EXTRA Dementia and Geriatric Cognitive Disorders

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Original Research Article

Body Mass Index in Different Dementia Disorders: Results from the Swedish Dementia Quality Registry (SveDem)

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Key Words

Dementia · Body mass index · Quality registry · Alzheimer's disease · Cognitive status

Abstract

Background: Most patients with dementia lose body weight over the course of the disease and have a lower body mass index (BMI) than subjects with normal cognition. ***Aims:*** To examine body mass index and how it correlates with cognitive status, age and gender in patients with different dementia disorders. ***Materials and Methods:*** Data from newly diagnosed dementia patients in the Swedish Dementia Quality Registry (SveDem) and recorded information about age, gender, cognitive status and BMI was analyzed using independent samples t tests and one-way analysis of variance. ***Results:*** A total of 12,015 patients, 7,121 females and 4,894 males were included in the study. The average BMI was 24. More than a quarter of the patients had a BMI of <22. Females were significantly older ($p < 0.001$) and males had a significantly higher BMI ($p < 0.001$) at the time of diagnosis. BMI differed significantly by gender in various dementia disorders and correlated significantly with cognitive status and age. ***Conclusion:*** At the time of diagnosis, patients with various dementia disorders had a BMI within the normal range. However, a significant number had a BMI in a lower, suboptimal range for older persons stressing the need for nutritional assessment as part of the dementia work up. Further analyses with longitudinal follow-up are needed to investigate BMI changes over time.

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Introduction

Dementia is a devastating disorder that burdens the patient, the family and society. It is expected that problems related to dementia will increase, especially in low-income and middle-income countries [1]. An increase in life expectancy contributes to the dementia epidemic. The number of older individuals is increasing particularly rapidly in China, India and Latin America, as are the proportions of older individuals in the population. It has been estimated that in 2050 close to 80% of subjects >60 years of age will live in the less developed regions in the world [1]. Further, it has been estimated that the number of dementia patients in the world will increase from the current value of 35,6–65,7 million by 2030, and to 115,4 million by 2050 [2]. In Sweden, 20,000–25,000 subjects are diagnosed with dementia each year and about 150,000 individuals currently suffer from dementia. The annual cost of dementia disorders in Sweden is SEK 50 billion [3, 4]. Approximately 1% of the population in Sweden suffers from a dementia disorder at 65 years of age and nearly 50% at 90 years of age [5].

Overweight and Obesity

It is well known that obesity increases the risk for vascular disorders such as atherosclerosis, chronic heart disease, hypertension and diabetes [6]. It has been suggested that these vascular disorders increase the probability that dementia will develop, particularly Alzheimer's disease (AD) and vascular dementia (VaD) [7, 8].

Body mass index (BMI) is a simple index of weight and height that is commonly used to classify overweight and obesity in adults [9]. BMI is defined as a person's weight in kg divided by the square of his or her height in meters (kg/m^2). Individuals whose BMI is >25 are considered overweight [9]. Obesity is defined as having a BMI of >30, and the incidence of obesity is increasing at a high rate throughout the world. The prevalence of overweight in the USA and Europe is >50%. Epidemiological studies focusing on the relationship between BMI and the risk of developing dementia have consistently shown different results in mid- versus late-life. A high BMI late in life is associated with a low risk of dementia [10–12], while a high BMI in midlife is associated with a higher risk of dementia [12–14]. BMI provides a useful population-level measure of overweight and obesity, as it is the same for both sexes and for all adult ages. It may not, however, correspond to the same degree of fatness in different individuals [9]. The relationship between BMI and longevity has been extensively studied. Overweight subjects have a similar relative risk of mortality as subjects who are not overweight, while the risk of mortality for underweight subjects (BMI <18.5) and obese subjects (BMI >30) is higher [15]. Several studies indicate that the optimal range for BMI is increased for older subjects, and that higher BMI cutoff points should be used for elderly (<65 years) [16–18].

Weight Loss, Malnutrition and BMI in Dementia

Weight loss and malnutrition are frequent in elderly individuals, and in individuals with dementia in particular [19]. Some studies have shown that patients with AD experience greater and more frequent weight loss compared with cognitively functioning elderly and subjects with VaD [19, 20]. Between 30 and 40% of patients with mild to moderate forms of AD experience a weight loss of 4% or more in a year [21]. As dementia progresses, severe weight loss becomes a serious problem, especially among the institutionalized elderly. Approximately 50% of institutionalized patients with dementia, especially AD, suffer from protein-energy malnutrition [22]. With a probable diagnosis of AD, low BMI and weight loss are predictors of morbidity [23], mortality [24] and increased rates of disease progression. Nutritional considerations and weight loss are most studied in AD. However, patients with other diagnosis, especially Lewy body dementia (LBD) may be even more at risk for malnutrition due to eating and swallowing difficulties.

The Multifactorial Etiology of Weight Loss

The etiology of weight loss in demented patients seems to be multifactorial. Potential contributing factors are: inability to prepare and eat foods [25], impairment of olfaction and taste, behavior problems like agitation, restlessness and wandering [26, 27], increased energy expenditure, inflammatory components and presence of comorbid medical illness.

The main objectives of this study were to characterize and compare BMI in patients with different dementia disorders at the time of diagnosis. In addition, we explored associations between BMI and cognitive status, age, and gender in different dementia disorders.

Materials and Methods

Dataset

Data was obtained from patients newly diagnosed with a dementia disorder, according to the ICD-10 classification, registered in the Swedish Dementia Quality Registry (SveDem; www.svedem.se) between May 1, 2007 and December 31, 2011.

The SveDem is a national quality registry which was started in 2007. Its purpose is to improve the quality of diagnostics, treatment and care of patients with dementia disorders [3, 28, 29]. The registry contains information such as age, gender, heredity, BMI, Mini-Mental State Examination (MMSE) scores, diagnoses, dementia work up investigations, medical treatment, and support from community and time from referral to diagnosis [3]. This information is registered for newly diagnosed patients and patients are followed up yearly. The Uppsala Clinical Trial Center, Uppsala, Sweden, is responsible for the online database and IT support. Today most information to the SveDem is provided by memory clinics but any health care unit is also eligible to participate. The following dementia diagnoses are registered in the SveDem: AD, late-onset AD (LOAD), early-onset AD (EOAD), VaD, mixed AD/VaD, LBD, Parkinson's disease with dementia (PDD), frontotemporal dementia (FTD), unspecified dementia (NOS) and other types of dementia disorders (including alcohol dementias and rare dementia disorders such as corticobasal degeneration).

BMI Cutoff

The optimal BMI in the elderly has not yet been defined. The European Society for Clinical Nutrition and Metabolism (ESPEN) and the national guidelines suggest that an older individual with a BMI of <22 should be considered as being at risk for malnutrition [30, 31]. In the present study, the following BMI cutoffs were chosen: <22, 22–25 and >25. We also used the BMI cutoffs determined by the WHO for comparison. The WHO's cutoffs are <18.5, 18.5–22, 22–25, 25–30 and >30.

Statistics

The Statistical Package for the Social Science (SPSS) software (IBM, USA) was used for statistical analysis. One-way analysis of variance (ANOVA) and independent samples t tests were employed to explore associations between BMI and age at diagnosis, dementia diagnosis group and gender. For between-group comparisons, Bonferroni post hoc test was used. Bivariate correlations between pairs of continuous variables were also calculated. Analysis of covariance (ANCOVA) was applied to evaluate whether the mean differences in BMI between different types of dementia remained significant while statistically controlling for the effects of other continuous variables such as age. Multivariate linear regression analysis was used to compare the strength and independency of the relationship between MMSE score and several anthropometric measurements (BMI and weight) adjusted for patients' age and

Table 1. Descriptive characteristics of the study population

	Total	Males	Females	p value
Number	12,015	4,894	7,121	
Age, years	78.6±7.9	77.6±8.0	79.3±7.8	<0.001
BMI	24.6±4.3	25.1±3.9	24.2±4.54	<0.001
MMSE score	21.4±5.0	21.6±5.1	21.2±5.0	0.25

Data are represented as means ± standard deviation.

Table 2. BMI divided into different BMI categories in all registered dementia patients

BMI category	Patients, %	Mean BMI	Age, years	MMSE score
<22	28%	19.9	80±8.0	21±5.0*
22–25	31%	23.6	79±7.8	22±5.0
>25	41%	28.7	78±7.9	22±5.0

* Significant ($p < 0.05$) compared to the other BMI groups.

sex. All p values were based on two-sided tests and considered statistically significant if <0.05.

Ethical Considerations

Information, both orally and written is given to the patient before registration in the SveDem. Patients are given the opportunity to decline participation in the SveDem registry and can ask at any time to be removed from it. Ethical permission for this study has been obtained from the regional human ethics committee of Stockholm, Sweden.

Results

Between 2007 and 2011, 17,056 patients newly diagnosed with a dementia disorder were registered in the SveDem. Available BMI information obtained from 12,015 patients were included in the study. There were 7,121 females and 4,894 males distributed across nine different dementia diagnoses. The prevalence in percentage was: LOAD 32%, mixed AD/VaD 26%, VaD 19%, NOS 11%, EOAD 4%, LBD 3%, FTD and other 2%, and PDD 1%.

Overall, 5,819 (49.0%) of the patients were under treatment with cholinesterase inhibitors, and 1,193 (10.1%) patients received NMDA antagonist (memantine) as anti-dementia medication. About 90% of the patients were living at home at the time of registration and were classified with mild dementia. Almost half of the patients had coresident(s)/caregiver(s) (n = 6,048, 51.7%). The average age at diagnosis was 79.3 ± 7.8 years for females and 77.6 ± 8.0 years for males ($p < 0.001$). Females had a lower BMI (24.2) compared to males (25.1, $p < 0.001$) (table 1).

Seven of 10 patients were normal or overweight at the time of diagnosis. However, 28% of the patients were scored as underweight according to the BMI <22 categorization (table 2). MMSE was significantly lower (21 ± 5) in patients with a BMI of <22 ($p < 0.01$). Using the BMI cutoff for <18.5 determined by the WHO for comparison, the significance between low BMI and cognitive impairment was even stronger ($p < 0.001$).

Table 3. BMI in different dementia diagnoses

Diagnosis	Total	Males	Females	p value[b]
EOAD	24.37±4.1 (486)	24.70±3.5 (167)	24.20±4.4 (319)	0.169
LOAD	24.07±4.0 (3,815)	24.47±3.5 (1,276)	23.87±4.2 (2,539)	<0.001[c]
Mixed AD/VaD	24.43±4.2 (3,159)	24.90±3.7 (1,293)	24.10±3.5 (1,866)	<0.001
VaD	25.34±4.5 (2,249)	25.75±4.1 (1,128)	24.93±4.9 (1,121)	<0.001
LBD	24.31±4.1 (337)	24.59±3.5 (205)	23.88±4.9 (132)	0.155
FTD	25.83±4.9 (260)	26.59±4.5 (118)	25.20±5.2 (142)	<0.020
PDD	24.10±3.7 (174)	24.42±3.4 (99)	23.68±4.0 (75)	0.190
NOS	24.93±4.9 (1,284)	25.78±4.4 (491)	24.40±5.0 (793)	<0.001
Other	24.39±4.5 (251)	24.72±4.4 (117)	24.09±4.6 (134)	0.269
p value[a]		<0.001	<0.001	

Data are represented as means ± standard deviation with numbers in parentheses.

[a] p value for ANOVA. [b] p value for the independent sample t test between males and females. [c] The lowest BMI was observed among patients diagnosed with LOAD ($p < 0.001$).

Table 4. Dementia diagnoses categorized into different BMI groups

	Total, n	<22	22–25	>25
EOAD	487	141 (29.0)	157 (32.2)	189 (38.8)
LOAD	3,810	1,189 (31.2)	1,233 (32.4)	1,388 (36.4)
Mixed AD/VaD	3,153	914 (29.0)	977 (31.0)	1,262 (40.0)
VaD	2,243	508 (22.6)	654 (29.2)	1,081 (48.2)
LBD	337	106 (31.5)	110 (32.6)	121 (35.9)
FTD	260	54 (20.8)	71 (27.3)	135 (51.9)
PDD	173	46 (26.6)	62 (35.8)	65 (37.6)
NOS	1,282	363 (28.3)	348 (27.1)	571 (44.5)
Other	250	76 (30.4)	75 (30.0)	99 (39.6)

Values in parentheses are percentages.

BMI by Type of Dementia

BMI was analyzed separately by gender in each diagnosis group (table 3). Independent samples t test showed that in LOAD, mixed AD/VaD, VaD, FTD and NOS a significantly higher BMI was found for males compared to females. Moreover, one-way ANOVA analysis revealed that there were significant differences in BMI between diagnoses. The highest BMI was observed among patients diagnosed with FTD and VaD, while the lowest BMI was observed among patients diagnosed with LOAD ($p < 0.001$). ANCOVA analysis showed that not only the type of dementia (LOAD vs. FTD; $F = 18.2$, $p < 0.001$) but also the patients' age ($F = 41.9$, $p < 0.001$) were statistically significant factors for the difference observed in the mean BMI between the LOAD and FTD groups. BMI was also divided according to different BMI cutoffs (i.e. a BMI of <22, 22–25, and >25) for each dementia diagnosis, showing no statistical differences between the groups in the percentage of patients with a BMI of <22 (table 4).

However, in FTD and VaD, the percentage of patients with a BMI of <22 was lower than for the other dementia groups, while the LBD and AD groups had the highest percentage of patients at risk for malnutrition (table 4).

BMI and Cognitive Status

The mean MMSE score was 21.4 ± 5.0. Bivariate correlation analysis showed weak but significant positive correlations between BMI and MMSE score (correlation coefficient =

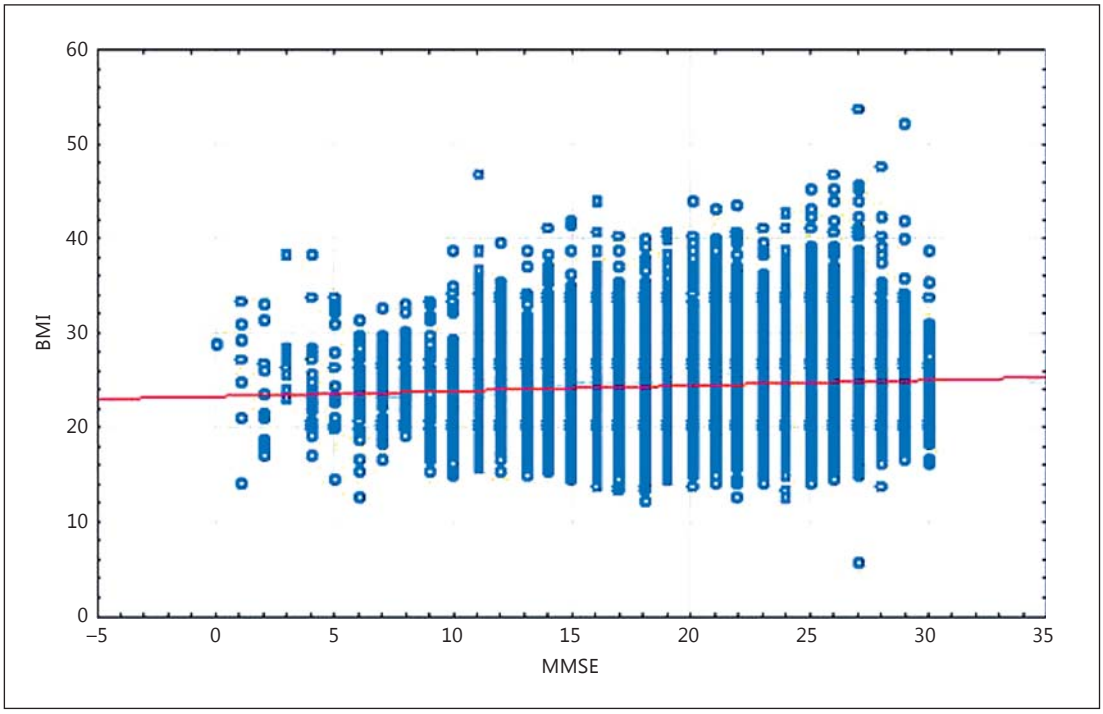

Fig. 1. Relationship between BMI and MMSE in all registered dementia patients. Correlation coefficient = 0.065, p < 0.001.

0.065, p < 0.001) (fig. 1). The weak positive correlation between BMI and MMSE score remained significant (B = 0.052, 95% CI 0.031–0.074) even after adjustment for type of dementia, gender and age at the time of diagnosis (table 5). The correlation was negative (inverse) between BMI and age (correlation coefficient = –0.127, p < 0.001).

Figure 2 shows the proportion of patients (%) in the different MMSE groups and the different BMI categories. The highest proportion of patients with a MMSE score of <9 (3.2%) and a MMSE score of 10–20 (46.7%) was found in patients with a BMI of <18.5; these prevalence rates gradually decreased with increasing BMI.

Discussion

The present study shows that the prevalences of different diagnoses in SveDem are in accordance with those reported in the literature. Men had significantly higher BMI and women were significantly older, as has been shown in the general population. At the time of diagnosis, the majority of patients had a mild stage of dementia and a normal BMI, which is in accordance with other studies [32, 33]. The mean BMI in VaD and FTD patients was significantly higher as compared to BMI in other dementia disorders. This difference could be caused by the behaviour changes in FTD, where hyperphagia, characterized by eating excessive amounts of food is a common symptom. For VaD it is known that overweight and obesity increase the risk for vascular events, which could explain the higher BMI in this group. With age, BMI decreases and this may be considered as a pathological process or as a part of the normal aging process. The LOAD group had the lowest BMI, which could be due to the fact that LOAD is diagnosed later in life compared to other dementia diagnoses; therefore, BMI is lower at

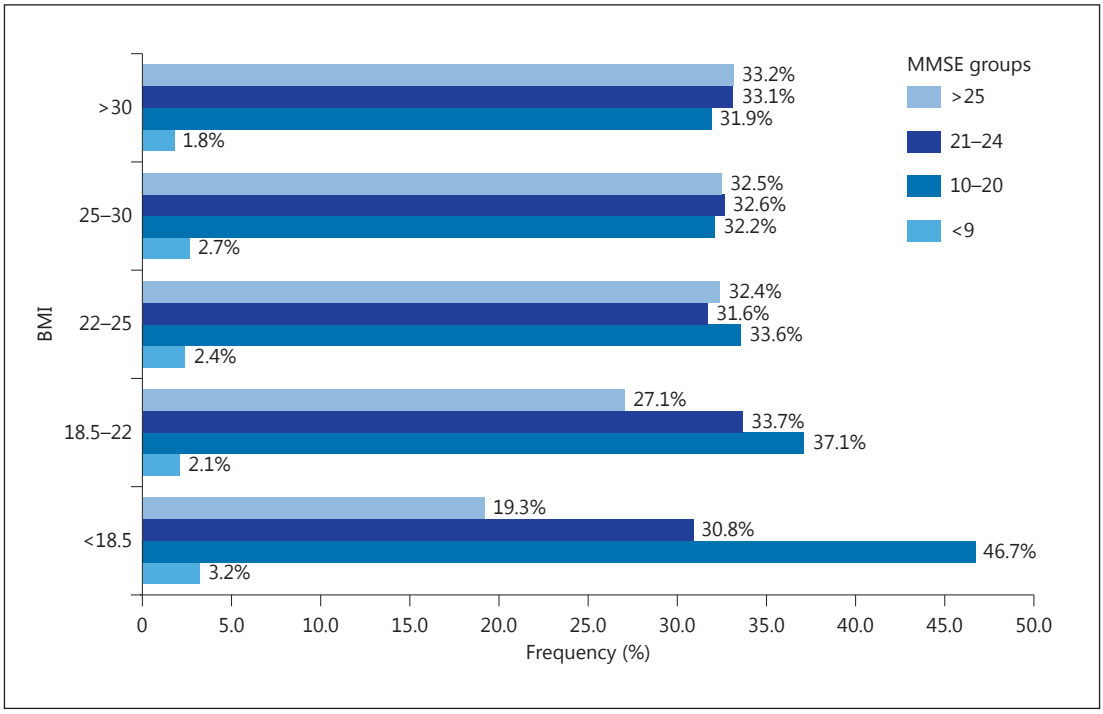

Fig. 2. Frequency of different levels of cognitive impairment (based on the MMSE score) in the different categories of BMI.

Table 5. Multivariate linear regression model to evaluate the effects of BMI and some confounder variables on the MMSE score in registered dementia patients

	B	SE	95% Wald confidence interval		Hypothesis test		
			lower	upper	Wald χ^2	d.f.	p value
Intercept	27.413	0.6833	26.074	28.752	1,609.592	1	<0.001
Male gender	0.121	0.0959	−0.067	0.309	1.601	1	0.206
Type of dementia							
EOAD	−0.145	0.4097	−0.948	0.658	0.126	1	0.723
LOAD	0.869	0.3439	0.195	1.543	6.382	1	0.012
Mixed AD/VaD	0.546	0.3474	−0.135	1.227	2.470	1	0.116
VaD	0.768	0.3515	0.079	1.457	4.776	1	0.029
LBD	0.632	0.4311	−0.213	1.476	2.146	1	0.143
FTD	1.993	0.4614	1.088	2.897	18.653	1	<0.001
PDD	0.004	0.5103	−0.996	1.004	0.000	1	0.993
NOS	−0.493	0.3631	−1.205	0.219	1.845	1	0.174
Other	ref.	–	–	–	–	–	–
Age	−0.101	0.0067	−0.114	−0.088	224.745	1	<0.001
BMI	0.052	0.0109	0.031	0.074	22.901	1	<0.001

the time of diagnosis. The patients in the present study were significantly older than the FTD patients. LOAD patients, also suffer from age-related factors such as frailty, sarcopenia, functional impairments and comorbidities besides their disease-related problems (behavior problems, inflammation and olfactory deficits) which all may result in weight loss and low BMI in contrast to patients with FTD [25, 27]. The patients with suboptimal BMI (<22; 28%) also had a significantly lower cognitive function than those with higher BMI. There was a positive but weak relationship between BMI and MMSE. The cross-sectional design of our study does not allow us to draw conclusions regarding causality.

According to the ESPEN and the Swedish national recommendations [30, 31], underweight (BMI <22) is a risk factor for malnutrition in older subjects. Most nutritional screening tools include BMI but also information about weight change, appetite and questions related to eating. The Mini-Nutritional Assessment (MNA) was developed for use in a geriatric population to identify persons at nutritional risk [34]. The MNA has been used in both non-demented and demented populations. The MNA SF is a short and less time-consuming version [35].

The fact that almost one third of the 12,015 patients had a suboptimal BMI suggestive of a risk for malnutrition should stress the need for nutritional assessment and intervention. Practical guidelines for the diagnosis and management of malnutrition in AD suggest a nutritional assessment at the time of diagnosis and in the follow-up and management of the disease [36]. Patients with a BMI of <22 were more cognitively impaired compared to normal and overweight patients. When using a BMI cutoff of <18.5, the significance association between low BMI and cognitive impairment becomes even stronger. This significant difference in cognitive function among those classified as underweight could be due to the fact that the diagnosis was established in a later stage of the disease and thus weight loss may already have started [32, 33]. Other plausible factors are malnutrition, causing or caused by cognitive decline, or other chronic diseases resulting in underweight. Involuntary weight loss should always be examined for any malignancy or food intake-related impairments.

There is yet not sufficient evidence on efficacy interventions aimed to avoid and treat dementia-related weight loss. However, some systematic reviews on non-pharmacological interventions such as nutritional support [37–39], progressive resistive exercise and aerobic exercise, report weight gain and increased oral intake effects. Positive effects by oral supplements are confirmed in a systematic review [40]. Furthermore, multidomain interventions suggest that strategies which target multiple factors simultaneously may prove more effective than focusing on a single mechanism or domain [41].

Strengths and Limitations

The primary strength of this study is the large population number included in the SveDem. The SveDem is one of the largest dementia registries in the world covering 30% of newly diagnosed patients in Sweden. The patients are diagnosed in different parts of the country, reflecting real medical practice, without many inclusion or exclusion criteria. One limitation is that the number of missing BMI data (usually length) is quite high (30%). The benefits with registries are large cohorts, but the risk that registration is not performed properly is always present, leaving large numbers of missing data. To ensure good registry quality it is necessary to improve the registration process in order to minimize the amount of missing data. The SveDem is already monitoring units by validating random patient registrations against the medical records.

The cross-sectional design of our study is another limitation from the point of view of discussing causality. We do not yet have enough information to study BMI changes over time. It would also be of interest to study BMI in this population 5–10 years before the diagnosis of dementia, which may be possible combining data from other registries. Furthermore, the SveDem provides no information on the nutritional status, socioeconomic variables, physical activities or the patients' diet.

Clinical Implication

The mean BMI was similar in all dementia disorders studied, and although some statistical differences were found these are of minor clinical importance. However, clinically relevant is that almost 30% of the patients were underweight with a BMI of <22 already at the time of diagnosis. Thus, there is a need to implement a routine for nutritional screening of all patients at the time of diagnosis to find patients at risk for malnutrition. Practical guidelines for the diagnosis and management of malnutrition in AD have suggested a nutritional assessment at the time of diagnosis and at follow-up [36]. Most studies conducted on dementia and nutrition include predominantly AD patients. This study includes data on BMI also from other dementia disorders. Without denying the fact that a different dementia diagnosis may have different biological mechanisms for weight loss, intervention may be designed on the basis of current evidence-based knowledge and clinical experiences.

Future Studies

As all registry-based studies, this study aims to inspire new hypotheses to be researched in the future. The epidemiological data presented here can be used as basis for intervention studies to prevent weight loss during the course of dementia. Future studies should focus on long-term follow-up. An intervention study on the group with a BMI of <22 would also be of interest.

Conclusion

The mean BMI in patients registered in the SveDem did not differ between different dementia disorders but was slightly different between men and women. The majority of patients newly diagnosed with dementia had a normal BMI, but almost a third was underweight having a BMI of <22. Therefore, it is important to perform nutritional screening and assessment of all patients with dementia at the time of dementia diagnosis, as well as to follow BMI changes over time. Data from the SveDem can contribute to the implementation of such a routine.

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Disclosure Statement

The authors have neither conflicts of interest nor any affiliations with the industry related to this work.

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