**Title**

The attitudes towards, and beliefs about, physical activity in people with osteoarthritis and comorbidity: a qualitative investigation.

**Abstract**

**Objective**

To investigate the attitudes towards, and beliefs about, physical activity (PA) in older adults with osteoarthritis (OA) and comorbidity to understand experiences and seek ways to improve PA participation.

**Methods**

Semi-structured interviews with adults aged ≥45, with self-reported OA and comorbidity (N=17). Face-to-face interviews explored participant perspectives regarding; (1) attitudes and beliefs about PA in the context of OA and comorbidity and (2) how people with OA and comorbidity could be encouraged to improve and maintain PA levels. Data were transcribed verbatim and inductive thematic analysis was undertaken using a framework approach.

**Results**

Participants did not conceptualise multiple Long-term conditions (LTCs) together and instead self-prioritised OA over other LTCs. Barriers to PA included uncertainty about both the general management of individual LTCs and the effectiveness of PA for their LTCs; and, negative perceptions about their health, ageing and PA. Participants experienced dynamic and co-existing barriers to PA, and problematized this as a multi-level process, identifying a barrier, then a solution, followed by a new barrier. Facilitators of PA included social support and support from knowledgeable health care professionals (HCPs), together with PA adapted for OA and comorbidity and daily life. PA levels could be increased through targeted interventions to increase self-efficacy for managing OA alongside other LTCs and self-efficacy for PA.

**Conclusion**

People with OA and comorbidity experience complicated PA barriers. To increase PA levels, tailored PA interventions could include HCP and social support to anticipate and overcome multi-level PA barriers and target increased self-efficacy for LTC management and PA.

**Key words**

Osteoarthritis, joint pain, comorbidity, physical activity, qualitative, interviews

**Introduction**

Approximately a third of all adults aged 45 and over have osteoarthritis (OA)(ARUK, 2015) and this prevalence is likely to rise with increasing obesity rates and ageing population demographics (NICE, 2014). People with OA are more likely to have comorbidity than those without OA (ARUK, 2015; Smith et al., 2016); the proportion of people with OA reporting various comorbidities ranges from 68 to 85% (Zambon et al., 2016) and comorbidity presence is associated with greater disability, functional limitations and reduced QOL (Dhalwani et al., 2016).

Clinical guidelines recommend physical activity (PA) as treatment for people with OA (NICE, 2014; OARSI, 2019; EULAR; 2013) with evidence-based health benefits, such as reduced pain, improved function and improved QOL (Kanavaki et al., 2017; Hurley et al., 2018). Therapeutic exercises have a favourable safety profile when compared to other common pharmacological OA management options (Quicke et al., 2015). PA in the form of strengthening and aerobic exercises is recommended for people with OA, irrespective of comorbidity (NICE, 2014; OARSI, 2019; ACR, 2020). PA has also been deemed an effective intervention and preventative approach for various other common long-term conditions (LTCs), such as cardiovascular disease (CVD), depression, type two diabetes (T2DM) and respiratory disease (DOH, 2019; Dekker et al., 2019; Schuch et al., 2016).

Despite guideline recommendations and the well-established clinical benefits, PA is underused as a treatment approach for patients with OA (Healey et al., 2018). People with OA often do not meet guideline-recommended levels of PA and are less active than age matched peers without joint pain (Holden et al., 2014; Herbolsheimer et al., 2016). PA levels in people with OA further reduce in the presence of comorbidity, with those with multiple LTCs being the least active (McKevitt et al., 2020). Comorbidity has previously been suggested as a barrier to the successful prescription, uptake and maintenance of PA in people with OA (Kanavaki et al., 2017; Theis et al., 2016; Schoenberg et al., 2009; de Rooij et al., 2017). Comorbidities may significantly impact and complicate LTC management (Theis et al., 2016) for example, comorbidity may aggravate OA symptoms, cause fatigue, or cause patient hesitancy to take part in PA (de Rooij et al., 2017; Campbell et al., 2001; Petursdottir et al., 2010; Paskins et al., 2014). However, specifically how comorbidity acts as a barrier, remains uncertain.

Although international OA guidelines (NICE, 2014; OARSI, 2019; ACR, 2020) recommend PA, they do not specify how advice should be tailored for those with comorbidity. These guidelines further state that clinicians need to make a judgement in each case on how to effectively ensure participation in PA and that this will depend upon the person's individual needs, self-motivation, and personal circumstance (NICE, 2014). Few studies have been designed specifically for OA populations with comorbidity (de Rooij et al., 2017), and research suggests that the effects of PA may be improved for people with OA and comorbidity when individualised by taking comorbidity into account (Theis et al., 2016), however, how to do this is not well understood. Therefore, the aim of this study was to investigate how people with OA experience PA in the context of comorbidity, and how best to support people with OA and comorbidity to be more active.

This qualitative study was part of a larger multi-method study investigating PA in people with OA and comorbidity. The multi-method study had three research questions to address gaps in knowledge about what PA interventions are effective for people with OA and comorbidity, whether comorbidity is associated with PA levels in people with OA, and how people with OA experience PA in the context of comorbidity. A Pragmatic paradigm was therefore adopted. Embracing both the positivist paradigm (namely quantitative and objective) and the constructivist paradigm (qualitative and subjective), pragmatism provides a middle position for using both, to answer research questions (Johnson and Onweugbuzie, 2004). Results from the quantitative sub studies are published elsewhere (e.g. Mckevitt et al., 2020). A future paper aims to publish data synthesis and integrated analysis using all three studies. This paper reports on results from the qualitative study only.

**Methods**

As the aim of this study was to investigate how people with OA experience PA in the context of comorbidity, and how best to support people with OA and comorbidity to be more active, understanding subjective experiences of people with OA was required. The pragmatic approach adopted acknowledges that multiple realities exit (Creswell and Plano Clark, 2011) and allowed for investigation of lived experiences, how participants made sense of their conditions and influences on perceptions of and actions related to physical activity (Creswell, 2009, Bryman, 2006). This approach encouraged the lead researcher (SM) to understand the perspectives of the participants, guiding the methods used for data collection and the analysis process, facilitating interpretative enquiry and consideration of participants’ wider social context (Creswell, 2007).

Individual semi-structured interviews with people who had OA and comorbidity were conducted. Prior to data collection, a meeting with members of the Patient and Public Involvement (PPI) group at Keele university shaped the study design (including community locations for recruitment and interview topics, such as daily life activities). Informed consent was obtained from participants prior to and following data collection.

**Participants and recruitment**

Criterion purposive sampling was used to select a diverse sample regarding gender, comorbidities, and age range (Palys, 2008). Based on previous similar qualitative research (Holden et al., 2012) experience from the study team and published literature (Creswell, 2009; Morse, 2000), it was estimated that 15-20 participants would be required. We defined data saturation according to categories outlined by Saunders et al. (2017) and therefore data collection stopped when new data repeated what was expressed in previously collected data. Criteria for inclusion in the study included both males and females, aged ≥45 years old, who self-reported OA with at least one comorbidity, located in the North West and West Midlands of England.

Participant recruitment occurred between February and May 2018. Participants were recruited from local community groups and third sector organisations (e.g. Arthritis Action, local library). Contact was made with community group leaders, to arrange a brief face-to-face talk with group members and provide study information. Potential participants were invited to fill in a reply slip or send it later via post. To advertise in some community settings, face-to-face or phone contact was made with gatekeepers to ask for permission to display a recruitment poster. Contact details of the lead researcher (SM) were included on the poster to allow potential participants to express an interest. All those that expressed an interest were sent a letter of invitation and information leaflet. Interviews were arranged at a convenient time, date and location (e.g. at the participant’s home, or a community group location). Informed consent was obtained from potential participants prior to and following data collection from the interviews.

Participants were invited to participate in a single semi-structured interview lasting approximately 60 minutes. All interviews were conducted, transcribed, and anonymised by SM.

**Interview guide development**

The interview guide was developed following (1) a literature search on electronic databases (MEDLINE, EMBASE, AMED, CINAHL, and SportDiscus) covering OA, comorbidity and barriers to PA, (2) input from the PPIE group, and (3) discussions between the research team (SM, CJ, JQ, EH) (see Table 1). The first three interviews were discussed by the research team resulting in minor adjustments to the interview guide including additional emphasising of the comorbidity context and encouraging detailed responses.

**Data analysis**

A flexible framework approach (Smith and Firth, 2011) was adopted to capture and interpret meaning within the data. Analysis began with verbatim transcription of the interviews followed by transcript reading and familiarisation (SM). To remain closely engaged with the data, transcripts were manually coded in Microsoft Word, which also facilitated a methodological, yet flexible process. SM and two additional members of the research team (CJ social scientist, JQ physiotherapist) independently coded the first three transcripts and met to discuss interpretations of the data and codes that best reflected participant’s responses. Coding began with identifying important portions of text, applying codes, grouping similar topics and labelling ideas. Codes with example data extracts (quotations) were defined in a code book enabling SM to keep track of how codes were being used, and to help make sense of data. In addition, SM created individual participant diagrams (reflecting each individual participant’s story) to enhance understanding of participants’ experiences and their wider social context.

Codes were amended and clarified through discussion and SM applied the finalised coding framework to the full dataset. Codes were grouped and clustered into themes and subthemes and then organised around central concepts and core ideas. SM, CJ and JQ reviewed and refined these themes and subthemes in regular meetings to discuss concepts. A thematic map was created linking themes, subthemes and codes. Themes were also reflected on and compared back to the raw data, to ensure referential adequacy of conclusions, firmly grounded in the data (Lincoln and Guba, 1985), through a process of constant comparison. SM used a matrix structure to systematically analyse the data by individual case, or code (Smith and Firth, 2011). This way, it was possible to gain an in-depth view of individual interviews, before exploring themes and findings across interviews, iteratively, linking back and forth to the raw data (Gale et al., 2013).

A reflexive stance was maintained throughout the process, with iterative cross-checking, multiple reviewers and the use of complimentary methods, for transparency, clarity, and consideration of alternative explanations (Malterud, 2001).

**Ethical approval**

Ethical approval was obtained (Keele University Ethics Review Panel (Ref: ERP3128)).

**Results**

17 participants consented to and completed an interview. Participant characteristics are shown in Table 2. The sample comprised of males (23.5%) and females, aged 49 to 95, with a range of comorbidities. All participants indicated that they engaged in some form of PA, however, definitions of PA varied.

Analysis identified two central themes; (1) barriers to PA and (2) facilitators of PA, with all sub-themes related to these (Table 3), summarised in the thematic map (Figure 1).

**Theme 1. Barriers to physical activity in people with osteoarthritis and comorbidity**

*Lack of concept of comorbidity with participants prioritising individual long-term conditions:* Participants largely talked about their conditions in isolation and did not conceptualise having OA at the same time as other LTCs as a construct of “comorbidity”. Instead, participants saw their conditions as separate entities and prioritised individual conditions, based on the perceived disability they caused and how each condition disrupted daily life. This meant that OA was often prioritised over other more life-threatening conditions for reasons including the level of pain it caused, impact on walking mobility, disruption to QOL and social functioning.

‘You see I forget that I’ve got other conditions, I always just think it’s my arthritis that hurts me’ (Laura)

I think my OA is the most important…it’s because it’s going to impact on my life, as to how much I can get about…meet friends and do the things I want to do really isn’t it…In fact I’m quite frustrated now because of my hip, I can’t get up and go’ (Kate)

‘That affects everything (OA) that’s the overriding thing…umm the others, I manage with tablets…I don’t feel they affect me very much on a day to day basis…I don’t really think about the hypertension at all, because I’m on the medication, that stabilized it. Yes, it’s another tablet you have to take every day’ (Dave)

Other conditions, in comparison to OA, were often less problematic due to their perceived predictability and manageability. Furthermore, participants’ experiences of healthcare consultations mirrored their own lack of conceptualisation of comorbidity, with HCPs only aware, or focussing on one condition at a time. This made it hard for participants to do the PA they were prescribed because the prescribed PA was often not tailored to account for all of their LTCs.

‘I’ve been shown one lot of exercises and that was for me knees. But what she was expecting me to do, I couldn’t do because of the pain in me back…When they come to give me exercise for me knees, all they know about is me knees, they don’t even know about me back…she was showing me these exercises…I couldn’t do it…she seemed quite surprised as though she didn’t know anything about me back’ (Jackie)

*Uncertainty about the management of long-term conditions and the effectiveness of physical activity:* Participants were often uncertain about how to best manage their LTCs (e.g. due to receiving mixed messages about condition management, and limited PA treatment availability). Some participants held the perception that HCPs preferred pharmacological, and surgical treatments, rather than endorsing PA as a key option for treating OA. This contributed to an overall lack of knowledge about whether PA was appropriate and uncertainty about the effectiveness of PA as a treatment in people with OA and comorbidity.

‘I need to know, what is going to help, the condition…I don't know enough about it sort of what would make things better, what would make things worse, so knowledge, knowledge is really important…this is recommended, but this isn't, or this could make it worse, you know’ (Rachel)

‘I’d been about this to the doctor before, and then again, ‘take some paracetamol…Nobody’s ever said to me like, you know, you ought to try (PA)’ (John)

‘I did go and see that physiotherapist…and she did give me these movements…but when I went to see the specialist, he said he doesn’t’ think, because my hip is so degenerated, he says he honestly doesn’t think that exercises would do me any good’ (Bill)

*Negative perceptions concerning long-term conditions and ageing, and physical activity:* Participants had negative perceptions about the future as they believed their conditions would lead to an inevitable decline in health and had low expectations of how much PA they could, or should, achieve in older age. Therefore, participants were not inclined to participate in PA to relieve current symptoms or prognosis, believing declining health was inevitable. For example, participants linked their health status with the feeling of succumbing to age and the expectation of an inevitable deterioration of their health and QOL. These fatalistic negative expectations were reinforced by how they perceived HCPs viewed them.

Because it’s not going to get better, its slowly going to get worse, isn’t it…I don’t know how long I can drive for though do I, once I can’t drive, that’s finished it, that’s another door closed to me’ (Kate)

‘She come she said, ‘it’s just arthritis I’m afraid it’s just something at your age, something you’ve got to live with’ (Ann)

Negative perceptions of PA also existed. These were linked to multiple attitudes and experiences including absent positive PA experiences or references, safety fears, and negative perceptions of gyms and PA classes.

‘I’ve never seen anybody with a condition, come out of it any better, with any activities or special classes…I’ve never known anybody to benefit in any real terms’ (John)

‘If I went on one of these physical things…it’d probably do more harm than good’ (John)

‘You can really put people off exercise if you tell them they have to lose weight first…Ways to motivate yourself when you aren’t getting the… the kinds of rewards that a lot of the popular media tell you should get from exercise’ (Alice)

*Co-existing biopsychosocial barriers:* Participants spoke of how they encountered multiple barriers to undertaking and maintaining PA, such as physical (e.g. physical impairment), psychological (fear of falling, mental fatigue), socio-environmental (lack of exercise partner, limited transport) factors and biopsychosocial factors (pain). Participants experienced these barriers concurrently, for example, experiencing pain alongside low exercise confidence. Co-existing barriers are illustrated in Dave’s example (Figure 2). Barriers impacted on participants’ PA in multiple ways. For example, pain was the most common barrier experienced and impacted PA through multiple biopsychosocial mechanisms (e.g. physical impairment, fatigue, fear avoidance, feelings of hopelessness, demotivation and doubt in physical ability).

‘That level of pain and that level of will power is quite tiring and quite fatiguing’ (Dave)

‘I won't do anything that gives me pain’ (Rachel)

‘Mental as well because you think, oh I can’t, I can’t do anything you know, and it hurts too much and a lot of people give in’ (Vera)

*Multi-level barriers:* As seen above, participants discussed co-existing biopsychosocial barriers to PA. Next, they identified solutions to barriers, but then further barriers to their own solutions, as described below:

*Solutions to barriers:* Solutions included maintaining routines or behaviour that could help embed PA into daily life, preparing or being equipped for side-effects of PA, identifying transport solutions to help access PA, identifying someone to support them, and finding enjoyable activities.

‘I set out errands each day to make me do it…it’s why I shop daily, its why on a Tuesday when the cleaner is there, I pack my books and go down to café Nero and on the way I got to the gym…deliberately pick longer routes’ (Alice)

‘I have to put enough money in my purse, now, if I’ve walked to town and I’m not well, I need enough money to get a taxi to bring me back home again (Kate)

‘I used to play things like squash, but we are going back a number of years, and table tennis which I love…so I really ought to find somewhere that does table tennis and get back to it…Dancing me say would be enjoyable, table tennis I would enjoy…I tried tai chi but I didn’t get on with that really. I prefer yoga’ (Rachel)

*Barriers to solutions:* After identifying solutions to barriers to PA, subsequent barriers to PA then appeared as a *barrier* *to the solution*.This goes beyond findings from previous OA studies. The way participants in this study problematized PA was, therefore; initial barrier, a solution to the barrier and, a barrier to the solution. For example, one participant lacked confidence to go to the gym to undertake PA. Her solutions included linking up with friends at the gym and attending classes run by a fitness professional, which improved her confidence in the safety of PA and provided a socially supportive PA environment. However, a further barrier was access to the class and a lack of transport options.

‘I’m frightened to go…I daren’t just because of the pain in my back, I just daren’t, I’d like to go out, do it…it’s probably going to make my back worse, that’s what I’m frightened of…I haven’t got the confidence to go on my own […] If somebody’s with me, I’d have a go at anything really…I’d like to go…I could go with Kate, you know…I’d like to go to the keep fit class, yeah, because a lot of the girls from the craft club go as well […] but. Yeah. Nobody comes, lives up here you know…if I could, depend on the buses, I would…but it’s getting there and back…I daren’t go and wait for a bus, the time to wait for buses, because my legs give way underneath me…sometimes they don’t turn up’ (Karen)

Furthermore, participants vocalised multiple, co-existing barriers to PA and barriers to solutions, as a result of experiencing multiple LTCs, having multiple appointments, time-consuming treatments, and exhaustion from multiple conditions, symptoms and treatments, but did not connect them as integrated experiences.

‘I could walk that, but I couldn’t walk there, do the activity and get back home again […] I don’t want to be walking down the road with sticks…seen as some poor old weak thing […] and I definitely can’t drive…my **visions** not brilliant […] I did go to the hospital for a little while…to do exercise because I had a **frozen shoulder**…but because my **hip** was getting worse, it was too difficult for me really […] because of my hip, I can’t get up and go…there’s something you want to do and then you’re waiting and waiting, the moment’s gone […] pain does impact but I don’t like taking pain killers…co-codamol has other side-effects like **constipation** […] if you’ve got **Raynaud’s**…all you can think about it keeping warm isn’t it…but if I had medication for my Raynaud’s, apparently it will impact (negatively) on my **blood pressure** […] my blood pressure bothers me because obviously I could fall over at any given time […] **palpitations** when they happen, they frighten me…I think, oh, I feel a bit dizzy now […] my **thyroid**, I don’t know whether that makes me tired…I am exceptionally tired…’ (Kate)

**Theme 2: Facilitators of physical activity in people with osteoarthritis and comorbidity**

*Social support:* Social support was a key facilitator for engaging in PA and appeared as general encouragement, a confidence booster and shared learning from others. The key aspect of social facilitation was being in a homogeneous group (e.g. peers with similar conditions or experiences of multiple conditions). Participants felt that having a group of people who could empathise with each other, and positively compare relatable PA experiences, would facilitate learning specifically according to their conditions and instil confidence in their current and future abilities.

‘People, with the same kind of condition…how they manage things, I think that would be useful, and what kind of things they did’ (Rachel)

‘People will actually listen to people who are only a few steps ahead of them, where they won’t listen to somebody who appears to be something they couldn’t possibly aspire to be’ (Alice)

‘The opportunity to exercise with people with the same complaint…There’s got to be a lot more than me, with exactly the same problems that I’ve got…getting that group of people together…for that particular complaint…’Oh I can lift me knee this far’ and ‘I’ve started doing this one and that one’’ (Tim)

*Healthcare professional support:* Participants also articulated the benefits of PA instructors who were knowledgeable of them as an individual and capable of advising personalised PA (inclusive of their conditions and unique circumstance). Participants valued both personable, and professional opinion and input, especially through face-to-face contact, to instil confidence in their ability to carry out PA to self-manage their conditions.

‘An instructor who, understands your condition…better than somebody who hasn’t got a clue what it’s all about…so they would know your limitations…to devise a programme around, various conditions that existed within the group’ (Kate)

‘Tailored to the people who would come to the class, and you can’t really make a program until you have met everyone’ (Vera)

‘There would be someone there from the NHS…just to make sure you’re alright…If there’s a professional doing it, yes, I would certainly consider it and give it a go…someone who knows what they’re talking about…a physician or…I mean the people that run the, our, they’re volunteers, they’ve been trained but they're not professional’ (Debbie)

*Physical activity mode and type:* The mode of PA was important to participants in overcoming aforementioned PA barriers. This included making a routine that fitted PA into daily life, intermittent modes of PA with a shorter duration, done more frequently and breaking up sedentary time, and adapting PA to suit their needs, by tailoring the duration, type, equipment, and environment, to enable participation.

‘There’s a tendency for fitness classes to assume three quarters of an hour or an hour and that’s actually long for me…I don’t often tend to do a whole workout in the sense of stopping and doing a workout, I’ll do 10 minutes, and then I’ll do 10 minutes later, and 10 minutes later on and that’s the way to move around…I’d want to focus on small and often’ (Alice)

‘If you can’t move a lot then chair based activity’ (Vera)

‘There is a tai chi class locally, but I can’t do tai chi as it is, real tai chi, the one that I went to, she adapted…and it makes a big difference’ (Debbie)

**Discussion**

This was the first UK-based study to investigate how people with OA experience PA in the context of comorbidity, and how best to support people with OA and comorbidity to be more active.

**Key findings**

We found that participants experienced numerous barriers to PA, including a lack of “comorbidity” conceptualisation, resulting in self-prioritisation of their individual LTCs. Uncertainty also existed around how to best manage LTCs, specifically regarding the role of PA. This uncertainty was linked to negative perceptions about their general health, ageing and PA. The new finding of ‘multi-level barriers’ was identified as co-existence of multiple biopsychosocial barriers and facilitators. Participants problematized PA in a three-level process; an initial barrier to PA, a solution to the barrier, and a subsequent barrier to the solution. More often, the result was a cyclical process that interrupted PA participation.

Key facilitators of PA included social support mechanisms, with a focus on social support (from people with similar LTCs and symptoms) and confidence instilled from knowledgeable HCPs, coupled with an adapted and personalised PA type that fits into the daily lives of those with OA and comorbidity.

**Comparison to existing literature**

A lack of conceptualisation of ‘OA and comorbidity’ supports the report from the Richmond Group of Charities that there is a need to find better ways of describing and understanding perspectives of people with more than one health condition (Aiden, 2018). Previously, other terms such as multimorbidity, complexity and burden have been used by HCPs and academics (Taskforce RGC, 2018) which yield a descriptive explanation and can offer patients identity in diagnosis (Møller et al., 2018). However, these terms offer little functional applicability for treatment, are often misunderstood, or rejected by patients and can be associated with negative connotations, experiences with healthcare and psychosocial outcomes from diagnosis (Møller et al., 2018; Chew-Graham et al., 2019). The current care system with specialist care targeting individual conditions, rather than the person with multiple LTCs, may in part, contribute to participants not conceptualising their health in terms of comorbidity.

In line with previous research (Morris et al., 2011, Alami et al., 2011), we found people with OA and comorbidity prioritise their conditions themselves, to manage treatments and daily life with OA often viewed as the priority condition (as a result of its impact on mobility, PA and social functioning). In contrast to patients’ priorities, HCPs tend to prioritise other conditions above OA (Alami et al., 2011; Christiansen et al., 2020), leading to a potential mismatch in provision of patient centred care.

Numerous individual barriers to uptake and maintenance of PA in those with OA have been described previously, including pain, a lack of knowledge and low PA self-efficacy (de Rooij et al., 2017; Petursdottir et al., 2010; Paskins et al., 2014). People with arthritis have also been shown to make ‘trade-off’ decisions in daily life, as common barriers such as pain, fatigue or competing responsibilities interact, thus reducing regular PA participation to prioritise other activities and self-care (Der Ananian et al., 2006) and increasing drop out from PA programs (Petursdottir et al., 2010). Previous research has suggested similar patterns and combined effects of co-existing and complex barriers to PA, amplified by, and linked with, the presence of comorbidity (Schutzer and Graves, 2004). Furthermore, Kanavaki et al. (2017) described biopsychosocial barriers to PA as being complex and having interactions among physical, psychological and socio-environmental domains. However, the existence of multi-level barriers to PA in people with OA and comorbidity is novel and draws parallels with patterns of multiplicative and synergistic barriers reported in multimorbidity patients more generally (Vancampfort et al., 2017).

Previous research has reported several facilitators of PA for people with OA (Kanavaki et al., 2017; Petursdottir et al., 2010) such as social support and organised PA opportunities. Social interactions have been reported as a key facilitator previously (Farrance et al., 2016) and in OA, those who perceive that they have good PA support, are more likely to be active (Holden et al., 2014; Hendry et al., 2006).

Many participants highlighted that carrying out PA with someone relatable (a peer) with similar LTCs, could be an important facilitator of PA. In addition, some participants indicated the potential value of peer-referral to a PA programme, but this was lacking, in their experience. Other studies (without a comorbidity focus) have found the social dimension of PA facilitates enjoyment and provides a “sense of belonging” (Hunt and Papathomas, 2019). Hearing of PA opportunities and successes, and relatable recommendations from peers, could instil confidence, provide demographic homogeneity and connectedness (Farrance et al., 2016; Normansell et al., 2014), and reduce isolation.

In the current study, participants valued HCP support, such as tailored instruction regarding PA, but this was lacking in their experiences of healthcare services. Previous research has shown how HCPs need specific condition knowledge, PA knowledge and skills to adapt treatment to the individual (de Rooij et al., 2020), but also continued contact for proper knowledge transfer to patients and subsequent integration of PA strategies in daily life (Campbell et al., 2001; de Rooij et al., 2020). Participants in the current study expressed a need for more consistent and positive collaborative communication about PA benefits and more endorsement to realign uncertainty and hesitancy regarding PA, supporting findings from Paskins et al. (2014). Forming a supportive HCP-patient collaborative partnership, could facilitate patient knowledge and confidence about their conditions, enhancing capacity to self-manage (Hendry et al., 2006). Then, attention could be focussed on overcoming PA barriers, improving exercise self-efficacy and PA behaviour (Hammer et al., 2016). Therefore, successful support from HCPs and social mechanisms could facilitate condition self-management abilities, self-efficacy for PA, and patient ability to overcome barriers to PA (Hammer et al., 2016).

**Study implications**

Findings from this study suggest the need to address conceptualisations of comorbidity and introduce more practical language to facilitate better understanding of health and focus on priorities of patients (Reuben and Tinetti, 2012). This focus could offer a subsequent platform for improved patient experience and engagement with healthcare, tailoring of treatment and interventions such as PA, and better health outcomes for people with OA and comorbidity (Chew-Graham et al., 2019). People with OA and comorbidity may require additional time with HCPs to develop tailored PA plans, including time to develop understanding of their LTCs and their influence on PA, problem-solve and anticipate multi-level barriers. Patient-centred approaches in consultation, rather than a single disease focus, could foster this way of working.

A gap remains in understanding how HCPs can best address key barriers in a time-limited consultation, to facilitate PA behaviour change. Further qualitative research with HCPs could help understand their perspective of barriers and facilitators to recommending PA and implementing this treatment for people with OA and comorbidity. In particular, how to understand and interpret the complex nature of multi-level barriers and support problem-solving in consultations is warranted. More research is required to investigate how best to discuss and encourage PA in people consulting with multiple LTCs.

Treatment approaches could be tailored toward homogeneous groups of people with OA and comorbidity, targeting self-management of health conditions including increasing knowledge about health conditions before offering strategies to improve PA self-efficacy, engaging patients in their care, and PA behaviour change. In the current study, social support offered participants encouragement, understanding and knowledge of their LTCs. For example, learning how to manage their conditions and symptoms, as well as receiving empathy, discussing expectations of their abilities, PA behaviour in the context of their health status, and increasing self-efficacy for carrying out PA.

**Strengths and limitations**

This novel study has several design and analysis strengths; criterion purposive sampling ensured a range of individual demographics and varied participant comorbidities, enhancing the transferability of results; PPI helped co-design the topic guide and recruitment methods, and regular team meetings ensured rigorous discussion about the meaning and interpretation of the data. These strategies help to make the results more trustworthy and credible. In addition, the use of the flexible framework approach alongside multiple coders and other analysis strategies (e.g. code book, memo recording and drawing diagrams) assisted in the reflexive and reflective interpretation of the data.

Limitations included the small region in the North West and West Midlands of the UK that the study participants were sampled from and potential participant volunteer bias. Participants were all Caucasian, mostly female and of an older age, limiting the transferability of findings to other groups. It is possible that interviewer influence may have contributed to socially desirable responses (e.g. participants reporting higher than actual PA levels) and the complex research topic led to difficulties in participants maintaining focus on the context of OA *and* comorbidity.

**Conclusion**

In conclusion, people with OA and other LTCs appear to lack a conceptualisation of “comorbidity” and so it was hard to discuss PA in this context. Several barriers to PA as a treatment exist in this group and the concept of ‘multi-level’ barriers to PA in OA and comorbidity was identified. There is a need to develop mutual understanding between HCPs and patients regarding the best language to use when discussing multiple LTCs together. This is a precursor to setting treatment priorities, and tailoring PA treatment. An opportunity to improve PA levels is presented as targeting improved LTC supported self-management and targeting increased PA, through tailored HCP interventions and social support.

**References**

Aiden, H. (2018). Multimorbidity. Understanding the Challenge. The Richmond Group of Charities. London. https://richmondgroupofcharities.org.uk/sites/default/files/multimorbidity\_understanding\_the\_challenge.pdf.

Alami, S., Boutron, I., Desjeux, D., Hirschhorn, M., Meric, G., Rannou, F., & Poiraudeau, S. (2011). Patients' and practitioners' views of knee osteoarthritis and its management: A qualitative interview study. PLoS One, 6, e19634.

American College of Rheumatology (ACR) Kolasinski, S. L., Neogi, T., Hochberg, M. C., Oatis, C., Guyatt, G., Block, J., ... & Reston, J. (2020). 2019 American College of Rheumatology/Arthritis Foundation guideline for the management of osteoarthritis of the hand, hip, and knee. *Arthritis & Rheumatology*, *72*, 220-233.

Arthritis Research (ARUK) UK. (2015). The musculoskeletal calculator. Online at www.arthritisresearchuk.org/ mskcalculator.

Bryman, A. (2006). Integrating quantitative and qualitative research: how is it done?. Qualitative research, 6(1), 97-113.

Campbell, R., Evans, M., Tucker, M., Quilty, B., Dieppe, P., & Donovan, J. L. (2001). Why don't patients do their exercises? Understanding non-compliance with physiotherapy in patients with osteoarthritis of the knee. Journal of Epidemiology & Community Health, 55, 132-138.

Chew-Graham, C., O’Toole, L., Taylor, J., & Salisbury, C. (2019). ‘Multimorbidity’: an acceptable term for patients or time for a rebrand? British Journal of General Practice, 69, 372-373.

Christiansen, M. B., White, D. K., Christian, J., Waugh, E., Gakhal, N., King, L., ... & Webster, F. (2020). “It... doesn’t always make it [to] the top of the list”: Primary care physicians’ experiences with prescribing exercise for knee osteoarthritis. Canadian Family Physician, 66, 14-20.

Creswell, J. W. (2009). Research design: Qualitative, quantitative, and mixed methods approaches. Los Angeles: Sage (3rd ed.).

Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. The counseling psychologist, 35(2), 236-264.

Creswell, J. W., Klassen, A. C., Plano Clark, V. L., & Smith, K. C. (2011). Best practices for mixed methods research in the health sciences. Bethesda (Maryland): National Institutes of Health, 2013, 541-545.

de Rooij, M., van der Leeden, M., Cheung, J., van der Esch, M., Häkkinen, A., Haverkamp, D., . . . Lems, W. F. (2017). Efficacy of tailored exercise therapy on physical functioning in patients with knee osteoarthritis and comorbidity: A randomized controlled trial. Arthritis Care & Research, 69, 807-816.

de Rooij, M., van der Leeden, M., van der Esch, M., Lems, W. F., Meesters, J. J., Peter, W. F., ... & Dekker, J. (2020). Evaluation of an educational course for primary care physiotherapists on comorbidity‐adapted exercise therapy in knee osteoarthritis: an observational study. Musculoskeletal Care, 18, 122-133.

Dekker, J., Buurman, B. M., & van der Leeden, M. (2019). Exercise in people with comorbidity or multimorbidity. Health Psychology, 38, 822.

Department of Health & Social Care (DOH). (2019) UK Chief Medical Officers’ Physical Activity Guidelines. Available at: https://assets.publishing.service.gov.uk/government/uploads /system/uploads/attachment\_data/file/832868/ukchief-medical-officers-physical-activity-guidelines.

Der Ananian, C., Wilcox, S., Saunders, R., Watkins, K., & Evans, A. (2006). Factors That Influence Exercise Among Adults With Arthritis in Three Activity Levels. Preventing Chronic Disease, 3. A81.

Dhalwani, N. N., O’Donovan, G., Zaccardi, F., Hamer, M., Yates, T., Davies, M., & Khunti, K. (2016). Long terms trends of multimorbidity and association with physical activity in older English population. International Journal of Behavioral Nutrition and Physical Activity, 13, 8.

European League Against Rheumatism (EULAR) Fernandes, L., Hagen, K. B., Bijlsma, J. W., Andreassen, O., Christensen, P., Conaghan, P. G., ... & Lohmander, L. S. (2013). EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. Annals of the Rheumatic Diseases, 72, 1125-1135.

Farrance, C., Tsofliou, F., & Clark, C. (2016). Adherence to community based group exercise interventions for older people: A mixed-methods systematic review. Preventive Medicine, 87, 155-166.

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Medical Research Methodology, 13, 117.

Hammer, N. M., Bieler, T., Beyer, N., & Midtgaard, J. (2016). The impact of self-efficacy on physical activity maintenance in patients with hip osteoarthritis–a mixed methods study. Disability and Rehabilitation, 38, 1691-1704.

Healey, E. L., Afolabi, E. K., Lewis, M., Edwards, J. J., Jordan, K. P., Finney, A., ... & Dziedzic, K. S. (2018). Uptake of the NICE osteoarthritis guidelines in primary care: a survey of older adults with joint pain. BMC Musculoskeletal Disorders, 19, 295.

Hendry, M., Williams, N. H., Markland, D., Wilkinson, C., & Maddison, P. (2006). Why should we exercise when our knees hurt? A qualitative study of primary care patients with osteoarthritis of the knee. Family Practice, 23, 558-567.

Herbolsheimer, F., Schaap, L. A., Edwards, M. H., Maggi, S., Otero, Á., Timmermans, E. J., ... & Eposa Study Group. (2016). Physical activity patterns among older adults with and without knee osteoarthritis in six European countries. *Arthritis care & research*, 68, 228-236.

Holden, M. A., Nicholls, E. E., Young, J., Hay, E. M., & Foster, N. E. (2014). Exercise and physical activity in older adults with knee pain: a mixed methods study. Rheumatology, 54, 413-423.

Hunt, E. R., & Papathomas, A. (2019). Being physically active through chronic illness: life experiences of people with arthritis. Qualitative Research in Sport, Exercise and Health, 12(2), 1-14.

Hurley, M., Dickson, K., Hallett, R., Grant, R., Hauari, H., Walsh, N., ... & Oliver, S. (2018). Exercise interventions and patient beliefs for people with hip, knee or hip and knee osteoarthritis: a mixed methods review. Cochrane Database of Systematic Reviews, (4).

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. Educational researcher, 33(7), 14-26.

Kanavaki, A. M., Rushton, A., Efstathiou, N., Alrushud, A., Klocke, R., Abhishek, A., & Duda, J. L. (2017). Barriers and facilitators of physical activity in knee and hip osteoarthritis: a systematic review of qualitative evidence. BMJ Open, 7, e017042.

Lincoln, YS. & Guba, EG. (1985). Naturalistic Inquiry. Newbury Park, CA: Sage Publications.

Malterud, K. (2001). Qualitative research: standards, challenges, and guidelines. The Lancet, 358, 483-488.

McKevitt, S., Healey, E., Jinks, C., Rathod-Mistry, T., & Quicke, J. (2020). The association between comorbidity and physical activity levels in people with osteoarthritis: Secondary analysis from two randomised controlled trials. Osteoarthritis and Cartilage Open, 2, 100057.

Møller, A., Willadsen, T. G., Jönsson, A. B. R., & Reventlow, S. (2018). 3 Definition of multimorbidity and risk of overdiagnosis. British Medical Journal, 23(2), 1-2.

Morris, R. L., Sanders, C., Kennedy, A. P., & Rogers, A. (2011). Shifting priorities in multimorbidity: A longitudinal qualitative study of patient's prioritization of multiple conditions. Chronic Illness, 7, 147-161.

Morse, J. M. (2000). Determining sample size. Qualitative Health Research. Sage Publications, 10, 3-5.

National Institute for health and Care Excellence (NICE). (2014). Osteoarthritis: care and management. Clinical guideline [CG177]. www.nice.org.uk/guidance/cg177.

Normansell, R., Smith, J., Victor, C., Cook, D. G., Kerry, S., Iliffe, S., ... & Harris, T. (2014). Numbers are not the whole story: a qualitative exploration of barriers and facilitators to increased physical activity in a primary care based walking intervention. BMC Public Health, 14, 1272.

Osteoarthritis Research Society International (OARSI) Bannuru, R. R., Osani, M. C., Vaysbrot, E. E., Arden, N. K., Bennell, K., Bierma-Zeinstra, S. M. A., ... & McAlindon, T. E. (2019). OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. *Osteoarthritis and cartilage*, 27, 1578-1589.

Palys, T. (2008). Purposive sampling. In L. M. Given (Ed.) The Sage Encyclopedia of Qualitative Research Methods. Sage: Los Angeles, 697-8.

Paskins, Z., Sanders, T., & Hassell, A. B. (2014). Comparison of patient experiences of the osteoarthritis consultation with GP attitudes and beliefs to OA: A narrative review. BMC Family Practice, 15, 46.

Petursdottir, U., Arnadottir, S. A., & Halldorsdottir, S. (2010). Facilitators and barriers to exercising among people with osteoarthritis: A phenomenological study. Physical Therapy, 90(7), 1014-1025.

Quicke, J. G., Foster, N. E., Thomas, M. J., & Holden, M. A. (2015). Is long-term physical activity safe for older adults with knee pain? a systematic review. Osteoarthritis and Cartilage, 23, 1445-1456.

Reuben, D. B., & Tinetti, M. E. (2012). Goal-oriented patient care-an alternative health outcomes paradigm. The New England Journal of Medicine, 366, 777.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., . . . Jinks, C. (2017). Saturation in qualitative research: Exploring its conceptualization and operationalization. Quality & Quantity, 1-15.

Schoenberg, N. E., Leach, C., & Edwards, W. (2009). “It’s a toss up between my hearing, my heart, and my hip”: prioritizing and accommodating multiple morbidities by vulnerable older adults. Journal of Health Care for the Poor and Underserved, 20, 134.

Schuch, F. B., Vancampfort, D., Richards, J., Rosenbaum, S., Ward, P. B., & Stubbs, B. (2016). Exercise as a treatment for depression: a meta-analysis adjusting for publication bias. *Journal of psychiatric research*, 77, 42-51.

Schutzer, K. A., & Graves, B. S. (2004). Barriers and motivations to exercise in older adults. Preventive Medicine, 39, 1056-1061.

Smith, J., & Firth, J. (2011). Qualitative data analysis: The framework approach. Nurse Researcher, 18, 52-62.

Smith, S. M., Wallace, E., O'Dowd, T., & Fortin, M. (2016). Interventions for improving outcomes in patients with multimorbidity in primary care and community settings. Cochrane Database of Systematic Reviews, (3).

Taskforce Richmond Group of Charities. (2018). ‘just one thing after another. Living with multiple conditions. A report from the Taskforce on Multiple Conditions. https://richmondgroupofcharities.org.uk/just-one-thing-after-another-living-multiple-condition.

Theis, K. A., Brady, T. J., & Helmick, C. G. (2016). No one dies of old age anymore: a coordinated approach to comorbidities and the rheumatic diseases. Arthritis Care & Research, 69, 1-4.

Vancampfort, D., Koyanagi, A., Ward, P. B., Rosenbaum, S., Schuch, F. B., Mugisha, J., ... & Stubbs, B. (2017). Chronic physical conditions, multimorbidity and physical activity across 46 low-and middle-income countries. International Journal of Behavioral Nutrition and Physical Activity, 14, 6.

Victor, C. R., Rogers, A., Woodcock, A., Beighton, C., Cook, D. G., Kerry, S. M., ... & Harris, T. J. (2016). What factors support older people to increase their physical activity levels? An exploratory analysis of the experiences of PACE-Lift trial participants. Archives of Gerontology and Geriatrics, 67, 1-6.

Zambon, S., Siviero, P., Denkinger, M., Limongi, F., Victoria Castell, M., van der Pas, S., ... & Sánchez‐Martinez, M. (2016). Role of osteoarthritis, comorbidity, and pain in determining functional limitations in older populations: European project on osteoarthritis. Arthritis Care & Research, 68, 801-810.

**Table 1.** Interview topic guide

|  |
| --- |
| **Theme A) Introduction** |
| Let me start by asking you some questions about yourself (*Demographic questions):*   * Age * Marital status * Education * Occupation   Can you tell me about your osteoarthritis (how long had it, which joints, what caused it?)  Can you tell me about other conditions you have?   * Can you tell me a bit about your experience living with osteoarthritis and other health conditions at the same time? (Pain, function, other comorbidity related reductions in QOL) |
| **Theme B) General challenges of comorbidity and PA** |
| The next few questions are about physical activity and exercise and how this has been influenced by your other health conditions.  Can you tell me about any physical activity or exercise that you do at the moment?   * What role does PA have in your life and has this been influenced by having both OA and comorbidity? (Fitness, social, psychological, therapeutic etc.) * Have you changed the type of PA you do because of OA and other long term conditions? * How do you feel about doing PA in the presence of your OA and other long-term conditions? |
| **Theme C) Advice about PA for OA and comorbidities** |
| What do you know about physical activity treatment options for someone like yourself with OA and other health condition(s)?   * How much physical activity do you think you should do? What are the reasons for your answer? * What types of physical activity do you think you should do? (probe reasons for answers)   Where do you get information and ideas about physical activity? (Doctor, family, books, self—help group etc.)  What has been the advice you have had about physical activity?   * How do you feel that this advice suits your situation of OA and \*other condition\*   How confident are you that you can follow advice to be physically active?  Did you try any instruction for PA you received? Did it help? If not, why? |
| **Theme D) Priority of conditions and PA** |
| Do you feel that any one of your conditions are more important than others? Can you explain the reasons for your answers?  How does having this combination of conditions impact on PA? (In what way? Why?)  What is different about having conditions together than alone?  Do you think it would be the same for other people with this combination of conditions? |
| **Theme E) Impact of OA and comorbidity on sedentary time** |
| Do you spend any time sitting, for example reading, watching television or on the computer?   * How do you feel about the amount time you spend sitting? * Does having OA and another condition affect this amount of time you spend sitting, reading etc, why?   What would make physical activity more appealing for somebody like you who has this combination of conditions? What makes it worse?   * What is it about having OA and other conditions that make it hard to exercise? * What are the problems that crop up when you want to be active but can’t? |
| **Theme F) Facilitating PA for someone with OA and comorbidity** |
| Can you tell me what supports you with regards to physical activity and maintaining a physically active lifestyle? (family, friends, community, internet, healthcare)   * How has this been supportive?   Are there other sorts of support that you would find helpful, or that you think other people with OA and long term conditions this combination of conditions might find helpful?  Is there any other kind of physical activity, exercise programme or opportunity that you have heard of, know someone else does it, or would like to try? Why haven’t you tried it?  What would make you want to try a new type of physical activity or take up activity you have previously done?  If you were asked to do a programme of exercise by a healthcare professional or if you we advised to go swimming or walking, what would you want to know about? What would help you to do that activity with regards to your conditions?  Have you ever heard of an intervention or programme which tries to encourage or make physical activity experiences better for people with OA and comorbidity? What would feature in an intervention if you helped to design it?  Do you have any future plans or goals for physical activity with your combination of conditions?  Have you got any thoughts about what would help people with the combination of OA and other health conditions exercise more or be more physically active? |
| **Theme G) Concluding questions** |
| What are your thoughts about PA for people with OA and other health conditions (Including, work, housework, gardening, and hobbies) Do you think it is safe, good for you and achievable? (Prompt for good or bad, if so what does good mean?)  Would you like to say anything further, that you consider to be important and I haven’t asked?  (Check consent is still in place. Check if participant would like to receive a summary of the interview findings).  Thank you very much for taking the time to participate in this research project. |

**Table 2.** Interview participant characteristics

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Pseudonym | M/F | Age | Marital status | Education | Occupation | Work status | Comorbidities |
| John | M | 75 | MA | S18 | Driver | R | Diabetes, AF, Cancer, Depression |
| Mary | F | 59 | WID | Nurse training | Nurse | R | Depression, Bilateral Uveitis, Underactive Thyroid, Crohn’s disease, OP |
| Tim | M | 79 | MA | S16 | Mortuary | R | High Blood Pressure, Obesity |
| Karen | F | 75 | WID | S18 | Tills | R | Had Cancer, Depression |
| Rachel | F | 70 | DIV | Degree | Teacher | R | Obesity |
| Jackie | F | 76 | DIV | S15 | Nurse | R | Back Pain, Neuropathy, Spondylitis, Diabetic, Blind |
| Bill | M | 58 | SING | Degree | Teacher | R | Depression, OCD |
| Alice | F | 49 | MA | PhD | Academic | NR | Coeliac, Chronic Migraines, Asthma |
| Laura | F | 92 | WID | S14 | Retail | R | High BP, Underactive Thyroid |
| Ann | F | 95 | WID | S14 | Nursery nurse | R | Cystitis, Anaemia |
| Vera | F | 77 | WID | A | Teacher | R | OP, Hypertension |
| Debbie | F | 80 | WID | S16 | Telegraphist | R | Bronchiectasis, RA |
| Holly | F | 86 | SING | Teacher training | Teacher | R | OP, Back Pain, Heart Arrhythmia, Carpal Tunnel Syndrome |
| Jane | F | 82 | WID | S15 | Retail | R | Heart Disease, Had Heart Attack |
| Clare | F | 90 | - | S14 | Retail | R | Sciatica, Cystitis, RA, OP |
| Dave | M | 54 | SEP | A | Police | R | Acid Reflux, High Blood Pressure |
| Kate | F | 77 | WID | A | Nurse | R | Underactive Thyroid, Palpitations, Raynaud’s disease |

M/F=Gender; M=Male; F=Female; MA=Married; WID=widow, DIV=divorced, SING=single; SEP=separated; S(N)=educated at school (age), A=A-levels; R=Retired; NR=Not Retired; AF=Atrial Fibrillation; OP=Osteoporosis; OCD=Obsessive Compulsive Disorder; BP=Blood Pressure; RA=Rheumatoid Arthritis

**Table 3.** Two main themes and subthemes about PA in people with OA and comorbidity

|  |  |  |
| --- | --- | --- |
| Main theme | | Subthemes |
| 1. | Barriers to PA | 1. Lack of concept of comorbidity with participants prioritising individual LTCs 2. Uncertainty about the management of health conditions and the effectiveness of PA 3. Negative perceptions concerning LTCs and ageing, and PA 4. Co-existing biopsychosocial barriers to PA 5. Solutions to barriers and barriers to solutions |
| 2. | Facilitators of PA | 1. Social support through shared learning and homogeneity 2. Healthcare professional support to facilitate self-management of PA 3. PA mode and type that is intermittent, adapted, and fits into daily life |

PA= physical activity; LTC=Long-Term Condition