Diet and Cognitive Health

Nutritional intake of dementia patients
living in nursery care

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ABSTRACT

Dietary habits are crucial determinants of health status. Especially in old-age, maintenance of adequate dietary intake becomes increasingly difficult. Deficiencies in nutritional factors could potentially increase oxidative stress and elevated levels of systemic inflammatory factors; pathological processes commonly found in dementia. The current study investigated the extent to which elderly individuals (≥50 years) living in nursery care, meet their nutritional requirements. Intake was evaluated by entering data from Food Record Forms into the NutriCount© program and then compared against European and Dutch reference values. Results indicated significant mineral and vitamin deficiencies in the majority of residents. This could have important implications for overall health status of institutionalized elderly individuals. Adjustments in nutritional intake through supplementation could constitute a powerful tool in improving health outcome in old age.

Keywords

Diet, cognitive health, dementia, neurodegeneration

INTRODUCTION

Diet has been established as an important determinant of health. Especially in old age, following a healthy dietary pattern is associated with improved health status (Berendsen et al. 2013). Deficiencies in nutritional factors are, however, associated with increased oxidative stress and elevated levels of systemic inflammatory factors (Mormino et al. 2009). These pathological processes are commonly associated with onset and progression of dementia (Folch, 2015). Up to date, the relationship between inadequacy in nutritional factors and dementia is not well understood (Prince, 2013). This might be due to past studies predominantly focussing on single nutrients, somewhat neglecting interaction effects between nutritional factors. The importance of the latter is reflected in the recent shift away from single nutrient factors towards more global approaches to dietary interventions (Prince, 2013; Berendsen et al., 2013; Caracciolo et al., 2014). This study seeks to further investigate the link between inadequacy in multiple nutrient factors and dementia. We investigated nutritional intake in a population of demented elderly individuals living in a nursery home in the Netherlands. The main objective of this study was to investigate the extent to which elderly with dementia (≥50 years) living in nursery care follow a diet that enables them to meet their nutritional requirements.

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REVIEWED LITERATURE

Inadequate nutritional intake in dementia

In addition to age-related physiological changes, such as a general decreased ability to absorb nutrients from the gastro-intestinal tract, external factors seem to put dementia patients at an elevated risk of being malnourished. Keller (2016) provides a comprehensive overview of determinants of adequate nutritional intake in different stages of dementia (see Table 1).

Especially, in the later stages of dementia, feeding assistance seems to become increasingly important. While age related physiological changes in taste, smell and food pickiness constitute determinants in early stages of dementia, motor disability, dysphagia and behavioural problems such as refusal to eat, distractibility or aggression seem to appear in mid- to late stage dementia (Keller, 2016).

Table 1 Keller (2016) Determinants of food intake in demented individuals

Early stage dementia	Mid stage dementia	Late stage dementia
Appetite	Lack of dietary choice (residential care)	Loss of communication
Food pickiness	Agitation	Motor impairment
Motivational factors	Aphasia	Distractibility
Changes in sensory domains	Aggression	Dysphagia
Depression, disorientation	Relocation trauma	Eating assistance
Inability to adapt		Refusal to eat
Difficulty to shop		No recognition of food

Linking nutritional deficiency to dementia

In the case of dementia, neurological changes could amplify a disturbed nutritional intake. Kanoski and Grill (2016) highlight the hippocampus as novel agent in 'higher-order' control of feeding behaviour. Neuronal tissue loss in the hippocampus and other cortical networks could potentially account for a disturbed appetite and intake regulation in older adults, increasing the risk of being malnourished.

Prince et al. (2013) found a wide variety in reported nutritional factors that could potentially affect cognitive health in old age. Generally speaking, the potential protective effects of nutrients can be broadly defined in two domains. The neuroprotective role of nutritional factors appears to predominantly lie in their anti-oxidative and anti-inflammatory effects. Oxidative stress is commonly observed in neural tissue where it can cause damage to synapses and nerve cells (Prince et al., 2014, Gustafson et al., 2015).The latter two are considered crucial steps in the onset and progression of AD (Gorelick, 2010, Prince et al., 2014). Gustafson et al. (2015) and Prince et al. (2013) specifically point towards the relevance of deficiencies in multiple nutritional factors in oxidative and inflammatory processes.

The reviewed literature strongly suggests that risk of nutritional deficiency seems to be amplified in dementia patients. In these patients, overall reduction in dietary intake seems to point towards global nutritional deficiencies. This study seeks to link dementia to inadequacy in multiple nutritional factors.

PILOT STUDY

Study sample

In total 11 residents (9 females), were included from an elderly home in the south of the Netherlands. These individuals came from the psycho-geriatric wards and were all suffering from dementia. Age, weight and BMI score were recorded from residents (Table 2).

Table 2 Sample characteristics (Age, weight and BMI)

	Mean	Range
Age	84.36 years	70-96years
Weight	64.8kg	32.1-89.9kg
BMI	23.85	14.3-34.4

Only one out of eleven participants used mineral and vitamin supplementation. The participant used Supradynvital50+® which provides supplementation for a wide array of vitamins, minerals and trace elements. It is administered in order counterbalance age related malnutrition and cognitive decline. The daily dose was set at one tablet per day. The participant who received the supplement was not at risk of being malnourished. Protein and carbohydrate enriched product were incorporated into the meal plan of three participants (Resource® Fruit, 250kcal per 200ml).

Materials

Dietary intake assessment was carried out by using a 7-day food record booklet. Based on the 7-day records a baseline assessment of nutrient intake and dietary habits was established. Food-record forms seem to be the most promising method of intake evaluation that is currently available and can provide high level of detail regarding food intake, when filled in adequately (Zuniga & McAuley, 2015). Dietary output values obtained from the NutriCount© program were assessed against European and Dutch reference values provided by the Voedingscenturm (2014) and the Nu-AGE study (Berendsen et al., 2013). Next to that, nutritional output was compared to cut-off values used in the DNFCS (2010-2012, Ocke, 2013).

Procedure

Food intake was recorded by nurses during seven consecutive days (Monday to Sunday). Every ward was given a total of seven A4 folders. Each folder contained a sheet for every resident along with an example of a completed food record. Due to alternating shifts, not all nurses could be instructed by the researchers. In these cases, instructions were given by the management of the nursery home.

The nursery home was visited by the researcher on the 3rd day of the study to check for compliance with instructions. On this basis, recommendations for further recording were given as well as a short hand-out on what to pay attention to during the remaining days of the study. On the last three days of the study, pictures of every individual plate were taken during the evening meal. This additional step was initiated in order to get a better impression of individual portion sizes and products used for meal preparation. The evening meal was most difficult to estimate. The addition of pictures to the food records greatly facilitated nutrient entry into the NutriCount© program. During the analysis the decision was made to exclude the first two days of data collection. This was deemed necessary due to the significant lack of detailed manners of food recording. In the end food records across 5 consecutive days (Wednesday to Sunday) were include in the analysis.

Analysis

Dietary output values were transferred into Microsoft Excel for further analysis. Average output values on selected nutrients were calculated across a 5 day period of investigation. Results from these calculations were then compared against dietary reference values. From this, a percentage of potential inadequacy was calculated by dividing cases that deviated from the reference value by the total number of individuals (N=11). The term ‘potential inadequacy’ was chosen as findings from this study should be understood as mere indications of inadequacy and separated from clinically relevant diagnoses of deficiency. The program used for significant testing was IBM SPSS Statistics. Deviations from reference guidelines were analyzed by means of one-sample T-tests. P-values were tested against a more strict significance level of $p<.001$ in order to account for the small sample size.

RESULTS

Weight

According to the updated guidelines of the Dutch Health Council, individuals meet the criteria of being undernourished if when having a BMI smaller than 18.5kg/m2 (Halfens, 2014). Two participants were identified as undernourished when evaluated against this standard. Next to that, two individuals were identified as overweight (≥25-30) and two individuals as obese (≥30). The remaining five participants were within the normal range of 20-25.

Energy Intake

Crucially, 91% of the sample was significantly below their daily intake requirement ($p<.001$). All but one individual were clearly below the reference value, even after accounting for deviation of ±100kcal for women and ±200kcal for men. In accordance with recommendations of the DNFCS, caloric intake below 1500 kcal was regarded as threshold below which risk of micronutrient deficiency is relatively high (Ocke et al., 2013). When taking into account that the recommended intake for men is set at a slightly higher value than for women, the observed deficiency might be even more dramatic for men than for women.

Vitamin and mineral intake

All participants were below the average mineral intake (Table 3). Especially in old age, insufficient intake of minerals might have important implications for risk of frailty.

Table 3 Potential macronutrient inadequacy in sample (%)

Resident	Magnesium	Iron	Calcium	Salt (mg)
Mean average intake	189.30	6.45	514.12	3170
Range	136-243.96	5.08- 7.38	309.46-797.83	2220-4810
Dietary Reference	280 (f), 350 (m)	10	1200-1300	6000
DNFCS 2010-2012	Low prevalence	2% (m) 4% (f)	No statement	51% (m) 25% (f)
Potential Inadequacy	100%	100%	100%	100%
Sig.	**	**	**	**

Similarly, all elderly individuals were found to have a potential inadequacy in all selected B-vitamins (Table 4). Furthermore, below threshold intake was observed for vitamin C, vitamin D, vitamin A and folate (Table 5).

Table 4 Potential vitamin inadequacy in sample (in %)

Resident	$VitB_1$ (mg)	$VitB_2$ (mg)	$VitB_{12}$ (mcg)	$VitB_6$ (mg)
Mean average intake	0.58	0.76	1.73	0.84
Range	0.35-0.86	0.51-1.12 (m)	0.71-2.20	0.13-0.96
Dietary Reference	1.1	1.1 (f), 1.5 (m)	5	1.5 (f), 1.8 (m)
DNFCS 2010-2012	Low (m); no statement (f)	10% (m), 7%(f)	1%(m), 2%(f)	6% (m), 10% (f)
Potential Inadequacy	100%	100%	100%	100%
Sig.	**	**	**	**

Table 5 Potential vitamin inadequacy in sample (in %)

Resident	VitC (mg)	VitD (mcg)	VitE (mg)	Folate (mcg)
Mean average intake	54.73	1.91	6.39	138.82
Range	21.34-73.87	0.88-3.66	3.40-11.03	99.04-196.33
Dietary Reference	75	≥10-15	5 (f), 6 (m)	≥300
DNFCS 2010-2012	11% (m), 6%(f)	95% (m), 91%(f)	1% (m, f)	6% (m), 13%(f)
Potential Inadequacy	100%	100%	9% (1/11)	100%
Sig.	**	**	-	**

CONCLUSION

The results of the current study indicate a potential nutritional inadequacy in all participants. What is rather striking is that inadequacy was especially pronounced in vitamins and minerals. Adequate levels of these nutritional factors are crucial in neuroprotection and successful regulation of systemic inflammation. A deficiency-induced dysregulation in these mechanisms can have detrimental effects on cognitive health and promote advancement of pathological, neurodegenerative processes that are commonly observed in AD. Changes to dietary patterns in accordance with recently published guidelines as well as nutritional supplementation could potentially counter-balance disease progression.

DISCUSSION

Implications of global deficiency

The observed deficiencies on multiple nutritional factors might have important implications for the cognitive health of residents. Global deficiencies in vitamins and other key nutrients can promote systemic inflammation and progression of neurodegeneration commonly observed in AD (Gorelick, 2010, de Wilde, 2014). Interestingly, de Wilde (2014) found nutrient deficiency to be independent of the individual's actual nutritional status. This is in line with the findings of this study where participants displayed deficiencies despite being in the normal to high range according to individual BMI measurements. Inadequate intake of nutrients could put participants at risk of a lower systemic availability of these factors. This could in return affect cognitive health by impairing the formation and preservation of neuronal membranes and synapses (Gustafson, 2012).

When considering the crucial synergistic effect of certain combinations of nutrients, the finding of a global deficiency might become especially troubling. The interaction between multiple nutritional factors in determining health outcome is increasingly emphasized (Prince et al., 2014; Berendsen et al., 2013; Caracciolo et al., 2014).

RECOMMENDATIONS

The quality of recordings can be greatly enhanced by taking pictures of serving sizes. This should be added to future study designs. The addition of pictures and other technological aids could further facilitate more detailed recordings of food components. Involving a trained nutritionist in the evaluation of dietary entries could potentially enhance the accuracy of nutrient entry into dietary assessment programs, such as NutriCount©. Next to that, indications for food preparation should be added to the current food record forms. In order to carry out more in-depth nutritional intake analysis, dietary reference values need to be further adapted to the specific nutritional needs of elderly individuals. This adaptation is crucial in order to make accurate dietary assessments. Future research should also take into account plasma levels of key nutrient factors for validation end more accurate evaluation of food-recordings.

With regard to the observed prevalence of nutritional deficiency in the studied nursery home, dietary supplementation of vitamins and minerals could be a very effective, and perhaps least intrusive, means to reduce nutritional deficiency in elderly individuals living in nursery care. As previously discussed, supplementation of certain vitamins, for instance vitamin B and D, could potentially slow down cognitive decline in elderly individuals. Crucially, it could be implemented without significant impact on the established dietary pattern of elderly individuals and be a rather simple addition to already existing meal plans. However, the extent to which single nutrient supplementation can tackle global nutritional deficiencies remains unclear.

ROLE OF THE STUDENT

Antonia Bauer was an undergraduate student working under the supervision of Dr. Gerda Andringa while carrying out this independent research project. The topic was proposed by the supervisor. Study design and data collection, as well as processing and evaluation of the results were carried out by the student. All materials used in the data selection process were created by the student.

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