ESC European Society of Cardiology

European Journal of Cardiovascular Nursing (2021) **20**, 315–323
doi:10.1093/eurjcn/zvaa019

ORIGINAL ARTICLE

The prevalence, awareness, treatment, and control of hypertension in older adults with an intellectual disability in Ireland: a cross sectional study

Frances O'Brien[1,2]*, Philip McCallion[2,3], Rachael Carroll[2], Máire O'Dwyer[2,4], Eilish Burke[1,2], and Mary McCarron[1,2]

[1]School of Nursing and Midwifery, Trinity College Dublin, 24 D'Olier Street, Dublin 2, D02 T283, Ireland; [2]IDS-TILDA, Trinity Centre for Ageing and Intellectual Disability, School of Nursing and Midwifery, Trinity College Dublin, Dublin 2, DO2 PN40, Ireland; [3]School of Social Work, Temple University, Philadelphia, PA 19122-6091, USA; and [4]School of Pharmacy and Pharmaceutical Sciences, Trinity College Dublin, Dublin, DO2 PN40, Ireland

Received 10 May 2020; first decision 19 October 2020; accepted 2 November 2020; online publish-ahead-of-print 4 January 2021

Aims Hypertension is a leading risk factor for cardiovascular disease, accounting for almost 50% of ischaemic heart disease mortality. This study aims to identify the prevalence, awareness, treatment, and control of hypertension and their predictors in older adults with an intellectual disability (ID).

Methods and results This cross-sectional study utilized data from the ID Supplement to the Irish Longitudinal Study on Ageing (IDS-TILDA). Participants were drawn from the nationally representative sample and included those who completed the self/informant report measures, in addition to objective blood pressure (BP) measurement. From the 551 individuals with ID, aged ≥40 years, hypertension prevalence was 35.2% [95% confidence interval (CI) 31.2–39.2%]. Of those with hypertension, 44.3% (95% CI 37.1–51.5%) were aware of their hypertensive status, and 64.2% (95% CI 57.3–71.1) were taking antihypertensive medication. Among those on treatment, 70.8% (95% CI 61.8–78.2%) had their BP controlled to below 140/90 mmHg. Significant predictors of awareness were age ($P = 0.036$) and level of ID ($P = 0.004$), predictors of treatment were age ($P = 0.002$), level of ID ($P = 0.019$), and diabetes ($P = 0.001$). Both diabetes and female gender were predictors of control of hypertension ($P = 0.013$ and $P = 0.037$, respectively).

Conclusion The prevalence of hypertension in older adults with ID was lower than reports for the general Irish population, with overall levels of treatment and control, when identified, higher in the ID population. There was under-treatment and lower levels of awareness among those with more severe ID, which requires addressing. The finding, that when diagnosed, people with ID respond well to treatment should encourage addressing the under-treatment found here.

Keywords Hypertension • Cardiovascular diseases • Intellectual disability • Risk factors • Older adults • General population

Implications for practice

- The under-treatment and lower awareness levels among those with more severe intellectual disability (ID) require addressing.
- Increase screening for hypertension in individuals with severe/profound levels of ID and in those without diabetes.
- When hypertension is diagnosed, people with ID respond well to hypertension treatments.
- Research is required to establish a cardiovascular disease risk profile for this vulnerable population.

* Corresponding author. Tel: +353 1 896 2692, Email: obrienfr@tcd.ie

Introduction

Cardiovascular diseases (CVD) accounts for almost one-third of mortality worldwide[1] and is the second most common cause of death in Ireland, at 30.5%.[2] In addition to family history, hypertension, hypercholesterolaemia, diabetes, smoking status, and obesity are known risk factors for CVD development.[3] From these, hypertension has been identified as the risk factor of greatest prevalence and impact,[3,4] accounting for almost 50% of ischaemic heart disease mortality.[5] Consequently, reducing or controlling hypertension should logically decrease CVD and related deaths.

Much of the research surrounding hypertension prevalence, awareness, treatment, and control has focused on the general population. The prevalence of hypertension in those aged ≥18 years is 30–45%, and this increases steeply with the progression of age.[3,6] In Ireland, cross-sectional data from the Irish Longitudinal Study on Ageing (TILDA), which involves a nationally representative sample of older community adults aged ≥50 years, reported a weighted hypertension prevalence of 63.7%.[7] Of those classified as hypertensive, 54.4% were aware they had hypertension, 58.9% were on antihypertensive treatment, with blood pressure (BP) controlled in just over half (51.6%).[7] Murphy *et al.*[7] concluded their study by drawing attention to the high prevalence of hypertension identified in Irish people over 50 and the low levels of awareness, treatment, and control. They recommend population and primary care level interventions to reduce prevalence and improve awareness, detection, and management.

There has not been the same attention given in Ireland, to the prevalence of CVD, the role of hypertension and its treatment or indeed its under-treatment in people with an intellectual disability (ID), along with the levels of control. This is despite international concerns regarding high levels of overweight and obesity,[8–11] low levels of physical activity and unhealthy nutrition practices[12] and high abdominal obesity[10,13–16] in the ID population. Further, some people with ID have increased CVD risk due to syndrome specific risk factors, such as in Prader–Willi syndrome and cerebral palsy.[17–19] Other syndromes, such as Down syndrome, despite early childhood congenital heart disease, are associated with reduced risk for CVD as adults.[10,20]

Past prevalence and risk studies on CVD and hypertension in persons with ID are largely limited by small, under-representative samples, lack of objective measures, and inconsistency in definitions. This has led to conflicting reports of lower,[21] comparable,[10,22–24] or higher levels of risk for persons with ID,[25] when compared with the general population. In New York, Janicki *et al.*[11] reported under-recognition of CVD in adults with ID compared to the general population, despite both groups having similar CVD mortality. Also in the USA, Erickson and Kornexl[26] identified a trend for lower proportions of people with ID as having a diagnosis of hypertension despite no significant differences between their diastolic BP (DBP) recordings and those of the general population. Similarly, a national Swedish study[21] reported that older adults with ID were less likely than the general population to have a diagnosis of hypertension and to be prescribed medication for it. Further, for those prescribed treatment, medications tended to be of the older variety compared to that prescribed for the general population.

Recent studies on mortality in people with ID have highlighted that the steady increase in their longevity has stalled over the last decade.[27–29] In particular, it has been reported that treatable conditions, risk factors, and associated behaviours are not being addressed to the same extent as for the general population.[27,30,31] Under recognition, under diagnosis, and less evidence of active management of conditions and modifiable risk factors in people with ID as compared to the general population, have been raised as concerns.[27] In order to address such concerns and, in particular, to advance the management of modifiable health risks and their consequences, this study aims to:

(1) identify the prevalence, awareness, treatment, and control of hypertension in older adults with an ID.
(2) Identify the predictors of awareness, treatment, and control of hypertension in the same population.

Methods

This study utilizes data collected in Wave 2 (2013–16) of the Intellectual Disability Supplement to the Irish Longitudinal Study on Ageing (IDS-TILDA).

Study sample

The IDS-TILDA sample was drawn from The National Intellectual Disability Database (NIDD), which collates information on all people with an ID in the Republic of Ireland who are eligible for or receiving services.[32,33] A random sample of 1600 people aged ≥40 years was identified from the NIDD and invited to participate in Wave 1 of the IDS-TILDA study. An age of ≥40 years was selected because of the lower life expectancy for some individuals with ID and earlier onset of age-related morbidities in this population, e.g. dementia.[34,35] In total, 753 persons participated in Wave 1, meaning an overall response rate of 46% and 8.9% of the total population of persons >40 years registered on the 2008 NIDD database. A comparison with the published demographics of the 2008 NIDD cohort confirmed that the IDS-TILDA sample was representative of the larger NIDD sample.[36] For Wave 2 of IDS-TILDA, all living Wave 1 respondents ($n = 719$) were invited to participate, from which 708 (98%) agreed to participate. Wave 2 participants were eligible for inclusion in this study if they completed the IDS-TILDA self or informant report measures AND completed the objective measurement of their BP.

Consent and data collection

Accessible material and full explanation supported informed consent. Based upon the ethical approval received, able participants provided written consent independently yet could request the support of a person they knew well in completing the pre-interview questionnaire (PIQ) and computer-assisted personal interview (CAPI). Equally, as per ethical approval, for those unable to provide consent independently, a family member, keyworker, or support person who knew the participant well (Proxy), consented on their behalf and supported them throughout the process. Paid staff members were required to have worked with the individual for at least 6 months. The PIQ and CAPI and data collection procedures were validated in the pilot study and subsequently in Wave 1.

Outcome measures

Prevalence

Blood pressure was measured using a digital automated oscillometric BP monitor. Measurements were completed as per protocol, in clinics

familiar to participants, by the same research clinician, using accessible explanatory materials. Following a period of rest, two measurements were recorded while seated, with 1-min rest between recordings. From these two measures, the mean systolic and diastolic measure was calculated. Prevalence of hypertension was defined as SBP ≥140 mmHg or DBP ≥90 mmHg,[37] and/or currently taking antihypertensive medications.

Awareness

A specific dichotomous (yes/no) question asked if participants (or their proxies) were aware of having received a doctor's diagnosis of hypertension.

Treatment

In the pre-interview questionnaire, participants/proxies were asked 'Can you tell me what medications (including prescribed and over the counter, herbal medicines) you take on a regular basis—like every day or every week?'. Interviewers subsequently confirmed this information with medication prescription data obtained from accompanying healthcare personnel. Medications were coded by two pharmacists using the World Health Organization (WHO) Anatomical Therapeutic Chemical (ATC) classification system,[38] a method described in detail elsewhere.[39] Antihypertensive treatment was defined as exposure to one or more of anti-adrenergic agents, diuretics, beta-blockers, calcium channel blockers, angiotensin-converting enzymes (ACE) inhibitors, and angiotensin II receptor betablockers (ARBs). Combination therapy included taking two or more antihypertensives concurrently. Medicines were recorded by brand or generic name, including prescription and non-prescription and over the counter, and length of time the participants were taking medicines and all data was anonymized.

Control

Measured BP data were used to determine how well hypertension was being managed, with BP control defined as SBP <140 mmHg and DBP <90 mmHg.

Covariates

Demographic covariates included age by group (for comparison across studies), sex, level of ID (mild, moderate, and severe/profound, based upon self-report or review of records or knowledge of the Proxy), and type of residence (independent/family, community group home, and residential care). Behavioural factors included current smoking status, problem drinking, body mass index (BMI), waist circumference, and level of physical activity. Smoking levels were self-reported. Self-reported problem drinking was defined as 3 or more/day or >7 per week for women and four drinks or more/day or >14 per week for men.[40] Physical activity was self-assessed using the International Physical Activity Questionnaire (IPAQ) short form which categorizes physical activity as low, moderate, or high, based on the intensity, duration, and frequency of activities undertaken in the preceding week.[41]

The research clinician measured height and weight. Body mass index (weight in kg/height in m^2) was classified as: underweight <18.5; normal weight 18.5 to <25; overweight 25 to <30; obese ≥30.[42,43] Surrogate measurements in the form of the Mid Upper Arm Circumference (MUAC) or Ulna length to measure height were used to estimate BMI,[44,45] for those for whom traditional measurement was not possible. As MUAC measurement of BMI yields three levels of classification (underweight, normal, and overweight), these three levels of BMI are used throughout this analysis, with overweight and obese combined into a single category.

Waist circumference (associated with increased risk of diabetes and CVD, such as high cholesterol and hypertension) was also measured by the research clinician and classified using WHO cut-offs.[46]

Morbidity covariates, which included the presence of diabetes and CVD (angina, heart attack, open-heart surgery, angioplasty/stent insertion, congestive heart failure, stroke, or transient ischaemic attack) was based on reporting ever having a doctor's diagnosis of these conditions or self-reporting having undergone a related procedure. Access to primary healthcare was assessed using three mutually exclusive categories of medical insurance (i) a medical card that provides free access to general practitioner (GP) care and heavily subsidized prescribed medicines, (ii) GP card only, and (iii) neither of these. Participants were also divided into those who had Down syndrome and those who did not.

Ethical considerations

The study conformed to the principles outlined in the Declaration of Helsinki.[47] Ethical approval was obtained from the Faculty of Health Sciences Ethics Committee at Trinity College Dublin and from all participating service providers ($N = 138$).

Statistical analysis

Descriptive statistics measured prevalence and awareness of hypertension and medication management approaches. Descriptives also measured the same variables for those ≥50 years, to facilitate discussion of findings here with previous reports of hypertension in the general population in Ireland. For the total sample, bivariate tests of association were conducted using Pearson's χ^2 test or where appropriate linear by linear *P*-value or Fisher's exact *P*-value. Binary logistic regression determined risk factors for awareness, treatment, and control of hypertension. Purposeful selection of variables for inclusion in the regression models was of independent variables significant in a bi-variate analysis and/or deemed important after two independent reviews of the literature. Crude odds ratios were used to measure the magnitude and strength of the predictors. Both crude odds ratios (cORs) and 95% confidence intervals (CIs) are reported for significant associations. Underweight participants were removed from the bivariate analysis due to small numbers and IPAQ scores were reclassified as low and moderate/high. Statistical significance was set at $P = 0.05$. The statistical software SPSS V 22 was used to conduct the analyses.

Results

Study sample

In total, 551 individuals from the 708 Wave 2 participants, completed the IDS-TILDA self or informant report measures AND objective measurement of BP and thus comprised the study sample (*Figure 1* for flowchart). Proxy respondents completed 37% of the report measures.

Demographics and clinical characteristics

Participants ranged in age from 44 to 92 years (mean 56.6, SD 9.3), 56.6% were female, while 50% had a moderate level of ID. The vast majority of participants (83.2%) had waist circumferences that placed them at increased/substantially increased risk of CVD, 68.4% were overweight/obese, while 72.1% reported low levels of physical activity. A minority had diabetes (7.8%), a history of CVD (6.2%), and were smokers (6.9%). The mean systolic and diastolic BP

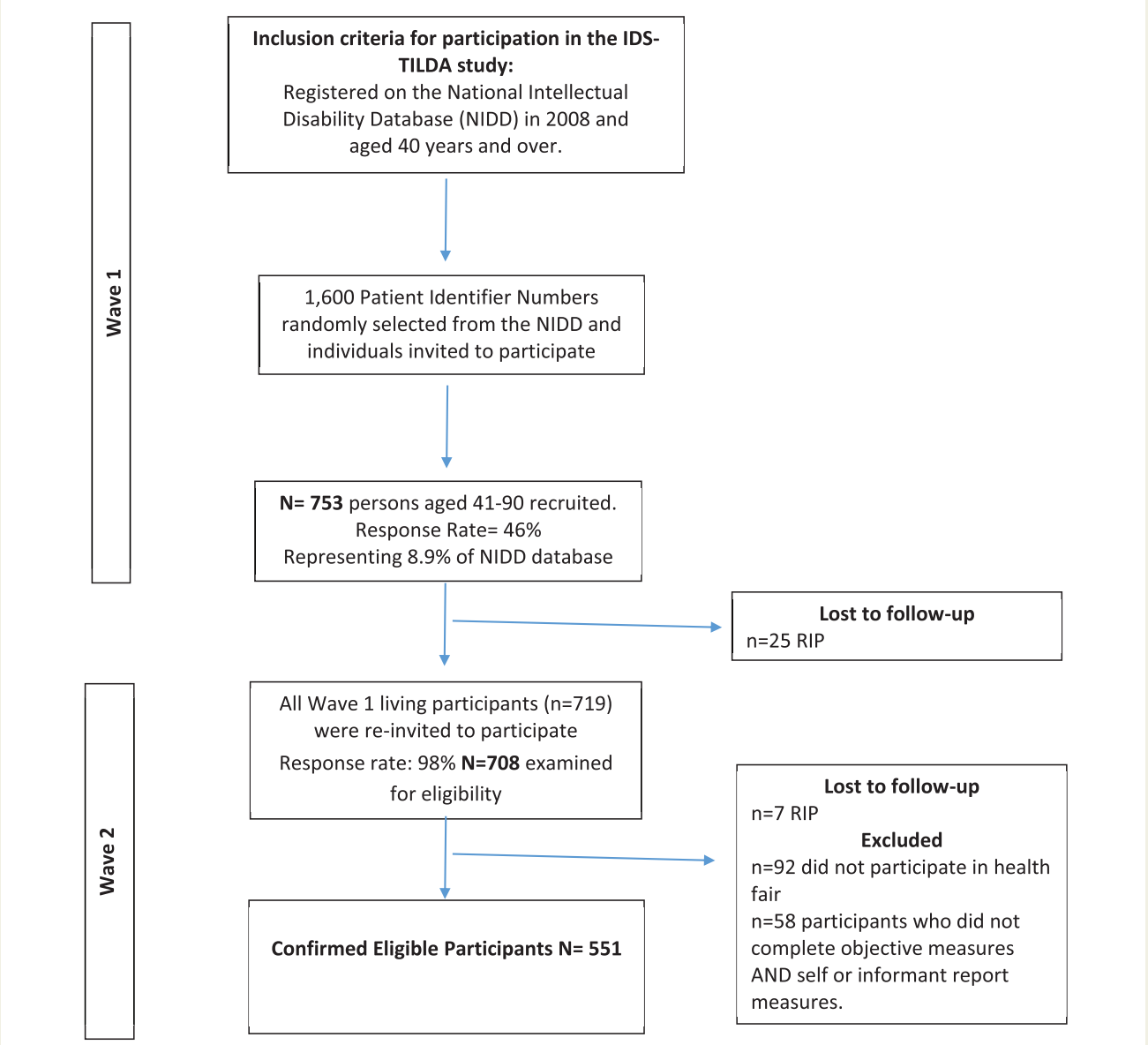

Figure 1 Flowchart for IDS-TILDA study participation at Wave 1 and Wave 2. This study used Wave 2 data.

measurements was 118.59 mmHg (SD 17.93) and 75.72 mmHg (SD 12.19), respectively. *Table 1* presents the full sample characteristics.

Prevalence, awareness, treatment, and control

The prevalence of hypertension was 35.2% (95% CI 31.2–39.2%) (*Table 2*). Prevalence was higher in men (37.2%) than in women (33.7%), although the difference was not statistically significant ($P = 0.38$). Prevalence was significantly higher in the oldest versus the youngest age group ($P = 0.000$), in those with diabetes ($P < 0.001$), and in those with a history of CVD ($P = 0.003$). Conversely, having Down syndrome was associated with lower prevalence of hypertension ($P < 0.001$) (*Table 2*).

Of those participants objectively classified as hypertensive, only 44.3% reported awareness of receiving such a diagnosis from their doctor, with marginally greater awareness in females (44.7%) than males (43.9%). As age increased, awareness also increased from 23.1% in the youngest age group to 50.9% in the oldest age group. Level of ID was inversely associated with awareness; those most aware (62.5%) had mild ID, while those less aware had severe/profound ID (31.0%) (*Table 3*).

Of those with hypertension, 64.2% were being treated with antihypertensive medication. As age increased, level of treatment also increased from 38.5% in the youngest age group to 75.9% in the oldest age group. Those with mild ID had the highest level of treatment at 78.0% decreasing to 53.5% for those with severe/profound ID. Among those on treatment, BP was controlled in 70.8% of the total

Table 1 Sample characteristics of adults with intellectual disability ≥40 years (*N* = 551)

Characteristics	*n*	%	95% CI
Age			
44–49	151	27.8	24.2–31.7
50–64	281	51.7	47.5–55.8
65+	112	20.6	17.3–24.3
Gender			
Male	239	43.4	39.2–47.6
Female	312	56.6	52.4–60.8
Level of ID (missing = 40)			
Mild	126	24.7	21.0–28.7
Moderate	255	49.9	45.5–54.3
Severe/profound	130	25.4	21.8–29.5
Type of residence			
Independent/family	87	16.0	12.9–19.1
Community group home	236	43.4	39.2–47.6
Residential setting	221	40.6	36.5–44.7
Current smoker (missing = 6)			
Yes	37	6.9	4.95–9.44
Alcohol consumption			
Excessive drinking	4	0.7	0.0–1.4
BMI (missing = 6)			
Under weight	16	2.9	17.5–4.83
Normal	156	28.6	24.9–32.7
Over weight/obese	373	68.4	64.3–72.3
Waist Circumference (missing = 70)			
Normal	81	16.8	13.5–20.1
Increased risk	83	17.3	13.9–20.7
Substantially increased risk	317	65.9	61.7–70.1
Physical activity (missing =15)			
Low	387	72.1	68.0–75.8
Moderate	138	25.7	22.1–29.7
High	12	2.2	1.21–4.0
CVD history			
Yes	34	6.2	4.3–8.3
Diabetes (missing = 4)			
Yes in Wave 2	42	7.8	5.8–10.5
Health insurance			
Full medical card or equivalent	528	98	96.3–98.9
GP visit card	5	0.9	0.3–2.3
Neither of these	6	1.1	0.5–2.5
Blood pressure measured			
Yes, within the last 2 years	515	96.4	94.4–97.8
Yes, over 2 years ago	11	2.1	1.1–2.8
No	8	1.5	0.7–3.1
Down syndrome			
Yes	100	18.1	14.9–21.3

BMI, body mass index; CVD, cardiovascular disease.

Table 2 Hypertension prevalence in adults with intellectual disability ≥40 years (*N* = 551), by age and gender and significant predictors of prevalence

	n	%	95% CI	*P* value
Prevalence	194/551	35.2	31.2–39.2	
Age[a]				
44–49	27/151	17.9	14.7–21.1	<0.001
50–64	105/281	37.7	33.6–41.8	
65+	56/112	50.0	45.8–54.2	
Gender				
Female	105/312	33.7	29.8–37.6	0.38
Male	89/239	37.2	33.2–41.2	
Diabetes[a]	33/42	78.6	66.2–91.0	<0.001
History of CVD[a]	20/34	58.8	42.3–75.4	0.003
Down syndrome[a]	13/100	13	6.41–21.12	<0.001

CVD, cardiovascular disease.
[a]Significance for prevalence of hypertension.

sample, with greater control noted in females (78.3%) than in males (60.8%) (*Table 3*).

For participants ≥50 years (*n* = 393), the more commonly reported age cut-off in general population studies, prevalence was 41.2% (95% CI 36.3–46.1%), awareness 47.8% (95% CI 40.0–55.6%), treatment 68.8% (95% CI 61.6–76.0), and control 70% (95% CI 61.4–78.6%) (*Table 4*).

Among those being treated in the full sample with medicines data (*n* = 153) (≥40 years), the most commonly reported medicine classes were ACE inhibitors (36.8%), diuretics (34.9%), and calcium channel blockers (26.3%). Just over 4 in 10 (42.8%) were prescribed combination therapy (*Table 5*). For participants ≥50 years in the full sample with medicines data and antihypertensive treatment (*n* = 133), the more commonly reported medication classes were ACE inhibitors (39.1%), diuretics (35.3%), and beta blockers (26.3%), with 45.9% prescribed combination therapy (*Table 5*).

Factors associated with awareness, treatment, and control of hypertension

Age and level of ID were significantly associated with awareness of hypertension (*Table 6*). The cOR for awareness and older age was 3.46 (95% CI 1.2–9.9) for those aged over 65, and 2.86 (95% CI 1.06–7.69) for those aged 50–64, relative to those in the youngest age group. Those with severe/profound ID were 3.7 times more likely to be unaware they had hypertension, than those with mild ID (cOR = 0.269, 95% CI 0.11–0.67) (*Table 7*).

Age, level of ID, and diabetes were significantly associated with treatment (*Table 6*). The strongest predictors were having a doctor's diagnosis of diabetes, followed by age. Those with diabetes were 5.2 times more likely to be treated for hypertension compared to those who did not have a doctor's diagnosis of diabetes (cOR = 5.167, 95% CI 1.729–15.44). Those aged over 65 years were five times more likely to be treated for hypertension than those aged 44–49 (cOR = 5.046, 95% CI 1.844–13.809). The cOR for those with severe ID indicated that they are 3.1 times less likely to be treated for hypertension than those with mild ID (cOR = 0.323, 95% CI 0.125–0.838) (*Table 7*).

Of those who were treated for hypertension, gender, and diabetes were significantly associated with BP control (*Table 6*). Females were 2.3 times more likely than males to have their BP controlled

Table 3 Hypertension awareness, treatment, and control, in adults with intellectual disability ≥40 years, who have hypertension (*n* = 194), by age, sex, and level of intellectual disability

	Aware (*n* = 185)[a]			Treated (*n* = 187)[b]			Controlled (*n* = 120)		
	%	95% CI	*n*	%	95% CI	*n*	%	95% CI	*n*
Total	44.3	37.1–51.5	82/185	64.2	57.3–71.1	120/187	70.8	61.8–78.2	85/120
Gender									
Male	43.9	33.2–54.6	36/82	60.7	50.3–71.4	51/84	60.8	47.4–74.2	31/51
Female	44.7	35.1–54.3	46/103	67.0	57.9–76.1	70/103	78.3	68.6–88.0	54/69
Age									
44–49	23.1	6.9–39.3	6/26	38.5	19.8–57.2	10/26	80.0	55.2-100	8/10
50–64	46.2	36.6–55.8	48/104	65.1	56.0–74.2	69/106	68.1	57.1–79.1	47/69
65+	50.9	37.7–64.11	28/55	75.9	64.5–87.3	41/54	73.2	55.6–86.8	30/41
Level of ID									
Mild	62.5	47.5–77.5	25/40	78.0	65.32–90.7	32/41	71.9	56.3–87.5	23/32
Moderate	43.8	33.5–54.1	39/89	64.0	54.0–74.0	57/89	71.9	60.2–83.6	41/57
Severe/profound	31.0	17.0–45.0	13/42	53.5	38.6–68.4	23/43	69.6	50.8–88.4	16/23

Missing level of ID for 14 participants with hypertension.
[a]Missing = 9 missing doctors diagnosis variable.
[b]Missing = 7 missing medication variable.

Table 4 Hypertension prevalence, awareness, treatment, and control in adults with intellectual disability ≥50 years (*N* = 393)

	Prevalence (*n* = 393)			Aware (*n* = 159)[a]			Treated (*n* = 160)[b]			Controlled (*n* = 110)		
	%	95% CI	*n*	%	95% CI	*N*	%	95% CI	*N*	%	95% CI	*n*
Adults with ID ≥50 years	41.2	36.3–46.1	162	47.8	40.0–55.6	76	68.8	61.6–76.0	110	70.0	61.4–78.6	77

Missing level of ID for 13 participants with hypertension.
[a]Missing = 3 missing doctor's diagnosis variable.
[b]Missing = 2 missing medication variable.

Table 5 Antihypertensive medication use in the total intellectual disabilities-TILDA population with medicines data, in adults with intellectual disability ≥40 years (*n* = 677) and ≥50 years (*n* = 489)

	ACE inhibitors % (*n*)	Diuretics % (*n*)	Calcium-channel blockers % (*n*)	Beta blockers % (*n*)	Angiotensin receptor blockers % (*n*)	Anti-adrenergic agents % (*n*)	Combination therapy % (*n*)
Adults with ID ≥44 years (*n* = 153)	36.8 (56)	34.9 (53)	26.3 (40)	24.3 (37)	19.1 (29)	2.0(3)	42.8 (65)
Adults with ID ≥50 years (*n* = 133)	39.1 (52)	35.3 (47)	28.6 (38)	26.3 (35)	21.8 (29)	2.3(3)	45.9 (61)

(cOR = 2.3, 95% CI 1.04–5.18), while control was 4.6 times more likely in those with diabetes than those without (cOR = 4.57, 95% CI 1.28–16.39) (*Table 7*). In this study, obesity and level of physical activity were not significant predictors of awareness (obesity, *P* = 0.953; physical activity, *P* = 0.519), treatment (obesity, *P* = 0.968; physical activity, *P* = 0.712) and control (obesity, *P* = 0.599; physical activity *P* = 0.787) of hypertension.

Discussion

Prevalence of hypertension in this representative population of adults with ID was 23% and 29% lower for those aged ≥40 and ≥50 years, respectively than participants in the representative general Irish population TILDA study.[7] There were, however, some similar trends with higher rates for men as compared to women, and in older age

cohorts. Overall, prevalence was lower than that reported in other studies of people with ID in the Netherlands,[10] Sweden,[21] and the USA.[11] The differences in findings may reflect that our sample: (i) was drawn from a nationally representative study population of people with ID, (ii) was carried out in tandem with the general Irish population study (TILDA) using the same measurement and diagnostic criteria, (iii) included objective measurement of BP in persons with all levels of ID, and across various living circumstances including those living in community and independently, and (iv) obtained detailed information about treatment with antihypertensive medicines. While further confirmatory studies are needed, a more robust understanding of hypertension prevalence and its management in adults with ID has emerged.

Differences with the general Irish population, confirmed by specifically looking at those with ID ≥50 years, are evident. Lower rates of hypertension, higher detection, and greater efficacy of medication were found in those with ID, as was a lessor impact of risk factors, such as obesity and low levels of physical activity. Among the diagnosed groups in both studies, participants with ID were more likely to be receiving antihypertensive treatment and when receiving treatment, participants with ID were more likely to have their BP controlled and were taking less combination therapy, compared to TILDA participants.[7] Of interest, when hypertension was diagnosed, antihypertensive therapy was both more likely to be used and to be effective in managing BP, a finding that should encourage greater effort at treatment. Antihypertensive compliance is reported to be higher among individuals with ID who are living in supervised residences and have frequent contact with a care provider.[48] Care providers may administer prescribed medications daily, which may provide some explanation for this finding regarding medication adherence and subsequent effectiveness.

The most frequently reported antihypertensive medication classes in this study were ACE inhibitors (36.8%), diuretics (34.9%), calcium-channel blockers (26.3%), and beta blockers (24.3%). These findings are similar to those of Vacek *et al.*[49] who used Kansas Medicaid data to characterize antihypertensive medication use for adults with ID aged 18–64 years who had prescription claims over 1 year. For TILDA participants, ACE inhibitors were also the most commonly reported medication used, with diuretics being the fourth most common (23.1%). Although diuretics remain the cornerstone of antihypertension treatment, their dysmetabolic effects may increase the risk of new-onset diabetes, particularly when combined with beta blockers.[37] Given the evidence that diabetes occurs more frequently in people with ID than the general population,[21] diuretic use in the treatment of hypertension in one-third of the ID population may require further exploration.

The findings regarding low levels of awareness of a diagnosis of hypertension in this ID population further supports the prior concern

Table 6 Significant predictors of awareness, treatment, and control of hypertension

Characteristics	Aware ($n = 185$)	Treated ($n = 187$)	Controlled ($n = 120$)
Age	**0.036**[a]	**0.002**[a]	0.784[b]
Gender	0.918	0.373	**0.037**
Level of intellectual disability	**0.004**[a]	**0.019**[a]	0.864[a]
Type of residence	0.405[a]	0.557[a]	0.153[b]
Current smoker	0.309	0.420	0.729[b]
Alcohol consumption	0.146[b]	0.401[b]	>0.999[b]
BMI (underweight excluded)	0.953	0.968	0.599
Waist circumference (normal excluded)	0.503	0.418	0.559[b]
Physical activity (low/not low)	0.519	0.712	0.787
CVD history	0.680	0.040[c]	0.775[b]
Diabetes	0.163	**0.001**	**0.013**
Health insurance	0.316[b]	0.794[b]	0.160[b]
Has had blood pressure measured	**0.018**[b]	0.099[b]	>0.999[b]
Down syndrome	0.110	0.419	0.057[b]

Bold indicates significant findings ($P < 0.05$).
Bivariate tests of association were conducted using Pearson's χ^2 test or where appropriate by linear by linear P value[a] or Fisher's exact test.[b]
[c]Confidence interval contains 1.

Table 7 Crude odds ratios for awareness, treatment, and control of hypertension

	Awareness			Treatment			Control		
	Crude OR	*P*-value	95% CI	Crude OR	*P*-value	95% CI	Crude OR	*P*-value	95% CI
Age									
44–49		0.065			0.007				
50–64	2.86	0.038	1.06–7.69	2.984	0.016	1.231–7.323			
65+	3.46	0.021	1.2–9.9	5.046	0.002	1.844–13.809			
Level of ID									
Mild		0.018			0.067				
Moderate	0.468	0.052	0.22–1.01	.501	0.114	.213–1.180			
Severe/profound	0.269	0.005	0.11–0.67	.323	0.020	.125–.838			
Diabetes: yes				5.167	0.003	1.729–15.44	4.57	0.02	1.28–16.39
Gender: female							2.32	0.039	1.04–5.18

by Janicki *et al.*[11] that there may not be sufficient active case finding. Despite the European Society of Cardiology guidelines[4] recommending that a total risk assessment (which includes BP monitoring) be routinely carried out on all adults >40 years of age, these guidelines have not been implemented in the ID population in Ireland and no such data have been published. Research is therefore required to establish a CVD risk profile for this vulnerable population. Nonetheless, lack of case finding alone does not provide a full explanation for the low rates of objectively established hypertension in adults with ID, despite the high levels of risk factors, as compared to the general population. Given this measured disconnect between risk and prevalence, additional research is needed to understand what protective factors may be present in this population and to further consider the presumed link between obesity, low levels of physical activity (more prevalent in people with ID), and measured/diagnosed hypertension.

The examination of factors associated with awareness, treatment, and control of hypertension, highlights that for persons with ID, their level of ID is an additional important and unique consideration, in that the greater their level of intellectual disability, the lower their level of awareness and treatment. Further, a concurrent diagnosis of diabetes is associated with greater levels of treatment, which raises concerns that those without a diabetes diagnosis, but with hypertension, are less likely to be treated.

The study has strengths and limitations. Proxy respondents completed just over one-third of the interviews, which could have introduced respondent bias. In order to reduce the chances of this from occurring, proxy respondents were required to be family members or key staff members who knew the participant well. In addition, using self-report questionnaires, as was the case in this study, runs the risk of recall bias along with the risk of over and under reporting, particularly if results are reliant on only one measurement. To counteract this and in line with the previously reported TILDA general population study and recommendations of epidemiological studies, independent measures of BP were completed[50] and medication prescription data were double checked. This added to the study's validity with respect to data on BP prevalence, treatment, and control. Further, providing some analyses on those ≥50 years facilitated direct comparison with the TILDA general population sample and added value to the study. Conversely, data on medications were not completely transparent and it was difficult to differentiate if beta blockers were used for dual or other indications, for example migraine and anxiety.

Conclusion

This study provides the most comprehensive information to date on the prevalence, level of awareness, treatment, and control of hypertension in older adults with ID in Ireland. In addition, it has facilitated some comparisons between the ID and the general population. Increased population and primary care level interventions to reduce hypertension prevalence and improve awareness, detection, and management has been recommended for all adults over 50 years in Ireland.[7] This study provides evidence that greater attention to screening in those with severe and profound levels of ID and in those without diabetes is required. Moreover, the findings that when hypertension is diagnosed, people with ID appear to respond particularly well to hypertension treatments should encourage addressing the under-treatment found here.

Acknowledgements

The authors would like to thank the people with ID who participated in the study, their families, carers, the services involved, the IDS-TILDA Scientific Advisory Committee, and the Intellectual Disability Consultative Groups for their support.

Funding

This research was funded by the Health Research Board and the Department of Health in Ireland [HRA-PHS-2012-14]. The funding body did not play a role in the study design or writing of the manuscript.

Conflict of interest: The authors declare(s) that there is no conflict of interest'.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

References

1. World Health Organization. *Cardiovascular Diseases*. Geneva: World Health Organization; 2017.
2. Central Statistics Office. *Vital Statistics Annual Report 2016*. Dublin: Central Statistics Office; 2018.
3. Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL, Cooney M-T, Corrà U, Cosyns B, Deaton C, Graham I, Hall MS, Hobbs FDR, Løchen M-L, Löllgen H, Marques-Vidal P, Perk J, Prescott E, Redon J, Richter DJ, Sattar N, Smulders Y, Tiberi M, van der Worp HB, van Dis I, Verschuren WMM. European Guidelines on cardiovascular disease prevention in clinical practice. The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice. *Eur Heart J* 2016;**37**:2315–2381.
4. Knuuti J, Wijns W, Saraste A, Capodanno D, BarbatoE Funck-BrentanoC PrescottE StoreyRF DeatonC CuissetT AgewallS DicksteinK EdvardsenT EscanedJ GershBJ SvitilP GilardM HasdaiD HatalaR MahfoudF MasipJMunerettoC, Valgimigli M, Achenbach S, Bax JJ; ESC Scientific Document Group. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes: the Task Force for the diagnosis and management of chronic coronary syndromes of the European Society of Cardiology. *Eur Heart J* 2019: 14:1–71. doi: 10.1093/eurheartj/ehz425.
5. World Health Organization. *Cardiovascular Diseases*. Geneva: World Health Organization; 2009.
6. Benjamin E, Virani S, Callaway Chamberlain A, Chang A, Cheng S, Chiuve S, Cushman M, Delling F, Deo R, de Ferranti S, Ferguson J, Fornage M, Gillespie C, Isasi C, Jiménez M, Jordan L, Judd S, Lackland D, Lichtman J, Lisabeth L, Liu S, Longenecker C, Lutsey P, Mackey J, Matchar D, Matsushita K, Mussolino M, Nasir K, O'Flaherty M, Palaniappan L, Pandey A, Pandey D, Reeves M, Ritchey M, Rodriguez C, Roth G, Rosamond W, Sampson U, Satou G, Shah S, Spartano N, Tirschwell D, Tsao C, Voeks J, Willey J, Wilkins J, Wu J, Alger H, Wong S, Muntner P. Heart disease and stroke statistics—2018 update: a report from the American Heart Association. *Circulation* 2018;**137**:e67–e492.
7. Murphy CM, Kearney PM, Shelley EB, Fahey T, Dooley C, Kenny RA. Hypertension prevalence, awareness, treatment and control in the over 50s in Ireland: evidence from The Irish Longitudinal Study on Ageing. *J Public Health* 2016;**38**:450–459.
8. Flygare Wallén E, Ljunggren G, Carlsson AC, Pettersson D, Wändell P. High prevalence of diabetes mellitus, hypertension and obesity among persons with a recorded diagnosis of intellectual disability or autism spectrum disorder. *J Intellect Disabil Res* 2018;**62**:269–280.
9. Susic D, Varagic J. Obesity: a perspective from hypertension. *Med Clin North Am* 2017;**101**:139–157.
10. de Winter CF, Bastiaanse LP, Hilgenkamp TIM, Evenhuis HM, Echteld MA. Cardiovascular risk factors (diabetes, hypertension, hypercholesterolemia and

metabolic syndrome) in older people with intellectual disability: results of the HA-ID study. *Res Dev Disabil* 2012;**33**:1722–1731.
11. Janicki MP, Davidson PW, Henderson CM, McCallion P, Taets JD, Force LT, Sulkes SB, Frangenberg E, Ladrigan PM. Health characteristics and health services utilization in older adults with intellectual disability living in community residences. *J Intellect Disabil Res* 2002;**46**:287–298.
12. de Winter CF, Magilsen KW, van Alfen JC, Penning C, Evenhuis HM. Prevalence of cardiovascular risk factors in older people with intellectual disability. *Am J Intellect Dev Disabil* 2009;**114**:427–436.
13. de Winter CF, Hermans H, Evenhuis HM, Echteld MA. Associations of symptoms of anxiety and depression with diabetes and cardiovascular risk factors in older people with intellectual disability. *J Intellect Disabil Res* 2015;**59**:176–185.
14. Hilgenkamp TIM, Reis D, van Wijck R, Evenhuis HM. Physical activity levels in older adults with intellectual disabilities are extremely low. *Res Dev Disabil* 2012; **33**:477–483.
15. Haveman M, Perry J, Salvador-Carulla L, Walsh PN, Kerr M, Van Schrojenstein Lantman-de Valk H, Van Hove G, Berger DM, Azema B, Buono S, Cara AC, Germanavicius A, Linehan C, Määttä T, Tossebro J, Weber G. Ageing and health status in adults with intellectual disabilities: results of the European POMONA II study. *J Intellect Dev Disabil* 2011;**36**:49–60.
16. Humphries K, Traci MA, Seekins T. Nutrition and adults with intellectual or developmental disabilities: systematic literature review results. *J Intellect Dev Disabil* 2009;**47**:163–185.
17. Nordstrøm M, Paus B, Retterstøl K, Kolset SO. The prevalence of metabolic risk factors of atherosclerotic cardiovascular disease in Williams's syndrome, Prader-Willi syndrome, and Down syndrome. *Intellect Dev Disabil* 2016;**41**:187–196.
18. Sinnema M, Maaskant MA, van Schrojenstein Lantman-de Valk HMJ, van Nieuwpoort IC, Drent ML, Curfs LMG, Schrander-Stumpel CT. Physical health problems in adults with Prader–Willi syndrome. *Am J Med Genet* 2011;**155A**: 2112–2124.
19. Strauss D, Cable W, Shavelle R. Causes of excess mortality in cerebral palsy. *Dev Med Child Neurol* 1999;**41**:580–585.
20. Draheim CC, Williams DP, McCubbin JA. Physical activity, dietary intake, and the insulin resistance syndrome in nondiabetic adults with mental retardation. *Am J Ment Retard* 2002;**107**:361–375.
21. Axmon A, Ahlström G, Höglund P. Prevalence and treatment of diabetes mellitus and hypertension among older adults with intellectual disability in comparison with the general population. *BMC Geriat* 2017;**17**: 10.1186/s12877-017-0658-2
22. Ng N, Flygare Wallén E, Ahlström G. Mortality patterns and risk among older men and women with intellectual disability: a Swedish national retrospective cohort study. *BMC Geriat* 2017;**7**: doi:10.1186/s12877-017-0665-3.
23. Erickson SR, Spoutz P, Dorsch M, Bleske B. Cardiovascular risk and treatment for adults with intellectual or developmental disabilities. *Int J Cardiol* 2016;**221**: 371–375.
24. Jansen J, Rozeboom W, Penning C, Evenhuis HM. Prevalence and incidence of myocardial infarction and cerebrovascular accident in ageing persons with intellectual disability. *J Intellect Disabil Res* 2013;**57**:681–685.
25. Stevens A, Courtney-Long E, Gillespie C, Armour BS. Hypertension among US adults by disability status and type, National Health and Nutrition Examination Survey, 2001-2010. *Prev Chronic Dis* 2014;**11**:E139.
26. Erickson SR, Kornexl K. Blood pressure screening, control, and treatment for patients with developmental disabilities in general medicine practices. *J Pharm Tech* 2016;**32**:234–239.
27. Heslop P, Blair PS, Fleming P, Hoghton M, Marriott A, Russ L. The confidential inquiry into premature deaths of people with intellectual disabilities in the UK: a population-based study. *Lancet* 2014;**383**:889–895.
28. Lauer E, McCallion P. Mortality of people with intellectual and developmental disabilities from select US state disability service systems and medical claims data. *J Appl Res Intellect Disabil* 2015;**28**:394–405.
29. McCarron M, Carroll R, Kelly C, McCallion P. Mortality rates in the General Irish Population compared to those with an intellectual disability from 2003 to 2012. *J Appl Res Intellect Disabil* 2015;**28**:406–413.
30. McCallion P, McCarron M. Death of people with intellectual disabilities in the UK. *Lancet* 2014;**383**:853–855.
31. Glover G, Williams R, Heslop P, Oyinlola J, Grey J. Mortality in people with intellectual disabilities in England. *J Intellect Disabil Res* 2017;**61**:62–74.
32. Kelly F, Kelly C. *Annual Report of the National Intellectual Disability Database Committee 2010*. Dublin: Health Research Board; 2011.
33. Kelly C. *National Intellectual Disability Database Committee Annual Report 2011*. Dublin: Health Research Board; 2012.
34. Leeder SR, Dominello A. Health, equity and intellectual disability. *J Appl Res Intellect Disabil* 2005;**18**:97–100.
35. Heller T, Sorensen A. Promoting health aging in adults with developmental disabilities. *Dev Disabil Res Rev* 2013;**18**:22–30.
36. McCarron M, Swinburne J, Burke E, McGlinchey E, Carroll R, McCallion P. Patterns of multimorbidity in an older population of persons with an intellectual disability: results from the intellectual disability supplement to the Irish longitudinal study on aging (IDS-TILDA). *Res Dev Disabil* 2013;**34**:521–527.
37. Williams B, Mancia G, Spiering W, Rosei E, Azizi M, Burnier M, Clement D, Coca A, de Simone G, Dominiczak A, Kahan T, Mahfoud F, Redon J, Ruilope L, Zanchetti A, Kerins M, Kjeldsen S, Kreutz R, Laurent S, Lip G, McManus R, Narkiewicz K, Ruschitzka F, Schmieder R, Shlyakhto E, Tsioufis C, AboyansV, Desormais I. 2018 ESC/ESH Guidelines for the management of arterial hypertension. The Task Force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH). *Eur Heart J* 2018;**39**:1–98.
38. World Health Organization. *Anatomical Chemical Therapeutic Classification System*. Geneva: World Health Organization; 2003.
39. O'Dwyer M, Peklar J, McCallion P, McCarron M, Henman MC. Factors associated with polypharmacy and excessive polypharmacy in older people with intellectual disability differ from the general population: a cross-sectional observational nationwide study. *BMJ Open* 2016;**6**:e010505.
40. Enoch MA, Goldman D. Problem drinking and alcoholism: diagnosis and treatment. *Am Fam Physician* 2002;**65**:441–448.
41. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003;**35**:1381–1395.
42. WHO Expert Committee on Physical Status: the Use and Interpretation of Anthropometry & World Health Organization. *Physical Status: The Use of and Interpretation of Anthropometry, Report of a WHO Expert Committee*. Geneva: World Health Organization; 1995.
43. World Health Organization. *Preventing and Managing the Global Epidemic—Report of a WHO Consultation on Obesity*. Geneva: World Health Organization; 2000.
44. BAPEN. Malnutrition Universal Screening Tool. 2012. http://www.bapen.org.uk/screening-for-malnutrition/must/introducing-must (26 November 2020).
45. Weekes E, Marinos E, Emery PW. The development, validation and reliability of a nutrition screening tool based on the recommendations of the British Association for Parenteral and Enteral Nutrition (BAPEN). *Clin Nutr* 2004;**23**: 1104–1112.
46. World Health Organization. *Waist Circumference and Waist–Hip Ratio; Report of a WHO Expert Consultation*. Geneva: World Health Organization; 2008.
47. Rickham PP. Human experimentation. Code of ethics of the World Medical Association. Declaration of Helsinki. *Br Med J* 1964;**2**:177.
48. Cyrus AC, Royer J, Carroll DD, Courtney-Long EA, McDermott S, Turk MA. Anti-hypertensive medication use and factors related to adherence among adults with intellectual and developmental disabilities. *Am J Intellect Dev Disabil* 2019; **124**:248–262.
49. Vacek JL, Hunt SL, Shireman T. Hypertension medication use and adherence among adults with developmental disability. *Disabil Health J* 2013;**6**:297–302.
50. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, Jones DW, Kurtz T, Sheps SG, Roccella EJ. Research Education of the American Heart Association Council on High Blood Pressure Statement for Professionals from the Subcommittee of Professional and Public Experimental Animals: Part 1: Blood Pressure Measurement in Humans: Recommendations for Blood Pressure Measurement in Humans. *Hypertension* 2005;**45**:142–161.