Older men and social activity: a scoping review of Men’s Sheds and other gendered interventions

CHRISTINE MILLIGAN*, DAVID NEARY†, SHEILA PAYNE‡, BARBARA HANRATTY§, PAMELA IRWIN* and CHRISTOPHER DOWRICK||

ABSTRACT
Finding ways of improving the health and wellbeing of older men is an important challenge for public health. This review aimed to assess evidence for the effects of Men’s Sheds and other gendered social activities on the health and wellbeing of older men, and to consider their effective components and theoretical frameworks. A scoping review using standardised search criteria and terms identified 31 relevant papers of sufficient quality for inclusion. Analysis was informed by guidance on interpretative and narrative synthesis and a quality assessment tool designed for reviewing disparate data from different disciplines and research paradigms applied. The review found some limited evidence that Men’s Sheds and other gendered social activities may have impact on the mental health and wellbeing of older men, but little evidence of the impact on physical health. Qualitative data provided valuable insights into how and why complex psycho-social activities can affect participants, but there was a lack of longitudinal evidence drawing on validated health and wellbeing measures. Key components of successful interventions included accessibility, range of activities, local support and skilled co-ordination. A variety of theoretical frameworks were employed. As yet, there is no conclusive evidence that Men’s Sheds and other gendered interventions confer health and wellbeing benefits on older men. Studies in this field to date are few and of variable quality. Larger and more robust mixed-methods studies, including randomised designs, are needed.

KEY WORDS – older men, social isolation, wellbeing, interventions, scoping review.
Introduction

Whilst population ageing is an almost universal phenomenon, women, on average, outlive men across all population groups and cultures (Salomon et al. 2012; Wang et al. 2012). Yet recent data for both the United Kingdom (UK) and the European Union more widely demonstrate that this gap in gendered life expectancy is closing (Davidson 2013; Eurostat 2012). Despite this shift, much of the literature on men’s health is dominated by negative portrayals of men’s life expectancy, in which men are constructed as being more likely to lead riskier lifestyles than women and less likely to make optimal use of health-care services (White et al. 2011: 41). Premature mortality amongst men is often attributed to unhealthy lifestyle choices, including those related to alcohol and tobacco. Finding ways of improving the health and wellbeing of older men thus presents an important challenge for public health.

Linked to debates about health and gender in later life is a growing concern about the health impacts of loneliness and social isolation. At its simplest, social isolation can be defined as an absence of other individuals (Hawton et al. 2011; Victor, Scambler and Bond 2009), whilst loneliness is viewed as the psychological counterpart of social isolation (Shankar et al. 2011). Social isolation, loneliness and stressful social ties are associated with poor physical and mental health, higher risk of disability, poor recovery from illness and early death (Cacioppo et al. 2011; Luanaigh and Lawlor 2011; Masi et al. 2011). Indeed, amongst older adults, the effect of social isolation and loneliness on mortality is believed to be of similar size to that of cigarette smoking (Holt-Lunstad, Smith and Layton 2010). Whilst loneliness is not an inevitable consequence of lone dwelling, those who do live alone are at greater risk of social isolation. In the UK alone, between 5 and 7 per cent of middle-aged and older people experience severe or persistent loneliness, with the number of older men who live alone reaching around one million for the first time (Steffick 2000; Victor, Scambler and Bond 2009).

Older women have tended to attract more scholarly attention than older men, hence there is still something of an academic ‘blind spot’ in research around older men in comparison to their female counterparts (Arber et al. 2003; Fennell and Davidson 2003; Fleming 1999). Yet social isolation is common amongst older men, particularly those who live alone or experience mood or cognitive problems (Illiffe et al. 2007). Finding activities and interventions that can successfully address the problems of social isolation amongst older men is thus an important health challenge. Older men not only find it harder than women to make friends late in life, they
are also less likely to join community-based social groups that tend to be dominated by women. They are known to use fewer community health services than women, and are less likely to participate in preventive health activities (Suominen-Taipale et al. 2006; White et al. 2011). This combination of need and lower rates of engagement with services has prompted the public and voluntary sectors to look to develop a range of social activity interventions specifically targeted at older men.

Social activity in a variety of forms has long been recognised as beneficial to health, particularly among older people. House, Landis and Umberson (1988), for example, highlighted the increased risk of death among those people with a low quantity, and sometimes low quality, of social relationships. Work underpinned by social activity theory for older people has thus hypothesised that health and wellbeing is promoted by high levels of participation in social and leisure activities and role replacement (Betts Adams, Leibbrandt and Moon 2011). A number of reviews have thus sought to consolidate knowledge on the links between social activity, health and wellbeing (e.g. Cattan et al. 2003; Dickens et al. 2011; Findlay 2003). Betts Adams, Leibbrandt and Moon (2011), in particular, found a diverse literature around 42 studies that showed positive associations between social activity and health and wellbeing. A systematic review by Cattan et al. (2003) further found that group activities with an educational or support input were most likely to be effective in alleviating social isolation amongst older people. Indeed, such is the impact of social activity on health and wellbeing, that a meta-analysis of 148 studies undertaken by Holt-Lunstad, Smith and Layton (2010) found a 50 per cent increase in the overall odds of survival as a function of social relationships. Drawing on the outcomes of a large-scale study of nearly 17,000 adults in North America, Pantell et al. (2013) were also led to conclude that as a predictor of mortality, the strength of social isolation is similar to that of well-documented clinical risk factors (although it is worth noting that the data did not allow the authors to account for the effect of social position on mortality).

Developing interventions to promote social activity among older men, particularly those who are lonely or socially isolated, has proven to be a difficult task (Greenfield and Marks 2004; Milligan et al. 2014). One recent and rapidly developing social activity intervention for older men is that of the Men’s Sheds movement. This has spread from Australia to several parts of the Anglophone world including the UK and Ireland (Wilson and Cordier 2013). Sheds provide a communal space for older men to meet, socialise, learn new skills and voluntarily take part in practical activities with other men. Much of this activity is focused around woodwork but Sheds can cover a wide range of activities, stretching from engineering
to model railways and the making of musical instruments. They can engage
men in informal adult learning activity, or provide health-related infor-
mation or signposting to relevant services (Milligan et al. 2012). Sheds
may also have a wider benefit to the local community in terms of engaging
with, and providing services for, individuals and groups within that commu-
nity (Carragher 2013). Many of the Sheds are member led or are supported
by voluntary-sector organisations, a few are supported by charitable
donations from the business sector. All, however, are tailored to their
local context and, hence, are not standardised. Whilst Shed members may
not necessarily recognise or welcome the notion of Sheds as an intervention,
we suggest that given their broad aims to improve physical, emotional, social
and spiritual health and wellbeing, and the increasing recognition and
support of Sheds within public health initiatives, Sheds can be considered
a complex intervention.

Sheds have captured the public imagination. Over 750 Men’s Sheds now
exist across Australia (Cordier and Wilson 2014), with more than 50,000
older men attending on a regular basis. Men’s Sheds have attracted at
least Aus dollars 750,000 between 2010-2013 from the Australian State
Government with further support from local sources (Australian
Government 2015). A similar, but more modest, pattern of growth and
funding has developed across the UK (Milligan et al. 2014) and Ireland
(Carragher 2013).

However, before advocating gender-based activity interventions for older
men, several issues need to be clarified. Firstly, we need a better understand-
ing of what the literature tells us about conceptual and measurement differ-
ences, reflecting the various academic disciplines that have conducted
research in this area. Importantly, to what extent does this enable us to
compare and synthesise across studies? Secondly, to what extent does the lit-
erature enable us to determine the direction of causality between activity
and health? Are older men more likely to be healthy because of the activities
they participate in, or are they more active due to the good health they
enjoy? Thirdly, there are unresolved questions around various types of activi-
ties and gender, with older men appearing to benefit from physical activities
and solitary hobbies much more than older women (Betts Adams, Leibbrandt and Moon 2011).

In the light of these issues, it is important to have a clear understanding of
what the evidence base tells us about the role and impact of gender-based
activity interventions on the health and wellbeing of older men. Whilst
Sheds are perhaps the fastest growing social activity interventions for
older men, we have also seen the emergence of a number of other social
activity interventions designed for older men in recent years. In terms of
their descriptive features, these other gendered interventions are clearly
more diverse than Men’s Sheds. A cooking club for older men, a community allotment and a ‘Gentleman’s Club’ in a residential care setting are clearly different forms of social activity intervention but, importantly, they are all defined by having older men as participants in voluntary social activity that is theoretically intended to improve their health and wellbeing. Furthermore, as they share this essential characteristic, some inferences on adequate causal links can be made (Buss 1999). In this paper, we thus draw on the outcomes of a high-quality scoping review of the existing published literature on Men’s Sheds and other gendered interventions that was designed to address the following questions:

- What are the effects on the physical health of older men?
- What are the effects on the mental health of older men?
- What are the effects on the wellbeing of older men?
- What are the effective components of interventions?
- What theoretical frameworks were employed?

Methods

The scoping review of the available studies on Men’s Sheds and on other forms of gendered interventions for older men aimed to compare and contrast the evidence of effects on the health and wellbeing of older men.

Our search strategy, incorporating electronic and hand searches of publications from 1990 to 2013, is set out in Table 1. Grey literature searches included the websites of a number of age-related and male-orientated voluntary organisations in the UK, Australia, New Zealand, Ireland, Canada and the United States of America (USA). The websites of appropriate Government departments in these countries were also searched along with the OpenGrey Repository (formerly OpenSIGLE) for relevant literature. The first 50 results from combinations of older men and interventions
were also screened for possible inclusion. Initial screening and searches demonstrated a declining relevance to the review topic beyond the first 40 results, hence a pragmatic decision was made to limit screening to the first 50.

The following search terms and all their variations, as set out in Table 2, were incorporated into a search strategy tailored to each database, drawing on specialist librarian support.

A clear set of inclusion and exclusion criteria was discussed and agreed by the research team prior to undertaking the searches. Inclusion criteria included all forms of publications containing original empirical data on interventions that provided an opportunity for older men to meet together face to face in a specified place for social activities, learning and teaching, or the receipt of advice. Included studies needed to contain some measure of how the intervention impacted on health, quality of life or wellbeing of participants or their families. No study design was excluded.

Exclusion criteria included studies that solely considered interventions or activities where the primary focus is sport or leisure activities in clubs or religious activity, formal education, paid work or volunteering, or part of statutory service provision (such as local authority day centres) or disease-specific support groups. Studies that reviewed interventions not specifically designed for older people were also excluded.

The search strategy aimed to include all relevant studies of Men’s Sheds and other gendered activity interventions that were exclusively or predominantly focused on older men. In line with current provider policy, an older man was defined as someone over the age of 50 years. Initially, a predominant focus was interpreted as a study with a sample that contained three-quarters of the total being older men, but at an early stage it was evident
that such a stringent approach would limit the number of studies included in the review with the loss of potentially valuable insights. A pragmatic decision was taken to include studies where older men formed the majority of the sample. This was defined as 50 per cent plus one of participants in the sample population, regardless of its size, and where there was clear data from only older males. Figures 1 and 2 detail the search and screening process used for both the Men in Sheds literature and the literature focusing on other gendered activity interventions for older men.

Our search included electronic and manual searches, including the checking of bibliographies of papers as well as relevant conference papers and presentations. In addition, individual contact was made with all Men’s Sheds projects in the UK as well as experts in Australia to identify further potential sources. The relatively small number of Men in Shed sources (N = 77) meant it was possible for all of these sources to be screened by two reviewers. Electronic searches for the ‘other gendered activity intervention’ sources however revealed 8,116 records, hence all of these records...
were screened by one reviewer (DN) and a 10 per cent randomised sample (N = 1,000) was screened by a second reviewer (PI) to ensure accuracy and consistency in the application of the inclusion and exclusion criteria. PI took the lead for work around Men’s Sheds, with DN taking the lead for work around other gendered interventions. Where uncertainty or disagreement around inclusion/exclusion occurred, a final decision was made by the whole research team. The whole research team also reviewed and agreed the final set of papers for inclusion.

Quality assessment and data extraction

We used the tool developed by Hawker et al. (2002) to appraise the quality of the studies in this scoping review. The tool uses a scale of 1 to 4 across nine domains to assess methodological rigour and clarity of reporting and was independently applied to the studies by both reviewers. The quality scores ranged from 13 to 34 out of a possible total of 36, with a median score of 27, with a high degree of agreement between the reviewers and the wider research team on the aggregate scores for the studies included in both reviews. These scores are included in Table 3 to inform the reader, but they played no part in any decisions to include or exclude individual studies. Our review encompassed qualitative and quantitative studies, and there are very few quality assessment tools that are applicable to such a wide range of methods. This tool has been widely used in UK research, though we do acknowledge that it has not undergone extensive validation.

A common data extraction tool, covering 18 substantive domains ranging from location and methodology through intervention and sample description to findings and limitations, was developed and tested by both reviewers on three studies from each review. This was independently applied to the studies of Men’s Sheds and gendered interventions. Minor differences were reconciled through discussions during and after data extraction.

Data analysis and synthesis

Reviews were informed by the Medical Research Council guidance on the development and evaluation of complex interventions (Craig et al. 2008; Medical Research Council 2008) and the Cochrane Collaboration guidelines for reviews on health promotion and public health interventions (Armstrong et al. 2007). The majority of the studies included were either qualitative studies, cross-sectional surveys or used a combination of these methods. There were no intervention studies, and only three of the Men’s Sheds studies included collected data at more than one point in time. This means that all the research discussed in this paper falls into
### Table 3. Summary and quality (QA) scores of included studies

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Study aim</th>
<th>Design and sample</th>
<th>Strengths</th>
<th>Limitations</th>
<th>QA score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men’s Sheds:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ballinger, Talbot and</td>
<td>2009</td>
<td>Australia</td>
<td>To explore men’s experiences of participating in a Men’s Shed programme and impact on their health and well-being in small rural town in Australia.</td>
<td>Observational case study of one Shed conducted between 2002 and 2009. Eight men participated in the research, mostly over 50 years of age, ex-tradesmen, lived alone, retired, on pensions or benefits.</td>
<td>Focus group questions provided in appendix adds to credibility and potential for replication and/or comparison.</td>
<td>Convenience sample of unstated representativeness, especially considering selection criteria aimed to obtain maximum variation in age, length of time at Shed and attendance. Authors maintain Shed is ‘typical’ of most Australian Men’s Sheds, but do not raise issues of relationship to urban Sheds, ethnicity and mixed-ability/background groups, so limiting utility, generalisability and transferability.</td>
<td>25/36</td>
</tr>
<tr>
<td>Verrinder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cass, Fildes and</td>
<td>2008</td>
<td>Australia</td>
<td>Not specifically stated, but a project/programme evaluation in Wollongong, New South Wales, Australia.</td>
<td>Prospective study capturing pre-, mid- and post-intervention longitudinal data through semi-structured interviews with participants and next of kin and journals completed by Shed facilitators. Also used participatory action research, observation, and questionnaires with nine men from one Shed. Average age 54 years from ethnic minority groups, predominantly the Portuguese community. All of the men experienced health conditions and social issues, took medication and consulted a doctor or specialist on a regular basis.</td>
<td>Thorough description of evaluation ‘tools’ and methodology.</td>
<td>Convenience sample (nine men) in a single site, but commendable focus on men from minority and ethnic backgrounds. Poor overall reporting of data collection limits credibility and transferability to other sites, contexts and ethnic groups.</td>
<td>27/36</td>
</tr>
<tr>
<td>Marshall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>Year</td>
<td>Country</td>
<td>Study aim</td>
<td>Design and sample</td>
<td>Strengths</td>
<td>Limitations</td>
<td>QA score</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------</td>
<td>---------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Golding et al.</td>
<td>2006</td>
<td>Australia</td>
<td>To conduct (the first) comprehensive survey of participants in Men’s Sheds in Victoria, Australia</td>
<td>Quantitative survey of active Men’s Sheds. Ten surveys sent to 27 active Victorian Men’s Sheds; 154 surveys returned from 22 Sheds; 39% of participants attended a Shed managed by an education-type organisation; 61% of participants were located in health-type organisations; 42% of participants attended metropolitan Sheds; 58% attended non-metropolitan Sheds.</td>
<td>First attempt to capture broad demographic profile of men attending a Men’s Shed in Australia, with quantitative and some qualitative data.</td>
<td>Authors note that though the survey response was high and the survey was inclusive of most active Men’s Sheds in Victoria, respondent numbers relatively small, impacting on accuracy and confidence levels when data are broken into several categories. Survey deliberately excluded the relatively small number of female participants who are active members of some men’s and particularly ‘community’ Sheds. No details of selection/stratification of specific Sheds in sample, and though 26 variables exist, power calculations/confidence levels are not noted.</td>
<td>29/36</td>
</tr>
<tr>
<td>Golding, Brown and Foley</td>
<td>2007</td>
<td>Australia</td>
<td>To illustrate some theoretical and practical implications and benefits of reciprocal workshop-based mentoring relationships involving men of different ages</td>
<td>Mixed-methods study (on-site interviews and survey) in sample of 24 Sheds providing a social and therapeutic function across five Australian states. Sample centred on young people, war veterans and men in aged residential care. Focus is on theoretical and practical implications and benefits of reciprocal workshop-based mentoring relationships involving men of different ages.</td>
<td>Provides qualitative insights into how the Shed model can accommodate special groups with varying needs.</td>
<td>Sub-samples from large Golding et al. (2007) survey. Much of introduction and background relates to older participants, but primary focus is utility of the Men’s Shed model for young people (male and female) and war veterans, rather than those aged over 65 years. Though emphasis on direct effects of Sheds to health and wellbeing for ex-military and older care recipients, no objective health measures used.</td>
<td>18/36</td>
</tr>
</tbody>
</table>
Golding et al. 2007  Australia  To investigate the learning styles employed in Men’s Sheds, as well as the motivations and experiences of the mainly older men who frequent them.  Mixed-methods study (on-site interviews and survey) in sample of 24 Sheds providing a social and therapeutic function across five Australian states. Sample centred on young people, war veterans and men in aged residential care. Focus on learning styles employed in Men’s Sheds, motivations and experiences of the mainly older men who frequent them.  First comprehensive investigation of Men’s Sheds in Australia, with a specific focus on men’s learning and adult education.  Shed selection was based on convenience (not randomisation) and skewed towards the ‘early adopter’ states and locations closer to cities for ease of researcher access. Respondent selection was possibly biased by key informants choosing survey participants.

Golding and Foley 2008  Australia  To explore the gendered roles associated with men’s informal learning, in particular the role of women as coordinators and participants in community organisations where men comprise the significant majority of participants.  Mixed-methods study (on-site interviews and survey) in sample of 24 Sheds providing a social and therapeutic function across five Australian states. Sample centred on young people, war veterans and men in aged residential care. Focus is on interview data to identify the status of women engaged in Men’s Sheds.  Provides qualitative insights into women’s roles in men’s organisations and helps identify what it is about the way some women participate in Men’s Sheds that is effective and ineffective for the older male participants.  As the research question is potentially sensitive and controversial, the study does not provide adequate details about: (a) theoretical base, some background but not fully contextualised – effort to ground in (limited) theory are not well related to research question; (b) ethical precautions; (c) findings, results lack clear presentation and explanation and do not progress logically from the findings.

Golding et al. 2009a  Australia  To assess links between participation and learning with health and wellbeing in a range of age- and disability-related community organisations directly comparable with Men’s Sheds.  Mixed-methods study with 34 age- and disability-related community organisations directly comparable with Men’s Sheds including adult and community education, sporting, religious, indigenous and cultural, fire and emergency services, in six sites across Western Australia. Survey followed by group interviews with focus on links between participation and learning with health and wellbeing.  Mixed-methods study incorporating a quantitative survey and qualitative interviews.  Men’s Sheds were minor subsample of other gendered interventions – the only Shed included in the study was grouped with a Masonic Lodge with concomitant difficulty in differentiating intervention-specific findings.
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Study aim</th>
<th>Design and sample</th>
<th>Strengths</th>
<th>Limitations</th>
<th>QA score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golding et al.</td>
<td>2009b</td>
<td>Australia</td>
<td>To assess links between participation and learning with health and wellbeing in a range of age- and disability-related community organisations directly comparable with Men’s Sheds.</td>
<td>Mixed-methods study with survey distributed to participants, followed by group interviews with older men who attended range of age- and disability-related community organisations directly comparable with Men’s Sheds, e.g. adult and community education, sport, religious, indigenous and cultural, fire and emergency services. Designed to assess links between participation and learning with health and wellbeing.</td>
<td>Mixed-methods study incorporating a quantitative survey and qualitative interviews.</td>
<td>Men’s Sheds were a minor subsample of other gendered interventions. Only two Sheds were clearly identified as Men’s Sheds and a third was classified as a community work-shed.</td>
<td>32/36</td>
</tr>
<tr>
<td>Graves</td>
<td>2001</td>
<td>Australia</td>
<td>To determine ‘the magic of the Shed’ – why men go to the Shed, barriers to attendance, what happens at the Shed and the benefits for the participants.</td>
<td>Mixed-methods evaluation of an early Shed in Australia with men aged 58–70 using focus groups, questionnaires and the PRECEDE framework to assess health education needs in a community setting. Aimed at exploring why men go to the Shed, barriers to attendance, what happens and the benefits for the participants.</td>
<td>Possibly the first evaluation of a Men’s Shed and, as such, tried to establish a baseline of organisational success factors.</td>
<td>–</td>
<td>23/36</td>
</tr>
<tr>
<td>Study</td>
<td>Year</td>
<td>Country</td>
<td>Objective</td>
<td>Methodology</td>
<td>Limitations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>---------</td>
<td>-----------</td>
<td>-------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthbox CIC</td>
<td>2012</td>
<td>UK</td>
<td>To evaluate effectiveness of four Men’s Sheds established by Age UK for inclusion of older men.</td>
<td>Evaluation of four Men’s Sheds in the UK consisting of observation and surveys (RAND health questionnaire) on use of health services – some qualitative responses in surveys.</td>
<td>Most limitations centre around: (a) self-report and related issues such as not controlling for memory loss, and poorly delimited perceptions of health; (b) composite use of the RAND scores and access to health care to make claims that lacked robustness (although raw data were available if requested); (c) limited information about background, research questions and aims, participant profiles, data analysis and limited interpretation of findings.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milligan et al.</td>
<td>2012</td>
<td>UK</td>
<td>To assess the effectiveness of the Age UK ‘Men in Sheds’ pilot programme in engaging isolated and lonely older men on low incomes and enhancing their quality of life and wellbeing.</td>
<td>Mixed-methods retrospective evaluation of three Men’s Sheds for older men in the UK using repeat observation, focus groups and face-to-face interviews with Shed Members, Shed co-ordinators and managers. Designed to assess the effectiveness of an Age UK ‘Men in Sheds’ pilot programme in engaging isolated and lonely older men on low incomes and enhancing their quality of life and wellbeing.</td>
<td>Limitations noted by authors primarily relate to limitations in some data collection (outside their control) and retrospective evaluation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>Year</td>
<td>Country</td>
<td>Study aim</td>
<td>Design and sample</td>
<td>Strengths</td>
<td>Limitations</td>
<td>QA score</td>
</tr>
<tr>
<td>---------------------</td>
<td>------</td>
<td>---------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Misan</td>
<td>2008</td>
<td>Australia</td>
<td>To better understand the phenomenon of Men’s Sheds and their influence on the social and other determinants of the health of men, including that of indigenous men, and to assess whether Men’s Sheds offer an opportunity for delivery of targeted health promotion programmes for older men.</td>
<td>Literature review with eight detailed case studies involving approximately 65 focus group participants and two (non-comparative) key informant interviews in South Australia. Designed to understand better the influence of Sheds on the social and other determinants of the health of men, including indigenous men; and whether Sheds can deliver targeted health promotion programmes for older men.</td>
<td>Rigorous evaluation utilising mixed methods, with case studies provided in appendices.</td>
<td>Extensive and detailed (generalised) review with explanatory rationale for sample and case study/exemplar selection, but no information about how the synthesis and analysis were conducted.</td>
<td>32/36</td>
</tr>
<tr>
<td>Ormsby, Stanley and Jaworski</td>
<td>2010</td>
<td>Australia</td>
<td>To explore Australian older men’s perceptions on participating in community-based Sheds.</td>
<td>Small qualitative observational study of two Sheds in Australia with five participants aged 67–82 years, four married with some care needs from their wife, mixture of occupations but all but one retired for at least 15 years. Designed to explore Australian older men’s perceptions on participating in community-based Sheds.</td>
<td>Offers insightful suggestions for further research.</td>
<td>Restricted sample size and setting with poor generalisability acknowledged but no discussion of implications of self-report in health.</td>
<td>22/36</td>
</tr>
<tr>
<td>Reynolds</td>
<td>2011</td>
<td>Canada</td>
<td>To develop a theoretical model of the processes of involvement of older male adults in Men’s Sheds in Manitoba, Canada.</td>
<td>Mixed-methods qualitative research (interviews, field notes, quantitative questionnaire) with 12 older men in two Sheds in Canada. Designed to develop a theoretical model of the processes of involvement of older male adults in Men’s Sheds.</td>
<td>Rigorous methodology with interview protocols provided in appendices.</td>
<td>--</td>
<td>34/36</td>
</tr>
</tbody>
</table>

Other gendered interventions:
Batt-Rawden and Tellnes 2005 Norway To evaluate the impact of a range of indoor and outdoor activities as a method of rehabilitation amongst adults and older adults. Participatory qualitative observational study in Norway using semi-structured interviews with convenience sample of 46 people (30 men) aged 40–79 years, most (82%) reporting common mental disorders or muscular-skeletal limitations and all of whom participated in a range of health-promoting group activities (hiking, gardening, physical activities along with more sedentary art and crafts) led by professionals in rehabilitation centre. Study designed to explore social characteristics, frequency and duration of attendance at group, life experiences and subjective views on quality of life. Provides some useful insights into rehabilitation centre using salutogenic approach. Distinguishes between impact on different groups of people. Observational data only so changes over time not known. No comparison group to assess interventions against. Potential sample bias/observer effect regarding positive views on centre. Limited sample size and brief reporting of methods.

Drummond, M. J. 2003 To assess the impact of the physical activity of a walking group and its association with health, competitive masculinity with friendship and camaraderie. Qualitative study using focus groups and interviews with convenience sample of six men aged 58–85 years who formed distinct part of walking group with trained fitness co-ordinator. Designed to explore views on health, ageing and masculinity using interpretative phenomenological analysis. Theoretically informed discussion of older men and masculinity. Phenomenology gives depth to study. Poorly reported observational data from a small sample of older men. No comparison group to assess intervention against.

Gleibs et al. 2011 UK To assess the effectiveness of men-only social groups in care home settings for addressing social isolation on older men. Mixed-methods ‘before and after’ study with convenience sample of 12 older men aged 70–90 years who chose to participate in ‘Gentlemen’s Club’ intervention in six residential care homes in the UK. Data captured at weeks 4 and 12 including composite questionnaire measuring social identity, cognitive ability and wellbeing. Data gathered at two points to assess changes in status. Validated tools to measure changes. Theoretically informed with claims not made on data per se but on theory they support. Small sample size with very limited diversity among participants. No comparison group to assess intervention against. Short time-frame for duration of intervention.
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Study aim</th>
<th>Design and sample</th>
<th>Strengths</th>
<th>Limitations</th>
<th>QA score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gleibs et al.</td>
<td>2011</td>
<td>UK</td>
<td>To assess the role of collective engagement in countering feelings of confinement and lack of autonomy in residential care settings.</td>
<td>Qualitative study using short semi-structured interviews with purposeful sample of five older men aged 70-90 years who had participated in ‘Gentlemen’ s Club’ intervention in six residential care homes in Cornwall. Designed to explore their views on life in residential care and the ‘Club’ intervention.</td>
<td>Provides further qualitative insights from original research. Provides further support for claims made in earlier paper regarding control and choice.</td>
<td>Small sample size with very limited diversity among participants. No comparison group to assess intervention against. Short time-frame for duration of intervention.</td>
<td>27/36</td>
</tr>
<tr>
<td>Golding et al.</td>
<td>2009a</td>
<td>Australia</td>
<td>To assess links between participation and learning with health and wellbeing in a range of age- and disability-related community organisations directly comparable with Men’s Sheds.</td>
<td>Mixed-methods study with 34 age- and disability-related community organisations directly comparable with Men’s Sheds including adult and community education, sporting, religious, indigenous and cultural, fire and emergency services, in six sites across Western Australia. Survey followed by group interviews with focus on links between participation and learning with health and wellbeing.</td>
<td>Mixed-methods study with survey of 187 and interviews with 100+ older men. Provides data on multiple activities and sites catering for needs of older men. Diversity allows similarities and differences to emerge.</td>
<td>Observational data with no comparison group. Insufficient sample size to provide comprehensive picture of learning and wellbeing of older men. Potential bias from opportunistically generated interview sample.</td>
<td>32/36</td>
</tr>
<tr>
<td>Golding et al.</td>
<td>2009b</td>
<td>Australia</td>
<td>To assess links between participation and learning with health and wellbeing in a range of age- and disability-related community organisations directly comparable with Men’s Sheds.</td>
<td>Mixed-methods study with survey distributed to participants, followed by group interviews with older men who attended range of age- and disability-related community organisations directly comparable with Men’s Sheds, e.g. adult and community education, sport, religious, indigenous and cultural, fire and emergency services. Designed to assess links between participation and learning with health and wellbeing.</td>
<td>Mixed-methods study with survey of 219 and interviews with 150 older men. Provides data on multiple activities and sites catering for needs of older men. Diversity of sites and activities allows similarities and differences to emerge.</td>
<td>Observational data with no comparison group. Insufficient sample size to provide comprehensive picture of learning and wellbeing of older men. Potential bias from opportunistically generated interview sample.</td>
<td>32/36</td>
</tr>
</tbody>
</table>
Keller et al. 2004

Canada
To assess the health and wellbeing impacts of volunteering on older men's cooking groups.

Mixed-methods study with convenience sample of older men participating in a monthly cooking club supported by a dietician in Canada. Design included questionnaires at start and end of evaluation year and semi-structured interviews. Designed to explore demographics and prior cooking experience. Data analysed primarily thematically.

Keller et al. 2004

Observational data with no comparison group. Insufficient sample size to provide comprehensive picture of learning and wellbeing of older men.

Keller et al. 2004

Longitudinal mixed-methods study with data gathered at several points. Provides insights into older men and motivations for participation. Qualitative data suggested healthy diet changes but no objective measures. First data collection not at start of project.

Hayes, Golding and Harvey 2004

Australia
To assess the value of volunteer work for older adult learning through fire and emergency service organisations in small and remote Australian towns.

Mixed-methods study (survey and group interviews) with volunteers who regularly take part in local learning through volunteering. Participants were aged over 60 years and 88% men. Study designed to focus on learning and voluntary participation.

Hayes, Golding and Harvey 2004

Mixed-methods study (survey and group interviews) with volunteers and older adults in small and remote Australian towns. The core of these units is often formed of older men with relatively limited level of education. Participants were aged over 60 years and 88% men. Study designed to focus on learning and voluntary participation.

Keller et al. 2004

Quebec, Canada
To assess the health and wellbeing impacts of men-only cooking groups.

Mixed-methods study with convenience sample of older men participating in a monthly cooking club supported by a dietician in Canada. Design included questionnaire at start and end of evaluation year and semi-structured interviews. Designed to explore demographics and prior cooking experience. Data analysed primarily thematically.

Keller et al. 2004

Observational data with no comparison group. Insufficient sample size to provide comprehensive picture of learning and wellbeing of older men.
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Country</th>
<th>Study aim</th>
<th>Design and sample</th>
<th>Strengths</th>
<th>Limitations</th>
<th>QA score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macdonald, Brown and Buchanan, 2001</td>
<td>Australia</td>
<td>To assess older men’s views on the importance of supporting and supportive social environment, difficulties of transition from paid work with loss of male identity and limited opportunities for volunteering.</td>
<td>Qualitative study with convenience sample of old men attending Old Men: New Ideas intervention in Australia – an intervention designed to address health and wellbeing of older men through community-based groups that typically meet on a fortnightly basis. Study used interviews and focus groups to explore various dimensions of health and wellbeing including work and retirement, volunteering, health and social services, male culture, relationships and social networks.</td>
<td>Very wide-ranging exploration of older men’s views on life, health and wellbeing. Provides useful insights on areas and issues that are not covered in other included studies.</td>
<td>Observational data with no comparison group. Poorly reported methods and sample description. Limited description of types of activities undertaken at Old Men: New Ideas.</td>
<td>18/36</td>
</tr>
<tr>
<td>Milligan, Gatrell and Bingley, 2004</td>
<td>UK</td>
<td>To assess the health and wellbeing benefits of community gardening for older people.</td>
<td>Ethnographic study of community gardening activity with older people supported by qualified gardener. Study undertaken in the UK using focus groups and interviews with participants at start of project and after nine months. Supplemented with weekly diaries from participants along with regular observational data from project researcher.</td>
<td>Multiple qualitative methods give rich account of replicable intervention. Strong on policy needs and implications regarding healthy ageing.</td>
<td>Relatively small sample size due to scale of project along with recruitment and attrition problems due to poor health. No comparison group reported to assess impact of intervention.</td>
<td>51/36</td>
</tr>
<tr>
<td>Pretty et al., 2007</td>
<td>UK</td>
<td>To examine the effects of green exercise in the UK countryside for health and psychological wellbeing of older men.</td>
<td>Quantitative study with convenience sample of older people (55% men) participating in green exercise including walking, woodland conservation and cycling, across UK. Study used composite questionnaire with validated measures designed to assess physical and mental health, fitness and lifestyle administered immediately before and after participation in activities.</td>
<td>Validated tools measuring mental health status. Strong on policy needs and implications regarding social physical activity.</td>
<td>Sample of people who were already active so no data on the more typical habitually inactive. Short time-frame for measuring effects of green exercise.</td>
<td>34/36</td>
</tr>
</tbody>
</table>
the lowest categories in hierarchies of research evidence which place greater weight on systematic reviews, randomised controlled trials and well-conducted observational studies (Guyatt et al. 1995).

The studies included contained some quantitative data, predominantly from surveys in mixed-methods papers, but most data were qualitative, offering insights into the perceptions of older men and the processes involved in Men’s Sheds and other gendered interventions. Given the preponderance of qualitative data, an interpretive synthesis (Noblit and Hare 1988) approach involving both induction and interpretation was used in both reviews. The four-step guidance on narrative synthesis in reviews (Armstrong et al. 2007; Popay et al. 2006) was used to address the research questions that were posed prior to the review commencing and provide the structure for the findings.

Results

Of the 14 studies included in the Men’s Sheds review, 11 came from Australia (including three on a single study), reflecting the national origin of this form of intervention, along with two studies from the UK and one from Canada. With the exception of a study by Graves (2001), who undertook a mixed-methods, longitudinal evaluation, most of the Australian studies tended to be descriptive and coalesced into either large-scale surveys or small-scale qualitative investigations of particular Sheds. Studies by Milligan et al. (2012, 2014) in the UK and Reynolds (2011) in Canada used mixed-methods approaches involving questionnaires, interviews, focus groups and observations at multiple sites to provide data with richness and depth. In these studies, data collected from older men were supplemented by information from family members and key informants such as project co-ordinators and health or social care professionals.

Twelve studies were included in the review of other gendered interventions. Four studies originated in Australia, including two by Golding et al. (2009a, 2009b) that were also included in the Sheds review, but also provided insights into alternative activities in communities where Sheds operated. Four studies emanated from the UK, including two on a single intervention in residential care homes in Cornwall, one study came from Norway, one came from Canada and one from the USA. One further study was not clearly geographically located. The types of interventions in these studies were more varied than the Sheds’ literature, covering a range of alternative social activities including a cooking club, a community allotment, walking groups and green exercise in the natural environment. The profile of participants was also more varied in terms of age and capability, with some data from employed active men in their
early fifties who volunteered in their community’s emergency response services, to older men in their eighties in residential care who engaged in more sedate activities. In terms of study design, there were cross-sectional studies, often including large-scale surveys supplemented with group interviews; and longitudinal research that used mixed methods to assess the impact of an intervention.

What are the effects on the physical health of older men?

There was limited evidence of any positive effects on physical health from the studies of Men’s Sheds or those of other gendered interventions. Self-reported improvements from participants suggested that such interventions could improve physical health through promoting moderate levels of physical activity, but we found no supporting evidence from more longitudinal studies using objective or validated physical health measures.

What are the effects on the mental health of older men?

There was more extensive evidence of positive effects on the mental health of those participating in Men’s Sheds, compared to people taking part in other social activities. The consistency and frequency of such reports suggests that older men find benefits to their mental health from participating in social and physical activities in Sheds, due to a greater sense of belonging and purpose in their lives.

A similar pattern of self-reported improvements in mental health emerged from the other gendered intervention studies. Both Pretty et al. (2007) and Gleibs et al. (2011) used composite administered research instruments containing questions from validated questionnaires, such as the Profile of Mood States test and the Hospital Anxiety and Depression Scale, to assess mental health status before and after the social activity. Both studies found significant positive effects in terms of improved mental health and wellbeing among participants immediately before and after (Pretty et al. 2007) and over a period of 12 weeks (Gleibs et al. 2011). It is notable that despite a commonly held perception that men are reluctant to acknowledge mental health issues, both reviews drew on studies in which older men talked candidly about their own mental health experiences, including feelings of anxiety, depression and even about committing suicide.

What are the effects on the wellbeing of older men?

There is some evidence of the beneficial effects of Men’s Sheds on the social wellbeing of older men. Men’s Sheds are socially inclusive spaces that provide participants with a sense of accomplishment, both personal – through
learning and sharing skills, and social – through contributing to their local community. Sheds also provide a sense of purpose for older men through social engagement with their peers, through enjoyment, and fun (Fildes et al. 2010). Men’s Sheds countered social isolation and loneliness by improving feelings of self-esteem and providing social support through the development of friendship and a sense of camaraderie with other men.

What are the effective components of interventions?

Successful Men’s Sheds were in a suitable location, provided a wide range of activities over extended opening hours, enjoyed strong local support and had a skilled co-ordinator who enabled its smooth operation (Milligan et al. 2014).

Men’s Sheds are a voluntary activity which operate in relatively unstructured and informal ways that enable older men to choose the activities they will undertake and through this process become ‘more than a place to do things but also a place of belonging, friendships and purpose’ (Ballinger, Talbot and Verrinder 2009: 26). It is important to note that ‘Shedders’ tend to view themselves as volunteers or members (rather than clients or patients) who come together, often to give something back to the community, through enjoyable hands-on activities rather than being the recipients of a complex social intervention designed to improve their health and wellbeing.

The other gendered interventions studies offered similar explanations for success in terms of older men coming together and finding a common sense of identity and purpose through shared experiences in volunteer emergency services (Golding et al. 2009b; Hayes, Golding and Harvey 2004) or learning new skills (Golding et al. 2009a; Keller et al. 2004; Milligan, Gatrell and Bingley 2004). The pivotal role of a skilled co-ordinator, usually in a paid position, to provide the organisational skills that enables older men to learn and share skills as well as empowering them to act as co-participants in the operation of an intervention was a common finding in both reviews (Milligan et al. 2012). The friendships and sense of support that can be built over time amongst older men engaged in purposeful voluntary social activities are the foundational building blocks for successful Men’s Sheds and other interventions.

What theoretical frameworks were employed?

A variety of theoretical frameworks were used in the studies to provide an underpinning for analysis and to develop a deeper understanding of why these types of gendered interventions may work. Importantly, the different theoretical approaches used reflect different aspects of the interventions.
that these studies were concerned to draw out, whether that be health, gender, inequalities, identity, learning or a combination of these and/or other issues.

In their study of Men’s Sheds, for example, Ballinger, Talbot and Verrinder (2009) used the World Health Organisation’s (WHO) Fields of Wellbeing model to inform their research. This model of health is derived from cross-cultural research on people’s conceptions and experiences, along with the WHO’s definition of health as physical, mental and social wellbeing. It contains six elements that capture the interdependency of health: vitality, positive social relationships, a personal sense of control over one’s life and living conditions, enjoyable activities, a sense of purpose and a connectedness to community. Other theoretical frameworks employed included a salutogenic perspective that emphasises factors contributing to health and wellbeing such as a sense of coherence and continuity in life. This theoretical perspective underpinned the purposeful social activities in the rehabilitation centre studied by Batt-Rawden and Tellnes (2005). Gleibs et al. (2011) drew on social identity theory in their studies of older men in residential care. This approach postulates that membership of a social group is critical in forming a shared sense of support through which people are able to understand who they are, and gain the social support they need to protect and enhance their health and wellbeing. Drummond’s (2003) study of older men in walking groups conceptualised issues through the lenses of masculinity and phenomenology in order to explore how older men experienced ageing and the steps they took to address it. Finally, (Ballinger, Talbot and Verrinder 2009) used the WHO’s Determinants of Disadvantage as a theoretical framework in their studies of Men’s Sheds and other types of gendered intervention aimed at older men. This framework identifies a series of factors that underpin the social disadvantages that contribute to health inequalities such as social exclusion, unemployment, difficult experiences earlier in life, the stresses of ageing and the transition from paid work to retirement to develop an explanatory understanding of the circumstances of older men and the scope for effective interventions.

It is worth noting that whilst the variety of theories and frameworks used can reflect different research priorities, it can also make direct comparisons difficult and hinders the identification of the direction of causal pathways between social activity, health and wellbeing.

Critical reflection on included studies

This review has found evidence to suggest that Men’s Sheds and other gendered interventions may have an impact on the mental health and wellbeing
of older men, but the evidence is not conclusive. There is limited evidence of impact on physical health; and what does exist is largely self-report and limited in scope. Key components of successful interventions included accessibility, range of activities, local support and skilled co-ordination.

Whilst the Men’s Sheds literature was relatively homogenous, given it was examining a clearly defined phenomenon, the studies on other gendered interventions were more heterogeneous, covering a wider range of activities stretching from men’s cooking clubs to walking groups. The range of activities within the gendered interventions category meant it was more difficult to make generalisable assessments of the impact of these interventions on the health and wellbeing of older men.

The review also identified a limited number and variable quality of studies available for synthesis, reflecting the paucity of interventions aimed at older men. This in itself is an important finding. There was also a preponderance of qualitative studies, and whilst smaller numbers are to be expected in qualitative studies, even taking this into account some studies were based on very small sample sizes. When larger samples were generated, there was often a lack of validated measures in survey instruments and the collection and analysis of qualitative data was not always clearly reported.

Despite the widespread availability and acceptance of objective scales, none of the studies used validated measures to assess physical, or even functional, changes in physical health status. This omission is significant given that some of the Men’s Sheds literature asserts that one of the primary benefits of Shed activity is that of participating in physical activities beneficial to health (Ormsby, Stanley and Jaworski 2010). There are self-reported improvements in physical health as a result of the intervention across both the Shed and the other gendered interventions literatures (Milligan et al. 2012), but reporting is limited and needs further verification. Hence, while such evidence should not be dismissed, there is a need for longitudinal and controlled studies that use validated measures of physical health status to provide more reliable evidence to support these self-reported claims that Men’s Sheds and other forms of intervention improve the physical health of older men.

Whilst the evidence of benefits to mental health and wellbeing is more consistent across the literature, it too is based largely on low-level studies using a qualitative research design. The mental health benefits of Men’s Sheds would benefit from further investigation using validated measures specifically designed to assess mental health status. The methods adopted within some of the research on other gendered interventions (e.g. Gleibs et al. 2011) provide a potentially useful guide for further work.

These studies also lacked a control group of older men who did not participate in the organised social activities, making it difficult to be confident
that self-reported improvements in physical or mental health and social wellbeing were directly attributable to the actual interventions. There is also no evidence about why some older men choose not to participate or, alternatively, initially participated but later withdrew.

Finally, it is worth reflecting that to date, most (though not all) of the Men’s Sheds research has been conducted in Australia, some of which has been in rural or remote settings. This raises questions about the need for a deeper understanding of the cultural context within which Sheds have been developed and the extent to which these may need to be adapted for other parts of the world.

**Implications of review**

This scoping review has highlighted limitations to the studies on Men’s Sheds and other gendered interventions that mean that there is, as yet, no conclusive evidence about their beneficial impact on the health and wellbeing of older men. Qualitative data from these studies provide valuable insights into how and why complex psycho-social interventions affect participants. The sense of identity and purpose in life that older men developed through building friendships and social networks by learning and participating in organised social activities can be difficult to measure but low-level evidence does suggest that it exists.

The wider social wellbeing benefits may be an important element of Men’s Sheds, in that they enable older men to share their health concerns and experiences in a supportive environment that is not viewed by participants as being part of the wider health-care system. This more informal ‘health by stealth’ approach to health promotion amongst older men (Milligan et al. 2012) may be one of the key benefits of Men’s Sheds. Misan noted that older men were less concerned about physical health, and more worried about social, emotional and mental health and wellbeing, about the effects of retirement and about the changing nature of rural communities … Sheds are important environments in which men offer support to each other on these issues. (2008: 42)

The literature on other gendered interventions was, similarly, generally supportive of improvements in social wellbeing related to participation in social activities that gave older men a ‘sense of balance’ (Macdonald, Brown and Buchanan 2001) in their lives. This may be important given that older men are at risk of reduced social wellbeing as a result of the transition from paid work into retirement or into residential care – although again the evidence is limited and low level. The study of older men in residential care by Gleibs et al. (2011), although modest in scale, provides some evidence of improved
social wellbeing and a useful guide for future research. The wider social wellbeing benefits of interventions that provide spaces where older men can stand ‘shoulder to shoulder’ (Golding and Foley 2008) have the potential to be considerable but need to be more thoroughly investigated.

The various analytical frameworks used in these studies reflect the variety of academic disciplines and research traditions deployed, but all tend to support the core assumptions of activity theory. They contend that the health and wellbeing of older people is promoted by high levels of engagement in social and leisure activities and role replacement when an established role must be relinquished. The frameworks for further research could include the WHO’s Determinants of Disadvantage for men approach that includes domains for social exclusion, unemployment, difficult past lives, the stresses of ageing and substance abuse issues, as used by Golding et al. (2009b). There is also a case for using the WHO’s Fields of Wellbeing approach, as used by Ballinger, Talbot and Verrinder (2009), which explores six dimensions of health and wellbeing.

Further studies of Men’s Sheds and other gendered interventions for older men are needed, in order to provide more definitive, generalisable and longitudinal answers to questions about whether there are any measurable effects for physical and mental health that would extend the existing evidence base. Future studies should involve larger samples of participants, consider adopting randomised designs, and deploy mixed methods including standardised measures of health and wellbeing and qualitative approaches.

References

Arber, S., Perren, K., Daly, T. and Davidson, K. 2009. Older Men: Their Social Worlds and Healthy Lifestyles. Economic and Social Research Council, Swindon, UK.


Suominen-Taipale, A., Martelin, T., Koskinen, S., Holmen, J. and Johnsen, R. 2006. Gender differences in health care use among the elderly population in areas of use, available at [https://www.cambridge.org/core/terms.](https://www.cambridge.org/core/terms)
Norway and Finland. A cross-sectional analysis based on the HUNT study and the FINRISK Senior Survey. *BMC Health Services Research*, 6, 1, 110.


**Accepted 15 December 2014; first published online 5 March 2015**

**Address for correspondence:**

Christine Milligan,
Centre for Ageing Research,
Faculty of Health and Medicine,
Lancaster University,
Bailrigg, Lancaster, UK

E-mail: c.milligan@lancaster.ac.uk