allow for progression and flexibility, whilst they were also designed through research trials exploring the specific components of exercise that are effective in preventing falls and have been rigorously evaluated and proven to work in practice.<sup>36</sup>

## **METHODS**

The aim of the research was to evaluate whether Dance to Health provides the health system with an effective and cost-effective means to address the issue of older people's falls. Detailed analysis and modelling were conducted to measure any changes in frequency of falls whilst also quantify the cost effectiveness of Dance to Health. This modelling was conducted by analysing of monitoring data (most notably frequencies including session attendance, falls, GP and hospital visits) collected as part of the evaluation of the Dance to Health programme, analysing financial information provided by the programme deliverer - Aesop (including detailed financial costs associated with the delivery of Dance to Health), and processing the results through Public Health England's economic model, titled: "A return on investment tool for falls prevention programmes in older people based in the community".<sup>37</sup> Cost savings of



the programme were calculated as Return on Investment (ROI). The Public Health England model was adjusted in its basis for the requirements of this research. The parameters of the model, such as duration, and proportion of hospitalisations have been altered. However, the principles of the model remain unaltered which enables comparisons with other methods and more general conclusions on the interventions for fall prevention.

At the time of the research, all participants that were taking part in Dance to Health sessions across all 6 geographical regions were eligible to take part. The following research methods were adopted: collection of monitoring data, physical testing of participants, and collection of data via surveys.

Data was collected between April 2017 and September 2019 across 40 Dance to Health programmes. These programmes spanned across 6 regions and 4 Royal British Legion care homes across the UK and included weekly activity classes. Participants initially provided a retrospective report of falls in questionnaires that were completed at the baseline. Following this, weekly falls diaries were maintained across the course of the 56-week programme. A monitoring spreadsheet was distributed to all programme leads to monitor data on a weekly basis, namely programme attendance and participants' number of falls since their last session. This methodology can elucidate how successful the programme has been in terms of reducing falls and engaging and retaining participants, i.e. through analysing individuals' adherence to the programme. Individuals were deemed to have adhered to the programme if they had attended at least 70% of Dance to Health sessions at their chosen class.

The study was exploratory and based within a critical realist paradigm of inquiry. The ontological and epistemological orientations of the research team aligned with the theoretical view that social structures have their origins in human action, as dynamic structures derived of the actions and interactions of individuals.<sup>38</sup>

## **Sample**

The total sample of participants included in the study was 1194. The sample of participants comprised of individuals taking part in the Dance to Health programme. Of the sample, 85% were females and 15% males, whilst the average age was 77 years, with the youngest participant being 42 years of age and the eldest 102 years of age. All participants were able to provide informed written consent. To avoid the risk of perceived coercion, eligible candidates were issued with a participant information sheet and invited to complete and return the form at their convenience should they wish to consider their involvement in the study. Individuals were reassured that participation was entirely voluntary.

## **RESULTS**

Of participants that could recall falls in the previous 12 months (246), based on overall data across both phases (a 56-week period); there was a reduction in falls of 58%, during the 56-week Dance to Health programme. This is a key statistic that indicates the effectiveness in the model. An important statistic, in terms of cost effectiveness, is the number of fall-related hospital admissions as a percentage of Accident and Emergency admissions. Of all recorded falls, 20% are classed as serious falls, and of these serious falls 80% require admission to Accident and Emergency, of which 35% then require admission as an inpatient.<sup>37</sup> By contrast, Dance to Health monitoring data collected as part of this study showed that only 13% of admissions to Accident and Emergency required admission as an inpatient. This leads to a significant cost saving not only in terms of front-line costs for the NHS but also in terms of reduced social care costs.

In addition to the reduction in falls, based on the analysis conducted there is a potential cost saving of over £196m over a 2-year period, of which £158m is a potential cost saving for the NHS in England. These savings assume a full roll out of the programme among the elderly in England, which is comparable to previous assumptions for economic evaluations (e.g. FaME).

Using the Public Health England model, when adjusting for the proportion of the population deemed at risk of a fall (34%) and those willing to take part in falls prevention programmes (38%), the cost of implementing Dance to Health in England (demonstrating a saving of over £196m) is shown in Figure 1.

**\*Figure 1 to be inserted here\***

Cost savings of the programme have been calculated as Return on Investment (ROI), the results of which can be seen in Table 1, alongside results from analysis of Otago and FaME.

**\*Table 1 to be inserted here\***

In terms of realised cost savings, the financial ROI is £1.18, i.e. for every £1 invested in Dance to Health there is a positive return of £1.18. For the societal ROI, the benefits include both savings (financial ROI) and the value of any improved quality of life, as measured by Quality Adjusted Life Years (QALYs). The latter are calculated using cost ratios and translated into a monetary value; each additional QALY generated by an intervention is valued at £70,800 based on guidance from the Department of Health.<sup>39</sup> Considering societal ROI, Dance to Health has a potential ROI of £2.89 for every £1 invested, indicating there is a positive return of £1.89.

Table 1 also shows a Net Monetary Benefit (NMB) of Dance to Health of £1,615.93 per person. The NMB is derived by calculating the difference in both financial cost and QALYs for Dance to Health against the financial cost and QALYs of usual care (no intervention). It is a summary statistic that represents the value of an intervention in monetary terms. Essentially, a positive NMB (as is shown here) indicates that the intervention is cost-effective.

## **DISCUSSION**

Findings from the research show that Dance to Health offers a significant potential cost saving for the NHS. Most interventions do not have a direct financial benefit for the NHS. In general, the only way to make a case for dance-based interventions is to include the qualitative element

of improving QALYs. The evidence collected as part of this study shows that Dance to Health differs in this respect. It is the first time that a dance-based intervention can demonstrate a financial return on investment. The reason for this is that the people who adhere to the programme, i.e. stay long enough in the programme, reduce the probability of hospitalisation (following a visit to Accident and Emergency) by more than a half.

Additionally, the programme achieved a reduction in the number of falls experienced by participants. Long term adherence to the programme can ensure that a participant maximises the benefits that Dance to Health has to offer, as physical improvements (i.e. improved strength and balance) can take time to build up.

An underlying strength of the evaluation is the very detailed nature of the PHE model used in this research. The model helps to differentiate the monetary side from the QALYs-related evaluation. Further, the fact that the model has been adjusted to the parameters of the research (such as the length of the programme) means that it can only produce results specific to our purposes and at the same time it gives results which are comparable to previous interventions. This comparability is a major strength of the model, as through it we can detect relative strengths and weaknesses of the intervention.

There are some limitations in the present study. Much of the data, including weekly monitoring data, involved self-reported figures. Therefore, there is the potential that the self-reported data could be biased. For example, there is the potential that participants chose to take part in the Dance to Health programme as they have a high affinity to dancing. Moreover, at the baseline stage of the study, participants were asked to recall previous falls; therefore, there may be a recall / selective memory bias in retrospective reporting of falls. Further research could incorporate prospective falls diaries, in which prospective participants could complete falls diaries prior to their participation in the Dance to Health classes.

Whilst comparisons between Dance to Health, Otago and FaME are a good indicator, it is important to note that Public Health England suggest that due to potential differences in clinical trials or research that informs the analysis, considerations of validity should be taken into account when making direct comparisons between the programmes.

The results of this study are based on pre- and post-intervention measurements. Future research, such as a Randomised Control Trial, would incorporate a control group into the research design. This would yield more robust data. Future research should also consider in more depth suitable methods through which feedback from participants that may have dementia could be incorporated.

Much of the criticism of Ismail (2017)<sup>29</sup> is also applicable here. The intervention, to generate the suggested savings assumes a national roll out which further assumes that the policy makers can be persuaded to pursue such an endeavour. Further, the fact that we use the PHE model means that we can change the model only within the logic used by the agency. We cannot for example explore the case of reduced costs through economies of scale which is likely to be the case in the suggested national roll out. Finally, because of the structure of the model we are restricted to health-related outcomes centred to monetary savings and the evaluation of QALYs. Future research should consider the impact of the intervention on wider socioeconomic indicators, including social interactions and community bonds. Tools such as Social Returns of Investment can also be used which would underline the subjective wellbeing from the intervention, including social capital and monetised measures of wellbeing gained through the intervention.

The evidence within this research outlines that Dance to Health offers the health system an effective and cost-effective means to address the issue of older people's falls. It is the first time that a programme showed financial returns outside the QALYS framework. The evidence could be used to help inform health care professionals, national and local organisations, stakeholders,

and decision makers of the impact the programme can have in reducing the associated costs of falls.

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