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Original Study

High Intake of Nonmilk Extrinsic Sugars Is Associated With Protein and Micronutrient Dilution in Home-Dwelling and Institutionalized Older People

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A B S T R A C T

Background: High dietary sugar intake may compromise protein and micronutrient intakes in people with low energy intakes. The results of micronutrient dilution studies in older people have been few and conflicting. We examined the nutritional status and nutrient intakes associated with nonmilk extrinsic sugars (NMES) intakes in older people representing a broad spectrum of both healthy and vulnerable older populations.

Design and participants: This cross-sectional study combined five Finnish data sets covering home-dwelling (n = 526) and institutionalized (n = 374) older people. Their nutritional status was assessed using Mini Nutritional Assessment (MNA) and nutrient intakes retrieved from 1- to 3-day food records. The participants were divided into quartiles corresponding to the proportions of energy received from NMES. Energy, nutrient, and fiber intakes were classified according to the NMES quartiles, and the participants were divided according to their places of residence (home, institution).

Results: High NMES intakes were associated with older age, female sex, poor cognition, low MNA scores, immobility, and institutionalization. In all, 90% of the participants in the highest NMES quartile (Q4) were institutionalized. In the institutionalized individuals, low protein and micronutrient intakes were observed in both those with low energy intake (Q1) and in those with very high NMES intakes (Q4). In home-dwelling individuals, the nutrient intakes tended to decline linearly with increasing NMES intakes in protein and most micronutrients.

Conclusions: Institutionalized older people consumed diets high in NMES, compared with those living at home, and their low energy and high NMES intakes were associated with low protein and micronutrient intakes.

High dietary sugar intake may have detrimental health effects and has been associated with increased dental caries, cardiovascular risk, and obesity.[1] Older people's nutritional risks differ from those of younger individuals, and the effects of their sugar intake have not been thoroughly examined.[2] Few studies have suggested micronutrient dilution in association with high sugar intakes in older individuals, but the results have been few and conflicting.[3] In older South African women and older Australians, micronutrient dilution was observed in association with diets high in added sugars.[4,5] In contrast, moderately high intakes of nonmilk extrinsic sugars (NMES) were not associated with micronutrient intakes in independent older people.[6] Furthermore, in younger people micronutrient dilution in association with total sugar intake has not been observed, although poor diet quality and lower nutrient intakes have been associated with diets high in added sugars.[3,7,8]

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The objective of this study was to determine how NMES intake affects protein, other nutrient, and fiber intakes in older people representing a wide spectrum of older populations, from healthy home-dwelling individuals to those in institutions, and to determine the factors associated with high NMES intake in older people.

Methods

Our cross-sectional study combined five Finnish data sets of studies of older individuals (n = 900). The participants came from the following studies: (1) nutrition education and cooking (NC) class (n = 54) follow-up study[9]; (2) men from the Helsinki Businessmen Study (HBS) (n = 68)[10]; (3) home-dwelling individuals with Alzheimer disease (AD) (n = 99); and (4) their spousal caregivers (CGs) (n = 97)[11]; (5) people screened for the Porvoo Sarcopenia and Nutrition Trial (PSNT) (n = 208)[12]; and (6) residents of assisted living facilities (ALFs) from the Helsinki metropolitan area (n = 374).[13] People younger than 60 years were excluded from the data analysis. The NC participants were healthy volunteers interested in nutrition- and health-related issues. The baseline findings of the study were used. The HBS longitudinal cohort included independently living men from the highest social class. The data used were from their most recent visit to the clinic in 2011. Home-dwelling AD patients and their spousal CGs participated in a study with the objective of supporting their nutrition by tailored nutritional counseling. The baseline data were used in this study. The PSNT was a trial investigating the effects of protein supplementation and home-based exercises on physical performance among home-dwelling people at risk of sarcopenia. We used the initial screening data of the study. The ALF participants were residents in the Helsinki metropolitan area. ALFs in Finland are similar to nursing homes, with round-the-clock care available, but in a more homelike setting. The recruitment and eligibility of the participants in each study were reported elsewhere.[9–13]

Nutritional status was assessed with the Mini Nutritional Assessment (MNA).[14] The nutritional intakes were retrieved from 1- to 3-day food diaries, which the participants filled in themselves (NC, HBS, CG, PSNT) or had someone fill in the diaries for them (AD, ALF). The food diaries were checked and verified by a nutritionist in face-to-face interviews (NC) or by phone calls (CG, AD, PSNT, HBS). The ALF residents' dietary intakes were recorded by trained nurses. The nutrient intakes were calculated using the Nutrica 3.1122 or Aivo programs developed for this purpose.[15,16]

Cognition was measured using the Clinical Dementia Rating (CDR) scale (0-3), in which 0 denotes no dementia, 0.5 possible dementia, 1 mild, 2 moderate, and 3 severe dementia.[17] The Charlson Comorbidity Index (CCI) (range 0-9) was calculated from reported diagnoses (NC, CG, AD, HBS) or from diagnoses verified from their medical records (PSNT, ALF).[18] The mobility of the participants was measured using the MNA's three-scale mobility question (0 = bed- or chairbound, 1 = able to get out of bed/chair, does not go out, or 2 = goes out).

The percentage of dietary energy (E%) received from NMES was calculated for each participant. The participants were then classified into quartiles corresponding to the E% received from NMES. The energy, nutrient, and fiber intakes were classified according to the NMES quartiles, and the participants were divided according to their place of residence (home, institution). The relationships between the NMES quartiles for energy, nutrient, and fiber were analyzed using the generalized linear model by analysis of variance (ANOVA) adjusted with weight and age when appropriate. Interaction was tested between the energy and nutrient intakes, place of residence, and E% received from NMES.

The percentage of participants in each NMES quartile receiving inadequate amounts of micronutrients, defined as intake values below the average requirement (AR), were calculated and the differences between the quartiles analyzed using the chi-square test for evaluating the differences between other groups with categorical variables.[19] The statistical analysis was performed using the SPSS statistical program, version 22 (IBM Corp, Armonk, NY), and Stata (release 13.1; StataCorp LP, College Station, TX).

Ethics

All participants signed an informed consent or, in case of poor capability of judgment, MMSE <20, or CDR memory item >1, the consent was acquired from the closest proxy. All of the study protocols were approved by the Ethics Committee of Human Sciences of the

Table 1
Baseline Characteristics According to the NMES Intake Quartiles

Baseline Characteristics	NMES Intake Quartiles				*P* Value*
	Q1 NMES, Mean 5 (0–6.9) E% (n = 225)	Q2 NMES, Mean 8 (7–9.7) E% (n = 225)	Q3 NMES, Mean 12 (9.8–15.1) E% (n = 225)	Q4 NMES, Mean 21 (15.2–38) E% (n = 225)	
Age, mean years	79 (7.6)	79.3 (7.3)	81.9 (6.5)	83.8 (7.2)	<.001
Sex, %					<.001
Males	47	42	29	20	
Females	53	58	71	80	
Place of residence, %					<.001
Home	91	80	52	10	
Institution	9	20	48	90	
Mobility					<.001
Bed-/chairbound or does not go out	5	11	30	58	
Goes out	95	89	70	42	
BMI	26.5 (4.2)	26.8 (4.9)	26.1 (4.4)	24.5 (4.5)	<.001
MNA	23.8 (3.2)	23.7 (3.3)	22.5 (3.3)	20.1 (3.8)	<.001
CCI	2.1 (1.8)	2.0 (1.6)	2.0 (1.5)	2.2 (1.4)	.41
CDR, %					<.001
0 = no dementia	57	39	22	8	
0.5–1.0 = possible or mild	25	30	25	22	
2–3 = moderate or severe dementia	18	31	54	71	

BMI, body mass index; CCI, Charlson Comorbidity Index[18]; CDR, Clinical dementia rating[17]; MNA, Mini Nutritional Assessment[14]; NMES, nonmilk extrinct sugars; Q, quartile.
*Statistical significance for the hypotheses of linearity was evaluated by analysis of variance (ANOVA). Differences between the groups for categorical variables were tested with the chi-square test or Fisher exact test.