SUPPORTING INDEPENDENT LIVING THROUGH THE PREDICTION AND PREVENTION OF FALLS

Etaine Lamy

SEPTEMBER 8, 2017
UNIVERSITY OF GLASGOW
Urban Big Data Centre
**Background and aims:** Understand the pattern of falls in the elderly population in Glasgow City in order to develop an effective policy on falls prevention. This research is a collaborative project between the Urban Big Data Centre and the Glasgow City Council.

Contact: ubdc@glasgow.ac.uk

**Contents**

Summary ............................................................................................................................... 3

Section 1: Introduction ........................................................................................................... 4

Section 2: Analysis – Where, when and for whom do falls happen? ................................. 5

  Section 2.1: Descriptive statistics on falls in Glasgow .................................................. 5

  Section 2.2: Predicting falls ......................................................................................... 6

  Section 2.3: Outdoor falls and road conditions ......................................................... 12

  Section 2.4: Weather and falls .................................................................................... 13

  Section 2.5: Behavioural and medical causes of falls: .............................................. 17

Section 3 – Cost of falls in Glasgow City ......................................................................... 17

Section 4: Recommendations for the City Council to support independent living ........... 19

  Section 4.1 – Adapting physical environments to the elderly ...................................... 19

  Section 4.2 – The NHS GGC Community Falls Prevention Programme ...................... 22

  Section 4.3 – Promoting healthy lifestyles at all ages ................................................. 23

Annex 1 ............................................................................................................................ 24

References ......................................................................................................................... 25
Summary

A major problem among the elderly, falls are considered as a ‘geriatric giant’ and represent a great cost for health and social care. In Glasgow, an average of 2.5% of the 65+ population are hospitalised each year due to falls and 7.1% call the Scottish Ambulance Service (SAS) for falls-related incidents. Both falls-related ambulance calls and hospital admissions have been increasing as the population at risk increases, but referrals to the falls-prevention service in NHS Greater Glasgow and Clyde (GGC) have decreased between 2010 and 2015. Projections from the National Records of Scotland (NRS) show that the 65+ population will increase by half between 2017 and 2037: it is now becoming urgent to put prevention at the heart of the health and social care system. The estimated cost of falls was £54.6 million in 2014/15, with £32.8 million borne by the City Council for social care: this represents 8.7% of the City Council’s 2014/15 Social Work budget. By 2037, this cost is estimated to rise to £81.1 million a year.

The initial aim of this study was to focus on falls occurring in the public realm. Outdoor falls represent half of total falls among the elderly and show different risk profiles than indoor falls. Indoor falls are associated with older age, inactive lifestyle and indicators of poor health while those who fall outdoors tend to be younger, live a relatively active and healthy lifestyle. However, as the data in our possession did not allow to predict outdoor falls separately, we decided to focus on falls in general, including both indoor and outdoor falls.

Our analysis shows that being from a more deprived area and being older (80 years-old or over) increase the risk of falling. Falls are also more likely in areas with poor pavement conditions and busy pedestrian streets. Deprivation is a weaker predictor for referrals to the Community Falls Prevention Programme (CFPP) led by the NHS GGC. There is a seasonal pattern in falls with an increase during December and January. No single weather condition such as freezing temperatures, high winds, snow or rainfall appear to predict falls; however, when there is a combination of two or more of these conditions, as often happens in winter, there is a higher incidence of falls.

Circulatory and respiratory diseases are the most significant health problems associated with emergency admissions to hospital due to falls, with respectively 30% and 15% of falls related to such conditions. About 10% of falls-related hospitalisations are associated with alcohol consumption and 5 % to type 2 diabetes. This suggests that with appropriate interventions to encourage healthy behaviours, falls among the elderly can be significantly reduced.

Based on literature and this study, the following recommendations are suggested to prevent falls in Glasgow:

1. Increase efforts to adapt public environments to people with reduced mobility by ensuring clear and even pavement surfaces and adapting streets and curbs.
2. Increase the visibility of the Community Falls Prevention Programme in order to increase the number of referrals and continue to use the most effective techniques.
3. Intensify the promotion of healthy lifestyle for all age groups, particularly in deprived areas.

Evidence suggests that appropriate interventions are cost-effective. Moreover, the CFPP was estimated to be cost-saving by a 2013 study (net saving of £23,448).
Section 1: Introduction

Falls among the elderly are often referred to as one of the ‘geriatric giants’, due to their frequency and the important array of both psychological and physical consequences. 30% of those aged 65 and over fall each year and this figure rises to 50% of those aged 80 and over. Women are more likely to be at risk due to a higher post-menopausal risk of osteoporosis. Among community dwelling older people (e.g. those living in the community) 5% a year experience a fracture and hospitalisation and 40% of care homes admissions are due to a fall-related reason. A fall can mark the start of a vicious circle of lack of physical activity and social isolation known as the post-fall syndrome.

The ageing of the population adds a greater sense of urgency to improving falls prevention. With a predicted increase of 86% of the population aged 75 and over by 2039 in Scotland and life expectancy increasing faster than healthy life expectancy, demand for health and care services will face unprecedented demand.

In the light of this expected change in needs and demand, the Scottish government aims to focus on prevention. The 2016 Health Care Delivery Plan aims to shift services towards prevention, anticipation and supported self-management with a target of 10% decrease in unscheduled bed-days in hospital care by 2018 (400,000 bed-days) through evidence-based interventions, and better integration between health and social care systems. As the biggest city in Scotland, Glasgow should play a leading role into delivering this plan and has already acknowledged this challenge. In the words of the Glasgow City Council in 2017: ‘Our approach to primary and community care on the one hand, and acute and hospital services on the other, should support the critical health challenges our society faces, not least with respect to an ageing population’.

The purpose of this report is to analyse patterns for falls among the elderly in Glasgow City and find when, where, and for whom it is most common. This will provide Glasgow City Council with evidence to develop effective strategies in terms of road maintenance and urban planning to support independent living in the context of a rapidly ageing population.

Our falls data covers Glasgow City for the population aged 65 and over. The Information Services Division (ISD) of NHS Scotland provided data from the Scottish Morbidity Records for falls-related emergency admissions in Glasgow City for the financial years 2011 to 2015. Data was also sourced from the Scottish Ambulance Service for falls-related incidents for financial years 2012 to 2016. The sum of people taking and attending an appointment with the Community Falls Programme was provided by the NHS Greater Glasgow and Clyde Safe Haven for the years 2010 to 2016. The sum of reports about pavements and potholes were obtained from the website FixMyStreet for calendar years 2010 to 2015. Details about the data and how to access it are presented in Annex 1.
Section 2: Analysis – Where, when and to whom do falls happen?

Section 2.1: Descriptive statistics on falls in Glasgow

Based on Health Department figures, the absolute risk of falling for the 65 and over is estimated at 34%. Applying this to population data from the National Records of Scotland (NRS), an average of 28,251 falls per year were expected for the years 2010 to 2015 in Glasgow City. While it is impossible to know the exact number of falls, some of these will lead to ambulance calls or hospitalizations and will become recorded. The data used in the section includes the discharge data (financial years 2011 to 2015) for falls-related emergency hospital admissions, SAS calls by incident location and patient’s postcode for financial years 2012-2016, as well as counts of attendance to CFPP appointments (calendar years 2010 to 2016). While the data SMR 01 for hospital admissions records outdoor falls, the numbers for these are likely considerably underestimated. In our data, outdoor falls only accounted for 16.4% of total falls-related hospitalisations, but based on previous research outdoor falls represent half of total falls. The data include falls among care home residents (estimated 7% of annual falls among the population).

Table 1 summarises falls in Glasgow City for the population 65+ from 2010/11 to 2015/16 as well as expected figures for 2037, 20 years from now, based on population projections. The number of falls is estimated to increase in line with the increase in population; by 2037, the expected number of falls is likely to be roughly 42,000, 48.3% higher compared to 2014/15.

The Scottish Ambulance Service recorded on average 5,884 fall-related incidents for 2012/16, which represent about 7% of the 65 and over population (falls by location incident). An average of 2,145 falls were recorded by the ISD per year as leading to emergency hospital admissions, representing 2.6% of the total 65 and over population. The number of falls have risen proportionally to increases in the 65+ population, with percentages of hospital admissions and SAS falls remaining stable across the years. The difference between SAS calls and hospital admissions may be explained by the fact that only 77% of those calling the SAS are taken to hospital and only 60% of those attending A&E are eventually admitted.

Our figures for referrals to the Community Falls Prevention Programme (CFPP) show that an average of 1% of the population at risk of falling is referred every year (based on 2010 to 2015 figures). The CFPP acts a single point of access for older people at risk of falling and provides a simple and inclusive referral pathway to health and care services. After referral and triage, the program provides a home assessment, interventions on any modifiable risk factors, links with outside specialists and advice for patients as well as their carers. The evaluation of the NHS Greater Glasgow and Clyde Community Falls Prevention Program by Skelton and Neil (2009) found that CFPP is the largest falls service in the United Kingdom per capita and follows published guidelines (NICE 2004, ABS/BGS 2008). The interventions it offers are evidence-based and provided by trained staff.

The evaluation of the CFPP by Skelton and Neil (2009) provides details about the origins of referrals to the program. In 2007/08, 30% of referrals originated from Pendant Alarm (a wearable device that can easily be activated to call emergency services), 25% from GPs, 15% from Physiotherapy and 15% from family, carer or self. In 2009, all patients aged 65 and over passing through the Southern General Hospital in Glasgow were screened for fall history and...
automatically referred to the CFPP. It is unclear whether that practice has extended to all hospitals since.

Trends show that while falls recorded by the SAS and serious falls leading to hospitalisation have increased proportionally to 65+ population increases, there is a decrease in the proportion of the population attending appointments with the CFPP: from 1.3% of the population in 2011 to 0.8% in 2015. This report cannot say why referrals to the programme have decreased.

Population projections (NRS) show that the 65 and over population is expected to increase by half by 2037 to 123,876. Incidence of falls is therefore expected increase as well. Our estimate of falls for 2037 are based on the current risk of falls and does not take into account the increasing prevalence of health conditions such as dementia in older people (from 940,000 by 2021 to 1.75 million by 2051) or potential improvements in healthy life expectancy.

### Table 1. Falls in Glasgow

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>65+ population</td>
<td>82,251</td>
<td>82,960</td>
<td>83,197</td>
<td>83,546</td>
<td>83,503</td>
<td>123,876</td>
</tr>
<tr>
<td>Total number of falls, estimated</td>
<td>27,965</td>
<td>28,206</td>
<td>28,287</td>
<td>28,406</td>
<td>28,391</td>
<td>42,118</td>
</tr>
<tr>
<td>Number of falls-related admissions</td>
<td>2,060</td>
<td>2,066</td>
<td>2,168</td>
<td>2,186</td>
<td>2,243</td>
<td>3,221</td>
</tr>
<tr>
<td>Percentage of admissions</td>
<td>2.5</td>
<td>2.5</td>
<td>2.6</td>
<td>2.6</td>
<td>2.7</td>
<td>2.6</td>
</tr>
<tr>
<td>Number of SAS calls**</td>
<td>5,879</td>
<td>5,844</td>
<td>5,798</td>
<td>6,015</td>
<td>8,795</td>
<td></td>
</tr>
<tr>
<td>Percent of SAS calls</td>
<td>7.1</td>
<td>7.0</td>
<td>6.9</td>
<td>7.2</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>Number of CFPP referrals*</td>
<td>1,053</td>
<td>922</td>
<td>1,120</td>
<td>782</td>
<td>704</td>
<td></td>
</tr>
<tr>
<td>Percentage of CFPP referrals*</td>
<td>1.3</td>
<td>1.1</td>
<td>1.3</td>
<td>0.9</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

Note: Percentages for admissions, SAS calls and CFPP appointments are calculated from the 65+ population.


** Scottish Ambulance Service falls by incident location.

### Section 2.2: Explaining falls

Several studies have found a relationship between deprivation and falls in the elderly. A study in the Edinburgh Royal Infirmary found that social deprivation is correlated to fall-related fractures in all age groups while another study in Nottingham found a 10% higher admission rate for falls in the most deprived areas compared to the most affluent Townsend score quintile. One explanation for this relationship is that people from more deprived background have poorer health than those from more affluent background and many health conditions are associated with falls.

The deprivation measure used in this study is the 2016 Scottish Index of Multiple Deprivation. SIMD is a relative measure of deprivation across data zones in Scotland and looks at multiple deprivation. 38 indicators of deprivation are grouped into seven domains (income, employment, education, health, access to services, crime and housing) which are combined into one SIMD, ranking each data zone in Scotland from 1 (most deprived) to 6,976 (least deprived). We use deprivation quintiles (population weighted) for this analysis, with the first quintile being the least deprived and the fifth quintile the most deprived in Scotland.
We found a positive relationship between deprivation and falls – hospital admissions and SAS calls (by patient home address) increase as deprivation increases. Figure 1 panels A and B illustrate these relationships. The average number of hospital admissions for the least deprived areas (quintile 1) between 2010-2015 was roughly 20 per 1000 people aged 65 or older, but for the most deprived areas (quintile 5) it was nearly 30 (Figure 1, panel A). Similarly, while 48 ambulance calls per 1000 were made for those from the least deprived areas, 70 were made for elderly from the most deprived areas (Figure 1, panel B).

Figure 1. Hospital admissions, CFPP appointments, and SAS calls by patient home and fall location, per 1000 population aged 65+ for Glasgow, 2010/15.

The rate of people taking up appointments with the CFPP is also related to deprivation (Figure 1, panel C), but less clearly than hospitalization or SAS call rates by patient home address. The rate of CFPP appointments is highest (16 per 1000) for the average deprived areas (quintile 3), and also high for the quintiles 2 and 5 (approximately 15 per 1000). The rate of CFPP appointment is lowest for the least deprived areas.
Figure 2. Scottish Ambulance Service calls by patient home address and deprivation.

Figure 3. Scottish Ambulance Service calls by incident location and deprivation.

SAS calls by the location of the incident are not related to deprivation (Figure 1, panel D). SAS calls are very high for quintile 2 and much lower similar for all other quintiles, which all experience roughly 70-80 ambulance calls per 1000 people aged 65 or more. This observed relationship is driven by many busy pedestrian areas (the likely location of falls) being in the second quintile. As will be shown below, once this is accounted for, deprivation has no effect on SAS calls by incident location.
Figures 2 and 3 also visualize the relationship between SAS calls and deprivation quintiles on a map of Glasgow. In Figure 2, for calls by patient home postcode, we can observe the pattern of fewer falls recorded in the least deprived areas such as the West End, compared to the more deprived areas, such as the East End. In Figure 3, where SAS calls are recorded by incident location, the pattern is different – busy pedestrian areas such as the city centre and data zones surrounding Byres Road appear to have the most falls despite low levels of deprivation. Together this suggests that while people from deprived areas are more likely to fall, the location of these falls is not necessarily their local community, but rather busy pedestrian areas.

We also ran Ordinary Least Squares (OLS) models for all four measures of falls and the results are presented in Table 2. We used SIMD deprivation quintiles, population composition and an indicator of whether the datazone is a busy pedestrian area as predictors. All city centre datazones are coded as busy pedestrian areas to account for the higher likelihood of falls in areas where many people walk (see Annex 1 for coding). Population composition is measured by the percent of people in the specified age groups (from the 65+ population). This is to account for the higher likelihood of falling among the oldest people. We then also added the number of complaints made about pavement conditions as a predictor. The only available data regarding pavement conditions in Glasgow was that collected by the FixMyStreet website (https://www.fixmystreet.com/), which allows residents to register claims such as potholes and overgrown weeds, which are then sent to the local authority in charge of the area.

Overall models 1 through 4 explaining hospitalization rates and SAS call rates (by patient home) confirm what was also seen in the figures above – the rate of hospitalizations and SAS calls increases as deprivation increases. Everything else equal, the models suggest we should expect roughly 12 more hospitalizations and 30 more SAS calls per 1000 people 65+ for the most deprived areas (quintile 5) compared to the least deprived areas (quintile 1). The results show that those living in deprived environments are more likely to fall, even after accounting for age composition, complaints about pavement and whether the datazone is a busy pedestrian area.

Models 5 and 6 show that deprivation is not related to SAS calls when these are recorded by the location of the incident. Instead, falls related SAS calls are much more likely to busy city centre pedestrian areas, which have roughly 800-900 more calls per 1000 people aged 65+ compared to all other areas. This is consistent with a Hong-Kong study, which found that most falls occurred along major streets and at junctions. The number of pavement problems reported in the area is also a strong predictor of SAS calls by location, with 104 more call-outs for each additional pavement report. Adding the pavement reports variable considerably strengthens the explanatory power of the model from 25% of variation in SAS calls (by location) explained by Model 5 to 35% explained by Model 6. The comparison of the two sets of models for SAS calls by patient home postcode and by incident location suggest that falls to the elderly are likely to take place in busy pedestrian areas and to those from the more deprived areas.

The results also show a relationship between deprivation level and the rate of CFPP appointments attended (Models 7 and 8). However, the results also suggest that unlike for hospitalizations and SAS calls (by patient home postcode), each increase in deprivation does not lead to an additional increase in CFPP appointments. Rather, least deprived areas (quintile 1) have the fewest appointments while all other quintiles have about 3-6 more appointments for every 1000 people 65 or older. Residents from areas of average deprivation (quintile 3) are most likely to take up appointments with the CFPP compared to the least deprived areas. Based on the results for hospitalizations and SAS calls (by patient home), we would expect the number of CFPP
appointments to be much higher for quintiles 4 and 5. While elderly people from the more deprived areas are at a higher risk of falling, this is not reflected in increases referrals to the CFPP. Finally, pavement reports, and whether the datazone is a busy pedestrian area do not explain the rate of CFPP appointments.

As expected, regression results indicate that population composition of the area affects all four measures of falls. Datazones with a higher proportion of the oldest people, those aged 85 or above, are more likely to have an increased rate of hospitalizations, SAS calls and CFPP appointments.

Overall, the outcomes of the regression models indicate that deprivation level is a strong predictor for all SAS calls (by patient home postcode) and hospital admissions. CFPP attendance is also associated with deprivation, but not such that each increase in area deprivation would lead to more appointments. Reports about pavement conditions as well as buys city centre areas are the strongest predictors of the rate of SAS calls by location and deprivation does not affect the rate of SAS calls when measured by location. This is consistent with previous research.
Table 2. OLS models for falls and CFPP appointments in Glasgow, 2010-2015

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model</th>
<th>Hospitalizations</th>
<th>SAS calls (by patient home)</th>
<th>SAS calls (by location)</th>
<th>CFPP appointments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Intercept</td>
<td>137.19***</td>
<td>139.92***</td>
<td>193.35**</td>
<td>197.73**</td>
<td>-2987.6**</td>
</tr>
<tr>
<td></td>
<td>42.26</td>
<td>42.05</td>
<td>94.73</td>
<td>95.25</td>
<td>1163.1</td>
</tr>
<tr>
<td>Quintile 2</td>
<td>3.94***</td>
<td>4.15***</td>
<td>14.06***</td>
<td>14.13***</td>
<td>33.93</td>
</tr>
<tr>
<td></td>
<td>1.35</td>
<td>1.34</td>
<td>3.06</td>
<td>3.06</td>
<td>37.37</td>
</tr>
<tr>
<td>Quintile 3</td>
<td>5.65***</td>
<td>5.53***</td>
<td>17.39***</td>
<td>17.33***</td>
<td>24.37</td>
</tr>
<tr>
<td></td>
<td>1.35</td>
<td>1.34</td>
<td>3.06</td>
<td>3.07</td>
<td>37.47</td>
</tr>
<tr>
<td>Quintile 4</td>
<td>8.94***</td>
<td>8.97***</td>
<td>21.81***</td>
<td>21.80***</td>
<td>12.93</td>
</tr>
<tr>
<td></td>
<td>1.33</td>
<td>1.33</td>
<td>3.03</td>
<td>3.03</td>
<td>37.23</td>
</tr>
<tr>
<td>Quintile 5</td>
<td>11.64***</td>
<td>11.57***</td>
<td>29.26***</td>
<td>29.18***</td>
<td>50.22</td>
</tr>
<tr>
<td></td>
<td>1.36</td>
<td>1.35</td>
<td>3.07</td>
<td>3.07</td>
<td>37.88</td>
</tr>
<tr>
<td>Busy pedestrian area</td>
<td>5.04</td>
<td>7.36***</td>
<td>19.22***</td>
<td>19.58***</td>
<td>956.47***</td>
</tr>
<tr>
<td>Pavement reports</td>
<td>2.86</td>
<td>2.96</td>
<td>7.23</td>
<td>7.27</td>
<td>76.76</td>
</tr>
<tr>
<td>Aged 65-69</td>
<td>-1.32**</td>
<td>-1.33***</td>
<td>-1.78*</td>
<td>-1.82*</td>
<td>32.6</td>
</tr>
<tr>
<td></td>
<td>0.42</td>
<td>0.94</td>
<td>11.59</td>
<td>10.75</td>
<td>0.53</td>
</tr>
<tr>
<td>Aged 70-74</td>
<td>-1.29**</td>
<td>-1.31***</td>
<td>-1.79*</td>
<td>-1.83*</td>
<td>29.74**</td>
</tr>
<tr>
<td></td>
<td>0.43</td>
<td>0.96</td>
<td>11.79</td>
<td>10.93</td>
<td>0.54</td>
</tr>
<tr>
<td>Aged 75-79</td>
<td>-1.16**</td>
<td>-1.19***</td>
<td>-1.78*</td>
<td>-1.81*</td>
<td>25.51**</td>
</tr>
<tr>
<td></td>
<td>0.43</td>
<td>0.96</td>
<td>11.75</td>
<td>10.90</td>
<td>0.54</td>
</tr>
<tr>
<td>Aged 80-84</td>
<td>-1.09**</td>
<td>-0.12***</td>
<td>-1.05</td>
<td>-1.09</td>
<td>22.77</td>
</tr>
<tr>
<td></td>
<td>0.43</td>
<td>0.97</td>
<td>11.93</td>
<td>11.06</td>
<td>0.55</td>
</tr>
<tr>
<td>Aged 85-89</td>
<td>-0.94**</td>
<td>-0.94***</td>
<td>-0.04</td>
<td>-0.08</td>
<td>47.34***</td>
</tr>
<tr>
<td></td>
<td>0.45</td>
<td>1.03</td>
<td>12.5</td>
<td>11.59</td>
<td>0.57</td>
</tr>
<tr>
<td>Aged 90-94</td>
<td>-0.34</td>
<td>-0.33</td>
<td>-0.24</td>
<td>-0.28</td>
<td>44.39***</td>
</tr>
<tr>
<td></td>
<td>0.53</td>
<td>1.18</td>
<td>14.54</td>
<td>13.48</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Note: *** p < 0.001; ** p < 0.01; * p < 0.1; R² followed by significance of F test for nested models; all regression coefficients are followed by standard errors.
Section 2.3: Outdoor falls and road conditions

Studies in different geographical locations such as England\textsuperscript{14}, Finland\textsuperscript{15}, Norway\textsuperscript{4}, Israel\textsuperscript{16}, Massachusetts\textsuperscript{2}, California\textsuperscript{1}, Hong-Kong\textsuperscript{13}, Japan\textsuperscript{17} and Canada\textsuperscript{18} have shown that outdoor falls represent about half of total falls among the elderly. Outdoor falls are mostly precipitated by extrinsic environmental factors such as weather or pavement conditions, with walking the main-fall related activity\textsuperscript{1 2 4 13}. A study in California conducted among people aged 45 and over found that 73\% of outdoor falls were caused by environmental factors such as uneven surfaces\textsuperscript{1}. Among people aged 65 and over, 72\% of falls were caused by one or more conditions including uneven surface, wet surface, trips or slips. This is consistent with another study in Hong-Kong among people aged 20 and over, which found that 98.8\% of outdoor falls were precipitated by one or more environmental causes such as uneven, wet or slippery surface. 78\% of those falling outdoors across all age groups, including those aged 64 and over, tripped over an uneven surface.\textsuperscript{13}

A study conducted in Nottingham, UK found a significant association between location and fall and age group: 71.6\% of those younger than 75 fell outside the home compared to 50\% of those aged 75 and over. Again, most falls were attributed to extrinsic factors such as tripping. This suggests a nuanced relationship between falls and health in the elderly: poorer health conditions may increase the risk of falling for the most mobile, as they are more exposed to risks and hazard situations, compared to those with restricted mobility\textsuperscript{14}. The differential risk profiles for indoor and outdoor falls are also found by studies in Norway\textsuperscript{4} and Massachusetts\textsuperscript{2}.

As was shown in Table 2 Model 6, the number of reports made by pavement conditions was related to a higher number of SAS calls when the latter was recorded by incident location, even after accounting for deprivation and the presence of busy pedestrian streets in the area. Figure 4
visualizes this relationship on a map of Glasgow. The city centre areas receive both high number of SAS calls for falls among the elderly and complaints about pavement. Elsewhere in Glasgow the reports made about pavement are also clustered around datazones where higher number of SAS calls are received.

It should, however be kept in mind that the reports made about pavement conditions might not reflect the actual conditions of the sidewalks accurately. For example, there may be biases in the reports as some people do not know about the website. Those who do know about the site and report problems might be more educated, possibly younger, more involved and concerned about their neighbourhood and of affluent background.

Table 3 shows an OLS model that explores whether the number of reports made about pavements is associated with deprivation and the presence of busy pedestrian streets. We find that 1.75 additional reports are made in busy pedestrian areas compared to other areas. This seems to reflect the idea that people report problems where they walk. There is however no clear relationship between deprivation and the number of reports. The number of reports is higher for quintile 2, but this might be due to the fact that there are more busy pedestrian streets in this quintile that have not been accounted for by the variable “busy pedestrian area”.

Table 3. OLS model explaining the number of pavement reports with deprivation

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>se</th>
<th>sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.56</td>
<td>0.09</td>
<td>***</td>
</tr>
<tr>
<td>Busy pedestrian area</td>
<td>1.75</td>
<td>0.28</td>
<td>***</td>
</tr>
<tr>
<td>SIMD Quintile 2</td>
<td>0.25</td>
<td>0.13</td>
<td>**</td>
</tr>
<tr>
<td>SIMD Quintile 3</td>
<td>-0.16</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>SIMD Quintile 4</td>
<td>-0.03</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>SIMD Quintile 5</td>
<td>-0.15</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>745</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted r2</td>
<td>6.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *** p < 0.01; ** p < 0.05, * p < 0.1

As described in section 2.2, pavement reports are strong predictor of Scottish Ambulance calls by location. Although we cannot be certain of the reliability of the data on pavement reports, these results appear to confirm the hypothesis that poor pavement conditions are a risk factor for falls in Glasgow and this is supported by literature.

Section 2.4: Weather and falls.

There have been several studies in different geographical locations demonstrating the effect of weather conditions on falls among the elderly. A study conducted in the United Kingdom in England, Wales and Scotland, found that outdoor falls appeared to be more frequent during winter, while walking on uneven pavements during wet weather conditions. Another study from Northern California found that 74.2% of outdoor falls were caused by either or both uneven surface, wet surface and tripping or slipping. These results are consistent with another study led in Hong-Kong (43% of 65+ fell due to wet or slippery surfaces).
We sourced weather data from the Met Office to study the potential effect of weather on falls related hospital admissions and SAS calls in Glasgow. We looked at the number of hours of freezing temperatures (below 0°C) per month, the number of hours of high winds (defined as above 10.38 meters per second, based on Penwarden’s scale) per month, the number of hours of snow per month, and the monthly volume of rainfall in millimetres as potential predictors of falls. Most of the data is from Bishopton weather station and covers the time from January 2012 to December 2016. Data for rainfall is from Paisley station and covers the period from January 2010 to December 2016.

Table 4 presents the averages for both weather conditions and falls related incidences among the elderly by month for the stated periods. The highlighted cells show above average values. Generally we can see that adverse weather conditions are more frequent in January and December – also months with above average numbers of hospital admissions and SAS calls related to falls. Between 2010 and 2015 an average of 210 falls-related admissions were recorded in December and an average of 197 in January, compared to an average of 179 per month across the years. The number of admissions in December is 17% higher and in January 10% higher than the average. Falls are also often higher in October and November, again months with generally poorer weather.

The data also suggest that falls related incidences sometimes peak in late spring and summer, which may be due to people being more active that time of year. The effect of weather on falling may be different from season to season. In winter, adverse weather can increase falls, as people are at higher risk when they have to go out. However, in summer good weather it may increase falls as people take advantage of the conditions and are more active, increasing the risk of falling. Poor weather in summer may reduce falls as people may choose to be less active.

Table 4. Average weather conditions, hospitalizations and SAS calls by month in Glasgow, 2010/2011-2015/16

<table>
<thead>
<tr>
<th>Month</th>
<th>Snowfall</th>
<th>Freezing</th>
<th>High wind</th>
<th>Rainfall</th>
<th>Hospitalizations</th>
<th>SAS calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>11.2</td>
<td>44.4</td>
<td>302</td>
<td>143</td>
<td>197</td>
<td>510</td>
</tr>
<tr>
<td>February</td>
<td>4.0</td>
<td>55.8</td>
<td>249</td>
<td>118</td>
<td>176</td>
<td>465</td>
</tr>
<tr>
<td>March</td>
<td>8.8</td>
<td>31.6</td>
<td>284</td>
<td>82</td>
<td>178</td>
<td>476</td>
</tr>
<tr>
<td>April</td>
<td>0.8</td>
<td>12.6</td>
<td>248</td>
<td>70</td>
<td>177</td>
<td>461</td>
</tr>
<tr>
<td>May</td>
<td>0.0</td>
<td>3.8</td>
<td>230</td>
<td>89</td>
<td>184</td>
<td>464</td>
</tr>
<tr>
<td>June</td>
<td>0.0</td>
<td>0.0</td>
<td>128</td>
<td>66</td>
<td>167</td>
<td>461</td>
</tr>
<tr>
<td>July</td>
<td>0.0</td>
<td>0.0</td>
<td>134</td>
<td>99</td>
<td>167</td>
<td>486</td>
</tr>
<tr>
<td>August</td>
<td>0.0</td>
<td>0.0</td>
<td>186</td>
<td>90</td>
<td>168</td>
<td>448</td>
</tr>
<tr>
<td>September</td>
<td>0.0</td>
<td>0.2</td>
<td>167</td>
<td>93</td>
<td>166</td>
<td>445</td>
</tr>
<tr>
<td>October</td>
<td>0.0</td>
<td>3.2</td>
<td>169</td>
<td>129</td>
<td>182</td>
<td>495</td>
</tr>
<tr>
<td>November</td>
<td>1.2</td>
<td>44.0</td>
<td>175</td>
<td>136</td>
<td>172</td>
<td>501</td>
</tr>
<tr>
<td>December</td>
<td>1.4</td>
<td>49.0</td>
<td>320</td>
<td>178</td>
<td>210</td>
<td>513</td>
</tr>
</tbody>
</table>

Note: Highlighted cells denote above average values.

Figures 5 through 7 allow for the comparison of weather and falls related incidents by month and year. Figure 5 shows a seasonal pattern in falls leading to hospitalisation, with a strong increase during December and January almost every year. Fewer than usual hospital admissions were recorded in December 2013 and 2014, but admissions were high in January and November of those years. When checking for seasonal patterns with Scottish Ambulance Services’ falls-related calls, an increase during winter can be observed every year except for December 2013. However, as we can see from both plots in Figure 5, falls related calls to SAS and hospitalizations often rise in March, October and during some summer months.
The patterns of falls related hospitalizations and ambulance calls in Figure 5 correspond in some cases to the patterns in weather. Figure 7 shows high numbers of freezing and snowy hours from November to February for most years except December 2013. This coincides with low level of SAS calls and admissions related to falls in December 2013. In fact, no falls-related hospitalisations specifically due to ice or snow were recorded that month, while 24 such cases were recorded in December 2012, a month that also had higher than usual number of freezing hours and snow.

The spikes of SAS calls and in hospital admissions in July 2013 and 2014 in Figure 5 correspond to a low volume of rainfall (less than 75 mm) in those months. Thus, people may have spent more time outdoors to enjoy the advantageous weather, putting them at a higher risk of falling. During summer months with poor weather, such as July 2012, when rainfall was higher (125mm), SAS calls and admissions were lower than average.

However, not all spikes in cold weather, wind or rain in winter correspond to increase in falls. March 2013 was both unusually cold and windy, but there was no significant increase in falls-related hospitalisations and SAS calls in March 2013. It appears that a combination of two or more extreme weather conditions and the persistence of these over many days, such as often happens during wintertime, best predicts an increase in falls.
Figure 6. Rainfall and high winds by month in Glasgow, 2010/2012 to 2016

Figure 7. Freezing temperatures and snowfall by month in Glasgow, 2012 to 2016
Section 2.5: Behavioural and medical causes of falls:

Falls can often be a symptom of other medical conditions, such as dizziness brought on by heart disease. Table 3 presents related medical causes for falls-related emergency admissions as percentages of total admissions for financial years 2010/11 to 2014/2015. The leading related causes for falls-related hospitalisations are circulatory diseases (i.e. hypertension, coronary artery disease, stroke). Approximately 30% of those admitted to the hospital due to a fall also suffered from circulatory disease. The second leading associated causes are respiratory diseases (i.e. pneumonia, bronchitis, common cold or asthma), with 15.3% of admissions related to these conditions. An average of 10% admissions are associated with musculoskeletal conditions such as osteoarthritis, osteoporosis, disorders of bone density, and structure or disorders of muscle.

Alcohol consumption is an independent risk factor for falls among the elderly. A study in southeast London found 21.4% of people aged 65 and over drank above safe limits with a strong relationship between lower socio-economic status and unsafe drinking. This problem is especially relevant to the Glaswegian population, where according to one study people aged 50 and over consumed on average over 6 units of alcohol on the heaviest drinking day in the previous week. Our data shows that almost 10% of falls-related admissions to hospital among the 65+ population are related to a mental and behavioural disorder due to alcohol.

Other major related causes include dementia, abnormalities of gait and mobility, Type 2 diabetes, and disorders of urinary systems. The proportion of hospitalizations related to any these associated conditions have remained relatively stable during the studied period. The prevalence of urinary diseases, abnormalities of gait and diseases of respiratory systems have increased between 2010 and 2015. However, this report cannot say why this might be the case.

Table 5. Related causes of emergency admissions due to falls in Glasgow, financial years

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases of the circulatory system</td>
<td>30.8</td>
<td>28.2</td>
<td>28.6</td>
<td>28.5</td>
<td>29.4</td>
</tr>
<tr>
<td>Diseases of the respiratory system</td>
<td>14.1</td>
<td>13.6</td>
<td>14.4</td>
<td>15.8</td>
<td>18.1</td>
</tr>
<tr>
<td>Diseases of the musculoskeletal system and connective tissue</td>
<td>11.1</td>
<td>10.1</td>
<td>9.3</td>
<td>8.7</td>
<td>10.6</td>
</tr>
<tr>
<td>Mental and behavioural disorders due to use of alcohol</td>
<td>8.9</td>
<td>9.3</td>
<td>9.8</td>
<td>9.3</td>
<td>9.4</td>
</tr>
<tr>
<td>Dementia</td>
<td>8.8</td>
<td>8.5</td>
<td>9.4</td>
<td>7.1</td>
<td>7.8</td>
</tr>
<tr>
<td>Abnormalities of gait and mobility</td>
<td>3.7</td>
<td>6.2</td>
<td>6.4</td>
<td>4.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Non-insulin-dependent diabetes mellitus</td>
<td>5.8</td>
<td>6.0</td>
<td>4.4</td>
<td>5.1</td>
<td>5.2</td>
</tr>
<tr>
<td>Other disorders of urinary system</td>
<td>3.1</td>
<td>4.6</td>
<td>4.8</td>
<td>5.4</td>
<td>6.6</td>
</tr>
</tbody>
</table>

Note: One individual may be diagnosed with several associated conditions and be counted several times in the above table.

The high proportions of falls-related hospitalisations due to diseases can be explained by the nature of the disease itself (osteoporosis increases the risk of fractures after a minor fall) but also by the use of medication related to the disease. The use of medication can be an independent risk factor for falls. The use of four or more prescription medications has been shown to increase the risk of falling, especially the use of antidepressants (serotonin-reuptake inhibitors, trycliclic antidepressants), neuroleptics and class IA antiarrhythmic medications used to treat circulatory
diseases. Benzodiazepines, prescribed for anxiety disorders and alcohol dependence, have negative effects on cognition, gait, and balance. Guidelines to prevent falls, including those followed by the NHS GGC Community Falls Prevention Programme, include medication review as a component of successful multifactorial interventions.

Section 3 – Cost of falls in Glasgow City

Falls represent a great burden on health and social care finances. With an increasing number of people in old age and with long-term disabilities and chronic conditions, the need for care will increase exponentially. Health and social care systems will need to adapt to meet this rising demand.

The 2016 audit on social work in Scotland has warned the Scottish social care system is ‘unsustainable’ given a reduction of 11% in real terms in councils’ total revenue funding since 2010/11. Faced by funding pressures, most councils now only provide services to those considered at critical risk, at the risk of affecting quality of services and damaging the effectiveness of prevention interventions. Services for the elderly made up around 44% of Scottish councils’ net spending on social work in 2014/15. Around 17% of the Scottish adult population are unpaid adult carers, offering savings totalling £7.68 billion a year to the health and social services.

In Glasgow, NHS Greater Glasgow and Clyde has already undergone a profound austerity period and savings efforts are still underway. 3% of its baseline Revenue Resource Limit (RRL: total funding allocated for revenue or day-to-day spending) was cut in 2015/2016 and an additional 3% target has been set for the year 2016/2017 (a total of £128.6 million in two years).

A study by Craig et al (2013) on the costs of falls for people aged 65 and over estimated the total cost for Scotland alone at £470,662,683 for 2010/11. Those are conservative estimates: they do not include indirect costs borne by families and carers or the financial consequences of the post-fall syndrome which is difficult to quantify (social isolation, depression, increased dependency). All costs per event used in our report are those found by this study, adjusted for inflation (for 2011 to 2016).

Table 6 shows the predicted cost of falls in Glasgow City. The average cost of a community fall was £1,721 in 2011 in Scotland; adjusted for inflation the cost rises to £1,924.9 in 2016. 60% of this cost is borne by social care. For the year 2014/15, this amounts to £32.8 million, 8.7% of the City Council’s Social Work budget for Community Care for the same year. Falls among the 65 and over in Glasgow City have cost an average of £54.4 million per year between 2011/15.

We have estimated the cost for Glasgow City for 2037 using population projections of National Records of Scotland. The population of 65 and over is expected to increase by 48.4%. The annual cost of falls for 2037 is therefore expected to reach £81.1 million (all other factors kept constant). It is therefore urgently necessary to improve prevention of falls in Glasgow in order to alleviate the burden on the City Council which could result in reduced quality and capacity of social work when the population at risk doubles.
Table 6. Cost of falls in Glasgow City (annual costs shown in millions), financial years

<table>
<thead>
<tr>
<th>Type of cost</th>
<th>Cost per event in 2016</th>
<th>2010/11</th>
<th>2011/12</th>
<th>2012/13</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2037</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of estimated falls</td>
<td>27,965</td>
<td>28,206</td>
<td>28,287</td>
<td>28,406</td>
<td>28,391</td>
<td>42,118</td>
<td></td>
</tr>
<tr>
<td>Cost of community falls</td>
<td>1,924.9</td>
<td>53.8</td>
<td>54.3</td>
<td>54.4</td>
<td>54.7</td>
<td>54.6</td>
<td>81.1</td>
</tr>
<tr>
<td>Of which social care</td>
<td>1,154.9</td>
<td>32.3</td>
<td>32.6</td>
<td>32.7</td>
<td>32.8</td>
<td>32.8</td>
<td>48.6</td>
</tr>
<tr>
<td>Of which NHS</td>
<td>770</td>
<td>21.5</td>
<td>21.7</td>
<td>21.8</td>
<td>21.9</td>
<td>21.9</td>
<td>32.4</td>
</tr>
<tr>
<td>Cost of SAS call-outs</td>
<td>287.4</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

The Christie Commission has highlighted the need to transform the way public services are planned and delivered through a switch to prevention and early interventions. Greater integration between health and social care will be needed to shift the balance of care from the acute sector to community settings.

Section 4: Recommendations for the City Council to support independent living

In light of the evidence provided by relevant literature and the present analysis, an effective approach for the prevention of outdoor falls in Glasgow would include the following actions:

1. Increase efforts to adapt public environments to people with reduced mobility by ensuring clear and even pavement surfaces and adapting streets and curbs.
2. Increase the visibility of the Community Falls Prevention Programme in order to increase the number of referrals and continue to use the most effective techniques.
3. Intensify the promotion of healthy lifestyle for all age groups.

Although estimating the cost-effectiveness of prevention is out of reach for this study, previous research suggests multi-factorial interventions which include provision of exercise training classes, reconstruction of pavements, and efforts to inform the population are cost-saving.

Section 4.1 – Adapting physical environments to the elderly

Based on section 2.4 we would recommend focusing on improving footpaths in Glasgow. This will be beneficial not only for the elderly but for all age groups. Efforts are already underway for the improvement of pavement conditions with £5 million spending on pavement resurfacing for 2017 and a total of £97.5 million spent over the last five years to repair and maintain roads and footpaths. Areas with a concentration of older people, particularly elderly women, people aged 80+ and those from most deprived backgrounds, should be given priority.

As can be seen from Figure 8, the proportion of elderly people is much higher in some areas compared to others. The average percent of people 65+ in a Glasgow datazone is roughly 14%, but in about 20 datazones this is above 30%. The differences between datazones are even more
prominent when looking at the percent of people 80+. The average across Glasgow datazones is just under 4%, but in some areas the percent of those who are 80 years or older is over 10%.

Table 7 lists the areas where the percent of population who are 80 or older is above 10%. The table also shows the percent of older people living in private households (i.e. not in care homes). Generally, the percent of older people in areas is strongly correlated to the percent of older people who live in private households, but in some cases the large proportion of older people in an area is due to a care home. The table also shows deprivation quintiles. Generally, these areas are not deprived, but there are exceptions, such as Old Shettleston and Parkhead North, where high deprivation coincides with a large proportion of elderly people.

In addition to areas of high deprivation and/or high concentration of the elderly, the city centre is also a hotspot for falls, with more than 500 falls a year among the 65+ population and many complaints about pavement conditions recorded on FixMyStreet. This and other busy pedestrian areas should be given particular attention.

Maintaining clear and clean pavement surfaces should also be a priority. Environmental features such as overgrown weeds or autumn leaves can cause slippery surfaces, which precipitate falls. Areas with high proportions of elderly should be given priority during winter for gritting schedules. Special attention should also be paid to temporary obstructions such as parked cars, bicycles and bins as well as permanent obstructions (benches, trees…). Such obstructions can cause a loss of balance and create uncertainty or cause detours that may result in falling.

A cost-effective multi-sectoral injury prevention programme in Sweden included reconstruction of pavements and walkways, improved winter road maintenance, improvement in evening-time lighting, information on prevention in local media, revising home environment and a ‘Safe Daily Walk’ with aides joining the elderly on exercise walks. Falls decreased by 26% in the 65-79 age group. Another multi-strategic community-based intervention in Australia addressed footwear, vision, physical activity, balance and gait, chronic conditions and home as well as environmental hazards and reported a net 24.6% decrease in falls incidence.

Figure 8. Distribution of datazones by the percent of older people in Glasgow, 2011 census data
Adapting public areas to people with reduced mobility should also be a focus. A study in the UK used go-along interview walks with older people to assess outdoor falls risks. It found that among environmental features increasing the risk of falls, changes in level are the most regularly mentioned by older people (i.e. kerbs, slopes, steps or unexpected uneven pavement). Changes in level require further efforts of concentration when walking. The 25mm vertical difference tolerance for uneven flags is not suitable for the elderly and tactile paving may not be adequate for the elderly as it causes imbalance; bitumen is the preferred pavement material as it is non-slip and usually flat.45

The World Health Organisation recommends inserting frequent rest areas, ensuring smooth and non-slip pavement surfaces (such as bitumen) with sufficient width for wheelchairs and clear from obstructions. Curbs should be dropped in order to be level with the road. Pedestrian crossings should be made safer with allowing sufficient time for the green light.46 Attention should be paid to curb cut areas which easily collect water and form puddles and are therefore dangerous for those who have difficulties stepping up. Ramps should be available at intersections and designated walkways in garages and parking lots.1
Section 4.2 – The NHS GGC Community Falls Prevention Programme

Glasgow already provides considerable services for prevention of falls. An evaluation of the Community Falls Prevention Programme by HealthQWest and Glasgow Caledonian University provided information for this service. In 2007/08, 30% of referrals originated from Pendant Alarm, 25% from GPs, 15% from Physiotherapy and 15% from family, carer of self. In 2009, all patients aged 65 and over passing through the Southern General Hospital in Glasgow were screened for fall history and automatically referred to the CFPP. It is unclear whether that practice has extended to all hospitals since.

No data was available regarding the aggregated counts of those offered exercise training. However, the exercise training provided by the CFPP follows approved guidelines of intensive mobility training for more than 50h for a duration of at least 10 weeks. The programme offered by the CFPP is the Otago Exercise Programme classes. The OEP is specifically designed to reduce falls and make the elderly steadier on their feet and is one of the most effective training programmes for the elderly, along with Tai Chi. As for 2009, only group classes of the Otago Exercise Programme were offered, limiting exercise training to those willing or capable of transporting to the classroom.

No data was available on the outcomes of the CFPP so far and it is therefore not in our power to determine its cost-effectiveness. However, a systematic Cochrane review found a 35% rate of falls reduction among attendees of Otago Exercise Programme. The 2010 evaluation of the CFPP found that 65% of those assessed (64% of those referred) attended an exercise programme. The cost of the service in 2013 for NHS GGC was estimated at £816,049, with more than 43% attributed to the cost of the staff delivering Otago lessons. Savings were estimated at £809,117 for 318 falls prevented (net saving of £23,448).

Cost-effectiveness could be further increased by providing resources (videos with regular check-up by a qualified member of staff) for home-based Otago Exercise Program. As an exercise programme, Tai-Chi is as effective as OEP but has been found to have the largest return on investment (over 500% compared to 127% for Otago for those aged 80+).

With less than 3% of the at-risk population entering the service every year, the CFPP has potential for expansion. Better information could lead to a rise in self-referrals. This could for example take the form of a letter/e-mail sent annually to those 65 and over, explaining the risks of falls and the benefits of joining a falls-prevention service such as the CFPP. Because all older people do not consider themselves at risk of falling, an invitation to an ‘ageing well’ assessment could be more effective than an invitation to a ‘falls’ assessment. The Prevention of Falls Network for Dissemination has highlighted areas to emphasize in order to encourage people to join: strength and balance training will help maintain their independence longer and could enable them to play with their grandchildren. An emphasis on group-based sessions could put forward the incentive of social interaction for older people, especially for Tai-Chi as it is perceived as more of a ‘normal’ activity compared with OEP, which may encourage those who do not identify as being at risk of falling.

An effective alternative to exercise classes may be the Lifestyle integrated Functional Exercise (LiFE). A study in Australia among people aged 70 and over found a 31% reduction in falls.
incidence using the LiFE approach: movements to improve balance or strength are embedded during daily activities, such as ‘bend knees’ (squatting instead of bending to close a drawer).52

Section 4.3 – Promoting healthy lifestyles at all ages

Interventions throughout a person’s lifetime, such as those promoting healthy living and decreasing social isolation, have significant potential to affect their health in old age. Unhealthy behaviours such as smoking, high alcohol consumption and physical inactivity significantly affect a person’s health in later life.53 Promoting healthy lifestyles in Glasgow is especially important as NHS England predicts one in three people will be obese by 2034 and one in 10 will develop Type 2 diabetes.54

In Glasgow, the male healthy life expectancy is only 55.9 years old for an average of 63.1 in Scotland (based on the 2011 Scottish Census)55. The healthy life expectancy is to be distinguished from life expectancy as the number of years an individual is expected to live in a ‘healthy’ state.

As 23.1% of falls-related hospitalisations during 2011/15 were related to circulatory diseases, we would suggest a focus on modifiable risk factors such as diets high in saturated fats and trans fats, cholesterol, being obese or overweight, physical inactivity, smoking and excessive alcohol56. Healthy diet and increased physical activity would also help to decrease incidence of type 2 diabetes, which is a cause for 5.5% of falls-related hospitalisations.

Because unsafe alcohol consumption and smoking are independent risk factors for falls among the elderly1, prevention efforts should also target this population. As outlined in section 2.5, 9.4% of falls-related emergency admissions in Glasgow City are directly related to alcohol consumption among people 65+.

Successful interventions have focused on small improvements, included several components (physical activity and diet) with a wide range of activities offered with regular follow-ups.57 A study tested encouraging older women to embed balance and strength exercises into daily life routines and found that using activity (i.e. eating) and object-based cues may be particularly effective in habit formation and behaviour maintenance.58
Annex 1. Data sources

Hospitalisation data
Hospitalisation data was purchased from the ISD Scottish Morbidity Records from non-obstetric and non-psychiatric acute hospitals (SMR01) in Scotland. Available at: http://ubdc.gla.ac.uk/dataset/glasgow-falls-people-65-2011-2015

Community Falls Prevention Programme data
Aggregated counts of attendance to CFPP appointments was provided by the NHS Greater Glasgow and Clyde Safe Haven. Available at: http://ubdc.gla.ac.uk/dataset/community-falls-prevention-programme-nhs-greater-glasgow-and-clyde-number-of-referrals-2010-2016

Scottish Ambulance Service and NHS24 data
The data was sourced from the UCD data mart and includes falls by location of incident and by patient home address from financial years 2012 to 2016, by month and datazone. Available at: http://ubdc.gla.ac.uk/dataset/gcc-over65-falls-2011-15

Scottish Index Multiple Deprivation data
SIMD 2016 ranks were sourced from the Scottish Government. Available at: http://www.gov.scot/simd

Population data
2011 data zone population estimates by 5-year age group were sourced from the National Records of Scotland. Available at: http://www.isdscotland.org/Products-and-Services/GPD-Support/Population/Estimates/

FixMyStreet data
Reports relating to potholes and pavements for Glasgow City from calendar years 2010 to 2015 were provided by FixMyStreet.com. Available at: http://ubdc.gla.ac.uk/dataset/fms-glasgow-to-2017

Weather data
Weather observations were sourced from the Met office, Bishopton and Paisley station. Available at: http://www.metoffice.gov.uk/pub/data/weather/uk/climate/stationdata/paisleydata.txt

Classified as busy pedestrian areas in section 2.2 are the following:

<table>
<thead>
<tr>
<th>Intermediate Zone</th>
<th>City Centre South</th>
<th>City Centre West</th>
<th>City Centre East</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datazones</td>
<td>S01010272</td>
<td>S01010266</td>
<td>S01010259</td>
</tr>
<tr>
<td></td>
<td>S01010273</td>
<td>S01010267</td>
<td>S01010260</td>
</tr>
<tr>
<td></td>
<td>S01010274</td>
<td>S01010268</td>
<td>S01010261</td>
</tr>
<tr>
<td></td>
<td>S01010275</td>
<td>S01010269</td>
<td>S01010262</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S01010270</td>
<td>S01010263</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S01010271</td>
<td>S01010264</td>
</tr>
</tbody>
</table>
References


21 https://www.lifeline24.co.uk/pendant-alarms/


26 http://www.gov.scot/simd


37 Bank of England. Inflation calculator. Available at: [http://www.bankofengland.co.uk/education/Pages/resources/inflationtools/calculator/default.aspx](http://www.bankofengland.co.uk/education/Pages/resources/inflationtools/calculator/default.aspx)


