Preventive Medicine 177 (2023) 107754

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

The cross-sectional associations of chronic conditions and disability with self-reported physical activity among adults in England

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ARTICLE INFO

Keywords:
Chronic conditions
Disability
Physical activity
Impairment
Cross-sectional
England

ABSTRACT

Objective: Using cross-sectional data from the 2018 Health Survey for England, this study describes the types of impairment reported by people with chronic conditions and the association of chronic conditions and impairments with physical activity(PA).

Methods: Participants self-reported the presence of seven chronic health conditions (diabetes; stroke/ischemic heart disease; hypertension; chronic obstructive pulmonary disease (COPD); asthma; arthritis/rheumatism/fibrositis; back problems), 11 types of impairment (vision, hearing, mobility, dexterity; learning; memory; mental health; stamina; social or behavioural; other; none); and their PA using the International Physical Activity Questionnaire. Multivariable Poisson regression was used to estimate the association of a)impairment type, b) number of impairments, and c)impairment type and chronic condition (mutually adjusted) with PA.

Results: In total, 2243 adults (55% female, 44% age > 55 yrs) reported having a chronic condition. PA volume (MET minutes per week: median (IQR)) was highest in participants with asthma (2093 (693–4479)), and lowest in those with COPD (454 (0–2079)). There was a negative association between number of impairments and levels of PA. After adjustment for age, sex, ethnicity and education, and mutually adjusting for all other conditions and impairments, diabetes (Incident rate ratio (95% confidence interval): 0.83 (0.73–0.94)), COPD (0.76 (0.59–0.99)), a mobility impairment (0.63 (0.56–0.72)), a dexterity impairment (0.86 (0.75–0.98)), or a memory impairment (0.84 (0.72–0.99)) was negatively associated with PA.

Conclusion: Future PA research requires consideration of the number and types of impairments that individuals experience, as well as assessing chronic conditions. This will improve understanding of the barriers to PA participation and inform interventions.

1. Background

According to the World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF), disability is an outcome of the interaction between health conditions and contextual (personal and environmental) factors(World Health Organization, 2001; World Health Organization and World Bank, 2011). There are around 15 million people in England with a chronic health condition (Department of Health, 2012). With an ageing population, this figure is rising and so too is the prevalence of disability(World Health Organization and World Bank, 2011). A growing body of evidence suggests numerous benefits of physical activity for both the prevention and management of chronic health conditions.(World Health Organization, 2010; Pedersen and Saltin, 2015). Data indicate, however, that physical inactivity is responsible for one in six deaths in the UK, resulting in an estimated annual cost of £7.4 billion to the UK economy(Scarborough et al., 2011). People living with a chronic condition or disability are more likely to be physically inactive than non-disabled people(Sport England, 2022), making them an important target group for physical activity promotion.

In 2020 the WHO published the first global guidelines on physical activity and sedentary behaviour for people living with chronic conditions and disabilities(World Health Organization, 2020). Separate guidelines were produced for these two population groups, although chronic conditions and disability are inextricably linked. For example,

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https://doi.org/10.1016/j.ypmed.2023.107754
Received 8 June 2023; Received in revised form 1 November 2023; Accepted 2 November 2023
Available online 10 November 2023

whilst Parkinson's is a chronic disease, it was considered within the evidence reviews underpinning the WHO 'disability' guidelines due to its long-term impact on neurological function. Recommendations from the WHO review process included the need to expand disability research beyond a limited number of specific health conditions, and for future research to better account for diversity in the physical and mental function of people living with a disability(Carty et al., 2021).

Much research in the physical activity field has focused on population groups with chronic conditions, without consideration of differing degrees of disability or impairment(Carty et al., 2021). There is likely to be variation in the number and types of impairments that individuals with the same chronic health condition experience, which will impact their capacity to undertake physical activity. For example, among people with multiple sclerosis, there can be varying symptoms and levels of severity, which lead to differences in a person's ability to participate in physical activity(Kalb et al., 2020). In addition, a recent report by Ross et al. (2022) identified that adults with a mobility limitation were less likely to meet physical activity guidelines compared to those with other functional limitations or without a disability. However, because physical activity research has typically focused on chronic conditions only, we have limited understanding of the variation in impairments experienced by people with chronic conditions, or how the combination of chronic health conditions and impairments impacts participation in physical activity. Examining the types of impairments that people experience because of a chronic health condition will enable a better understanding of the implications of health conditions on physical activity participation, allowing interventions to be better designed and targeted to support these groups.

The objectives of this study were to: (1) describe the number and types of impairments reported by people with selected chronic conditions; (2) describe the levels of physical activity participation in people with different chronic conditions; (3) examine the association of type and number of impairments with physical activity levels in people with a chronic condition; and (4) examine the relative importance of chronic conditions and impairments as correlates of physical activity.

2. Methods

2.1. Study sample

Data were from the Health Survey for England (HSE), an annual national survey conducted since 1991 to monitor trends in health and health related behaviours in children and adults(NHS Digital, 2022). HSE uses multi-stage stratified probability sampling to recruit a nationally representative sample of the general population. Data collected in 2018 were selected because this was the most recent available wave to include information on the outcomes of interest for this analysis. HSE 2018 data were collected via an interview, which included verbal responses to questions and completion of a questionnaire(Health Survey for England, 2019). For objectives one to three of this study, the analytical sample comprised participants aged 16 years and over that self-reported having a chronic condition, as defined below. For objective four, the analytical sample also included participants who did not report to have a chronic condition.

2.2. Measures

2.2.1. Chronic health conditions

Participants reported whether they had any "*physical or mental health conditions or illnesses lasting or expected to last 12 months or more*". If they responded 'yes' to this question, they were asked to identify up to six conditions or illnesses, which were recorded verbatim. Responses were categorised by the HSE team prior to the data being made available for analysis. Excluding categories labelled 'other' such as 'other endocrine/metabolic', where we were unable to clearly identify a person's specific health condition, seven condition groups were identified for inclusion in this study: (1) diabetes; (2) stroke and/or ischemic heart disease (IHD); (3) hypertension; (4) chronic obstructive pulmonary disease (COPD); (5) asthma; (6) arthritis/rheumatism/fibrositis; and (7) back problems.

2.2.2. Impairments

As a follow on to the chronic health conditions question above, participants were asked whether "*any of your conditions or illnesses affect you in the following areas?*" (1) vision; (2) hearing; (3) mobility; (4) dexterity; (5) learning or understanding or concentrating; (6) memory; (7) mental health; (8) stamina or breathing or fatigue; (9) social or behavioural; (10) other; and (11) none of the above. Due to small sample sizes ($n < 65$), 'social or behavioural' and 'other' were only included in our descriptive statistics and analyses of the number of impairments and the association with physical activity.

2.2.3. Physical activity

Participants completed the International Physical Activity Questionnaire (IPAQ) - Short-Form, (Craig et al., 2003) comprising 7-items assessing frequency and duration of walking, moderate, and vigorous intensity physical activity in the previous 7 days. Following established guidelines for data processing and analysis of IPAQ, (IPAQ Research Committee, 2005) weekly minutes of each activity were calculated by multiplying the reported duration (minutes) of a typical bout of activity by the number of days on which the activity was undertaken. The Metabolic Equivalents (METS) of each activity (walking = 3.3, moderate = 4.0 and vigorous = 8.0) was multiplied by minutes per week to provide an estimate of total MET-minutes of physical activity per week. Two physical activity outcomes were used for this analysis: MET-minutes of physical activity and walking-minutes per week.

2.2.4. Covariates

Participants reported their date of birth (16+ years, 5-year age bands), sex (male, female), ethnicity (White, Black, Asian, mixed/multiple ethnic background, any other ethnic group) and level of education (none, below degree, and degree or equivalent (NVQ level 4 or 5, or university degree)). These were the covariates for this study.

2.3. Data analysis

Sample characteristics and the number of impairments reported by participants with each chronic condition are presented as frequencies and percentages. As the data were not normally distributed, median and interquartile ranges (IQR) are reported for the two physical activity outcomes. To accommodate the substantial proportion of zero values observed for each physical activity outcome, multivariable Poisson regression models were used to estimate the association of a) impairment type, b) number of impairments, and c) impairment type and chronic condition (mutually adjusted) with physical activity (MET-minutes per week and walking-minutes per week). We used the robust estimator of variance to account for mild violations of the underlying model assumptions (mean not equal to the variance). Models were adjusted for age (fitted as a quadratic term), sex, ethnicity and education as described above, and analyses were conducted separately for each chronic health condition groups. For objectives 3 and 4, we mutually adjusted models for all impairment types (objective 3) and impairment type and chronic condition (objective 4) to ascertain relative associations with physical activity outcomes. We present results using incidence rate ratios (IRR) and 95% confidence intervals (CI), where an IRR less than one indicates a lower level of activity in the exposed group relative to the reference group. Variance inflation factors (VIF) were assessed to check for collinearity; all VIF's were below 3.5, with the majority <2. A P value <0.05 was considered statistically significant. All analyses were conducted using Stata 17(StataCorp, 2021).

Table 1
Demographic characteristics and impairment type, stratified by chronic condition. Data from the Health Survey for England 2018.

	No chronic condition	Any chronic condition	Diabetes	Stroke and/or IHD	Hypertension	COPD	Asthma	Arthritis/ rheumatism/ fibrositis	Back problems
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
	4441	2243	424 (18.9)	211 (9.4)	531 (23.7)	170 (7.6)	438 (19.5)	839 (37.4)	422 (18.8)
Age									
16–34	1413 (31.8)	140 (6.2)	8 (1.9)	4 (1.9)	3 (0.6)	0 (0.0)	84 (19.2)	9 (1.1)	36 (8.5)
35–54	1628 (36.7)	565 (25.2)	90 (21.2)	17 (8.1)	112 (21.1)	23 (13.5)	148 (33.8)	161 (19.2)	152 (36.0)
55–74	1144 (25.8)	1064 (47.4)	225 (53.1)	116 (55.0)	281 (52.9)	107 (62.9)	160 (36.5)	449 (53.5)	178 (42.2)
75+	256 (5.8)	474 (21.1)	101 (23.8)	74 (35.1)	135 (25.4)	40 (23.5)	46 (10.5)	220 (26.2)	56 (13.3)
Sex									
Female	2393 (53.9)	1243 (55.4)	199 (53.1)	85 (40.3)	258 (48.6)	89 (52.4)	257 (58.7)	555 (66.2)	246 (58.3)
Male	2048 (46.1)	1000 (44.6)	225 (46.9)	126 (59.7)	273 (51.4)	81 (47.7)	181 (41.3)	284 (22.9)	176 (41.7)
Ethnicity									
White	3730 (84.0)	2029 (90.5)	345 (81.4)	193 (91.5)	464 (87.4)	165 (97.1)	394 (90.0)	789 (94.0)	381 (90.3)
Black	151 (3.4)	66 (2.9)	31 (7.3)	5 (2.4)	18 (3.4)	1 (0.6)	8 (1.8)	16 (1.9)	11 (2.6)
Asian	421 (9.5)	102 (4.6)	38 (7.3)	9 (4.3)	33 (6.2)	4 (2.4)	21 (4.8)	25 (3.0)	20 (4.7)
Mixed/multiple ethnic	82 (1.9)	20 (0.9)	2 (0.5)	2 (1.0)	4 (0.8)	–	8 (1.8)	4 (0.5)	4 (1.0)
Any other ethnic group	43 (1.0)	20 (0.9)	7 (1.7)	1 (0.5)	10 (1.9)	–	5 (1.1)	3 (0.4)	5 (1.2)
Education									
Degree or equivalent	1428 (32.4)	457 (20.5)	73 (17.3)	32 (15.3)	123 (23.2)	12 (7.1)	117 (26.8)	141 (16.9)	80 (19.0)
Below degree	2304 (52.2)	1072 (48.0)	198 (46.9)	89 (42.6)	250 (47.1)	69 (40.6)	224 (51.4)	377 (45.2)	218 (51.8)
None	682 (15.5)	705 (31.6)	151 (35.8)	88 (42.1)	158 (29.8)	89 (52.4)	95 (21.8)	316 (37.9)	123 (29.2)
Impairments									
Vision		257 (11.5)	77 (18.2)	43 (20.4)	67 (12.6)	23 (13.5)	38 (8.7)	108 (12.9)	41 (9.7)
Hearing		306 (13.6)	73 (17.2)	48 (22.8)	81 (15.2)	25 (14.7)	50 (11.4)	144 (17.2)	54 (12.8)
Mobility		1074 (47.9)	190 (44.8)	122 (57.8)	178 (33.5)	117 (68.8)	137 (31.3)	575 (68.5)	277 (65.6)
Dexterity		649 (28.9)	101 (23.8)	68 (32.2)	86 (16.2)	69 (40.6)	86 (19.6)	369 (44.0)	202 (47.9)
Learning		187 (8.3)	36 (8.5)	41 (19.4)	35 (6.6)	21 (12.4)	28 (6.4)	80 (9.5)	49 (11.6)
Memory		294 (13.1)	63 (14.9)	64 (30.3)	62 (11.7)	36 (21.2)	55 (12.6)	119 (14.2)	73 (17.3)
Mental health		301 (13.4)	45 (10.6)	30 (14.2)	52 (9.8)	35 (20.6)	61 (13.9)	122 (14.5)	92 (21.8)
Stamina		892 (39.8)	147 (34.7)	124 (58.8)	153 (28.8)	154 (90.6)	280 (63.9)	323 (38.5)	159 (37.7)
Social or behavioural		64 (2.9)	12 (2.8)	3 (1.4)	13 (2.5)	3 (1.7)	19 (4.3)	16 (1.9)	27 (6.4)
Other		38 (1.7)	8 (1.9)	3 (1.4)	9 (1.7)	2 (1.2)	9 (2.1)	16 (1.9)	4 (1.0)
None		620 (27.6)	149 (35.1)	35 (16.6)	233 (43.9)	10 (5.9)	103 (23.5)	141 (16.8)	74 (17.5)

Note: Ethnicity and education sample sizes are less than the total sample due to missing data (n = 20 and 36 respectively). Sum of condition specific subsamples exceeds overall chronic condition subsample (N = 2243) due to some participants reporting multiple conditions. Sum of impairment subsamples exceeds overall or condition specific subsample due to some participants reporting multiple impairments.

2.4. Ethics

Ethical approval for the HSE between 2016 and 2019 was granted from East Midlands Nottingham 2 Research Ethics Committee in 2015 (Reference no. 15/EM/0254). Additional elements to the 2018 survey were approved in October 2017(NatCen Social Research and UCL, 2019). Verbal consent was acquired from participants, and participants were informed that consent would be assumed if they took part in the survey. This study uses anonymised, publicly available data obtained from the UK Data Service (https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=8649).

3. Results

From a total sample of 6684, 2243 adults reported having at least one of the seven chronic conditions of interest. Demographic characteristics and experience of impairment for the whole sample and stratified by chronic condition are presented in Table 1. Of those with a chronic condition, 55% ($n = 1243$) were female, 69% ($n = 1538$) were aged 55 years or above, and 21% ($n = 474$) were 75 years or above. Across the seven conditions, stroke and/or IHD was reported least frequently ($n = 211$, 9%), with arthritis/rheumatism/fibrositis reported most frequently ($n = 839$, 37%). Compared to those without a chronic condition ($n = 4441$), those with a chronic condition were older (21% versus 6% aged 75+, $p \leq 0.01$) and reported lower levels of education (21% versus 32% with a degree or equivalent, $p \leq 0.01$) but did not differ by sex.

3.1. Objective 1: Describe the number and types of impairments reported by people with chronic conditions

As presented in Table 1, mobility impairment ($n = 1074$, 48%) and stamina impairment ($n = 892$, 40%) were reported most frequently across the seven chronic conditions. Social or behavioural impairment was the least commonly reported impairment type. Twenty-eight percent ($n = 620$) of participants with a chronic health condition reported having none of the impairments listed. Fig. 1 displays the number of impairments reported by participants with each chronic condition. Participants with hypertension were most likely to report having no impairment ($n = 238$, 45%), while participants with COPD ($n = 33$, 19%) or stroke and/or IHD ($n = 42$, 20%) were most likely to report having five or more impairments.

3.2. Objective 2: Describe the levels of physical activity participation in people with different chronic conditions

Total MET minutes of physical activity per week and walking minutes per week are presented in Table 2, stratified by chronic condition. Median MET-minutes of physical activity per week ranged from 454 to 2093, whilst median walking-minutes ranged from 105 to 280. Participants with asthma reported the highest MET-minutes of physical activity and walking-minutes per week, whilst those with COPD reported the fewest.

3.3. Objective 3: Association of type and number of impairments with physical activity levels

The association of impairment type with MET-minutes of physical activity and walking-minutes, stratified by chronic condition, is presented in Figs. 2 and 3. In participants with diabetes, hypertension, or arthritis/rheumatism/fibrositis, having a mobility impairment was associated with lower levels of physical activity across both outcomes compared to individuals with the same chronic health condition but no mobility impairment. In participants who reported having stroke and/or IHD or arthritis, having a dexterity impairment was associated with lower levels of physical activity (both outcomes). The largest relative difference in physical activity across both outcomes was found among

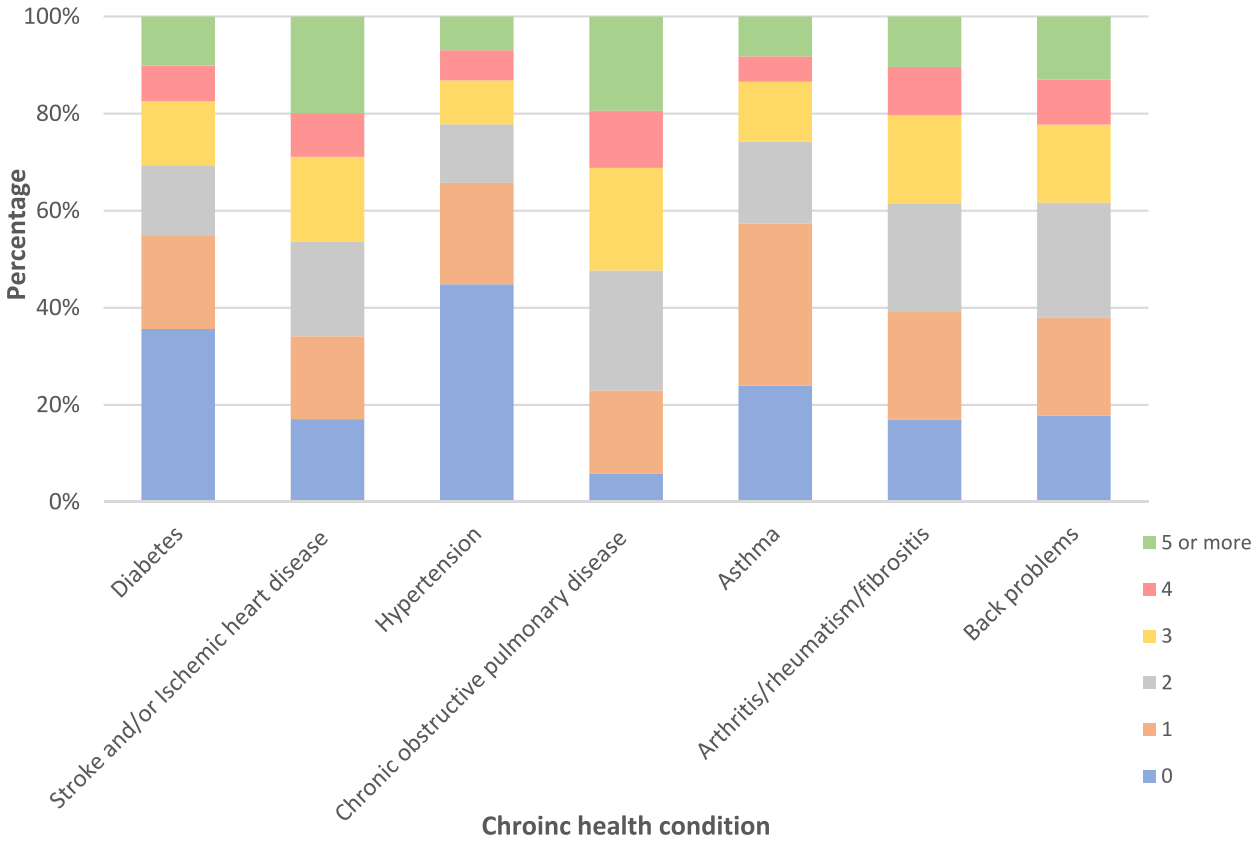

Fig. 1. Cumulative percentage of the number of impairments, stratified by chronic health condition. Data from the Health Survey for England 2018.

Table 2
Median and interquartile range (IQR) for MET-minutes of physical activity and walking minutes per week, stratified by chronic condition, and those with no chronic condition. Data from the Health Survey for England 2018.

	MET-minutes of physical activity per week			Walking-minutes per week		
	N	Median	IQR	N	Median	IQR
No chronic condition	3654	2892	1386–4986	3657	240	60–540
Diabetes	323	1386	347–2970	325	210	60–420
Stroke and/or IHD	155	990	99–3226	156	140	0–508
Hypertension	420	1766	594–3683	424	210	80–600
COPD	140	454	0–2079	141	105	0–315
Asthma	364	2093	693–4479	365	280	105–630
Arthritis/rheumatism/fibrositis	679	1043	139–3360	679	160	20–490
Back problems	354	1425	297–3793	355	210	40–540

Some participants provided incomplete physical activity responses (ranging from 29 to 787 participants, 16–27% across the eight samples); consequently, sample sizes vary across physical activity outcomes.

individuals with COPD and a memory impairment (MET-minutes: IRR = 0.29, 95% CI = 0.13–0.69, $p \leq 0.01$; Walking-minutes: IRR = 0.32, 95% CI = 0.16–0.63, $p \leq 0.01$).

The association of number of impairments with MET-minutes and walking-minutes, stratified by chronic condition, is presented in Figs. 4 and 5. For both outcomes, there was a negative association between number of impairments and levels of physical activity (p for trend <0.01 in all cases); this pattern was observed for all condition subgroups. For example, participants with diabetes reported lower MET-minutes of physical activity per week as the number of impairments increased, from −27% for those with one impairment (IRR = 0.73, 95% CI = 0.51–1.05, $p = 0.09$) to −90% for individuals with five or more impairments (IRR = 0.10, 95% CI = 0.05–0.20, $p < 0.01$) compared to people with no impairment.

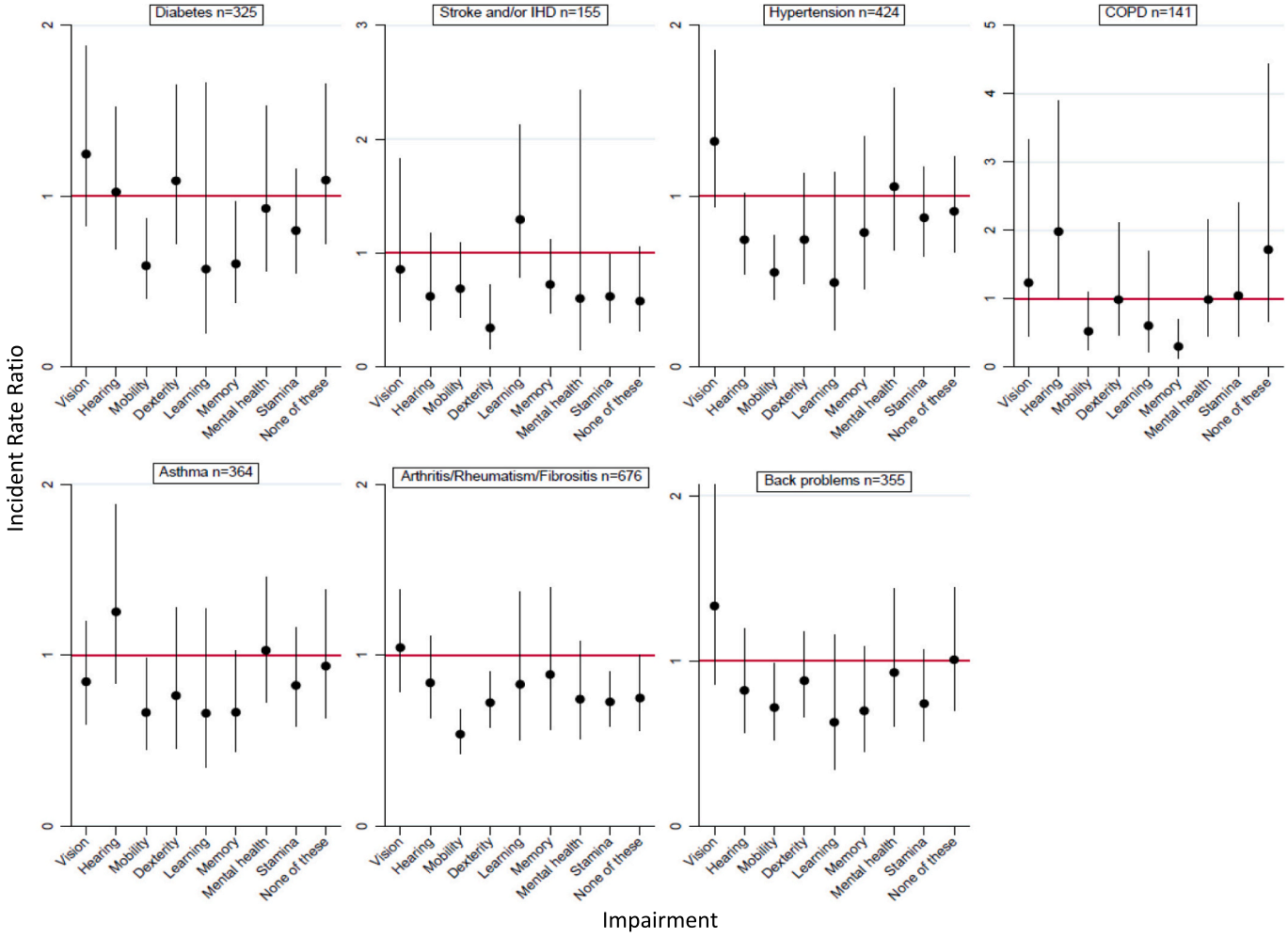

Fig. 2. Incidence rate ratio and 95% confidence intervals for MET-minutes of physical activity per week, across impairment types and stratified by chronic condition. Data from the Health Survey for England 2018.
Interpretation: Incident rate ratio less than one indicates lower MET-minutes of physical activity compared to participants with the same chronic health condition but not the impairment titled.

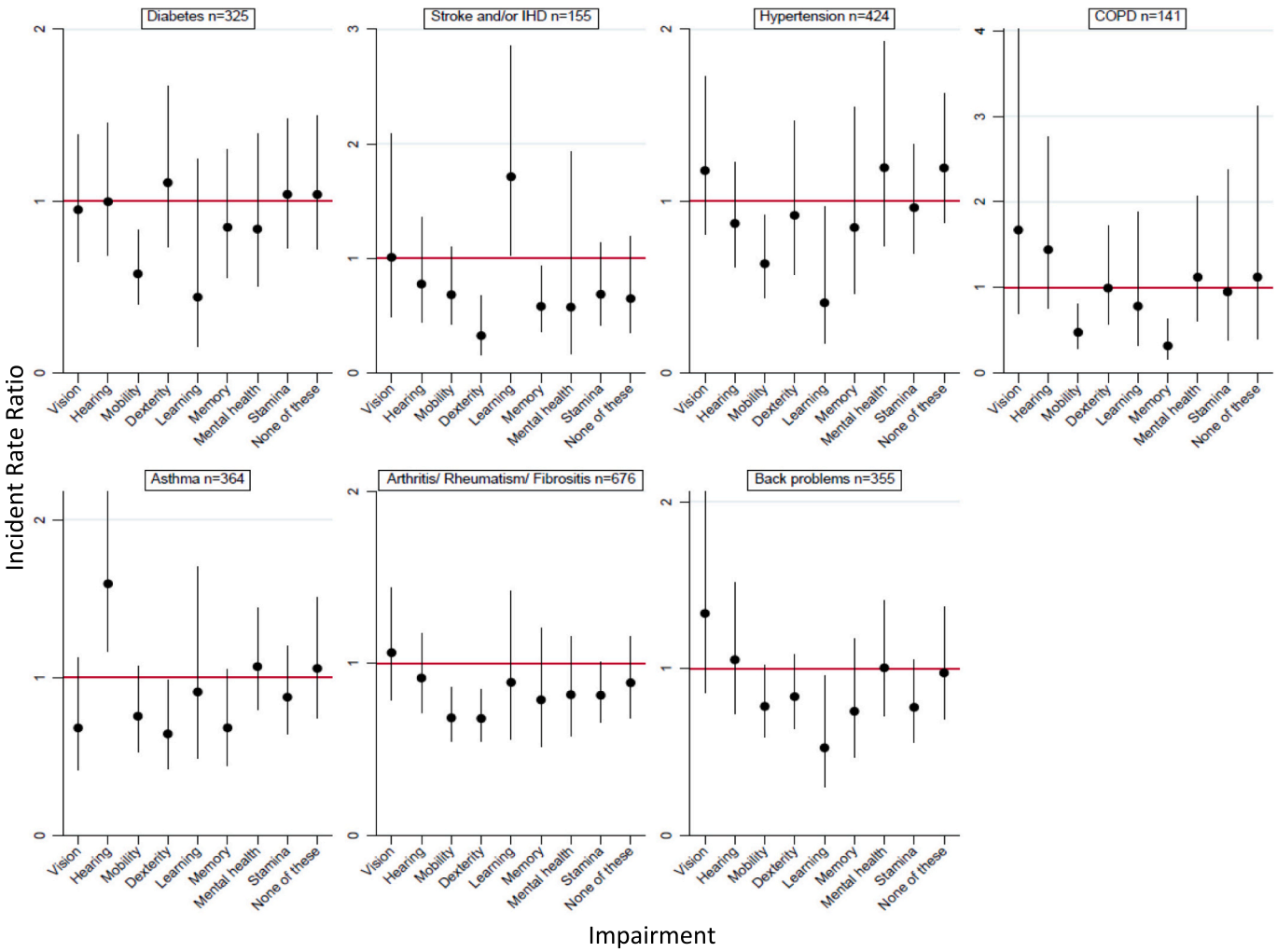

Fig. 3. Incidence rate ratio and 95% confidence intervals for walking minutes per week, across impairment types and stratified by chronic condition. Data from the Health Survey for England 2018.
Interpretation: Incident rate ratio less than one indicates lower walking-minutes compared to participants with the same chronic health condition but not the impairment titled.

3.4. Objective 4: Relative importance of chronic conditions and impairments as correlates of physical activity

Table 3 presents IRRs and 95% CIs indicating the mutually adjusted association of chronic condition and impairment type with physical activity. When adjusting for all other chronic conditions and impairments, having diabetes, COPD, a mobility impairment, a dexterity impairment, or a memory impairment was associated with lower levels of physical activity across both physical activity outcomes, compared to those without these conditions or impairments. For MET-minutes of physical activity, individuals with a hearing impairment (IRR = 0.87, 95% CI = 0.76–0.99, $p = 0.04$) or a stamina impairment (IRR = 0.87, 95% CI = 0.77–0.97, $p = 0.02$) had lower levels of activity per week compared to individuals with no hearing or stamina impairment respectively.

4. Discussion

The aims of this study were to describe the differing types of impairment reported by people with chronic conditions and to explore the association of chronic conditions and impairments with levels of physical activity. The types and number of impairments reported by participants varied substantially within and between different chronic condition groups, as did reported levels of physical activity. We observed an inverse association between the number of reported impairments and levels of physical activity, but the association of specific types of impairment with activity levels varied between condition groups.

Our study highlights the wide range of impairments that can be experienced by individuals with the same chronic condition, indicating that people with the same chronic condition can be impacted in different ways; this is likely due to variation in the severity of the condition and/or how well it is managed. Across the seven chronic health conditions studied, mobility was the impairment type most frequently associated with lower levels of physical activity. This supports previous research that also found individuals with a mobility impairment to have lower levels of physical activity compared to those with a hearing, vision, cognitive, or no impairment(Carroll et al., 2014a). There is evidence that energy expenditure requirements for a given activity may differ for people with a mobility impairment compared to non-disabled people, making physical activity more demanding for people with a mobility impairment compared to other impairment types(Martin Ginis et al., 2021). Consequently, it is important to understand which population groups are at greatest risk of experiencing mobility impairments, due to the implications this may have on their levels of physical activity.

Alongside impairment types, there were also differences in the number of impairments experienced by people with the same chronic condition. Across all studied conditions, we observed an approximately

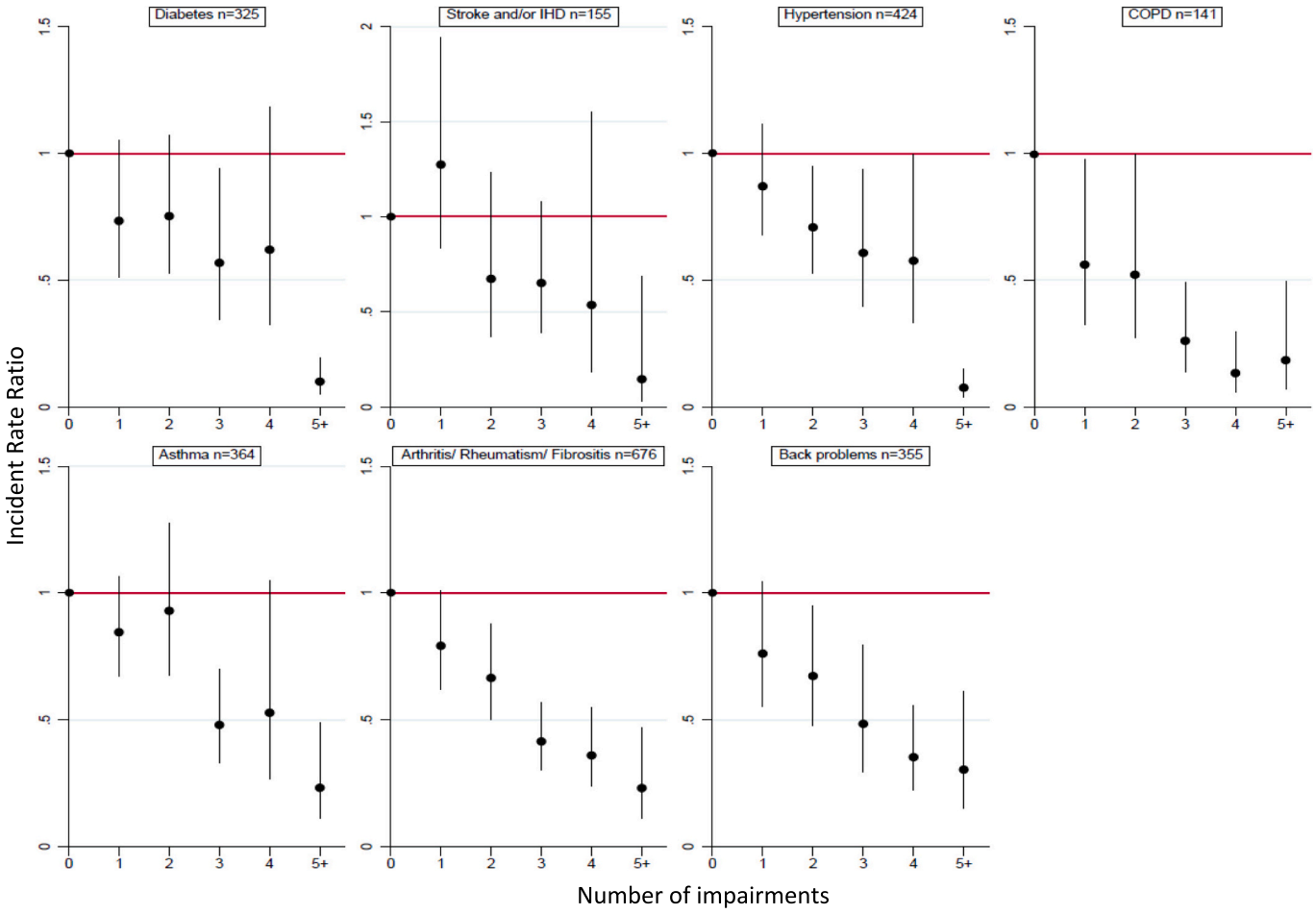

Fig. 4. Incidence rate ratio and 95% confidence intervals for MET-minutes of physical activity per week, by number of impairments and stratified by chronic condition. Data from the Health Survey for England 2018.
Interpretation: Incident rate ratio less than one indicates lower MET-minutes of physical activity compared to participants with the same chronic health condition but no impairment.

linear negative association between the number of reported impairments and MET-minutes of physical activity and walking-minutes per week. This is consistent with findings from previous research, (Singer et al., 2019) including Sport England's Active Lives Survey (November 2020–21), which found that just 38% of participants with three or more impairments were achieving 150 min of physical activity per week, compared to 54% with one impairment(Sport England, 2022). These findings suggests that categorisation in physical activity research based on chronic condition only, may be inappropriate, as the number of impairments a person experiences has a significant influence on their physical activity level.

After mutually adjusting for all other chronic health conditions and impairments, the only two chronic conditions found to be associated with lower physical activity levels were diabetes and COPD. Conversely, several impairments were associated with lower MET-minutes of physical activity and walking-minutes, with the strongest associations being for mobility, dexterity, and memory impairments. This is consistent with previous research showing that mobility and dexterity are the impairment types more likely to affect a person's physical ability (de Hollander and Proper, 2018; Carroll et al., 2014b), such as through restrictions on a person's physical movements and actions(Kissow, 2015). While physical activity has been shown to reduce the risk of cognitive decline (Blondell et al., 2014), for individuals with a memory impairment, such as dementia patients, research has shown them to be less physically active compared to people without a cognitive/memory impairment (Hartman et al., 2018). This emphasises the importance of promoting physical activity among people with a memory impairment, as well as those with a mobility and dexterity impairment to help with the prevention and management of chronic health conditions and other forms of impairment.

The current study shows that similar types of impairment can be experienced by people with different chronic health conditions, and that impairment appears to be a more consistent correlate of activity level than health condition per se. Future physical activity research and surveillance should aim to capture both health conditions and impairments (including number and type) to facilitate an improved understanding of the functional barriers that individuals experience to participation, as well as the inter-relations between physical activity engagement and health outcomes.

A key strength of this study is the examination of both chronic conditions and impairments as influences on physical activity participation. This is an advancement on previous research which has typically focused solely on chronic conditions. This study therefore makes an important contribution towards improving knowledge and understanding of the diversity in the number and types of impairments experienced by people with the same chronic condition, emphasising the importance of assessing both chronic health conditions and impairments in future physical activity research.

There are also limitations that need to be acknowledged. A lack of data on impairment severity meant we were unable to account for this in our analyses; we advocate for future research to take this into consideration. The IPAQ-SF is one of the most widely used self-report physical

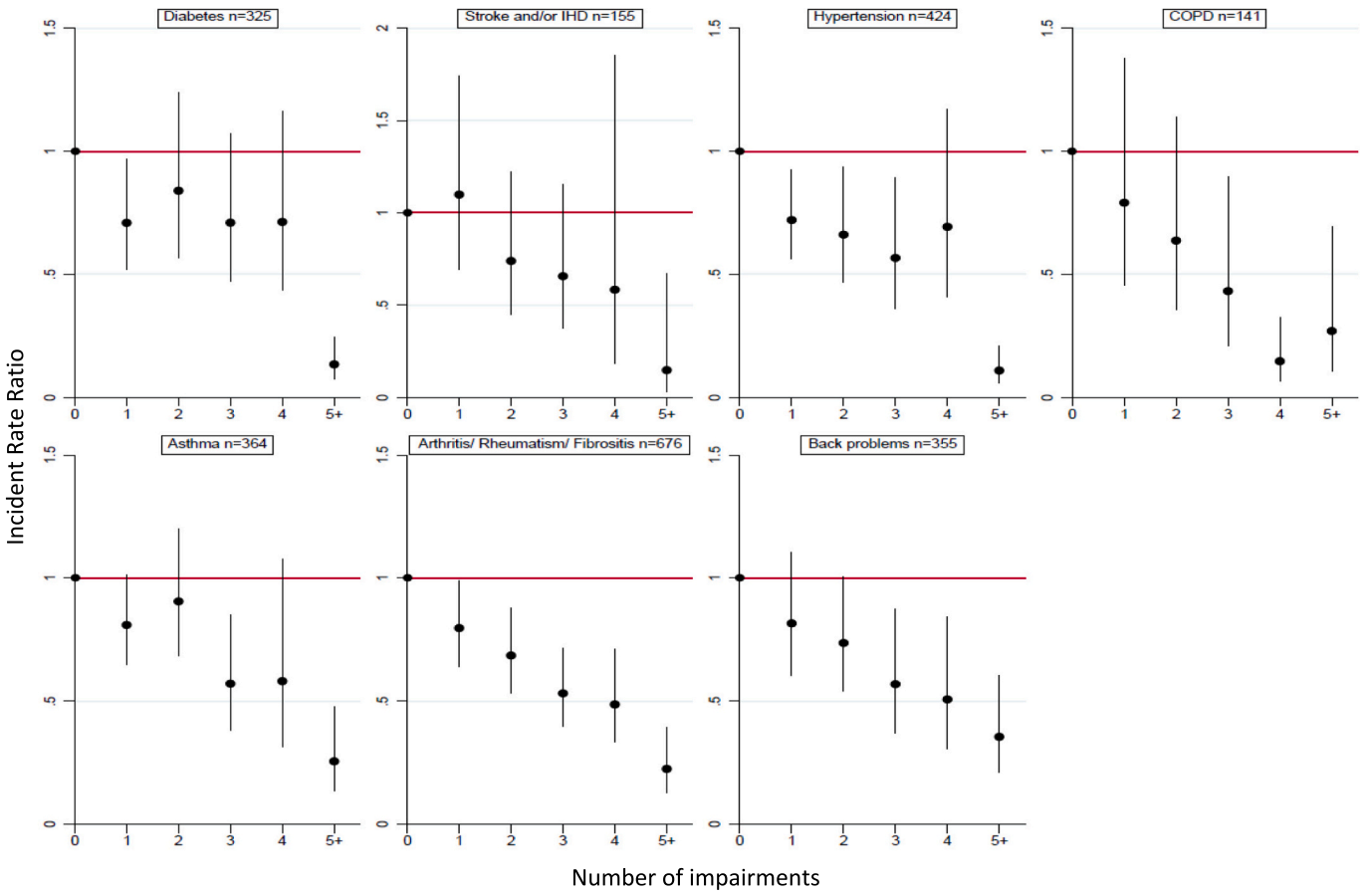

Fig. 5. Incidence rate ratio and 95% confidence intervals for walking minutes per week, by number of impairments and stratified by chronic condition. Data from the Health Survey for England 2018.
Interpretation: Incident rate ratio less than one indicates lower walking-minutes compared to participants with the same chronic health condition but no impairment.

Table 3
Incidence rate ratio (IRR) and 95% confidence intervals (CI) indicating the mutually adjusted association of chronic condition and impairment type with MET-minutes of physical activity and walking-minutes per week. Data from the Health Survey for England 2018.

	MET-minutes of physical activity per week					Walking-minutes per week				
	IRR	95% CI			P	IRR	95% CI			P
Diabetes	0.83	0.73	–	0.94	<0.01	0.84	0.75	–	0.96	<0.01
Stroke and/or IHD	0.93	0.77	–	1.13	0.48	1.00	0.83	–	1.21	1.00
Hypertension	0.92	0.83	–	1.02	0.12	1.01	0.91	–	1.12	0.84
COPD	0.76	0.59	–	0.99	0.04	0.80	0.63	–	1.00	0.05
Asthma	1.09	0.97	–	1.23	0.13	1.07	0.96	–	1.19	0.23
Arthritis/rheumatism/fibrositis	1.04	0.93	–	1.17	0.48	1.05	0.95	–	1.16	0.34
Back problems	1.10	0.97	–	1.26	0.15	1.09	0.97	–	1.23	0.16
Vision	1.15	0.99	–	1.33	0.07	1.02	0.88	–	1.18	0.80
Hearing	0.87	0.76	–	0.99	0.04	0.93	0.82	–	1.06	0.29
Mobility	0.63	0.56	–	0.72	<0.01	0.70	0.62	–	0.78	<0.01
Dexterity	0.86	0.75	–	0.98	0.02	0.83	0.73	–	0.95	<0.01
Learning	0.85	0.70	–	1.02	0.08	0.85	0.72	–	1.01	0.07
Memory	0.84	0.72	–	0.99	0.04	0.81	0.70	–	0.94	<0.01
Mental health	0.88	0.77	–	1.00	0.05	0.91	0.81	–	1.02	0.10
Stamina	0.87	0.78	–	0.97	0.02	0.91	0.82	–	1.02	0.09

IRR = incidence rate ratio, 95%CI = 95% confidence interval.

activity questionnaires among general populations (Craig et al., 2003), though there is some evidence that it may be less suitable in some subgroups, such as those with intellectual disabilities (Moss and Czyz, 2018) or progressive muscular diseases (Roberts-Lewis et al., 2022). These conditions were not identified within the HSE categorisation, thus we cannot rule-out their presence amongst some participants in the current analysis. In addition, some chronic health conditions were grouped at the data processing stage by the central HSE team (for example, arthritis/rheumatism/fibrositis); this may have masked condition specific variations in impairment type/number and associations with physical activity. We opted to use time spent walking as an outcome measure in our analyses as it is one of the most accessible forms of physical activity; however, we acknowledge that this would not be an appropriate for people with certain health conditions and impairments, including wheelchair users. Our analyses entailed the conduct of multiple hypothesis tests; we acknowledge the potential for increased type 1

error for null associations but opted not to adjust for multiple comparisons as advised by Rothman (1990). Additionally, the data were cross-sectional, and caution needs to be taken in interpretation of the results due to some small sample sizes and differences in sample sizes across chronic condition groups.

5. Conclusion

When considered simultaneously, impairment type was more strongly and frequently associated with physical activity than chronic condition. We call for future physical activity research to account for the number and types of impairments that individuals experience, in addition to assessing chronic health conditions. This will facilitate an improved understanding of the functional barriers that individuals experience to participation, as well as the inter-relations between physical activity engagement and health outcomes.

Funding source

This work was supported by funding from the University of East Anglia Faculty of Medicine and Health Studentship, awarded to the lead author.

CRediT authorship contribution statement

Shelby Carr: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Andrew J. Atkin:** Conceptualization, Methodology, Writing – review & editing. **Andy P. Jones:** Conceptualization, Methodology. **Karen Milton:** Conceptualization, Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data is freely available from United Kingdom Data Service

Acknowledgments

None.

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