# Prevalence of Cardiovascular Risk Factors in Older People With Intellectual Disability

**Channa F. de Winter**
Bartiméus, Organization for People With Visual Impairment and Intellectual Disability (Doorn, Netherlands)

**Karla W. Magilsen**
Cordaan, Organization for People With Intellectual Disability (Amsterdam, Netherlands)

**J. Claudia van Alfen**
Bartiméus, Organization for People With Visual Impairment and Intellectual Disability

**Corine Penning and Heleen M. Evenhuis**
Erasmus University Medical Center, Intellectual Disability Medicine (Rotterdam, Netherlands)

## Abstract

The prevalence and correlates of cardiovascular risk factors in older adults with intellectual disability was examined. We conducted a cross-sectional study with 50- to 90-year-old clients ($N$ = 470) of three Dutch intellectual disability care providing organizations and found that healthy behavior was low, with 98.9% of the participants having an unhealthy diet and 68.3%, a lack of exercise. Smoking (13.6%) and alcohol abuse (0.3%) were relatively minor problems. Abdominal overweight (70.4%), diabetes (8.7%), hypertension (36.8%), and hypercholesterolemia (31.8%) were highly prevalent. These profiles have important implications in determining the risk of cardiovascular disease in people with intellectual disability. Campaigns to promote health should be focused on education and the introduction of preventive screening programs.

DOI: 10.1352/1944-7558-114.6.427

Cardiovascular disease is the leading cause of death in prosperous countries. Because of the high mortality, disability, and health care costs associated with cardiovascular disease, an active preventive approach has been adopted internationally, based on European guidelines on cardiovascular disease prevention (De Backer et al., 2003). Lifestyle and other risk factor modifications by means of education and other preventive measures have been shown to reduce mortality and morbidity (De Backer et al., 2003; Eliasson, Janiert, Jansson, & Stegmayr, 2006; Gillum, 1994; Kennedy, Kasl, Brass, & Vaccano, 2002; Scheuermann et al., 2000).

Similar to the general population, in people with intellectual disability, cardiovascular disease is an important health issue that is associated with high morbidity and mortality rates (Akker, Maaskant, & Meijden, 2006; Draheim, 2006; Patja, Mölsa, & Livanainenö, 2001). Certain syndromes causing intellectual disability, such as Down syndrome, can be associated with increased mortality of cardiovascular disease (Day, Strauss, Shavelle, & Reynolds, 2005; Hill et al., 2003). In contrast to the situation in the general population, cardiovascular mortality rates have not declined in this population (Carter & Jancar, 1983; Draheim, 2006; Janicki, Dalton, & Henderson, 1999). Although preventive measures in this population are addressed by individual physicians, there is a need for far-reaching global prevention policies.

In the Netherlands, a preventive program for general practitioners (GPs) to reduce cardiovascular risk factors in the general population aged 50 years and over, has been introduced (Nederlands Huisartsen Genootschap, 2006; Dutch Institute for Health Improvement, 2006). In this program, GPs are advised to obtain a complete cardiovascular risk profile on all persons with established cardiovascular disease, diabetes, or risk of developing cardiovascular disease (e.g., persons who smoke or have single elevated risk factors such as hypertension, obesity, or hypercholesterolemia). Other persons included in the program are those who ask to have their blood pressure or cholesterol checked. A cardiovascular risk profile consists of the following patient characteristics: age, gender, smoker, blood pressure, lipid spectrum, serum glucose, family history of cardiovascular disease, diet, use of alcohol, exercise, body mass index, and waist circumference. The profiles are used to determine the 10-year risk (%) of fatal cardiovascular disease, according to the SCORE risk function (De Backer et al., 2003), which indicates the necessity of intervention. The SCORE risk function has been derived from outcomes of the European SCORE project (Conroy et al., 2003). In this project, longitudinal data for over 200,000 people without a history of myocardial infarction from 12 European cohort studies were used to predict 10-year cardiovascular disease morbidity. Until now, the Dutch GP guideline has not systematically been introduced for older people with intellectual disability.

Studies on the prevalence of cardiovascular risk factors in the population with intellectual disability are scarce. In a study among older people with Down syndrome, 19% had two or more cardiovascular risk factors, such as diabetes mellitus, hypertension, cardiovascular disease, and/or smoker (Coppus et al., 2008). Weight control is important to prevent the development of type 2 diabetes at older age for people with Down syndrome (Uchiyama, Hanaoka, Tomono, & Kurabayashi, 2000). Published studies in broader populations with intellectual disability suggest a high prevalence of unhealthy lifestyle and similar or increased prevalence of cardiovascular risk factors (Beange, McElduff, & Baker, 1995; Bhaumik, Watson, Thorp, Tyrer, & McGrother, 2008; Draheim, Stanish, Williams, & McCubbin, 2007; Draheim, Williams, & McCubbin, 2002a, 2002b; Emerson, 2005; McGuiree, Daly, & Smyth, 2007; Rimmer , Braddock, & Fujiura, 1994; Robertson et al., 2000). However, in these studies researchers either followed highly select populations or based their findings on incomplete cardiovascular risk profiles.

People with intellectual disability may need a more active approach than other patients of GPs do. They often lack the ability to notice or address symptoms of disease and may not be able to understand and be appropriately concerned about risk factors of cardiovascular disease. Because this can delay detection and intervention (Beange et al.,1995; Draheim, 2006; Evenhuis,1997), active population screening should be introduced at the age of 50. To justify population screening in this group, data on cardiovascular risks obtained by unbiased larger study groups is urgently needed. Therefore, we applied the Dutch GP screening guideline to a large group of older persons with intellectual disability, with the aims of (a) determining the prevalence of cardiovascular risk factors (smoking, hypertension, hypercholesterolemia [high serum cholesterol], diabetes mellitus, family history of cardiovascular disease, unhealthy diet, lack of physical activity, overweight, history of cardiovascular accidents, and/or myocardial infarction) in older people with intellectual disability and (b) identifying the relation of these occurrences with Down syndrome and level of intellectual disability.

## Method

### *Study Population*

We conducted a multicenter, observational, cross-sectional study. Three agencies that provide care for people with intellectual disability participated. These organizations, whose aims are care, support, integration, and participation, provide residential care, small-scaled community-based homes, supported independent living, and day care. Residential clients receive health care either from a GP or from specialists in intellectual disability. In total 1,781 people live in homes run by these three agencies. The inclusion criteria for this study were age 50 years or over and receiving their primary healthcare from an intellectual disability physician. Individuals who received medical care from GPs were excluded for logistical reasons.

A power analysis showed that, for a confidence interval (CI) of 95% and maximum error of 5%, at least 369 individuals needed to be included. This was based on the 40% prevalence of obesity in women residing in group homes (Rimmer et al., 1994).

### *Study Approval*

Introduction of an active screening program according to the Dutch GP guideline was considered as an improvement of the quality of health care for people with intellectual disability by the three Boards of Management of the participating organizations, the clients/representatives committees, the ethics committees, and the intellectual disability physicians. The local ethics committees approved analysis of the data obtained by the screening. Individual clients, or in cases where an individual was considered unable to give informed consent, their legal guardians were asked to give written informed consent to participate in the screening and for use of their medical records for scientific evaluation and publication of the outcomes.

### *Data Collection*

All participants were screened according to the Dutch GP guideline for cardiovascular health management (Dutch Institute for Health Improvement, 2006) by intellectual disability physicians from the three care-providing organizations. Because symptoms may be unrecognized and not addressed by people with intellectual disability, we obtained a complete cardiovascular risk profile (age, gender, smoker, systolic blood pressure, lipid spectrum, serum glucose, family history of cardiovascular disease, diet, use of alcohol, exercise, body mass index (BMI), and waist circumference) for all participants, independent of known risks or concerns of participants or caregivers.

Demographic data were collected from the participants' medical charts. These consisted of age (years), gender, etiological diagnosis (either Down syndrome or other etiologies), congenital heart disease and use of antihypertensive, cholesterol-lowering and antidiabetic medication. Each participant had formerly been tested on intellectual functioning by psychologists working for the care-providing organizations. Severity of intellectual disability was classified as mild (IQ 50–69), moderate (IQ 35–49), severe (IQ 20–34), and profound (IQ $<$ 20) (Division of Mental Health and Prevention of Substance Abuse, 1996).

In a semi-structured interview, we asked participants about lifestyle (smoking, alcohol, diet, exercise). People with mild intellectual disability completed the interviews themselves ($n = 57$); for people with moderate to profound intellectual disability ($n = 413$), information was gathered with help from the staff member assigned as their personal coach. A *smoker* was defined as smoking a minimum of one cigarette, cigar, or pipe a week. Alcohol intake was noted as units per week. *Alcohol abuse* was defined as three or more alcoholic drinks a day for men and two or more alcoholic drinks a day for women (Dutch Institute for Health Improvement, 2006). According to World Health Organization (WHO) guidelines, we defined a *healthy diet* as at least 200 g of vegetables per day, two pieces of fruit per day, and two portions of fish per week (Health Council of the Netherlands, 2001). Diet information was based on 3-day recall. In order to compare the data on fruit intake of our sample with data from the general population, we calculated the pieces of fruit in g. A *sufficient amount of exercise* was defined as at least 30 min of moderate exercise on at least 5 days out of the week (World Health Organization, 2005).

Medical history of the participants was obtained by an interview and chart review. A history of previous cerebrovascular accident as confirmed by computed tomography scan (CT) changes or previous myocardial infarction as confirmed by electrocardiogram (ECG) changes was noted. A *positive family history* was defined as occurrence of a myocardial infarction or cerebrovascular accident before the age of 60 years in parents or siblings. We obtained family history from legal representatives (a relative or close caregiver who was the legal guardian) using a standardized written interview.

In the physical examination, we measured the BMI (see Table 1), waist circumference to determine central (abdominal) obesity (Table 1), and systolic blood pressure ($\geq$ 140 mm Hg or use of antihypertensive drugs was classified as *hypertension*) (Dutch Institute for Health Improvement, 2006; World Health Organization, 2005). Blood samples were obtained after an overnight fast. In the blood samples the following risk factors were assessed (with references of elevated values indi-

**Table 1.** Reference Values of Body Mass Index (BMI) and Waist Size

| | | Waist | |
|---|---|---|---|
| Characteristic | BMI (kg/m2) | Male (cm) | Female (cm) |
| Underweight | $< 18.5$ | $< 79$ | $< 68$ |
| Healthy weight | 18.5–24.9 | 79–93.9 | 68–79.9 |
| Overweight | 25.0–29.9 | 94–101.9 | 80–87.9 |
| Obese | $\geq 30.0$ | $> 102$ | $> 88$ |

*Note*. From the World Health Organization (2005).

cated): glucose ($\geq$ 7.0 mmol/L), total cholesterol (varying from $>$ 5.1 mmol/L to $\geq$ 6.5 mmol/L, depending on the reference values of the three laboratories involved), low density lipoprotein levels–LDL ($\geq$ 3.5 mmol/L), and total cholesterol/high density lipoprotein cholesterol (TC/HDL) ratio. Participants who used antidiabetic drugs or cholesterol-lowering drugs were classified as having diabetes or hypercholesterolemia, respectively.

### *Statistical Analysis*

We analyzed data using SPSS version 14.0. People with more severe intellectual disability were likely to be overrepresented because of exclusion of clients receiving nonspecialist medical care by GPs. Women were expected to be overrepresented because one location (a former nunnery) provided care only for females. Therefore, the results could not be directly extrapolated to the total older adult population with intellectual disability in the Netherlands. To compensate for the skewed study population, we applied re-weighting (Rubin & Schenker, 1991). A large study on the composition of the Dutch population with intellectual disability ($N$ = 16,482) was performed by Van Schrojenstein Lantman-de Valk, Van Hern-Nijsten, and Wullink (2002). Based on this information, we computed the weighted prevalence from the figures found in the 4 (level of intellectual disability: mild, moderate, severe, profound) $\times$ 2 (gender) matrix Chi-square analysis was used to compare the weighted prevalence of overweight, hypertension, hypercholesterolemia, diabetes mellitus, lack of exercise, and smoking between subgroups (participants with and without Down syndrome and the four levels of intellectual disability).

Furthermore, we evaluated any possible correlation of hypertension, hypercholesterolemia, overweight, and diabetes mellitus with relevant patient variables: gender, age (linear in years), family history, exercise, weight (two categories: overweight, not overweight), smoker, Down syndrome, and level of intellectual disability (four categories). First, we performed univariate regression analyses for hypertension, hypercholesterolemia, being overweight, and diabetes mellitus with each of the variables. Patient variables that seemed relevant, $p < .2$, were included in the subsequent multiple logistic regression analysis.

## Results

### *Study Population*

Out of the 1,781 clients from the three organizations, 478 participants ages 50 or older received primary health care from intellectual disability physicians. They all consented for screening according to the Dutch GP guideline. They were screened for cardiovascular risk factors in the period from December 2006 to June 2007. Eight participants or legal representatives consented to participate in the screening but did not give consent for publication of results. The remaining 470 patients were included in the present study.

Table 2 shows the demographic statistics. Mean age was 60.8 years ($SD$ = 8.3, range 50 to 90). Distribution of the age groups compared to published data on age groups in the general population (Viet et al., 2001) is shown in Figure 1. As expected, women were overrepresented (72.8% vs. 27.2%). The majority of participants had a moderate or severe intellectual disability.

### *Prevalence of Cardiovascular Risk Factors*

The weighted prevalence of the studied cardiovascular risk factors and comparison with the published prevalence in the general Dutch population are shown in Table 3. Of the sample, 70.4% were central overweight (weighted prevalence). Hypercholesterolemia according to total cholesterol levels was present in 31.9%. An elevated LDL was present in 42.6% (95% CI 38.1 to 47.2%). The TC/HDL ratios were 4 to 5.9: 36.1% (95% CI 31.7 to 40.5%), 6 to 7.9: 11.5% (95% CI 8.6 to 14.4%), and $\geq$ 8: 3.7% (95% CI 1.9 to 5.4%). No comparable data for the general population were found for LDL and TC/HDL

 

**Table 2.** Demographic Characteristics for Participants ($N = 470$)

| Characteristic | Absolute number | Relative number (%) |
|---|---|---|
| Gender/Age[a] | | |
| Male | | |
| 50–59 (53.6) | 94 | 20.0 |
| 60–69 (63.7) | 24 | 5.1 |
| ≥ 70 (75.1) | 10 | 2.1 |
| Total | 128 | 27.2 |
| Female | | |
| 50–59 (54.5) | 158 | 33.6 |
| 60–69 (65.3) | 108 | 23.0 |
| ≥ 70 (73.6) | 76 | 16.2 |
| Total | 342 | 72.8 |
| Level of intellectual disability | | |
| Mild | 57 | 12.1 |
| Moderate | 156 | 33.2 |
| Severe | 161 | 34.3 |
| Profound | 96 | 20.4 |
| Etiology | | |
| Down syndrome | 54 | 11.5 |
| Other | 416 | 88.5 |
| Congenital heart disease | 16 | 3.4 |
| History of cerebrovascular infarction | 11 | 2.3 |
| History of myocardial infarction | 6 | 1.7 |

[a]Average age in parentheses.

levels. A family history of cardiovascular disease was present in 33.6% of the sample (95% CI 28.5 to 38.8) ($n = 327$). The weighted prevalence of lifestyle factors is shown in Table 4. The prevalence of having an unhealthy diet was 98.9%, which was defined as not meeting the recommendations for fish, fruit, and vegetable intake. Fruit and vegetable intake for our sample compared with the general population is shown in Table 5.

### *Associations With Down Syndrome and Level of Intellectual Disability*

Comparison with chi square analysis showed that people with Down syndrome smoked less often, $p = .011$, were more likely to be overweight, $p = .023$, and suffered less often from diabetes mellitus, $p = .0001$, than did people without Down syndrome. Comparison of different levels of intellectual disability revealed that people with mild intellectual disability smoked significantly more often than did people with more severe levels of intellectual disability, $p = .013$. Because of the almost 100% prevalence of unhealthy diet and the near absence of alcohol abuse, we did not compare these factors between groups.

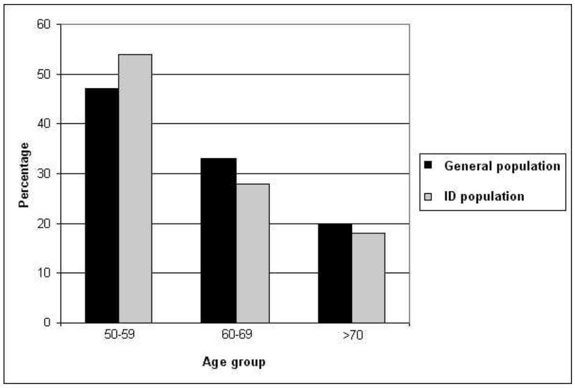


**Figure 1.** Comparison of age distribution between study intellectual disability (ID) population and general population (Viet et al., 2001).

### *Associations With Hypertension, Hypercholesterolemia, Overweight, and Diabetes*

Univariate analyses showed that for hypercholesterolemia, relevant variables, $p < .2$, were age, exercise, weight, and level of intellectual disability. For being overweight, relevant variables were gender, Down syndrome, and level of intellectual disability. For diabetes mellitus, relevant variables were age, family history, exercise, weight, Down syndrome, and level of intellectual disability.

Subsequently, in the multiple logistic regression analysis, we found no significant associations for hypertension and diabetes with any of the patient variables that were assumed to be relevant (see Table 6). For hypercholesterolemia there was a significant association with having severe intellectual disability, $p = .016$, and a trend towards significance for higher age, $p = .054$. Females and individuals with Down syndrome in the study group were more at risk for being overweight, $ps < .004$ and $.008$, respectively.

 

**Table 3.** Weighted Prevalence of Cardiovascular Risk Factors by Study Group and General Population

| Group/Risk factor | Total no.[a] | Prevalence % | Prevalence CI[b] |
|---|---|---|---|
| Study population (*N* = 470) | | | |
| Hypertension | 441 | 36.8 | 32.3–41.3 |
| Body mass index ≥ 30 | 466 | 15.0 | 11.8–18.3 |
| Waist circumference obesity | 459 | 45.7 | 41.0–50.3 |
| Hypercholesterolemia | 458 | 31.9 | 27.6–36.1* |
| Diabetes mellitus | 456 | 8.8 | 6.2–11.4 |
| General population[d] (*N* = 1,742) | | | |
| Hypertension[c] | 496 | 33.0 | 29.8–36.3 |
| Body mass index ≥ 30 | 790 | 19.8 | 16.3–23.3 |
| Waist circumference obesity | 790 | 41.3 | 37.8–44.7 |
| Hypercholesterolemia | 731 | 18.3 | 15.5–21.1* |
| Diabetes mellitus | 427 | 6.1 | 3.8–8.4 |

[a]Those with missing data were excluded. [b]95% 2-tailed confidence interval. [c]Hypertension based on WHO-criteria systolic pressure ≥ 140 mmHg and/or diastolic pressure ≥ 90 mmHg and/or use of antihypertensive. [d]Information for general population from Viet et al. (2001).
*Difference in confidence interval.

Participants with severe or profound intellectual disability had a significantly lower risk of being overweight, *p*s < .017 and .019, respectively.

## Discussion

This is the first study in which complete cardiovascular risk profiles according to the Dutch GP screening guideline were investigated. Participants were 470 Dutch adults with intellectual disability ages 50 years and over. We applied weighting to obtain the representative population prevalence of cardiovascular disease risk factors. Several of such factors appeared similar to those in the general population, including rates of central overweight (70.4%), hypertension (36.8%), and diabetes (8.7%). An exception was the high prevalence of hypercholesterolemia (31.8%). There were also high rates of unhealthy diets (98.9%) and lack of physical activity (68.3%).

Because we did not assess a control group from the general population, we compared the weighted prevalence of risk factors found in this study with published occurrences in the general Dutch population (Viet et al., 2001). The prevalence of smoking (13.6%) and alcohol abuse (0.3%) were low in our study group, but no comparable data were found for the older (50+ years) Dutch population.

**Table 4.** Weighted Prevalence of Lifestyle Factors in the Study Group

| Lifestyle factor | Total no.[a] | Prevalence % | Prevalence CI[b] |
|---|---|---|---|
| Unhealthy diet[c] | 440 | 98.9 | 97.9–99.9 |
| Not eating enough fish | 465 | 97.7 | 96.4–99.1 |
| Not eating enough vegetables | 440 | 81.8 | 78.2–85.4 |
| Not eating enough fruit | 442 | 96.6 | 94.9–98.3 |
| Alcohol abuse | 470 | 0.3 | 0.0–0.6 |
| Smoking | 470 | 13.6 | 10.5–16.7 |
| Lack of exercise[d] | 461 | 68.3 | 64.1–72.6 |

[a]Those with missing data were excluded. [b]95% 2–tailed confidence interval. [c]Not meeting recommendations for fish, fruit, and vegetables. [d]Not meeting recommendations.

**Table 5.** Fruit and Vegetable Intake by Study Group and General Population

| Group/Age/Intake | Vegetables | Fruit |
|---|---|---|
| Study population | | |
| Aged 50–59 (*n* = 272) | | |
| Mean daily intake[a] | 137 | 117 |
| Aged 60–69 (*n* = 108) | | |
| Mean daily intake[a] | 125 | 150 |
| General population[b] | | |
| Aged 50–59 (*n* = 281) | | |
| Mean daily intake | 155 | 227 |
| Aged 60–69 (*n* = 166) | | |
| Mean daily intake[a] | 146 | 223 |

[a]g/day. [b]Information from Viet et al. (2001).

 

**Table 6.** Multiple Logistic Regression Analyses and Odds Ratios (OR)

| Disease/Risk factor | OR[a] | CI[b] |
|---|---|---|
| Hypertension | | |
| Age, years | 1.03 | 0.98–1.09 |
| Family history | 1.94 | 0.82–4.58 |
| Overweight | 1.15 | 0.37–2.78 |
| Hypercholesterolemia | | |
| Overweight | 1.59 | 0.96–2.62 |
| Lack of exercise | 1.65 | 0.95–2.84 |
| Age | 1.03 | 1.00–1.06 |
| Level of ID (Mild = 1) | | |
| Moderate | 1.95 | 0.87–4.37 |
| Severe | 2.68 | 1.21–5.96* |
| Profound | 2.08 | 0.77–5.58 |
| Overweight | | |
| Gender (male = 1) | 1.96 | 1.25–3.08* |
| Down syndrome | 2.97 | 1.32–6.68* |
| Level of ID (Mild = 1) | | |
| Moderate | 0.68 | 0.35–1.33 |
| Severe | 0.44 | 0.22–0.86* |
| Profound | 0.37 | 0.16–0.85* |
| Diabetes | | |
| Overweight | 3.71 | 0.90–15.30 |
| Lack of exercise | 3.21 | 0.48–21.32 |
| Family history | 2.17 | 0.78–11.28 |
| Age | 1.05 | 0.98–2.65 |
| Down syndrome | 0.05 | 0.00–2.65 |
| Level of ID (Mild = 1) | | |
| Moderate | 1.01 | 0.17–6.02 |
| Severe | 0.73 | 0.16–4.67 |
| Profound | 0.72 | 0.08–6.46 |

[a]Odds ratio. [b]2-tailed 95% confidence interval.
$^{*}p < .05$.

The high rates of unhealthy diet, lack of physical activity, and central obesity support findings in previous studies of people with intellectual disability (Bhaumik et al., 2008; Draheim et al., 2002a, 2002b; Emerson, 2005; Ewing et al., 2004; McGuiree et al., 2007; Robertson et al., 2000). We found higher levels of hypercholesterolemia and hypertension as compared with previous studies by Beange et al. (1995) and Akker et al. (2006). However, this was expected because these earlier studies included young adults.

The above-mentioned results may warrant concern. The combination of unhealthy diet and lack of exercise leads to high rates of central obesity, especially for females and people with Down syndrome or mild intellectual disability. The first two subgroups are prone to be overweight because of genetic influences (Carmeli, Kessel, Bar-Chad, & Merrick, 2004; Ogden et al., 2006), whereas the high prevalence of obesity in people with mild intellectual disability can be explained by living independently combined with a lack of insight into the impact of a healthy lifestyle. These individuals make their own choices on their diet and whether to exercise. People with severe and profound intellectual disability rely on food prepared by caregiving staff and structured group exercise activities, which may explain the opposing lower risk of being overweight for this group.

The high prevalence of hypercholesterolemia (both by total cholesterol and LDL-cholesterol levels) might be related to the lack of exercise and the unhealthy diet (Dutch Institute for Health Improvement, 2006). Other possible culprits are the use of antipsychotics and the genetic syndrome(s) that caused the intellectual disability. Moreover, for the general population much attention (by media and educators) is given to healthy cholesterol levels (Eliasson et al., 2006), which might not be the case for the intellectual disability population.

Do the present cardiovascular disease risk profiles imply a higher or lower risk of cardiovascular disease for people with intellectual disability than for same-age people in the general population? The low rates of confirmed myocardial infarction and stroke may be misleading due to a lack of objective diagnostic confirmation or missed diagnoses rather than actual lower morbidity rates. Because age distribution in the intellectual disability population studied here is equal to the distribution in the general population, this is not a healthy survivor cohort. Here, we provide a broad cardiovascular disease risk profile, but the consequences of cardiovascular disease risk factors on cardiovascular disease morbidity and mortality compared to the general population needs further investigation.

The characteristics of the study population introduced several limitations to this study. As a result of the inclusion of one participating care organization, formerly caring exclusively for female patients, and the exclusion of clients receiving medical care by GPs, the study population was skewed towards an overrepresentation of females and individuals with more severe intellectual disability, respectively. Therefore, the observed prevalence of cardiovascular disease risk factors was not directly representative of the total population of older adults with intellectual disability. Nevertheless, the study population and subgroups were large enough to compute the weighted prevalence of these factors, compensating for any bias due to unequal distribution in gender or level of intellectual disability. Second, the food questionnaire, based on the Dutch GP guideline, did not provide information on fat intake. It also remains difficult to acquire accurate information on dietary intake through use of interviewing methods. Moreover, we had to compare our data to published data for the general Dutch population. Our data were collected in 2006, whereas the general population data were published in 2001. It is difficult to predict the possible effects on the general population of cardiovascular risk factors and lifestyle habits, which may have changed in the 5-year interval. For example, obesity is receiving increasing attention as a major health problem and awareness of cardiovascular risks is also increasing.

However, compensating strengths in the present study include the large study group and a high level of participation. By active screening according to the Dutch GP guideline (Dutch Institute for Health Improvement, 2006), we obtained complete and standardized cardiovascular risk profiles. Future research should be focused on the consequent risk of cardiovascular disease in people with intellectual disability compared to the general population in longitudinal morbidity and mortality studies.

Recommendations for clinical practice include an active approach to detect risk factors to prevent cardiovascular disease. Importantly, active identification and treatment of risk factors is needed in the intellectual disability population. It has become clear that although people with intellectual disability have equal risk factors for cardiovascular disease, they may be less capable of noticing or addressing early signs of this disease and/or may lack the understanding to be appropriately concerned about risk factors. We suggest developing active screening programs for people with intellectual disability ages 50 years and over. Programs should be based on cost-effective guidelines, such as the Dutch GP guideline for cardiovascular risk management (or might be incorporated into the present GP guideline). We suggest that this protocol should be repeated every 5 years because cardiovascular risks increase steadily with age. Furthermore, administrators of intellectual disability careproviding organizations should focus their policies on promoting healthy behaviors. Because people with mild to moderate intellectual disability increasingly live independently, education on lifestyle and consequent health benefits is necessary (Marshall, McConkey, & Moore, 2003). People with severe and profound intellectual disability rely on staff for exercise and diet, necessitating health education for these staff members. We believe that preventive measures may improve the quality of life and life expectation of individuals with intellectual disability.

## References

Akker, van den, M., Maaskant, M. A., & Meijden, van der, R. J. M. (2006). Cardiac diseases in people with intellectual disability. *Journal of Intellectual Disability Research*, *50*, 515–522.

Beange, H., McElduff, A., & Baker, W. (1995). Medical disorders of adults with mental retardation: A population study. *American Journal on Mental Retardation*, *99*, 595–560.

Bhaumik, S., Watson, J. M., Thorp, C. S., Tyrer, F., & McGrother, C. W. (2008). Body mass index in adults with intellectual disability: Distribution, implication and service implications: A population-based prevalence study. *Journal of Intellectual Disability Research*, *52*, 287–298.

Carmeli, E., Kessel, S., Bar-Chad, S., & Merrick, J. (2004). A comparison between older persons with Down syndrome and a control group: Clinical characteristics, functional status and sensorimotor function. *Down's Syndrome Research and Practice*, *9*, 17–24.

Carter, G., & Jancar, J. (1983). Mortality in the mentally handicapped: A 50 year survey at the Stoke Park group of hospitals (1930–1980). *Journal of Mental Deficiency Research*, *27*, 143–156.

Conroy, R. M., Pyorala, K., Fitzgerald, A. P., Sans, S., Menotti, A., De Backer, G., et al. (2003). Estimation of ten-year risk of fatal cardiovascular disease in Europe: The SCORE project. *European Heart Journal*, *24*, 987–1003.

Coppus, A. M. W., Evenhuis, H. M., Verberne, G. J., Visser, F. E., Oostra, B. A., Eikelenboom, P., et al. (2008). *Journal of the American Geriatrics Society*, *56*, 2311–2316.

 

Day, S. M., Strauss, D. J., Shavelle, R. M., & Reynolds, R. J. (2005). Mortality and causes of death in persons with Down syndrome in California. *Developmental Medicine and Child Neurology*, *47*, 171–176.

De Backer, G., Ambrosioni, E., Borch-Johnsen, K., Brotons, C., Cifkova, R., Dallongeville, J., et al. (2003). European guidelines on cardiovascular disease prevention in clinical practice. Third Joint Task Force of European and Other Societies on Cardiovascular Disease Prevention in Clinical Practice. *European Heart Journal*, *24*, 1601–1610.

Division of Mental Health and Prevention of Substance Abuse. (1996). *ICD-10 guide for mental health* (10th ed.). Geneva: World Health Organization.

Draheim, C. C. (2006). Cardiovascular disease prevalence and risk factors of persons with mental retardation. *Mental Retardation and Developmental Disabilities Research Reviews*, *12*, 3–12.

Draheim, C. C., Stanish, H. I., Williams, D. P., & McCubbin, J. A. (2007). Dietary intake of people with mental retardation who reside in community settings. *American Journal on Mental Retardation*, *112*, 392–400.

Draheim, C. C., Williams, D. P., & McCubbin, J. A. (2002a). Physical activity, dietary intake and the insulin resistance syndrome in nondiabetic adults with mental retardation. *American Journal on Mental Retardation*, *107*, 361–375.

Draheim, C. C., Williams, D. P., & McCubbin, J. A. (2002b). Prevalence of physical inactivity and recommended physical activity in adults with mental retardation residing in community settings. *Mental Retardation*, *40*, 436–444.

Dutch Institution for Health Improvement (CBO). (2006). *Dutch guideline cardiovascular risk management*. Utrecht, The Netherlands: Dutch Institute for Healthcare Improvement CBO and Dutch College of General Practitioners.

Eliasson, M., Janiert, U., Jansson, J. H., & Stegmayr, B. (2006). Time trends in population cholesterol levels 1996–2004: Influence of lipid-lowering drugs, obesity, smoking and educational level. The northern Sweden MONICA study. *Journal of Internal Medicine*, *260*, 551–559.

Emerson, E. (2005). Underweight, obesity and exercise among adults with intellectual disabilities in supported accommodation in Northern England. *Journal of Intellectual Disability Research*, *49*, 134–143.

Evenhuis, H. M. (1997). Medical aspects of ageing in a population with intellectual disability: III. Mobility, internal conditions and cancer. *Journal of Intellectual Disability Research*, *41*, 8–18.

Ewing, G., McDermott, S., Thomas-Koger, M., Withner, W., & Pierce, K. (2004). Evaluation of a cardiovascular health program for participants with mental retardation and normal learners. *Health Education and Behaviour*, *31*, 77–87.

Gillum, R. F. (1994). Trends in acute myocardial infarction and coronary heart disease in the United States. *Journal of the American College of Cardiology*, *23*, 1273–1277.

Health Council of the Netherlands (Gezondheidsraad). (2001). *Standard on dietary intake of energy, proteins, fat and digestible carbohydrates* (*Voedingsnormen energie, eiwitten, vetten en verteerbare koolhydraten*). (Publication No. 2001/19). The Hague, The Netherlands: Author.

Hill, D. A., Gridley, G., Cnattingius, S., Mellemkjaer, L., Linet, M., Adami, H. O., et al. (2003). Mortality and cancer incidence among individuals with Down syndrome. *Archives of Internal Medicine*, *163*, 705–711.

Janicki, M. P., Dalton, A. J., & Henderson, C. M. (1999). Mortality and morbidity among older adults with intellectual disability: Health service considerations. *Disability and Rehability*, *21*, 284–294.

Kennedy, B. S., Kasl, S. V., Brass, L. M., & Vaccarino, V. (2002). Trends in hospitalized stroke for blacks and whites in the United States, 1980–1999. *Neuroepidemiology*, *21*, 131–141.

Marshall, D., McConkey, R., & Moore, G. (2003). Obesity in people with intellectual disabilities: The impact of nurse-led health screening and health promotion activities. *Journal of Advanced Nursing*, *41*, 147–153.

McGuiree, B. E., Daly, P., & Smyth, F. (2007). Lifestyle and health behaviours of adults with an intellectual disability. *Journal of Intellectual Disability Research*, *51*, 497–510.

Nederlands Huisartsen Genootschap (Dutch General Practitioners Association). (2006). *Cardiovasculair risicomanagement* (*Cardiovascular risk management*). Utrecht, The Netherlands: Author.

Ogden, C. L., Caroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. L., & Flegal, K.

M. (2006). Prevalence of overweight and obesity in the United States, 1999–2004. *Journal of the American Medical Association*, *295*, 1549–1555.

Patja, K., Mölsa, P., & Livanainen, M. (2001). Cause-specific mortality of people with intellectual disability in a population-based, 35-year follow-up study. *Journal of Intellectual Disability Research*, *45*, 30–40.

Rimmer, J. H., Braddock, D., & Fujiura, G. (1994). Cardiovascular risk factor levels in adults with mental retardation. *American Journal on Mental Retardation*, *98*, 510–518.

Robertson, J., Emerson, E., Gregory, N., Hatto, C., Turner, S., Kessissoglou, S., et al. (2000). Lifestyle related risk factors for poor health in residential settings for people with intellectual disabilities. *Research in Developmental Disabilities*, *21*, 469–486.

Rubin, D. B., & Schenker, N. (1991). Multiple imputation in healthcare databases. An overview and some applications. *Statistics in Medicine*, *10*, 585–598.

Scheuermann, W., Razum, O., Scheidt, R., Wiesemann, A., Von Frankenberh, H., Topf, G., & Nüssel, E. (2000). Effectiveness of a decentralized, community-related approach to reduce cardiovascular disease risk factor levels in Germany. *European Heart Journal*, *21*, 1591–1597.

Uchiyama, T., Hanaoka, T., Tomono, S., & Kurabayashi, M. (2000). Prevalence of diabetes in adult patients with Down's syndrome living in a residential home. *Diabetes Care*, *23*, 705–706.

Van Schrojenstein Lantman-de Valk, H., Van Hern-Nijsten, E. W. A., & Wullink, M. (2002). *People with intellectual disabilities in the Netherlands. (Mensen met een verstandelijke beperking in Nederland.)*. Maastricht, The Netherlands: Maastricht University.

Viet, van den, A L., Hof, van den, S, Elvers, L H., Ocke, M. C., Vossenaar, M., Seidell, J. C., et al. (2001). Risk factors and health in the Netherlands, a survey by municipal public. *Het Regenboogproject*. RIVM report, Bilthoven, The Netherlands.

World Health Organization. (2005). *Avoiding heart attacks and strokes: Don't be a victim, protect yourself*. Geneva: Author.

*Received 10/26/08, accepted 6/17/09.*
*Editor-in-charge:* Eric Emerson

The authors thank 's Heerenloo-Zuid Rivierenland, Center for People With Intellectual Disability; Druten, De Prinsenstichting, Organization for People With Intellectual Disability; Purmerend, Bartiméus, Organization for People With Visual Impairment and Intellectual Disability; and the clients for participating in this study. Furthermore, the authors thank W. B. Oswald and W. Anderson for their comments on the manuscript.
Correspondence regarding this article should be sent to Heleen Evenhuis, Erasmus University Medical Center, Intellectual Disability Medicine, Department of General Practice. Rotterdam, 3000 CA, Netherlands. E-mail: h.evenhuis@erasmusmc.nl

 