

Dunham, A., Kinnear, D. , Allan, L., Smiley, E. and Cooper, S.-A. (2018) The relationship between physical ill-health and mental ill-health in adults with intellectual disabilities. *Journal of Intellectual Disability Research*, 62(5), pp. 444-453.

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Deposited on: 03 April 2018

## ABSTRACT

### Background

People with intellectual disabilities face a much greater burden and earlier onset of physical and mental ill-health than the general adult population. Physical-mental comorbidity has been shown to result in poorer outcomes in the general population, but little is known about this relationship in adults with intellectual disabilities.

### Aims

To identify whether physical ill-health is associated with mental ill-health in adults with intellectual disabilities, and whether the extent of physical multi-morbidity can predict the likelihood of mental ill-health. To identify any associations between types of physical ill-health and mental ill-health.

### Method

1,023 adults with intellectual disabilities underwent comprehensive health assessments. Binary logistic regressions were undertaken to establish any association between the independent variables: total number of physical health conditions, physical conditions by ICD-10 chapter, and specific physical health conditions; and the dependent variables: problem behaviours, mental disorders of any type. All regressions were adjusted for age, gender, level of intellectual disabilities, living arrangements, neighbourhood deprivation, and Down syndrome.

### Results

The extent of physical multi-morbidity was not associated with mental ill-health in adults with intellectual disabilities as only 0.8% of the sample had no physical conditions. Endocrine disease increased the risk of problem behaviours (OR: 1.22, 95% CI: 1.02-1.47), respiratory disease reduced the risk of problem behaviours (OR: 0.73, 95% CI: 0.54-0.99) and mental ill-health of any type (OR: 0.73, 95% CI: 0.58-0.92), and musculoskeletal disease reduced the risk of mental ill-health of any type (OR: 0.84, 95% CI: 0.73-0.98). Ischaemic heart disease increased the risk of problem behaviours approximately 3-fold (OR: 3.29, 95% CI: 1.02-10.60).

## Conclusions

The extent of physical multi-morbidity in the population with intellectual disabilities is overwhelming, such that associations are not found with mental ill-health. Mental health interventions and preventative measures are essential for the entire population with intellectual disabilities, and should not be focussed on subgroups based on overall health burden.

## Key Words

Intellectual disabilities; health; mental disorders; physical disorders; multi-morbidity

## INTRODUCTION

People with intellectual disabilities face a much greater burden and earlier onset of physical and mental ill-health than the general adult population (Cooper et al., 2015). Cooper et al. (2015) found that 61.5% of adults with intellectual disabilities had at least one physical health condition out of a limited list restricted to 32 physical conditions, and adults with intellectual disabilities have been reported to have an average of 5.4 comorbid conditions (Beange et al., 1995). With regards to mental ill-health, the largest and most comprehensive study found the point-prevalence of “mental ill-health of any type” (including autism spectrum disorders and problem behaviours) to be 40.9% based on clinical diagnosis (Buckles et al., 2013; Cooper et al., 2007). With prevalence rates for physical and mental disorders so high in this population, it is likely that they coexist.

The Adult Psychiatric Morbidity Survey 2014 (Rai et al., 2016) found that chronic physical conditions (such as asthma, cardiovascular disease, epilepsy and diabetes) are associated with common mental disorders (e.g. anxiety and depression) and poorer mental wellbeing in the general adult population. Additionally, Barnett et al. (2012) found the prevalence of physical-mental comorbidity to be 8.3% in the general population, and the likelihood of having mental ill-health increased as the number of physical conditions increased. It is well recognised that physical-mental comorbidity results in poorer outcomes compared to the presence of either physical or psychiatric illness alone (Scott et al., 2009; Qin et al., 2014; Sareen et al., 2006; Egede, 2007; Schmitz et al., 2007; Katon et al., 2007). Consequences of such comorbidity are: increased mortality (Kang et al., 2015), higher risk of suicide (Qin et al., 2014), poorer quality of life (Sareen et al., 2006), functional impairment (Sareen et al., 2006; Egede,

2007; Schmitz et al., 2007), diminished productivity (Egede, 2007), increased health care utilisation (Egede, 2007) and higher medical care costs (Kang et al., 2015).

There is little research examining the relationship between physical and mental ill-health in adults with intellectual disabilities, with only four studies being identified by a literature search, all with limitations. Three studies focused on this relationship in older adults only (Moss et al., 1993; Cooper, 1997; McCarron et al., 2013). Moss et al. (1993) found no association between physical and psychiatric ill-health, but only investigated 105 adults over the age of 50, with severe intellectual disabilities. Cooper (1997) demonstrated a positive association between physical ill-health and dementia in 134 adults aged 65 and over, but found no association with other mental ill-health. More recently, McCarron et al. (2013) found a significant association between gastrointestinal disease and mental ill-health, but no other physical conditions to be associated in 753 adults over the age of 40. Deb et al. (2001) found epilepsy was significantly associated with occurrence of psychiatric ill-health in 101 adults with mild-moderate intellectual disabilities, aged between 16 and 64 years.

The aims of this study were, with adults with intellectual disabilities, to:

1. Identify whether physical ill-health (extent of physical multi-morbidity) is associated with mental ill-health.
2. Discern if the extent of physical comorbidity predicts the likelihood of mental ill-health.
3. Identify any associations between ICD-10 physical health chapters and mental ill-health.

4. Discern if the relationship between certain individual physical health conditions and mental ill-health found in the general adult population is also present in the adult population with intellectual disabilities.

## METHODS

### Ethical Approval

Ethical approval was obtained from the Local Research Ethics Committee of the NHS Greater Glasgow Primary Care Trust. Each person with intellectual disabilities gave informed consent to participate as far as they had decision making capacity to do so. If the participant lacked such capacity, consent was gained from their nearest relative/welfare guardian, in keeping with Scottish law.

### Participants

The analysis is part of a large-scale, population-based, prospective cohort study (see Cooper et al. (2007) for more information). Individuals with intellectual disabilities over the age of 16 living within the geographical area of Greater Glasgow Health Board, Scotland, were invited to participate in the study. Of the 1,562 individuals who were invited, consent to participate in the study was gained for 1,023 (65.5%).

### Measures & Procedures

A data collection form was used to review primary care case records by nurses in primary care, and a comprehensive semi-structured health interview and physical examination was conducted using the C21st Health Check (Glasgow University Affiliated Programme, 2001). The C21st Health Check includes a phlebotomy protocol (available from corresponding author on request). Any further investigations that were indicated were also done. Following a review of the results with one of three general practitioners who specialised in intellectual disabilities, the physical health conditions were coded using the International Classification of Diseases (ICD-10: World Health Organisation, 1990). Mental ill-health assessments were undertaken by psychiatrists

specialising in intellectual disabilities, and mental health was classified following a psychiatric case conference.

The level of intellectual disabilities of each participant was classified per the ICD-10 Classification of Mental and Behavioural Disorders (World Health Organisation, 1992), from information gained from recorded assessments or from the assessment by the nurses.

The full range of living arrangements were included in the cohort, as the cohort was population-based. Living arrangements were then categorised into one of four groups: 1. living with family carer(s), 2. living with paid carer support, i.e. not with family-carers; typically this accommodation type referred to people with a single or shared tenancy agreement with a support package provided by an external care-support agency, 3. living independently of carer support, for example, either alone, or with a partner, or 4. congregate care home, such as residential care homes and a small number in hospital settings.

Neighbourhood deprivation was classified from the person's post-code, using the Carstairs index (Carstairs and Morris, 1989). This categorises the neighbourhood area into quintiles of deprivation, from the most affluent, through to the most deprived areas.

## Analysis

The Statistical Package for Social Sciences Version 22 (SPSS) was used to analyse the data. Descriptive statistics were generated to obtain information on the number of



participants, age, gender, level of intellectual disabilities, accommodation type, ethnicity and extent of neighbourhood deprivation.

Two binary logistic regressions were undertaken to establish any association between each of two dependent variables: presence of a mental health condition (excluding specific phobias), and problem behaviours (excluding pica). The investigated independent variable was the number of physical conditions, categorised into 0, 1-4, 5-9, and 10+, with the analyses adjusted for age, gender, level of intellectual disabilities, living arrangements, extent of neighbourhood deprivation, and Down syndrome.

Next, binary logistic regressions were undertaken to establish any association between the above two dependent variables and the total number of physical health conditions by ICD-10 chapter: infection; neoplasia; blood disorders; endocrine; circulatory; respiratory; gastrointestinal; skin; musculoskeletal; genito-urinary; congenital; symptoms, signs and abnormal test results; and injuries. The analyses were adjusted for age, gender, level of intellectual disabilities, living arrangements, extent of neighbourhood deprivation and Down syndrome.

Finally, binary logistic regressions were undertaken to establish any association between the above two dependent variables and specific physical health conditions, identified as being associated with mental ill-health in the general population (Rai et al., 2016): diabetes, diseases of the circulatory system (split into hypertension, myocardial infarction and angina (ischaemic heart disease), and stroke), epilepsy, and

asthma. The analyses were adjusted for age, gender, level of intellectual disabilities, living arrangements, extent of neighbourhood deprivation and Down syndrome.

Amongst the variables used in the analyses there were no missing values.

## RESULTS

### Demographics

1,023 individuals participated in the study. 562 (54.9%) were male and 461 were female (45.1%). Their age ranged from 16 to 83 years, with the mean age being 43.9 years (standard deviation 14.6). 398 (38.9%) of the participants had mild intellectual disabilities, 248 (24.2%) had moderate intellectual disabilities, 193 (18.9%) had severe intellectual disabilities, and 184 (18.0%) had profound intellectual disabilities. 390 (38.1%) participants lived with a family carer, 467 (45.7%) lived with paid support, 102 (10.0%) lived independent of carer support, and 64 (6.3%) lived in congregate settings. Extent of neighbourhood deprivation was split into Carstairs score quintiles, with 22.3% living in the most affluent areas, and around half (52.6%) of the cohort lived in the most deprived areas. The majority of participants (96.4%) were Caucasian. 186 (18.2%) had Down syndrome. 40.9% of the sample had mental disorders of any type (excluding specific phobias), and 22.5% had problem behaviours (excluding pica). Only 8 (0.8%) were free from physical ill-health, and 615 (60.1%) experienced 10 or more physical conditions. Demographics are displayed in Table 1.

- Insert table 1 about here -

### Extent of physical multi-morbidity and mental ill-health

#### Problem behaviours (excluding pica)

The full model containing the independent predictor (number of physical health conditions) and adjusted for the six other potential independent predictors was statistically significant,  $\chi^2$  (21, n=1,023) = 134.47,  $p < 0.01$ , indicating that the model had good fit. The model as a whole explained between 12.3% (Cox & Snell R Square)

and 18.8% (Nagelkerke R Square) of the variance in problem behaviours. Total number of physical health conditions was not significantly associated with problem behaviours. The odds ratios and their 95% confidence intervals for each category of physical health are shown in Table 2.

- Insert table 2 about here -

#### Mental disorders of any type (excluding specific phobias)

The full model containing the independent predictor (number of physical health conditions) and adjusted for the six other potential independent predictors was statistically significant,  $\chi^2$  (21, n=1,023) = 108.20,  $p < 0.001$ , indicating that the model had good fit. The model as a whole explained between 10% (Cox & Snell R Square) and 13.5% (Nagelkerke R Square) of the variance in mental disorders. Total number of physical health conditions was not significantly associated with mental disorders of any type. The odds ratios and their 95% confidence intervals for each category of number of physical health conditions are shown in Table 3.

- Insert table 3 about here -

#### Physical ill-health by ICD-10 chapter and mental ill-health

Each of the ICD-10 chapter variables were modelled individually; all models had a significance of  $< 0.01$  and so had good fit. 26 binary logistic regressions were carried out in total (13 ICD-10 Chapters x 2 dependent variables; problem behaviours, mental disorders of any type). For reasons of space, only the odds ratios (OR) and 95% confidence intervals (CI) for all conditions within each ICD-10 chapter are shown in

Table 4, although the regressions were all adjusted for age, gender, level of intellectual disabilities, living arrangements, neighbourhood deprivation, and Down syndrome.

- Insert table 4 about here -

#### Problem behaviours (excluding pica)

Endocrine disease was the only chapter positively associated with problem behaviours. Individuals who reported past or present endocrine disease were 1.22 (95% CI: 1.02 - 1.47) times more likely to exhibit problem behaviours. Respiratory disease was negatively associated with problem behaviours, with the odds being reduced to 0.73 (95% CI: 0.54 - 0.99). All results are displayed in Table 4.

#### Mental disorders of any type (excluding specific phobias)

Respiratory disease was also negatively associated with mental disorders of any type, reducing the odds by 0.73 (95% CI: 0.58-0.92). In addition, musculoskeletal disease reduced the odds of mental ill-health by 0.84 (95% CI: 0.73 – 0.98). See Table 4.

#### Specific physical conditions and mental ill-health

Each of the specific physical health conditions were modelled; all models had a significance of <0.01 and so had good fit. 12 binary logistic regressions were carried out in total (6 ICD-10 physical health conditions x 2 dependent variables; problem behaviours, mental disorders of any type).

Ischaemic heart disease had a positive association with problem behaviours, increasing the odds by 3.29 (95% CI: 1.02 – 10.60). No association was found

between any of the specific physical conditions and mental disorders of any type.  
These results are displayed in Table 5.

- Insert table 5 about here –

## DISCUSSION

### Interpretation of Findings

Unlike the general population, the extent of physical multi-morbidity does not appear to be associated with mental-ill health in adults with intellectual disabilities. This is surprising, given findings in the general adult population (Barnett et al., 2012). It is likely that the extent of physical multi-morbidity is so great in adults with intellectual disabilities (only 0.8% of the sample had no physical conditions) that associations could not be found.

Endocrine disorders were found to increase the risk of having problem behaviours by 22.4% (OR 1.22), though the lower level of the confidence interval equated to 2.3%. This finding is in accordance with the general population. For example, hyperthyroidism can result in psychosis, irritability/behaviour change, restlessness and hyperkinesia (Kumar and Clark, 2012), which could be interpreted as problem behaviours in adults with intellectual disabilities, and obesity is associated with mental ill-health and aggression (Mather et al., 2009; McCrea et al., 2012; Tso et al., 2017).

Respiratory disorders were found to be protective against problem behaviours and mental disorders of any type, reducing the risk by 26.6% (OR 0.73) and 26.8% (OR 0.73) respectively, though the upper level of the confidence interval equated to a reduction of 0.7% and 7.6% respectively. This finding is not due to respiratory disease being more common in people with more severe intellectual disabilities, as the regressions were all adjusted for level of intellectual disabilities. These findings contradict those of the general adult population, where asthma and chronic obstructive pulmonary disease (COPD) have been found to significantly increase the risk of

developing anxiety or depression (Goodwin et al., 2003; Di Marco et al., 2006). In addition, many drugs used to treat respiratory disease can cause anxiety, such as theophylline and beta-adrenergic bronchodilators (Levenson, 2007). Respiratory disease may protect against problem behaviours in adults with intellectual disabilities due to lack of respiratory reserve, oxygen saturation, or through the ease of detection of symptoms (such as cough, breathlessness, wheeze), resulting in perhaps more attention by carers and/or family members, producing a positive psychosocial effect. This interpretation is however, entirely speculative.

Additionally, musculoskeletal disease was found to reduce the risk of mental disorders of any type by 15.8% (OR 0.84), though the upper level of the confidence interval equated to a reduction of 2.1%. This finding could be attributed to the anti-inflammatory effect of the drugs used to treat musculoskeletal problems. Studies have found that inflammation can induce depression symptoms and elevated cytokines are seen in psychiatric patients. Increased inflammatory cytokines have been mechanistically linked to a number of interacting neural pathways that reduce mood and contribute to the development of depression (Makhija and Karunakaran, 2013). It has therefore been suggested that anti-inflammatory drugs may have antidepressant effects. A recent meta-analysis demonstrated anti-depressant effects following anti-cytokine therapy (Kappelmann et al., 2016).

Findings for specific types of physical conditions differed from the general population. An exception was ischaemic heart disease, which increased the risk of problem behaviours three-fold. Depression is around three times more common in patients following an acute myocardial infarction than in the general population (Thombs et al.,



2006). The mechanisms behind the association in adults with intellectual disabilities may well be similar to those between ischaemic heart disease and myocardial infarction seen in the general population.

## Strengths & Limitations

The main limitation is that many logistic regressions were undertaken, introducing the potential of type I error. Despite this, the most interesting finding of our study is that hardly any associations were found between physical and mental ill-health, contrary to findings in the general population; hence our negative findings are in fact the study's main point of interest. In addition, the study was only undertaken in one area of Scotland and, although the ethnicity of the population is representative of the area, the lack of diversity may mean there is reduced generalisability to some areas. Finally, the sample size, though large, was not sufficient to allow separate analysis for individuals with Down syndrome.

The comprehensive health assessments carried out by trained health professionals, and the population-based sampling method of adults with intellectual disabilities are major strengths of this study. Further strengths are its high participation rate and large sample size.

Finally, this study should be repeated in a large population of individuals with Down syndrome, given their different health profile compared with other adults with intellectual disabilities.

## Conclusion

This study found that the total number of physical health conditions is not associated with mental ill-health; a finding contrary to that in the general adult population. This finding was not accounted for by the level of a person's intellectual disabilities, as all regressions were adjusted for level of intellectual disabilities. This lack of association is thought to be because the extent of physical multi-morbidity is so great, with very few individuals being free of physical ill-health. Endocrine disease increased the risk of problem behaviours, respiratory disease reduced the risk of problem behaviours and mental ill-health of any type, and musculoskeletal disease reduced the risk of mental ill-health of any type. Furthermore, ischaemic heart disease was found to increase the risk of problem behaviours approximately three-fold, but no associations were found between other physical conditions that are associated with mental ill-health in the general adult population. An important implication of this study is that mental health interventions and preventative measures are essential for the entire population of people with intellectual disabilities, so service availability should not be focussed on sub-groups based on their overall health profile.

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## TABLES

*Table 1. Demographics and characteristics of participants.*

Participants		N (1,023)	%
Gender	Male	562	54.9
	Female	461	45.1
Age (years)	16-24	121	11.8
	25-34	156	15.2
	35-44	253	24.7
	45-54	238	23.3
	55-64	169	16.5
	65-74	70	6.8
	75+	16	1.6
Level of intellectual disabilities	Mild	398	38.9
	Moderate	248	24.2
	Severe	193	18.9
	Profound	184	18.0
Accommodation type	Lives with family carer	390	38.1
	Lives independently	102	10.0
	Lives with paid support	467	45.7
	Lives in congregate setting	64	6.3
Neighbourhood deprivation category	1 Most affluent	228	22.3
	2	92	9.0
	3	66	6.5
	4	99	9.7
	5 Most deprived	538	52.6
Ethnicity	Caucasian	986	96.4

	Non-Caucasian	37	3.6
Down syndrome	No	837	81.8
	Yes	186	18.2
Prevalence of mental ill-health	Problem behaviours (excluding pica)	230	22.5
	Mental disorders of any type (excluding specific phobias)	418	40.9
Total number of physical health conditions	0	8	0.8
	1-4	55	5.4
	5-9	345	33.7
	10+	615	60.1

Table 2. Association of total number of physical health conditions, and problem behaviours in adults with intellectual disabilities.

		Odds Ratio	95% CI for Odds Ratio	
			Lower	Upper
Total number of physical health conditions	0 (Reference)			
	1-4	1.70	0.18	16.13
	5-9	1.60	0.19	13.72
	10+	2.10	0.25	17.88
Gender	Female	1.50	1.09	2.07
Age	16-24 (Reference)			
	25-34	0.83	0.46	1.52
	35-44	0.54	0.30	0.98
	45-54	0.45	0.24	0.83
	55-64	0.30	0.15	0.59
	65-74	0.27	0.12	0.61
	75+	0.11	0.02	0.58
Level of intellectual disabilities	Mild (Reference)			
	Moderate	1.84	1.15	2.94
	Severe	2.80	1.75	4.50
	Profound	3.27	2.04	5.25
Down syndrome	Present	0.33	0.19	0.57
Accommodation type	Lives with family carer (Reference)			
	Lives independently	2.31	1.14	4.68
	Lives with paid support	3.56	2.30	5.49
	Lives in a congregate setting	3.97	1.95	8.07
Neighbourhood deprivation category	1 Most affluent (Reference)			
	2	0.58	0.30	1.11
	3	0.93	0.46	1.89
	4	0.68	0.36	1.28
	5 Most deprived	0.78	0.53	1.15
Constant		0.08		



Table 3. Association of total number of physical health conditions, and mental ill-health for adults with intellectual disabilities.

		Odds Ratio	95% CI for Odds Ratio	
			Lower	Upper
Total number of physical health conditions	0 (Reference)			
	1-4	1.20	0.24	5.96
	5-9	1.31	0.29	5.89
	10+	1.31	0.29	5.87
Gender	Female	1.25	0.96	1.64
Age	16-24 (Reference)			
	25-34	0.74	0.44	1.24
	35-44	0.63	0.39	1.03
	45-54	0.57	0.34	0.95
	55-64	0.40	0.23	0.71
	65-74	0.26	0.13	0.53
	75+	0.10	0.03	0.40
Level of intellectual disabilities	Mild (Reference)			
	Moderate	1.23	0.86	1.78
	Severe	1.81	1.23	2.66
	Profound	1.66	1.12	2.48
Down syndrome	Present	0.39	0.26	0.57
Accommodation type	Lives with family carer (Reference)			
	Lives independently	2.07	1.23	3.48
	Lives with paid support	2.84	2.00	4.03
	Lives in a congregate setting	3.24	1.76	5.98
Neighbourhood deprivation category	1 Most affluent (Reference)			
	2	0.79	0.46	1.35
	3	0.86	0.47	1.57
	4	0.58	0.34	0.99
	5 Most deprived	0.99	0.70	1.39
Constant		0.44		

Table 4. Results of 26 regression analyses on association of physical health conditions by ICD-10 chapter, with (1) problem behaviours, and (2) mental disorders of any type, for adults with intellectual disabilities.

ICD-10 chapter	Dependent variable			
	Problem behaviours*		Mental disorders of any type†	
	OR	95% CI	OR	95% CI
Infection	1.01	0.76-1.33	1.06	0.84-1.33
Neoplasia	1.16	0.64-2.06	0.73	0.44-1.21
Blood disorders	0.97	0.56-1.67	0.81	0.50-1.30
<b>Endocrine</b>	<b>1.22</b>	<b>1.02-1.47</b>	1.06	0.91-1.24
Circulatory	1.12	0.90-1.41	1.01	0.84-1.22
<b>Respiratory</b>	<b>0.73</b>	<b>0.54-0.99</b>	<b>0.73</b>	<b>0.58-0.92</b>
GI	0.95	0.82-1.09	0.97	0.86-1.09
Skin	1.15	0.98-1.35	1.12	0.98-1.28
<b>MSK</b>	0.85	0.71-1.02	<b>0.84</b>	<b>0.73-0.98</b>
GUM	1.02	0.83-1.27	1.02	0.85-1.23
Congenital	0.94	0.74-1.19	0.86	0.71-1.05
Symptoms, signs & tests	1.03	0.93-1.13	1.05	0.97-1.14
Injuries	1.10	0.93-1.30	1.05	0.91-1.21
GI: gastrointestinal; MSK: musculoskeletal; GUM: genito-urinary medicine				
* Excludes pica				
† Excludes specific phobias				
Regressions adjusted for age, gender, level of intellectual disabilities, living arrangements, extent of neighbourhood deprivation and Down syndrome				

Table 5. Results of 12 regression analyses on the association of specific physical health conditions with (1) problem behaviours, and (2) mental disorders of any type, for adults with intellectual disabilities.

Physical health condition	Dependent variable			
	Problem behaviours*		Mental ill-health†	
	OR	95% CI	OR	95% CI
Diabetes	1.70	0.84-3.46	1.04	0.56-1.93
Hypertension	1.07	0.68-1.71	1.02	0.69-1.48
<b>Ischaemic heart disease</b>	<b>3.29</b>	<b>1.02-10.60</b>	1.38	0.46-4.20
Stroke	1.11	0.41-2.98	0.60	0.25-1.46
Epilepsy	0.96	0.68-1.35	0.80	0.59-1.07
Asthma	1.13	0.59-2.15	1.19	0.72-1.98
Ischaemic heart disease: myocardial infarction & angina				
* Excludes pica				
† Excludes specific phobias				
Regressions adjusted for age, gender, level of intellectual disabilities, living arrangements, extent of neighbourhood deprivation and Down syndrome				