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A qualitative investigation of physical activity compensation among older adults

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Objectives. This study explored the mechanisms of physical activity (PA) compensation among older adults who recently reduced their non-exercise physical activity (NEPA) in response to a structured PA intervention.

Design. A post-trial, retrospective qualitative process evaluation using interviews was employed.

Methods. Levels of PA compensation were determined by comparing NEPA prior to and during the final week of a 4-week structured PA intervention. Those who reduced their NEPA by 10% or greater were considered as compensators. Interviews were conducted with older adult compensators (mean age = 58.56 ± 3.88 years; $n = 9$), employing thematic analysis to identify potential mechanisms of PA compensation.

Results. The findings suggest that the majority of participants were unaware that they had compensated in their PA, suggesting that this may be a non-volitional process. Most participants perceived PA compensation to hold negative implications for health and well-being. Physiological processes of fatigue and delayed onset of muscle soreness were cited as the principal cause of PA compensation, whereas psychological processes including a drive to be inactive, fear of overexertion, deficient motivation, and perceived time constraints were cited to a lesser extent.

Conclusion. A range of physiological and psychological compensatory barriers were identified. Implications of and methods to overcome these compensatory barriers are discussed.

Statement of contribution

What is already known on this subject?

- Physical activity compensation holds negative implications for physical activity promotion and health.
- Older adults are an age group more likely to compensate in their physical activity levels.

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What does this study add?

- Physical activity compensation may be a result of a range of physiological and psychological processes including fatigue and delayed onset of muscle soreness, compensatory health beliefs, fear of overexertion, deficient motivation, and perceived time constraints.
- Most older adult compensators may be unaware they are compensating and, however, agree that physical activity compensation has negative implications for health and well-being.

Being sufficiently physically active elicits physical and psychological health benefits for older adults (Department of Health [DOH], 2011). The current UK physical activity (PA) guidelines posit that to accrue health benefits, healthy older adults should accumulate a minimum of 150 min of moderate intensity or 75 min of vigorous PA per week in bouts of 10 min or greater (DOH, 2011). In addition, the minimization of sitting time for prolonged periods, coupled with engagement in strength, flexibility, and balance exercises, is advised (DOH, 2011). However, despite the recognized benefits, in Northern Ireland, only 43% of males and 30% of females aged 65–74 years old meet recommended PA levels (Northern Ireland Statistics and Research Agency [NISRA], 2014). This reduces to 26% of males and 20% of females aged 75 and over (NISRA, 2014).

The UK PA guidelines suggest that physically inactive older adults should incrementally increase their PA until sufficiently active (DOH, 2011), and one proposed method of achieving this is via structured PA programmes. Structured PA programmes are characterized as being group-based, engaged within a demarcated time period, and led by an instructor who can prescribe appropriate intensities and ensure correct exercise techniques. Despite being the most prevalent intervention mode among older adults, structured PA programmes were reported as the least effective intervention mode to augment older adults, PA in a recent systematic review (Chase, 2013), a finding possibly owing to compensatory responses (Gomersall, Rowlands, English, Maher, & Olds, 2013; Washburn *et al.*, 2014). These compensatory responses occur when an older adult increases PA in one domain (e.g., structured PA) whilst subsequently decreasing in another, for example, housework, gardening, active transportation, or other forms of structured PA (King *et al.*, 2007; Laybourne, Biggs, & Martin, 2008).

Two recent systematic reviews (Gomersall *et al.*, 2013; Washburn *et al.*, 2014) suggest that PA compensation may be age dependent. Gomersall *et al.* (2013) reported that when considering older adults, 80% of studies included within their review exhibited PA compensation compared to 40% among a younger cohort. Similarly, Washburn *et al.* (2014) observed that the mean age of participants in studies supporting compensation was 61 years in comparison with 44 years of papers refuting compensation. Employing a non-randomized control trial design, Meijer, Westerterp, and Verstappen (1999) demonstrated that older adults' (mean age of 58.90 ± 3.50 years) PA did not increase in response to a 12-week exercise programme consisting of 150 min of individual and group-based cardiovascular and resistance exercises, owing to a reduction in non-exercise physical activity (NEPA) on training days. Moreover, the incremental intensity of the programme resulted in temporal decline in NEPA, suggesting a dose–response relationship in relation to compensation. Among post-menopausal women, Di Blasio *et al.* (2012) demonstrated that those who reduced NEPA in response to a 13-week walking programme exhibited less beneficial effects on plasma lipids and lipoproteins compared to those who maintained NEPA, suggesting compensation may hold implications for older adults' health.

Despite the compelling evidence suggesting compensation occurs among older adults, coupled with its known implications for health, its underlying mechanisms are relatively unknown. King *et al.* (2007) suggested that the underlying mechanisms for PA compensation may be psychological or physiological processes. Physiologically, alterations in NEPA may stem from exercise-induced fatigue and delayed onset of muscle soreness (DOMS). Fatigue owing to structured exercise may consequently cause a displacement of normal bouts of activity with periods of inactivity. For instance, Morio *et al.* (1998) purported that increased sleep time was responsible for no observed increases in energy expenditure among 13 elderly men who participated in thrice-weekly supervised exercise sessions on a cycle ergometer for 14 weeks. Similarly, it has been suggested that older adults may reduce afternoon and evening PA subsequent to morning exercise sessions, owing to fatigue (Goran & Poehlman, 1992).

Alternatively, compensatory decreases in NEPA may be volitional. Individuals who engage in exercise may contend that they can afford to rest thus 'rewarding' themselves with inactivity. This 'drive to be inactive' (King *et al.*, 2007) may occur for instance when an older adult perceives that they can afford to take the escalator or lift instead of the stairs, or to drive to local amenities instead of active transportation, prior or subsequent to participation in exercise. Evidence suggests these volitional behaviours occur across health-related behaviours, for example, an older adult rewarding themselves with high calorie/saturated fat foods subsequent to exercise (Dohle, Wansink, & Zehnder, 2014), congruent with tenets of the Compensatory Health Beliefs (CHB) Model (Rabia, Knäuper, & Miquelon, 2006). However, support for these hypothesized psychological and physiological processes within the PA domain specifically is deficient.

Thus, a qualitative investigation of the causes of compensation among older adults who reduced NEPA in response to structured PA is warranted, and this study aimed to address this research gap using qualitative methods to explore complex aspects of older adults' opinions regarding the mechanisms of PA compensation in greater depth. To the best of the authors' knowledge, this study is the first to qualitatively investigate PA compensation among older adults thereby providing a unique contribution to the literature.

Methods

Ethics

Prior to data collection, ethical approval was granted by the Ethics Committee of the School of Psychology, Ulster University, and all participants provided written informed consent.

Participants

Participants were recruited from a previous study which explored the efficacy of using a 4-week structured PA programme plus a supplementary lifestyle intervention (intervention group) versus structured PA programme plus advice only (control group) to assist older adults to attain current PA guidelines. In this study, participants resided in counties Antrim and Londonderry, Northern Ireland, and were recruited via telephone following the intervention study, by the same authors. The inclusion criteria required participants to be (1) aged 50 years and above; (2) community dwelling and independent living; (3) able to converse in English; (4), compensated in their PA levels by reducing their NEPA, as determined by the method described in the Procedure section; and (5) participated in the control group (i.e., not receiving a supplementary lifestyle intervention in addition to structured PA). Participants of the lifestyle group were excluded given a component of the intervention explored the benefits of NEPA maintenance, thus potentially influencing their awareness and perceptions of PA compensation.

Procedure

Determining physical activity compensation

A 7-day sampling frame was employed to objectively measure PA levels at baseline and during the final week of the intervention to determine reductions in NEPA in response to the structured intervention. This method of determining PA compensation was chosen as it has been shown that PA patterns are not random rather they exhibit stable cyclic weekly variability where PA levels fluctuate around a baseline value (Rowlands *et al.*, 2015). Minutes spent in moderate and vigorous physical activity (MVPA) were determined using the RT3 accelerometer (RT3 Tri-axial Research Tracker; Stayhealthy Inc., Monrovia, CA, USA), employing known data reduction protocols (Chen, Jerome, Laferriere, Young, & Vollmer, 2009). Firstly, for each participant, the total MVPA participated in during the final weeks exercise session (a weekly 75-min session) was subtracted from the total weekly MVPA during the final week to produce total NEPA for that week, a procedure employed in past research (Hollowell *et al.*, 2009; Kozey-Keadle *et al.*, 2013). Subsequently, NEPA during the final week of the intervention was compared to MVPA engaged in during the same timeframe at baseline (i.e., total weekly MVPA at baseline minus the 75 min period), to allow direct comparison. We acknowledge this procedure may have omitted some MVPA engaged in the 75-min period omitted at baseline. This may have occurred, for example, if the structured PA intervention displaced time that was normally spent participating in a walking group, that is, isotemporal substitution (Thompson, Peacock, & Betts, 2014). However, through inspection of accelerometer files, no participant in this study participated in any MVPA in 10-min bouts during this timeframe at baseline. An alternative analysis was conducted by comparing NEPA during the final week of the intervention, to MVPA at baseline (without subtracting the 75-min period), and as expected, the results were identical to the previous analysis. Those who reduced their NEPA by 10% or greater (to avoid potential misclassification) were deemed compensators. The levels of compensation exhibited by participants in this study are presented in Table 1.

Interviews

A post-trial, retrospective qualitative process evaluation using one-to-one semi-structured interviews to explore potential mechanisms of PA compensation was employed.

Table 1. Levels of compensation exhibited by participants

Participant	Total weekly MVPA at T1 (mins)	Total weekly MVPA at T2 (mins)	MVPA during exercise session at T2 (mins)	Non-exercise MVPA at T2 (mins)	Reductions in non-exercise PA (mins) (compensation)
1	74	80	57	23	51
2	106	113	56	57	49
3	85	102	52	50	35
4	89	108	30	78	11
5	67	108	65	43	24
6	82	82	45	37	45
7	66	98	64	34	32
8	67	89	44	45	22
9	75	75	47	28	47

Note. T1 = baseline; T2 = final week of structured PA intervention; mins = minutes; MVPA = moderate and vigorous physical activity.

Interviews were conducted with each participant within 1 week of the cessation of the preceding intervention, in a comfortable and familiar setting, using the same format lasting 30–50 min. The interviews were performed by P.G., who had received three, 1-day training courses in qualitative methods prior to this study. The four stages proposed by Howitt (2010) for delivering interviews were utilized. Firstly, the researcher ensured that the interview was tape-recorded and the recording quality intact (e.g., ensuring adequate proximity to participants, eliminating extraneous noise). Secondly, the orientation stage of the interview comprised of the researcher introducing themselves, providing a rationale for the interview, indicating an approximate duration of the interview, and explaining ethical considerations. The researcher subsequently delivered the semi-structured interview comprising of six open-ended questions developed to probe the underlying mechanisms for compensation (Table 2). If a participant indicated that they were unaware they had reduced NEPA, the researcher continued to probe participants' perceptions of the likely mechanisms. The interviewer formulated new questions and probes in response to the interviewees' answers (Howitt, 2010). The final stage involved the researcher bringing the interview to a conclusion, which included a 'time out' (Howitt, 2010) to review the interview and incorporate further probes where information was deficient. Information regarding participants' socio-demographic characteristics including age, sex, and educational attainment was provided. Objectively measured PA levels were ascertained from the post-test data of the preceding intervention study.

Data analyses

Audiotapes were transcribed verbatim by a researcher (P.G.). Thematic analysis was conducted to identify the main themes emerging from the interviews. Thematic analysis provides the researcher with a flexible yet methodical and thorough means of obtaining a rich and detailed data set (Braun & Clarke, 2006). The six stages suggested by Braun and Clarke (2006) were employed as a framework for the analysis. Stage 1 comprised of two researchers (P.G. & E.S.) immersing themselves within the data, obtaining a sense of the whole and establishing patterns and meanings. Stage 2 involved the two independent researchers manually scanning each transcript for words, phrases, or paragraphs which

Table 2. Semi-structured interview schedule

Questions	
1.	Did you enjoy the structured physical activity programme that you recently engaged in? What aspects did you enjoy the most/least?
2.	Do you think that the intensity of the class was appropriate?
3.	We compared the data from the two occasions you wore the accelerometer – before the exercise programme started and during the final week of the intervention. It appears from the data that there was not an increase in physical activity levels to the extent that one would expect from incorporating the extra activity into the routine. This may have resulted from a reduction in your activity levels outside of the physical activity class. Do you follow? Were you aware of this reduction in activity outside of the class?
4.	What may have been the reasons for your reduced activity levels outside of the class?
5.	Do you believe that a reduction in activity outside of the class may subtract from the health benefits gained from taking part in the intervention?
6.	Are there any other issues regarding the intervention that you would like to raise?

participants cited as influencing PA compensation and assigning codes to each segment of text from the transcripts. Stage 3 entailed a broader level of analysis and involved the researchers identifying suitable themes to which codes could be assigned. The fourth stage involved the researchers reviewing and refining the identified themes, with the aim of generating individually distinct themes. The penultimate stage comprised of the researchers attributing a clear and concise name to each theme and subtheme whereas the final stage encompassed the researcher writing up the results in a coherent and engaging manner. Both researchers were experienced in the methodology of Braun and Clarke (2006). Furthermore, intercoder agreement was calculated by Cohen's Kappa (Cohen, 1960), with criteria of .7 or greater required for agreement.

Results

Participant characteristics

Nine of 14 individuals approached agreed to participate in this study. Socio-demographic characteristics of participants are presented in Table 3. The majority of the participants were female (66.67%), university educated (55.60%), married (66.66%), and employed (55.60%). The mean age of participants was 58.56 (±3.88) years. All participants were participating in low levels of MVPA (mean MVPA = 95.00 ± 13.51 min per week, range 75–113) and reduced their NEPA by an average of 35.11 (±14.01, range 11–51) minutes per week. All participants were community dwelling and physically independent.

Thematic analysis

Thematic analysis yielded an array of themes and subthemes which are presented in Table 4. An intercoder agreement (kappa score) of .84 indicated a high level of agreement between the independent researchers. Three main themes were identified including perceived mechanisms of compensation, awareness of PA compensation, and implications of PA compensation.

Table 3. Socio-demographic characteristics of participants (n = 9)

	%/mean (*SD*)	*n*
Females	66.67	6
Age	58.56 (3.88)	9
Education		
Primary	11.10	1
Secondary	33.33	3
Tertiary	55.56	5
Marital status		
Married	66.67	6
Separated/divorced	33.33	3
Employment status		
Employed	55.56	5
Retired/unemployed	44.44	4
Physical activity levels (minutes per week)[a]	95.00 (13.51)	9

Notes. n = number; *SD* = standard deviation.
[a]RT3 Tri-axial accelerometer.

Table 4. Themes and subthemes identified from thematic analysis

Theme	Subtheme	F
Mechanisms of compensation	Fatigue	26
	Drive to be inactive	11
	Time	11
	Fear of overexertion	7
	Motivation	3
Awareness of compensation	Aware they compensated	4
	Unaware they compensation	5
Implications of compensation	Detracts from health benefits	12
	Does not detract from health benefits	3

F = Frequency.

Mechanisms of compensation

Participants identified several potential causes of PA compensation including fatigue, a drive to be inactive, time constraints, a fear of overexertion, and deficient motivation.

Fatigue. A prominent reason for PA compensation cited by seven of nine (78%) participants was exercise-induced fatigue. Participants stated that fatigue from the evening exercise session made it difficult to participate in subsequent habitual bouts of PA, with many indicating that they reduced walking. Participants also indicated that they increase time spent sleeping in response to structured PA.

> Yes as I said, I would usually got out walking in the morning, but for me the exercise, made it more difficult, I think because I was tired. . . I remember getting back and wanting to sleep. (Participant [P] 2)

> He made us do squatting, which can be quite tough on the legs, so walking was going to be a problem the next day. (P8)

Moreover, participants perceived that increasing age rendered them more susceptible to fatigue, which may have contributed to a reduction in NEPA.

> It would definitely be the tiredness factor for me that would be the top reason. When you exercise at that pace- especially for people like me- getting older and used to more gentle activities, your muscles and joints get sore. (P1)

> It is not a great thing, you get older and you get less active and exercise can tire you out. (P4)

Drive to be inactive. Three participants (33%) indicated one reason for a reduction in NEPA was their perception that they could afford to rest after exercise. They perceived that they had derived health benefits from the structured PA class, thus justifying their subsequent compensatory behaviours.

> That's right I had done the exercise, it was out of the way and done for the day, so I felt that I deserved a rest and all, as I said you can't do too much, it can be counterproductive. (P1)

> Yes like after the class I may have sat around the club and not do other activities, you know, because I had exercised and it was done and it did me good. (P4)

Indeed, these compensatory beliefs extended to the anticipation of future exercise. Participants perceived that given they were exercising later in the evening, they could afford to be sedentary prior to the exercise sessions.

> And I suppose its thinking about the exercise class, maybe some people wouldn't do their normal exercise during the day or something if they were exercising that night, you know. And I suppose it fits in with the whole fatigue thing. (P8)

Time constraints. Three participants (33%) indicated that time constraints limited the amount of time that they could devote to physical activities. They cited that other competing priorities including caring for grandchildren rendered little time for physical activities, and with any remaining discretionary time, physical activities had to be prioritized.

> I think it may be a timing reason, as I said there is only a certain amount you can do in a day, there is only 24 hours and we are so so busy. . .so you have to prioritise one activity over another. (P5)

> Not sure really probably other commitments, I have a lot on you see, some weeks more than others. (P3)

Fear of overexertion. A fear of overexertion resulting in injury was cited as reason for compensation among three participants (33%). Moreover, they perceived advancing age as contributing to the likelihood of injury.

> Aye that's right, injury is a big problem, not so much for the younger ones but for us it can be serious, like we have to be careful at this age, the joints are a little less flexible as you age and certain things could injury them. It's not a good place to be when you are injured and hurt. Then you can't do any exercise at all. I like to limit the amount that I do for that reason. (P5)

> I suppose so, there is only a certain amount your body can take, you don't want to overdo it as well and get injured that would be counterproductive. (P8)

Motivation. Two participants (22%) indicated that motivation may have contributed to reductions in NEPA. They believed that individuals with low levels of motivation would find it difficult to maintain their normal physical activities when incorporating new PA into their routine.

> I suppose a lack of motivation. These don't apply to me personally. But some people may only be motivated to do a certain amount and that . . .they don't want to do any more exercise. (P8)

> Probably a motivation thing, or a lack of it, I think it may contribute, you might only be motivated to do a bit here and there. (P1)

Awareness of compensation

The extent to which participants were aware of their reduced NEPA was mixed. Four of nine participants (44%) indicated that they were aware of a decrease in NEPA.

> Yes I think I reduced my walking a bit, I did notice it. I said to you when we were doing those tests, that the last week was tough, so I was still suffering. I recollect that I done less walking than usual. (P1)

> I was aware yes, and that the most I was doing that week was the motorcross. (P9)

Conversely, five of nine participants (56%) indicated that they were unaware of reductions in their NEPA.

> That's surprising, may have been the weather or something that week perhaps, or something may be that I had to do, something may have come up, meaning I had less time maybe, I don't know. I wasn't aware of it. (P3)

Moreover, one participant indicated that they perceived their NEPA to increase.

> Did I? . . .. I remember thinking that. . .. I remember thinking that I did more by the end of your study. You know I made an effort to increase the activity, the class kind of spurred me on a bit. (P6)

Perceived implications of PA compensation

Regarding the implications of compensation for health and well-being, six participants indicated that it detracts from health benefits derived from structured PA, two indicated that it did not, and one was unsure. Those who indicated that compensation held negative implications for health perceived that sedentary periods subsequent to exercise negated any health benefits derived.

> Because the objective is to get healthier and sitting around for the rest of the time would defeat the purpose. You could pile on the weight, look at taxi men for example, they work hard but they pile on weight, they do not do much. They may do half an hour here or there, but they sit around the rest of the time. (P9)

> If you are exercising, doing the boxing or running or something but you actually sit around the rest of the time, you know, sitting around doing nothing you are kind of defeating the purpose in one way. (P8)

In contrast, two participants (22%) perceived any health benefits from the new structured PA, replaced any benefit derived from other forms of PA previously engaged in. They believed that as long as they participated in some PA, they would derive health benefits.

> I think that even though I stayed in and rested [after structured PA], I would only have watched TV or took the dog out, so I don't think I would be losing out much in terms of health. (P1)

> No as I said, you are just doing one instead of the other, you would usually get your fitness from the spin you see, but during those weeks I got it from the exercise class. . . you do less here but more here it will still do you good. (P5)

One participant's views were mixed; they perceived that the compensation in response to structured PA held implications for restricting weight loss. However, they still advocated that structured PA would still be beneficial to fitness regardless of compensation.

> Aye with the weight for sure, but as you said earlier, you may still get the benefits in terms of being physically fit. Because I think my strength actually got wee bit better as the weeks went on, even though the weight didn't shift. (P4)

Discussion

The present study provides a unique contribution to the literature by exploring the mechanisms underlying PA compensation among older adults. The findings suggest that fatigue may be the primary factor influencing NEPA reductions. Volitional reductions in PA due to 'a drive to be inactive', fear of overexertion, deficient motivation, and perceived time constraints were cited to a lesser extent. The majority of participants were unaware that they had compensated by reducing their NEPA in response to structured PA, suggesting that PA compensation may be predominantly a non-volitional process. Despite the majority of participant's exhibiting deficient awareness of compensation, the majority agreed that reductions in NEPA would detract from health benefits derived from participating in structured PA.

Participants indicated that post-exercise, exercise-induced fatigue prevented them from partaking in habitual bouts of activity, with many citing that they replaced active with vehicular transportation coupled with increased periods of rest and sleep. This is congruent with Goran and Poehlman (1992) who speculated that among 11 older adults, fatigue may have been responsible for a reduction in NEPA subsequent to exercise. Similarly, these findings also concur with Morio *et al.* (1998), who suggested that an increase in time spent sleeping owing to fatigue may have been responsible for no significant increase in energy expenditure in 13 elderly men who participated in 14 weeks of endurance training. The mechanisms by which exercise-induced fatigue effects subsequent PA are dependent on complex peripheral and central fatigue processes. A subsequent decrease in PA may be due to substrate depletion including reductions in glycogen stores, blood glucose, and the ability to produce adenosine triphosphate, or the accumulation of metabolic by-products including ammonia, lactate and hydrogen ions heat, and inorganic phosphate reducing contractile force (Ament & Verkerke, 2009).

Participants in the current study frequently cited that muscle soreness and feelings of stiffness contributed to their reduction in NEPA. This may be attributed to DOMS, a discomfort within the muscle originating at distal sites and subsequently diffusing throughout the muscle, intensifying and peaking 24–72 hr post-exercise (Cheung, Hume, & Maxwell, 2003). The mechanisms of DOMS are debated, however, may be a function of a spasm of motor units, damage to connective tissue, disruptions at weakened Z-lines of the muscle, inflammatory responses, and the accumulation of calcium which constrains cellular respiration (Cheung *et al.*, 2003). DOMS has been shown to hold implications for joint motion (Goff, Hamill, & Clarkson, 1998), walking kinematics (Tsatalas *et al.*, 2013), and strength (Paddon-Jones & Quigley, 1997), with the latter being demonstrated in certain studies not to recover until 1–2 weeks post-exercise (MacIntyre, Reid, & McKenzie, 1995). Thus in the current study, DOMS may have influenced NEPA via a reduction in mobility owing to a diminished muscular force and range of motion, or perceived discomfort associated with continued PA.

In addition to physiological processes, participants also indicated that compensation may derive from psychological processes. Many participants stated that they had derived health benefits from structured PA, thus licensing subsequent bouts of inactivity, congruent with the hypothesis of King *et al.* (2007) that certain individuals may possess a 'drive to be inactive'. Moreover, this licensing of inactivity was evident prior to exercise sessions, whereby participants attempted to conserve energy, a finding confirming the speculations of Meijer *et al.* (1999), who implicated such processes as contributing to PA compensation among 15 older adults.

The finding that older adults may reward themselves with bouts of inactivity is consistent with the tenets of the CHB Model (Rabia *et al.*, 2006). The premise of the CHB Model is that the negative consequences of one unhealthy behaviour (e.g., bouts of inactivity, consuming high calorie foods, smoking) can be negated by engaging in a healthy behaviour (e.g., structured PA). According to the CHB Model, when individuals experience a temptation (e.g., inactivity prior to exercise), the conflict between that temptation and other goals (e.g., weight loss) may create motivational conflict, a state which can be alleviated by subsequently partaking in a volitional healthy behaviour (e.g., structured PA). Thus, it is likely that participants who reduced PA prior to structured exercise sessions in the current study justified these bouts of inactivity by taking cognizance that they would subsequently exercise, thereby resolving any motivational conflict. Given that prolonged (Gardiner *et al.*, 2011), and in particular uninterrupted (Healy *et al.*, 2008), bouts of sedentary behaviour is a risk factor for morbidity, the activation of CHB may have ramifications for health and well-being, particularly among those engaging in low levels of PA (Ekelund *et al.*, 2016). Moreover, even when an intention to partake in a subsequent volitional healthy behaviour is formed, the behaviour may not be undertaken, due to barriers that may hinder the translation of intention into action (Sheeran, 2002). An integral concept within the CHB Model is that the possession of autonomous as opposed to controlled motives increases the likelihood of resistance to compensatory behaviours (Rabia *et al.*, 2006). Those regulated by autonomous motives, who exercise for interest, satisfaction, or identify with its benefits are likely to persist in pursuit of their goals, thus resisting temptation (i.e., bouts of inactivity) and seldom requiring CHB to diminish cognitive dissidence. In contrast, an older adult who holds controlled motives are likely to actuate CHB, given the strength of motivation may be sufficient to commit to goals (e.g., weight loss), yet inadequate to resist temptation (e.g., inactivity; Rabia *et al.*, 2006). Participants of the current study suggested insufficient motivation may be a mechanism for compensation; however through a CHB Model lens, we suggest that specifically they may have been devoid of autonomous motivation.

Time constraints were cited as contributing to participants' reduction in NEPA. Time barriers have consistently been cited as a factor impeding older adult PA participation in past qualitative research (Gray, Murphy, Gallagher, & Simpson, 2016) and substantiated by past quantitative research demonstrating low discretionary time being associated with low PA levels (Wolin, Bennett, McNeill, Sorensen, & Emmons, 2008) and PA guideline attainment (Welch, McNaughton, Hunter, Hume, & Crawford, 2009). The current findings suggest that for certain older adults, time barriers do indeed curtail participation and guideline attainment, however through the medium of PA compensation. Time is finite and can be distributed among various mandatory (sleeping, paid and unpaid work, eating, etc.) and discretionary activities (e.g., PA, TV viewing, reading). Thus in the current study, it is plausible after mandatory activities were undertaken, and this rendered a limited timeframe to which discretionary activities such as PA could be apportioned. Given this limited 'time budget' for discretionary activities, the adoption of PA in one domain, that is, structured PA, may have displaced other modes of PA, that is, PA compensation. This may be potentiated if greater value is placed upon competing discretionary activities, for example, television viewing, problematic given individuals may require a degree of relaxation time accumulated through TV viewing or other sedentary activities (Gomersall, Norton, Maher, English, & Olds, 2015), thus rendering a more constricted time budget for PA. In contrast to the participants in the current research, a sample of younger adults in a recent study exhibited no PA compensation in response to prescribed PA and the incorporation of 36 min of MVPA per week into ones routine largely displaced television viewing (Gomersall *et al.*, 2015). It is plausible that participants of the current study placed greater value on other discretionary activities (e.g., television viewing), or perhaps enjoyed less total discretionary time than participants in Gomersall *et al.* (2015).

Participants indicated that a fear of overexertion leading to a musculoskeletal injury contributed to their PA compensation. Fear of injury has previously been identified as a prominent factor influencing older adults' PA participation in past qualitative (Cousins, 2000; Moschny, Platen, Klaaßen-Mielke, Trampisch, & Hinrichs, 2011) and quantitative (Crombie *et al.*, 2004) research. As Cousins (2000) notes, older adults typically perceive adequate nutrition and rest as contributing to successful ageing whereas physically fatiguing activities are considered risky. When undertaking physical activities, older adults are subject to certain physiological states, for example, aches, pains, or breathlessness (Bandura, 1997), often construed as the onset of 'health scares' (Lee, Arthur, & Avis, 2008). This adverse arousal may generate fear, subsequently evoking further negative arousal, and possible behaviour reduction. Thus in the current study, participants may have misinterpreted normal physiological states associated with structured PA as the onset of musculoskeletal injuries, subsequently inducing fear of 'overexertion' if NEPA was maintained. However, despite these perceptions, evidence suggests that PA-related injuries among older adults is low, the prevalence no greater than among younger adults, and the benefits of PA participation, particularly with increased volume greatly outweigh the associated risks (Stathokostas, Theou, Little, Vandervoort, & Raina, 2013). Injuries are likely to occur when new demands markedly exceed one's fitness levels and allow insufficient time for recovery and adaptation (Dishman, Heath, & Lee, 2012), whereas structured PA programmes that encourage gradual progressive overload allowing sufficient periods for adaptation typically report minimal adverse effects (Powell, Paluch, & Blair, 2011) and greater adherence (Hawley-Hague, Horne, Skelton, & Todd, 2016). Thus, such programmes which additionally educated older adults by offering alternative interpretations of the aforementioned physiological states (e.g., educating older adults that aches are a product of DOMS, not the onset of injury) may be warranted to alleviate such apprehensions, and maintain NEPA.

Strengths and limitations

Several limitations of the current study warrant consideration. Firstly, the highly educated sample curtails generalizability, thus should be duplicated in more representative samples. Secondly, only a limited number (14 of 44; 32%) of older adults within the control group of the preceding study reduced their NEPA sufficiently, therefore restricting eligibility for the present study. Nonetheless, we are confident that data saturation was realized given no new themes emerged in the latter stages of data collection, and to our knowledge, the PA compensation literature confers no additional compensatory barriers. Participants of the preceding intervention who reduced their NEPA by less than 10% were excluded from the current study. It was viewed that these individuals may not have been 'true' compensators (e.g., one participant reduced NEPA by 1 min). Thus, it is unlikely that the mechanisms outlined within this paper, for example, CHB and time constraints were processes contributing to this minimal NEPA reduction. However, measurement error associated with the RT3 may have misclassified participants of the current study as compensators (e.g., participant 4 who reduced NEPA by 11 min per week).

A further limitation is that subsequent to data analysis, participants were not provided with an opportunity to comment on the findings, which may have strengthened the validity of the researcher's interpretation of their perspectives (Tong, Sainsbury, & Craig, 2007).

Despite these limitations, the current study also possesses a number of strengths given high intercoder agreement was observed and is the first among any age group to ascertain mechanisms underlying PA compensation.

Implications for research, clinicians, and policymakers

The results of the present study may furnish researchers, clinicians, and policymakers with an understanding of the mechanisms of PA compensation. In regard to physiological processes, the findings imply that exercise-induced fatigue and DOMS are the primary factors in NEPA reduction. Given fatigue and DOMS are pronounced with new and high-intensity exercise (Cheung *et al.*, 2003), future PA programmes should be tailored towards older adults' fitness levels, by employing a more graduated progressive overload and afford sufficient periods for adaptation. Older adults should be educated that DOMS is a normal sensation experienced at the beginning of exercise programmes typically diminishing as the programme progresses (MacIntyre *et al.*, 1995), thus stemming the potential for dropout and NEPA reduction post-exercise. Moreover, the severity of DOMS and indeed the fear of overexertion and injury may be reduced and thus NEPA maintained by the practice of techniques including cryotherapy, static stretching, massage, and compression post-exercise (Cheung *et al.*, 2003). Other findings suggest that engagement in further PA of low or moderate intensity post-exercise may alleviate DOMS (Andersen *et al.*, 2013); thus, older adults should be educated that the sustainment of NEPA may be beneficial in this regard.

To combat perceived time barriers, researchers and clinicians should highlight to older adults that PA can be accumulated in bouts or comparable benefits may be achieved by higher intensity, shorter duration exercise sessions (DOH, 2011). Moreover, it is asserted that time barriers to PA may be a misconception (Heesch & Mâsse, 2004); thus, encouraging older adults to monitor their daily activities (e.g., activity diaries) and employ time management skills (e.g., scheduling or encouraging the prioritization of physical activities over other discretionary activities) may be an effective means of reducing this barrier.

To curtail older adults 'drive to be inactive', researchers and practitioners should take cognizance of and promote the constructs which are purported to moderate the avoidance of CHB (e.g., autonomous motivation). This could be achieved through the delivery of intervention modes which promote autonomy (e.g., choice), structure (setting goals), and involvement (provision of empathy), such as motivational interviewing (Miller & Rollnick, 2012), or well-designed forms of structured PA (see Hawley-Hague *et al.*, 2016).

Moreover, given that volitional healthy behaviours may not be undertaken following periods of inactivity, practitioners and researchers could educate those identified as likely to activate CHB (i.e., those exhibiting low autonomous motivation) to develop action plans specifying when, where, and how the subsequent behaviour will be undertaken, thus increasing the likelihood that it will be performed (Scholz, Schüz, Ziegelmann, Lippke, & Schwarzer, 2008). Individuals may be unaware of the extent of which they utilize CHB; thus, the recording of CHB activation via diaries may help for self-monitoring purposes, which may additionally enable goal setting for their reduction. Lastly, older adults should be educated in the detriments of prolonged uninterrupted sitting, prior or subsequent to exercise, which could reduce the likelihood of CHB activation.

Future directions

The current study provides a unique contribution to the literature by investigating the mechanisms underlying PA compensation in older adults. Future research could advance the work of the current study by qualitatively comparing mechanisms of compensation between different socio-demographic profiles, to ascertain the generalizability of the findings. Moreover, further qualitative research could ascertain the processes by which certain individuals maintain NEPA despite experiencing compensatory barriers such as fatigue, DOMS, and constrained time budgets. These strategies could subsequently be implemented in future research to circumvent PA compensation among those identified as likely to compensate. Given the CHB Model predicts individuals who possess low autonomous motivation are more likely to activate CHB, future quantitative research could substantiate these assertions by comparing the psychosocial profile (autonomous motivation, self-efficacy, social support, etc.) of older adults who compensate versus those who maintain NEPA in response to structured PA. Future quantitative research may wish to explore the extent to which the compensatory barriers identified in the current study predict actual PA compensation by regressing predictors (e.g., perceived time barriers, fatigue, CHB, motivation, fear of injury) upon levels of NEPA reduction exhibited. Similarly, the development of a scale to assess compensatory barriers to PA may be warranted to ascertain which individuals are likely to compensate in their PA levels and the primary underlying mechanism (e.g., time constraints), thus enabling a tailored approach in future interventions attempting to maintain NEPA. Moreover, given the detriments of prolonged sitting, future studies may wish to employ posture-based accelerometers, to determine whether reduced NEPA reflects increased sitting time, or light-intensity PA.

Conclusion

The findings of the current study suggest that PA compensation among older adults may be a function of physiological and psychological processes. Physiologically, fatigue and DOMS were cited as the primary influence upon NEPA. Psychological processes such as a drive to be inactive, fear of overexertion, motivation, and perceived time barriers were cited to a lesser extent. Clinicians, practitioners, and researchers should take cognizance of such findings, by employing the aforementioned strategies (e.g., methods to alleviate DOMS, time management techniques, and the promotion of autonomous motivation) to overcome these barriers to sustain older adults' NEPA when implementing PA programmes.

Conflict of interest

All authors declare no conflict of interests.

References

Ament, W., & Verkerke, G. J. (2009). Exercise and fatigue. *Sports Medicine*, *39*, 389–422. https://doi.org/10.2165/00007256-200939050-00005

Andersen, L. L., Jay, K., Andersen, C. H., Jakobsen, M. D., Sundstrup, E., Topp, R., & Behm, D. G. (2013). Acute effects of massage or active exercise in relieving muscle soreness: Randomized controlled trial. *The Journal of Strength and Conditioning Research*, *27*, 3352–3359. https://doi.org/10.1519/JSC.0b013e3182908610

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*, 77–101. https://doi.org/10.1191/1478088706qp063oa

Chase, J. A. (2013). Physical activity interventions among older adults: A literature review. *Research and Theory for Nursing Practice*, *27*, 53–80. https://doi.org/10.1891/1541-6577.27.1.53

Chen, C., Jerome, G. J., Laferriere, D., Young, D. R., & Vollmer, W. M. (2009). Procedures used to standardize data collected by RT3 triaxial accelerometers in a large-scale weight-loss trial. *Journal of Physical Activity and Health*, *6*, 354–359. https://doi.org/10.1123/jpah.6.3.354

Cheung, K., Hume, P. A., & Maxwell, L. (2003). Delayed onset muscle soreness: Treatment strategies and performance factors. *Sports Medicine*, *33*, 145–164. https://doi.org/10.2165/00007256-200333020-00005

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, *20*, 37–46. https://doi.org/10.1177/001316446002000104

Cousins, S. (2000). "My Heart Couldn't Take It" older women's beliefs about exercise benefits and risks. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *55*, 283–294. https://doi.org/10.1093/geronb/55.5.P283

Crombie, I. K., Irvine, L., Williams, B., McGinnis, A. R., Slane, P. W., Alder, E. M., & McMurdo, M. E. (2004). Why older people do not participate in leisure time physical activity: A survey of activity levels, beliefs and deterrents. *Age and Ageing*, *33*, 287–292. https://doi.org/10.1093/ageing/afh089

Department of Health. (2011). *Start active, stay active: A report on physical activity from the four home countries' Chief Medical Officers*. Retrieved from the Department of Health Website https://www.gov.uk/government/publications/start-active-stay-active-a-report-on-physical-activity-from-the-four-home-countries-chief-medical-officers

Di Blasio, A., Ripari, P., Bucci, I., Di Donato, F., Izzicupo, P., D'Angelo, E., . . . Napolitano, G. (2012). Walking training in postmenopause: Effects on both spontaneous physical activity and training-induced body adaptations. *Menopause*, *19*, 23–32. https://doi.org/10.1097/gme.0b013e318223e6b3

Dishman, R., Heath, G., & Lee, I. M. (2012). *Physical activity epidemiology* (2nd ed.). Leeds, UK: Human Kinetics.

Dohle, S., Wansink, B., & Zehnder, L. (2014). Exercise and food compensation: Exploring diet-related beliefs and behaviors of regular exercisers. *Journal of Physical Activity and Health*, *12*, 322–327. https://doi.org/10.1123/jpah.2013-0383

Ekelund, U., Steene-Johannessen, J., Brown, W. J., Fagerland, M. W., Owen, N., Powell, K. E., . . . Lee, I. M. (2016). Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *Lancet*, *388*, 1302–1310. https://doi.org/10.1016/S0140-6736(16)30370-1

Gardiner, P. A., Healy, G. N., Eakin, E. G., Clark, B. K., Dunstan, D. W., Shaw, J. E., . . . Owen, N. (2011). Associations between television viewing time and overall sitting time with the metabolic syndrome in older men and women: The Australian diabetes obesity and lifestyle study. *Journal of the American Geriatrics Society*, *59*, 788–796. https://doi.org/10.1111/j.1532-5415.2011.03390.x

Goff, D., Hamill, J., & Clarkson, P. (1998). Biomechanical and biochemical changes after downhill running. *Medicine and Science in Sport and Exercise*, *30*(Suppl.), 5. Retreived from http://journals.lww.com/acsm-msse/Citation/1998/05001/BIOMECHANICAL_AND_BIOCHEMICAL_CHANGES_AFTER.569.aspx

Gomersall, S., Norton, K., Maher, C., English, C., & Olds, T. (2015). In search of lost time: When people undertake a new exercise program, where does the time come from? A randomized controlled trial. *Journal of Science and Medicine in Sport*, *18*, 43–48. https://doi.org/10.1016/j.jsams.2014.01.004

Gomersall, S. R., Rowlands, A. V., English, C., Maher, C., & Olds, T. S. (2013). The ActivityStat hypothesis. *Sports Medicine*, *43*, 135–149. https://doi.org/10.1007/s40279-012-0008-7

Goran, M. I., & Poehlman, E. T. (1992). Endurance training does not enhance total energy expenditure in healthy elderly persons. *American Journal of Physiology*, *263*, E950–E957. Retrieved from http://ajpendo.physiology.org/content/263/5/E950

Gray, P. M., Murphy, M. H., Gallagher, A. M., & Simpson, E. E. (2016). Motives and barriers to physical activity among older adults of different socio-economic status. *Journal of Aging and Physical Activity*, *24*, 419–429. https://doi.org/10.1123/japa.2015-0045

Hawley-Hague, H., Horne, M., Skelton, D. A., & Todd, C. (2016). Older adults' uptake and adherence to exercise classes: Instructors' perspectives. *Journal of Aging and Physical Activity*, *24*, 119–128. https://doi.org/10.1123/japa.2014-0108

Healy, G. N., Dunstan, D. W., Salmon, J., Cerin, E., Shaw, J. E., Zimmet, P. Z., & Owen, N. (2008). Breaks in sedentary time. *Diabetes Care*, *31*, 661–666. https://doi.org/10.2337/dc07-2046

Heesch, K. C., & Mâsse, L. C. (2004). Lack of time for physical activity: Perception or reality for African American and Hispanic women? *Women and Health*, *39*(3), 45–62. https://doi.org/10.1300/J013v39n03_04

Hollowell, R. P., Willis, L. H., Slentz, C. A., Topping, J. D., Bhakpar, M., & Kraus, W. E. (2009). Effects of exercise training amount on physical activity energy expenditure. *Medicine and Science in Sports and Exercise*, *41*, 1640–1645. https://doi.org/10.1249/MSS.0b013e31819c71a4

Howitt, D. (2010). *Introduction to qualitative methods in psychology*. Harlow, UK: Prentice Hall.

King, N. A., Caudwell, P., Hopkins, M., Byrne, N. M., Colley, R., Hills, A. P., . . . Blundell, J. E. (2007). Metabolic and behavioral compensatory responses to exercise interventions: Barriers to weight loss. *Obesity*, *15*, 1373–1383. https://doi.org/10.1038/oby.2007.164

Kozey-Keadle, S., Staudenmayer, J., Libertine, A., Mavilia, M., Lyden, K., Braun, B., & Freedson, P. (2013). Changes in sedentary time and physical activity in response to an exercise training and/or lifestyle intervention. *Journal of Physical Activity and Health*, *11*, 1324–1333. https://doi.org/10.1123/jpah.2012-0340

Laybourne, A. H., Biggs, S., & Martin, F. C. (2008). Falls exercise interventions and reduced falls rate: Always in the patient's interest? *Age and Ageing*, *37*(1), 10–13. https://doi.org/10.1093/ageing/afm190

Lee, L. L., Arthur, A., & Avis, M. (2008). Using self-efficacy theory to develop interventions that help older people overcome psychological barriers to physical activity: A discussion paper. *International Journal of Nursing Studies*, *45*, 1690–1699. https://doi.org/10.1016/j.ijnurstu.2008.02.012

MacIntyre, D. L., Reid, W. D., & McKenzie, D. C. (1995). Delayed muscle soreness. The inflammatory response to muscle injury and its clinical implications. *Sports Medicine*, *20*, 24–40. https://doi.org/10.2165/00007256-199520010-00003

Meijer, E. P., Westerterp, K. R., & Verstappen, F. T. (1999). Effect of exercise training on total daily physical activity in elderly humans. *European Journal of Applied Physiology and Occupational Physiology*, *80*, 16–21. https://doi.org/10.1007/s004210050552

Miller, W. R., & Rollnick, S. (2012). *Motivational interviewing: Helping people change* (3rd ed.). New York, NY: Guilford press.

Morio, B., Montaurier, C., Pickering, G., Ritz, P., Fellmann, N., Coudert, J., . . . Vermorel, M. (1998). Effects of 14 weeks of progressive endurance training on energy expenditure in elderly people. *British Journal of Nutrition*, *80*, 511–519. https://doi.org/10.1017/S0007114598001603

Moschny, A., Platen, P., Klaaßen-Mielke, R., Trampisch, U., & Hinrichs, T. (2011). Barriers to physical activity in older adults in Germany: A cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity*, *8*, 121. https://doi.org/10.1186/1479-5868-8-121

Northern Ireland Statistics and Research Agency (2014). *Health survey Northern Ireland – 2013/14*. Belfast, UK: Department of Health Social Services and Public Safety.

Paddon-Jones, D. J., & Quigley, B. M. (1997). Effect of cryotherapy on muscle soreness and strength following eccentric exercise. *International Journal of Sports Medicine*, *18*, 588–593. https://doi.org/10.1055/s-2007-972686

Powell, K. E., Paluch, A. E., & Blair, S. N. (2011). Physical activity for health: What kind? How much? How intense? On top of what? *Annual Review of Public Health*, *32*, 349–365. https://doi.org/10.1146/annurev-publhealth-031210-101151

Rabia, M., Knäuper, B., & Miquelon, P. (2006). The eternal quest for optimal balance between maximizing pleasure and minimizing harm: The compensatory health beliefs model. *British Journal of Health Psychology*, *11*, 139–153. https://doi.org/10.1348/135910705X52237

Rowlands, A. V., Gomersall, S. R., Tudor-Locke, C., Bassett, D. R., Kang, M., Fraysse, F., . . . Olds, T. S. (2015). Introducing novel approaches for examining the variability of individuals' physical activity. *Journal of Sports Sciences*, *33*, 457–466. https://doi.org/10.1080/02640414.2014.951067

Scholz, U., Schüz, B., Ziegelmann, J. P., Lippke, S., & Schwarzer, R. (2008). Beyond behavioural intentions: Planning mediates between intentions and physical activity. *British Journal of Health Psychology*, *13*, 479–494. https://doi.org/10.1348/135910707X216062

Sheeran, P. (2002). Intention—behavior relations: A conceptual and empirical review. *European Review of Social Psychology*, *12*, 1–36. https://doi.org/10.1080/14792772143000003

Stathokostas, L., Theou, O., Little, R. M., Vandervoort, A. A., & Raina, P. (2013). Physical activity-related injuries in older adults: A scoping review. *Sports Medicine*, *43*, 955–963. https://doi.org/10.1007/s40279-013-0076-3

Thompson, D., Peacock, O. J., & Betts, J. A. (2014). Substitution and compensation erode the energy deficit from exercise interventions. *Medicine and Science in Sports and Exercise*, *46*, 423. https://doi.org/10.1249/MSS.0000000000000164

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, *19*, 349–357. https://doi.org/10.1093/intqhc/mzm042

Tsatalas, T., Giakas, G., Spyropoulos, G., Sideris, V., Kotzamanidis, C., & Koutedakis, Y. (2013). Walking kinematics and kinetics following eccentric exercise-induced muscle damage. *Journal of Electromyography and Kinesiology*, *23*, 1229–1236. https://doi.org/10.1016/j.jelekin.2013.04.008

Washburn, R. A., Lambourne, K., Szabo, A. N., Herrmann, S. D., Honas, J. J., & Donnelly, J. E. (2014). Does increased prescribed exercise alter non-exercise physical activity/energy expenditure in healthy adults? A systematic review *Clinical Obesity*, *4*, 1–20. https://doi.org/10.1111/cob.2014.4.issue-1

Welch, N., McNaughton, S. A., Hunter, W., Hume, C., & Crawford, D. (2009). Is the perception of time pressure a barrier to healthy eating and physical activity among women? *Public Health Nutrition*, *12*, 888–895. https://doi.org/10.1017/S1368980008003066

Wolin, K. Y., Bennett, G. G., McNeill, L. H., Sorensen, G., & Emmons, K. M. (2008). Low discretionary time as a barrier to physical activity and intervention uptake. *American Journal of Health Behavior*, *32*, 563–569.

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