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## **Dietary supplements for aggressive behavior: studies in people with intellectual disability**

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# *Chapter 2*

## **DIET QUALITY AMONG PEOPLE WITH INTELLECTUAL DISABILITIES AND BORDERLINE INTELLECTUAL FUNCTIONING**

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## ABSTRACT

**Background:** We sought to assess diet quality among people with intellectual disabilities or borderline intellectual functioning, living in residential facilities or receiving day care.

**Methods:** We measured diet quality using the Dutch Healthy Diet Food Frequency Questionnaire (DHD) and compared this between participants with ( $n = 151$ ) and controls without intellectual disabilities ( $n = 169$ ). Potential correlates of diet quality were explored.

**Results:** We found lower mean diet quality among people with intellectual disabilities ( $M = 80.9$ ) compared to controls ( $M = 111.2$ ; mean adjusted difference  $-28.4$ ; 95% CI  $[-32.3, -24.5]$ ;  $p < .001$ ). Participants with borderline intellectual functioning and mild intellectual disabilities had lower diet quality and higher body mass index than individuals with severe to profound intellectual disabilities. Being female was a predictor of better diet quality.

**Conclusion:** Overall, we found that diet quality was low in the sample of people with intellectual disabilities or borderline intellectual functioning.

## INTRODUCTION

Individuals with intellectual disabilities are at an increased risk of poor diet, but there is insufficient information to understand how nutritional problems are expressed in this population (Humphries et al., 2009). Obesity, diabetes and stunted growth are examples of chronic diet-related health problems that are relatively prevalent in individuals with intellectual disabilities (Cushing et al., 2012; Ptomey & Wittenbrook, 2015). These health problems are not evenly distributed across the different severity levels among intellectual disabilities. A high prevalence of obesity (34.4%–43.9%) is found in people with mild intellectual disabilities and moderate intellectual disabilities (Hsieh et al., 2014). There is a relatively high prevalence of being underweight (10.1%) in people with severe to profound intellectual disabilities (Hsieh et al., 2014). Nutritional status among the different severity levels of intellectual disabilities needs to be systematically assessed to support effective nutritional interventions. In this study, we focused on the dietary intake of people with intellectual disabilities or borderline intellectual functioning, which is usually assessed using food frequency questionnaires (FFQs) and food diaries (Koritsas & Iacono, 2016). Compared to the recommended daily intake, people with intellectual disabilities scored low on the dietary intake of fibres (Adolfsson et al., 2008; Bertoli et al., 2006), vegetables and fruits (Draheim et al., 2007; Hamzaid et al., 2020; Humphries et al., 2004) and poly-unsaturated fatty acids (PUFAs; Molteno et al., 2000; Soler Marín & Graupera, 2011). In several studies, the relative proportion of saturated fats or simple carbohydrates to the total energy intake was high (Cunningham et al., 1990; McGuire et al., 2007; Robertson et al., 2000). However, the concept of diet quality goes beyond looking at the individual micro- or macronutrients; it aims to evaluate the entire food intake (van Lee et al., 2016; Wirt & Collins, 2009). The relationship between diet quality and the severity of an intellectual disability has not yet been explored. Furthermore, people with borderline intellectual functioning are not often included in studies, even though they may adaptively function at the same level as people with mild intellectual disabilities (Arvidsson & Granlund, 2018). To date, no quality diet studies have been conducted among people with intellectual disabilities or borderline intellectual functioning that differentiate between the levels of intellectual disabilities. Diet studies in which diet quality was compared to a control group from the general population are

also scarce. Being overweight is linked in complex bidirectional ways to caloric intake and food choices. Sundararajan et al. (2014) found that body mass index (BMI) was inversely associated with diet quality in the general population, but there is a gap in the literature regarding the potential association between BMI and diet quality among people with intellectual disabilities. The first aim of our study was to assess diet quality among people with intellectual disabilities or borderline intellectual functioning and to compare this assessment to the general population. The second aim of our study was to compare diet quality and BMI distribution between the people with different levels of intellectual disabilities.

## **METHOD**

The current study was part of an overarching research project investigating the effectiveness of nutritional supplementation on aggressive behaviour among people with intellectual disabilities (clinicalTrials.gov, NCT03212092). There were two steps in the inclusion procedure. First, the inclusion criteria to participate in the informed consent procedure included having an IQ < 85 and living in a residential facility or receiving day care for at least 5 days a week. During this first step, we collected dietary and all other data used for the current analyses. Second, participants who met specific exclusion criteria regarding age, behavior, breastfeeding, medication, morbidity or pregnancy could not proceed with the randomised controlled trial (RCT).

### **Ethical statement**

The research was conducted in full accordance with the ethical principles of the World Medical Association Declaration of Helsinki. The ethical review board of the Leiden University Medical Centre (LUMC) approved the study (NL60839.058.17). All study participants or their legal representatives gave their written informed consent before the start of the data collection. Certain participants had sufficient cognitive functions to judge what participation in the study would entail, but they nevertheless had a legal representative because of their minor age or because a legal representative had been appointed by the court. In these cases, both the client and the legal representative gave written informed consent. Special versions of informed consent forms were designed to be comprehensible for people with moderate to mild intellectual disabilities.

## Participants

**Table 2.1** Descriptive Characteristics of Participants and Control Subjects

	Participants with Intellectual Disabilities			Controls			<i>p</i> *
	<i>n</i>	Mean ( <i>SD</i> ) or %	Range	<i>n</i>	Mean ( <i>SD</i> ) or %	Range	
<b>Male</b>	98	64.9%		142	84.0%		
<b>Female</b>	53	35.1%		27	16.0%		
<b>Age (years)</b>	151	23.2 (7.9)	12–57	169	26.4 (7.5)	14–40	<.001
<b>Body Mass Index (BMI)</b>	149	24.9 (6.1)	14–52	168	22.7 (3.8)	16–44	<.001
<b>IQ</b>	142	52.6 (20.6)	10–85				
<b>Receiving Day Care Only</b>	9	6.0%					
<b>Staying in a Residential Facility</b>	142	94.0%					

Note. \* Difference between groups

All persons who gave informed consent (or for whom informed consent was given) were included in this study. We also included participants who were not included in the subsequent RCT. Participants were recruited between March 2018 and April 2020 from six intellectual disabilities service provider organisations located throughout the Netherlands. For the sake of readability, we will refer to this entire group as ‘people with intellectual disabilities’ and will only refer to ‘borderline intellectual functioning’ when it is necessary to distinguish between these groups. Two of the organisations were forensic care facilities for people with mild intellectual disabilities.

**Table 2.2** BMI, Mean Age, and Proportion of Females Among Participants

Severity of ID	<i>n</i>	BMI ( <i>SD</i> )	<i>n</i>	Age in Years ( <i>SD</i> )	% female
<b>Borderline</b>	42	26.1 (5.9)	42	20.2 (7.4)	52.4%
<b>Mild</b>	41	27.1 (7.8)	42	23.6 (7.9)	38.1%
<b>Moderate</b>	22	23.4 (4.8)	22	25.3 (6.6)	27.3%
<b>Severe to Profound</b>	44	22.4 (3.9)	45	24.5 (8.5)	20.0%
<b>Total</b>	149	24.9 (6.1)	151	23.2 (7.9)	35.1%

Note. Borderline = borderline intellectual functioning, BMI = Body Mass Index

The control group was drawn from of the ‘EetMeetWeet’ (EatMeasureKnow) study ([www.eetmeetweet.nl](http://www.eetmeetweet.nl)). This longitudinal online study on the relationship between food and health is open to all adults who want to commit themselves to a long-term study on

this topic. For the control group, we included all participants between the ages of 12 and 40 years who applied to the 'EetMeetWeet' study between February 2017 and July 2017. The control group consisted of 169 participants who had a mean age of 26.4 (SD = 7.5) years.

### **Data collection**

We assessed diet quality using the Dutch Healthy Diet Food Frequency Questionnaire (DHD) ([www.eetscore.nl](http://www.eetscore.nl)), a questionnaire based on the 2015 Dutch food-based guidelines for a healthy diet (Gezondheidsraad, 2015; Kromhout et al., 2016). The DHD is a short self-report screener with 40 items and is derived from the more extensive Dutch Healthy Diet Index (Looman et al., 2017; van Lee et al., 2016). The DHD evaluates to what extent someone adheres to the Dutch Dietary Guidelines as suggested by the Health Council of the Netherlands (Gezondheidsraad, 2015). The total score ranges from 0 to 160, with higher scores indicating a better diet quality. Sixteen food groups, with a score between 0 and 10, include vegetables, fruits, whole-wheat products, legumes, nuts, dairy, fish, tea, fats and oils, coffee, red meats, processed meats, sweetened beverages, alcohol, salt and unhealthy food products. The last group is based on the guidelines set by the Netherlands Nutrition Centre (Brink et al., 2019). For the healthy food groups, such as 'fruits' and 'vegetables', a higher intake resulted in a higher score (between 0 and 10). For unhealthy food groups, such as 'processed meats' or 'sweetened beverages and fruit juices', a higher intake resulted in a lower score. Whole grain products were based on the ratio of whole grain to refined grain, and 'fats and oils' were based on the ratio of saturated to unsaturated fats. For dairy, we used an optimum score of 300–450 g per day (Looman et al., 2017; see Appendix 2.1). In the paper questionnaires, participants provided details regarding their daily diet from the preceding month. A caregiver assisted the participants with mild intellectual disabilities when the detailed nutritional questions were too complex for them to complete independently. The caregiver completed the questionnaire as a proxy for participants with severe to profound intellectual disabilities (Table 2.3). We included three additional questions that determined who decided what the participants ate, how well informed the proxy was about the food habits of a participant, and who completed the DHD. The control group completed the DHD questionnaire online using an e-form (<http://www.eetscore.nl/>). Caregivers obtained the following demographic characteristics from participants: age, gender, weight (kilogramme) and height (metre). We used the case-file data provided by the healthcare

organisations to obtain participants' IQ scores. The IQ and developmental age tests were conducted by psychologists at various time points, who used the following validated tests: Bayley, Snijders-Oomen non-verbal intelligence test (Son-R), Vineland Adaptive Behavior Scale (VABS), Wechsler Adult Intelligence Scale (WAIS), Wechsler Intelligence Scale for Children (WISC), Wechsler Non-Verbal (WNV) and the Universal Non-verbal Intelligence Test (UNIT). When a participant with severe to profound intellectual disabilities did not have a measured IQ, we estimated that participants' IQ from his or her developmental age using the WHO developmental age range as a reference (World Health Organization, 2010). The IQ cut-off values used for the intellectual-disabilities severity groups are shown in figure 2.2 (Boat & Wu, 2015). The BMI (in kg/m<sup>2</sup>) was calculated and used as a potential predictor for diet quality, in addition to age and gender (Hiza et al., 2013; Temple et al., 2010).

**Table 2.3.** Additional Questions in the Group of People With Intellectual Disabilities About the Food Choice and the Use of Proxy Informants for Completing the DHD (n = 150)

	<i>n</i>	%
<b>Who Decides What the Participant Eats?</b>		
Not the caregiver nor the participant	20	13.3
Caregiver	50	33.3
Caregiver together with the participant	71	47.3
Participant only	1	0.7
Parents	8	5.3
<b>Who Completed the DHD?</b>		
Proxy	64	42.7
Proxy together with participant	85	56.7
Participant alone	1	0.7
<b>Does the Proxy Know Everything the Participant Is Eating?</b>		
Yes, every meal including snacks	89	59.3
All meals except snacks	32	21.3
Two meals a day	20	13.3
One meal a day	8	5.3
No	1	0.7

Note. DHD = Dutch Healthy Diet Food Frequency Questionnaire

## Data analysis

Multivariate linear regression analysis was used to compare the DHD total and subscores between people with intellectual disabilities and controls, adjusting for age, gender and



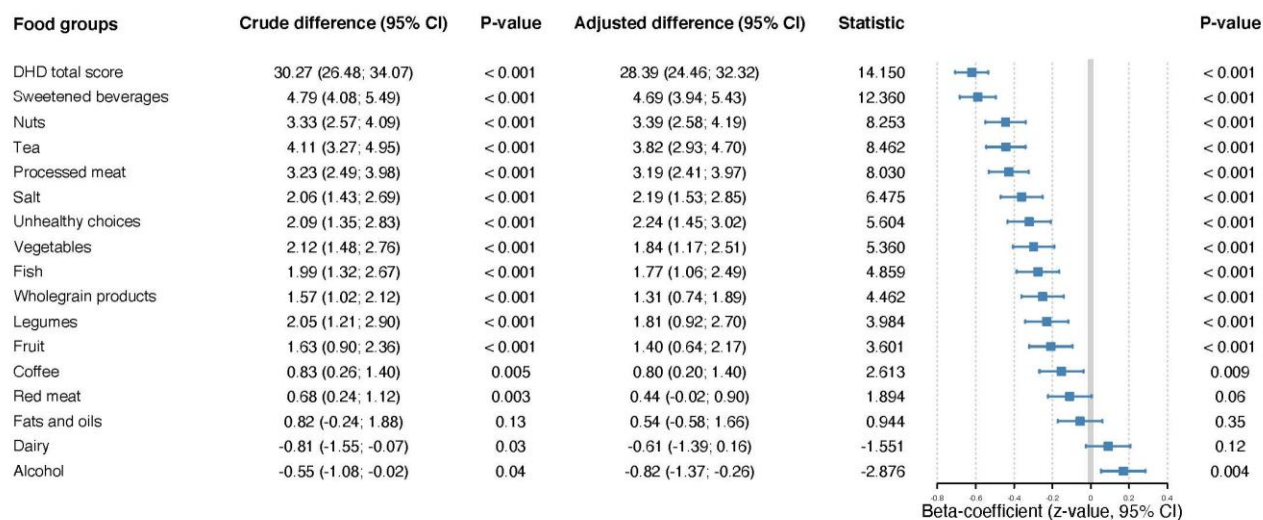
BMI. Furthermore, as potential correlates of the DHD total score, we entered the categories age, gender, BMI and IQ into a linear regression model. Using an ANCOVA, we assessed the difference in BMI between the severity groups of people with intellectual disabilities, adjusting for age and gender. Significance levels were adjusted for multiple testing based on the Benjamini–Hochberg procedure (Benjamini & Hochberg, 1995). Data were analysed using SPSS statistical software 25.0 (version 25, IBM Corp.) and the R statistical software, version 3.4.1 (R Foundation for Statistical Computing, Vienna, Austria 2016, <https://www.R-project.org/>)

## RESULTS

Demographic characteristics of participants and controls are presented in Table 2.1. We included 320 participants (of whom 21.9% were women): 151 people with intellectual disabilities and 169 controls. The mean age of the group of people with intellectual disabilities was significantly higher than that of the controls. Men were overrepresented in both groups: 64.9% (people with intellectual disabilities) and 84.0% (controls). The group of people with intellectual disabilities showed a higher mean BMI than controls. Table 2.2 shows the mean BMI according to intellectual disability severity group. It is noteworthy that the BMI is significantly higher in participants with mild intellectual disabilities than participants with severe and profound intellectual disabilities,  $F(3, 143) = 5.3, p = .002$ .

At most locations, the food choices were made by the caregiver together with the participant (Table 2.3). Figure 2.1, the mean DHD total score of the participants with intellectual disabilities was 80.9 (SE  $\pm$  1.4; range: 26–118). The poorest adherence to the Dutch Dietary Guidelines was seen in the subcategories unhealthy choices (mean score 1.1), nuts (score 1.9), tea (score 2.3), processed meats (score 2.7), sweetened beverages (score 3.2) and fish (score 3.6). The best adherence was seen in the subcategories coffee (score 7.3), red meat (score 8.9) and alcohol (score 9.4). The total DHD score of participants with intellectual disabilities was on average 30 points lower compared to that of controls (80.9 vs. 111.2;  $p < .001$ ). Furthermore, significant mean differences were observed for all subcategories except for red meat, fats and oils and dairy. All subcategory scores that differed significantly from the control group showed a lower score in the

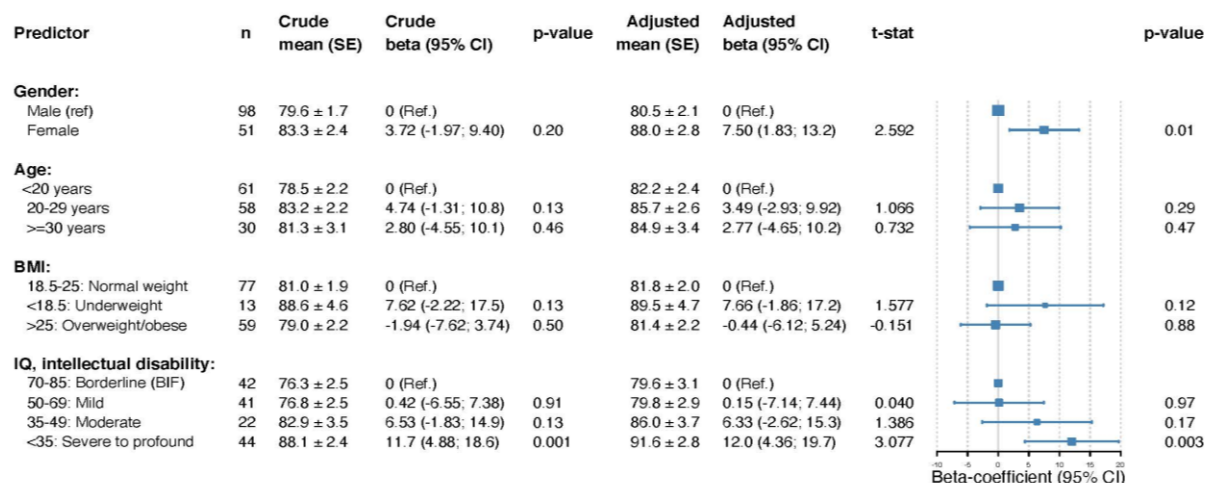
group of people with intellectual disabilities compared to the control group, except for alcohol. The largest mean differences in subcategory scores were observed for the following categories: processed meats (3.2 points lower), nuts (3.4 points lower), tea (3.8 points lower) and sweetened beverages (4.7 points lower). Significant associations persisted after adjusting for multiple testing.



**Figure 2.1** Frequency questionnaire (DHD) score of participants with intellectual disabilities and controls and their adjusted differences. DHD = Dutch Healthy Diet Food Frequency Questionnaire

### Predictors of diet quality

Figure 2.2 presents the analyses of the potential correlates of overall diet quality for the 151 participants with intellectual disabilities. In the multivariate analysis, women had on average a better diet quality compared to men ( $p = .01$ ). Participants with mild intellectual disabilities and borderline intellectual functioning had a lower diet quality compared to participants with severe to profound intellectual disabilities ( $p = .007$ ). Age and BMI groups were not significant predictors in the multivariable model.



**Figure 2.2** Predictors of diet quality in people with intellectual disabilities, crude and adjusted means and crude and adjusted betas with Forest plots. BIF, borderline intellectual functioning; BMI, body mass index; IQ, intelligence quotient

## DISCUSSION

Overall, our results showed that diet quality in participants with intellectual disabilities was lower than that of the control group. This applied to almost all food groups, with the exception of dairy products and alcohol. The general pattern was that participants with intellectual disabilities tended to over-consume sugar, processed meats and other unhealthy food products and under-consume omega-3 FAs (i.e., fish and nuts). Male participants and those with mild intellectual disability and borderline intellectual functioning were at the highest risk of consuming a low-quality diet. It is likely that a change in eating habits in these individuals will reduce the burden of disease. The finding of an overall low-diet quality in people with intellectual disabilities compared to the controls is consistent with previous research (Bertoli et al., 2006; Braunschweig et al., 2004; Draheim et al., 2007; Hoey et al., 2017; McGuire et al., 2007). Likewise, many studies found similar consumption patterns in the ‘unhealthy choices’ and ‘sweetened beverages’ categories (Cartwright et al., 2015; Chia-Feng & Jin-Ding, 2010). In our study, alcohol consumption was low in all severity categories among people with intellectual disabilities. Among people with mild intellectual disabilities; however, alcohol consumption can be similar or even higher than that found in peers of average intelligence (Didden et al., 2020). The difference in our study can be explained by the fact that many of our participants with mild intellectual disabilities had zero or restricted

access to alcoholic beverages. Although our research was not designed to study potential causes of the relatively low-diet quality in people with intellectual disabilities, some speculations can be made. First, it is often easier and cheaper to make unhealthy food choices (Appelhans et al., 2012; Jetter & Cassady, 2006). Without proper support, people with intellectual disabilities lack the insight and money to go for the healthier choices. In previous studies among people with moderate and mild intellectual disabilities, researchers have suggested that unsupported autonomy in food choice may lead to less healthy food choices (Adolfsson et al., 2012; Bryan et al., 2000; Grammatikopoulou et al., 2008). Second, the support staff may also lack sufficient training in foods and nutrition (Humphries et al., 2004). The low-diet quality in people with mild intellectual disabilities is of concern. We found different intake levels of diverse food groups, which may increase the risk of weight gain and abdominal obesity (Barnes et al., 2015; Ruanpeng et al., 2017; Schlesinger et al., 2019). It is also known that the prevalence of obesity and nutrition-related diseases in people with moderate intellectual disabilities to mild intellectual disabilities is high (Bryan et al., 2000; Hsieh et al., 2014; Ptomey & Wittenbrook, 2015; Ranjan et al., 2018). It is likely that a change in eating habits in these individuals will reduce the burden of disease.

### **Limitations**

The DHD is a 40-item screener providing a rough estimate of the diet quality. This retrospective questionnaire may be susceptible to recall bias. The method of administration of the DHD differed among the cases and controls. Participants with intellectual disabilities often needed assistance from the support staff (observer) to complete a paper questionnaire; the control group used an online version of the questionnaire as a self-report scale. Both methods have their own risks of measurement error and bias. When filling in a self-report scale, there may be an increased risk of participants giving socially desirable answers. When support staff helps to complete the questionnaire, some errors may be introduced because the observer is not always observing what the client is eating. Although our sample size is larger than that of previous diet quality studies in this study population, it is still small for our purposes. Moreover, participants and controls were not matched by age or gender, but we adjusted for these potential confounders in the multivariate analyses. The IQ data of the care organisations were measured using various instruments and collected at various time points, which makes a comparison of the scores less accurate. In addition, the

classification of the severity level of intellectual disabilities based solely on IQ scores is outdated (Tassé et al., 2016). Since the DSM-5, it is advised to include the level of adaptive functioning in a patient's assessment (American Psychiatric Association [APA], 2013, p. 33). Furthermore, our participants may not be representative of the whole population of people with intellectual disabilities, as they were recruited for a study on aggression and displayed higher levels of aggressive behavior. Therefore, our findings need to be replicated in other groups of people with intellectual disabilities. Additionally, the control group may have had some self-selection for a relatively healthy lifestyle (given the lower than average BMI) compared to the general population (RIVM, 2012).

### **Strengths**

The same FFQ was used in people with intellectual disabilities and controls. Moreover, we adjusted our analysis for potential confounders, and we analysed the potential effects of different severity levels among intellectual disabilities. Additionally, the data were collected in 76 locations from four intellectual disabilities care organisations and two forensic intellectual disabilities care organisations in the Netherlands, which increased the external validity.

### **Conclusion**

Even if people with moderate to mild intellectual disabilities can identify healthy food, they still need support to translate this knowledge into making healthy choices (Adolfsson et al., 2012; Kuijken et al., 2016). To sustainably increase the diet quality, more is needed apart from simply training the support staff. In a study regarding the facilitating factors for health promotion, Kuijken et al. (2019) concluded that a healthy lifestyle should be embedded in the mission of the care organisation and in the individual support plans of the clients with intellectual disabilities and should also be part of the employees' job descriptions. Diet quality among people with intellectual disabilities might be improved through a deeper integration into the entire care system.

## REFERENCES

1. Adolfsson, P., Fjellström, C., Lewin, B., & Sydner, M. Y. (2012). Foodwork among people with intellectual disabilities and dietary implications depending on staff involvement. *Scandinavian Journal of Disability Research*, *14*(1), 40–55. <https://doi.org/10.1080/15017419.2010.507384>
2. Adolfsson, P., Sydner, Y. M., Fjellstrom, C., Lewin, B., & Andersson, A. (2008). Observed dietary intake in adults with intellectual disability living in the community. *Food & Nutrition Research*, *52*. <https://doi.org/10.3402/fnr.v52i0.1857>
3. American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington DC
4. Appelhans, B. M., Milliron, B. J., Woolf, K., Johnson, T. J., Pagoto, S. L., Schneider, K. L., ... Ventrelle, J. C. (2012). Socioeconomic status, energy cost, and nutrient content of supermarket food purchases. *American Journal of Preventive Medicine*, *42*(4), 398–402. <https://doi.org/10.1016/j.amepre.2011.12.007>
5. Arvidsson, P., & Granlund, M. (2018). The relationship between intelligence quotient and aspects of everyday functioning and participation for people who have mild and borderline intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities*, *31*(1), e68–e78.
6. Barnes, T. L., French, S. A., Harnack, L. J., Mitchell, N. R., & Wolfson, J. (2015). Snacking behaviors, diet quality, and body mass index in a community sample of working adults. *Journal of the Academy of Nutrition and Dietetics*, *115*(7), 1117–1123. <https://doi.org/10.1016/j.jand.2015.01.009>
7. Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological)*, *57*(1), 289–300.
8. Bertoli, S., Battezzati, A., Merati, G., Margonato, V., Maggioni, M., Testolin, G., & Veicsteinas, A. (2006). Nutritional status and dietary patterns in disabled people. *Nutrition, Metabolism and Cardiovascular Diseases*, *16*(2), 100–112.
9. Boat, T. F., & Wu, J. T., (Eds.). (2015). *Mental disorders and disabilities among low-income children*. Washington, DC, USA: National Academies Press.
10. Braunschweig, C. L., Gomez, S., Sheean, P., Tomey, K. M., Rimmer, J., & Heller, T. (2004). Nutritional status and risk factors for chronic disease in urban-dwelling adults with Down syndrome. *American Journal on Mental Retardation*, *109*(2), 186–193.
11. Brink, E., van Rossum, C., Postma-Smeets, A., Stafleu, A., Wolvers, D., van Dooren, C., ... Ocké, M. (2019). Development of healthy and sustainable food-based dietary guidelines for the Netherlands. *Public Health Nutrition*, *22*(13), 2419–2435. <https://doi.org/10.1017/s1368980019001435>
12. Bryan, F., Allan, T., & Russell, L. (2000). The move from a long-stay learning disabilities hospital to community homes: A comparison of clients' nutritional status. *Journal of Human Nutrition and Dietetics*, *13*(4), 265–270.
13. Cartwright, L., Reid, M., Hammersley, R., Blackburn, C., & Glover, L. (2015). Food choice by people with intellectual disabilities at day centres: A qualitative study. *Journal of Intellectual Disabilities*, *19*(2), 103–115. <https://doi.org/10.1177/1744629514563423>
14. Chia-Feng, Y., & Jin-Ding, L. (2010). Factors for healthy food or less-healthy food intake among Taiwanese adolescents with intellectual disabilities. *Research in Developmental Disabilities*, *31*(1), 203–211. <https://doi.org/10.1016/j.ridd.2009.09.003>
15. Cunningham, K., Gibney, M. J., Kelly, A., Kevany, J., & Mulcahy, M. (1990). Nutrient intakes in long-stay mentally handicapped persons. *British Journal of Nutrition*, *64*(1), 3–11. <https://doi.org/10.1079/bjn19900004>
16. Cushing, P., Spear, D., Novak, P., Rosenzweig, L., Wallace, L. S., Conway, C., ... Medlen, J. G. (2012). Academy of Nutrition and Dietetics: Standards of practice and standards of professional performance for registered dietitians (competent, proficient, and expert) in intellectual and developmental disabilities. *Journal of the Academy of Nutrition and Dietetics*, *112*(9), 1454–1464 <https://doi.org/10.1016/j.jand.2012.06.365>
17. Didden, R., VanDerNagel, J., Delforterie, M., & van Duijvenbode, N. (2020). Substance use disorders in people with intellectual disability. *Current Opinion Psychiatry*, *33*(2), 124–129. <https://doi.org/10.1097/YCO.0000000000000569>

18. Draheim, C. C., Stanish, H. I., Williams, D. P., McCubbin, J. A., & MacLean, Jr., W. E. (2007). Dietary intake of adults with mental retardation who reside in community settings. *American Journal on Mental Retardation*, 112(5), 392–400.
19. Gezondheidsraad [Health Council of the Netherlands]. (2015). *Aanbieding advies Richtlijnen goede voeding 2015* (Uw kenmerk: GZB/VVB/98653). Retrieved from <https://www.gezondheidsraad.nl/documenten/adviezen/2015/11/04/richtlijnen-goede-voeding-2015>
20. Grammatikopoulou, M. G., Manai, A., Tsigga, M., Tsiligioglou-Fachantidou, A., Galli-Tsinopoulou, A., & Zakas, A. (2008). Nutrient intake and anthropometry in children and adolescents with Down syndrome—A preliminary study. *Developmental Neurorehabilitation*, 11(4), 260–267. <https://doi.org/10.1080/17518420802525526>
21. Hamzaid, N. H., O'Connor, H. T., & Flood, V. M. (2019). Observed dietary intake in adults with intellectual disability living in group homes. *Nutrients*, 12(1). <https://doi.org/10.3390/nu12010037>
22. Hiza, H. A., Casavale, K. O., Guenther, P. M., & Davis, C. A. (2013). Diet quality of Americans differs by age, sex, race/ethnicity, income, and education level. *Journal of the Academy of Nutrition and Dietetics*, 113(2), 297–306. <https://doi.org/10.1016/j.jand.2012.08.011>
23. Hoey, E., Staines, A., Walsh, D., Corby, D., Bowers, K., Belton, S., ... Trépel, D. (2017). An examination of the nutritional intake and anthropometric status of individuals with intellectual disabilities: Results from the SOPHIE study. *Journal of Intellectual Disabilities*, 21(4), 346–365.
24. Hsieh, K., Rimmer, J. H., & Heller, T. (2014). Obesity and associated factors in adults with intellectual disability. *Journal of Intellectual Disability Research*, 58(9), 851–863. <https://doi.org/10.1111/jir.12100>
25. Humphries, K., Traci, M. A., & Seekins, T. (2009). Nutrition and adults with intellectual or developmental disabilities: Systematic literature review results. *Intellectual and Developmental Disabilities*, 47(3), 163–185. <https://aiddjournals.org/doi/pdf/10.1352/1934-9556-47.3.163>
26. Humphries, K., Traci, M. A., & Seekins, T. O. M. (2004). A preliminary assessment of the nutrition and food-system environment of adults with intellectual disabilities living in supported arrangements in the community. *Ecology of Food and Nutrition*, 43(6), 517–532. <https://doi.org/10.1080/03670240490888731>
27. Jetter, K. M., & Cassady, D. L. (2006). The availability and cost of healthier food alternatives. *American Journal of Preventive Medicine*, 30(1), 38–44. <https://doi.org/10.1016/j.amepre.2005.08.039>
28. Koritsas, S., & Iacono, T. (2016). Weight, nutrition, food choice, and physical activity in adults with intellectual disability. *Journal of Intellectual Disability Research*, 60(4), 355–364. <https://doi.org/10.1111/jir.12254>
29. Kromhout, D., Spaaij, C. J., de Goede, J., & Weggemans, R. M. (2016). The 2015 Dutch food-based dietary guidelines. *European Journal of Clinical Nutrition*, 70(8), 869–878. <https://doi.org/10.1038/ejcn.2016.52>
30. Kuijken, N. M. J., Naaldenberg, J., Nijhuis-van der Sanden, M. W., & van Schroyen Lantman-de Valk, H. M. J. (2016). Healthy living according to adults with intellectual disabilities: Towards tailoring health promotion initiatives. *Journal of Intellectual Disability Research*, 60(3), 228–241. <https://doi.org/10.1111/jir.12243>
31. Kuijken, N. M. J., Vlot-van Anrooij, K., van Schroyen Lantman-de Valk, H. M. J., Leusink, G., Naaldenberg, J., & Nijhuis-van der Sanden, M. W. (2019). Stakeholder expectations, roles and responsibilities in Dutch health promotion for people with intellectual disabilities. *Health Promotion International*, 34(5), e59–e70. <https://doi.org/10.1093/heapro/day059>
32. Looman, M., Feskens, E. J., de Rijk, M., Meijboom, S., Biesbroek, S., Temme, E. H., ... Geelen, A. (2017). Development and evaluation of the Dutch Healthy Diet index 2015. *Public Health Nutrition*, 20(13), 2289–2299. <https://doi.org/10.1017/S136898001700091X>
33. Magenis, M. L., Machado, A. G., Bongiorno, A. M., Silva, M. A. D., Castro, K., & Perry, I. D. S. (2018). Dietary practices of children and adolescents with Down syndrome. *Journal of Intellectual Disabilities*, 22(2), 125–134. <https://doi.org/10.1177/1744629516686571>
34. McGuire, B. E., Daly, P., & Smyth, F. (2007). Lifestyle and health behaviours of adults with an intellectual disability. *Journal of Intellectual Disability Research*, 51(Pt 7), 497–510. <https://doi.org/10.1111/j.1365-2788.2006.00915.x>
35. Molteno, C., Smit, I., Mills, J., & Huskisson, J. (2000). Nutritional status of patients in a long-stay hospital for people with mental handicap. *South African Medical Journal*, 90(11), 1135–1140.

36. Ptomey, L. T., & Wittenbrook, W. (2015). Position of the Academy of Nutrition and Dietetics: Nutrition services for individuals with intellectual and developmental disabilities and special health care needs. *Journal of the Academy of Nutrition and Dietetics*, *115*(4), 593–608. <https://doi.org/10.1016/j.jand.2015.02.002>
37. Ranjan, S., Nasser, J. A., & Fisher, K. (2018). Prevalence and potential factors associated with overweight and obesity status in adults with intellectual developmental disorders. *Journal of Applied Research in Intellectual Disabilities*, *31*(1), 29–38. <https://doi.org/10.1111/jar.12370>
38. RIVM (2012). Gemiddelde Body Mass Index (kg/m<sup>2</sup>) naar leeftijd en geslacht (Average Body Mass Index (kg/m<sup>2</sup>) by age and gender). Retrieved from <https://www.rivm.nl/documenten>.
39. Robertson, J., Emerson, E., Gregory, N., Hatton, C., Turner, S., Kessissoglou, S., & Hallam, A. (2000). Lifestyle related risk factors for poor health in residential settings for people with intellectual disabilities. *Research in Developmental Disabilities*, *21*(6), 469–486.
40. Ruanpeng, D., Thongprayoon, C., Cheungpasitporn, W., & Harindhanavudhi, T. (2017). Sugar and artificially sweetened beverages linked to obesity: A systematic review and meta-analysis. *QJM: An International Journal of Medicine*, *110*(8), 513–520. <https://doi.org/10.1093/qjmed/hcx068>
41. Schlesinger, S., Neuenschwander, M., Schwedhelm, C., Hoffmann, G., Bechthold, A., Boeing, H., & Schwingshackl, L. (2019). Food groups and risk of overweight, obesity, and weight gain: A systematic review and dose-response meta-analysis of prospective studies. *Advances in Nutrition*, *10*(2), 205–218. <https://doi.org/10.1093/advances/nmy092>
42. Soler Marín, A., & Graupera, J. M. X. (2011). Nutritional status of intellectual disabled persons with Down syndrome. *Nutricion Hospitalaria*, *26*(5), 1059–1066.
43. Sundararajan, K., Campbell, M. K., Choi, Y. H., & Sarma, S. (2014). The relationship between diet quality and adult obesity: Evidence from Canada. *Journal of the American College of Nutrition*, *33*(1), 1–17. <https://doi.org/10.1080/07315724.2013.848157>
44. Tassé, M. J., Luckasson, R., & Schalock, R. L. (2016). The relation between intellectual functioning and adaptive behavior in the diagnosis of intellectual disability. *Intellectual and Developmental Disabilities*, *54*(6), 381–390.
45. Temple, V. A., Walkley, J. W., & Greenway, K. (2010). Body mass index as an indicator of adiposity among adults with intellectual disability. *Journal of Intellectual and Developmental Disability*, *35*(2), 116–120. <https://doi.org/10.3109/13668251003694598>
46. van Lee, L., Feskens, E., Meijboom, S., van Huysduynen, E. J. H., van't Veer, P., de Vries, J. H., & Geelen, A. (2016). Evaluation of a screener to assess diet quality in the Netherlands. *British Journal of Nutrition* *115*(3), 517–526.
47. Wirt, A., & Collins, C. E. (2009). Diet quality—What is it and does it matter? *Public Health Nutrition*, *12*(12), 2473–2492. <https://doi.org/10.1017/S136898000900531X>
48. World Health Organization. (2010). *ICD-10 International Classification of Diseases*. World Health Organization.



## APPENDIX

**Appendix 2.1** Components of the Dutch dietary guidelines with the maximum and minimum score based on the DHD15-index (Looman *et al.* 2017).

Component	Recommendations Dutch dietary guideline	Minimum score (=0)	Maximum score (=10)
Vegetable	Eat at least 200 gram vegetables / day	0 g	≥ 200 g
Fruit	Eat at least 200 gram fruit / day	0 g	≥ 200 g
Wholegrains	1. Eat at least 90 grams of brown, whole grain bread or other whole grain products per day (50%). 2. Replace refined grain products with whole grain products (50%)	0 g No consumption of whole grain products OR ratio of whole grain to refined grain products ≤ 0.7	≥ 90 g No consumption of refined grain products OR ratio of wholegrain / refined grain products ≥ 11
Legumes	Eat legumes weekly	0 g	≥ 10 g
Nuts	Eat at least 15 grams unsalted nuts / day	0 g	≥ 15 g
Dairy	Take a few servings of dairy a day, including milk and yogurt	0 g OR ≥ 750 g	300-450 g
Fish	Eat fish, preferably fatty fish, once a week	No fish consumption	Consumption of fish at least 4 times a month, of which at least 3 times fatty fish.
Tea	Drink three cups of tea a day	0 ml	≥ 450 ml
Fats and oils	Replace butter, hard margarine and cooking and frying fat with soft margarine, liquid baking and frying fat and vegetable oils.	No consumption of soft margarines, liquid shortening and vegetable oils OR ratio of liquid shortening / hard cooking fat ≤ 0.6	No consumption of butter, hard margarines and hard cooking fats OR ratio of shortening / hard cooking fat ≥ 13
Coffee	Replace unfiltered with filtered coffee	Consumption of unfiltered coffee	Consumption of only filtered coffee or no coffee consumption
Red meat	Limit the consumption of red meat	100 g	≤ 45 g
Processed meat	Limit consumption of processed meat	≥ 50 g	0 g
Sugar containing beverages	Drink as few sugar containing beverages as possible	≥ 250 g	0 g
Alcohol	Do not drink alcohol, or at least no more than 1 glass a day	☹ 2 glasses or more a day OR binge drinking (4 glasses or more per day) ☹ 3 glasses or more a day OR binge drinking (6 glasses or more per day)	No alcohol, or no more than 1 glass a day
Salt	Eat no more than 6 grams of table salt per day	≥ 3.8 g (sodium)	< 1.9 g (sodium)
Unhealthy choices*	Energy dense and nutrient poor food items not included in one of the 15 DHD components	Less than 3 unhealthy choices	7 or more unhealthy choices

Note. \* “Unhealthy choices” are added to the DHD-15 components and consist of food products that contribute significantly to the total energy intake



