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## LIST OF PAPERS

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This thesis is based on the following three papers. The papers are included as full text chapters in the appendices of this thesis.

- Paper I.** Signe Loftager Okkels, Marie-Louise Saxosen, Susanne Bügel, Annemarie Olsen, Tobias Wirenfeldt Klausen, Anne Marie Beck.  
**Acceptance of texture-modified in-between-meals among old adults with dysphagia.**  
Clinical Nutrition ESPEN, 2018; 25: 126-132.
- Paper II.** Signe Loftager Okkels, Ditte Rokkjær Dybdal, Tobias Wirenfeldt Klausen, Anne Marie Beck, Susanne Bügel, Annemarie Olsen.  
**An investigation of main meal preferences in nursing home residents.**  
Submitted to Journal of sensory studies, November 20<sup>th</sup> 2018.
- Paper III.** Signe Loftager Okkels, Ditte Rokkjær Dybdal, Rie Johanne Pedersen, Tobias Wirenfeldt Klausen, Annemarie Olsen, Anne Marie Beck, Susanne Bügel.  
**A two-course meals-on-wheels menu in a cluster-randomized controlled trial influencing health-related quality of life in nursing home residents.**  
Submitted to BMC Nutrition, September 19<sup>th</sup> 2018.

## OTHER ACTIVITIES

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### List of contributions to international conferences

- European Conference on Sensory and Consumer Research (Eurosense), Dijon, France. Poster presentation. *Acceptance test of two types of almond-flour muffins for the old people*. September 11<sup>th</sup>-14<sup>th</sup>, 2016.
- European Society for Clinical Nutrition and Metabolism (ESPEN), 38<sup>th</sup> Congress, Copenhagen, Denmark. Moderator at session about taste preferences and palatability. September 17<sup>th</sup>-20<sup>th</sup>, 2016.
- International Conference on Culinary Arts and Science (ICCAS) 10<sup>th</sup> Conference, Copenhagen. Poster presentation. *Old adults with dysphagia assessing texture modified between-meals*. July 5<sup>th</sup>-7<sup>th</sup>, 2017.

### Related presentations

- Eating in later life. Pleasure & health in everyday life. Symposium at Institute Paul Bocuse, Paul Bocuse Research Center, Lyon, France. English Presentation: *Almond flour muffins for the old people*. A pilot project testing different process conditions and ingredient adjustments of muffins”. June 12<sup>th</sup>-14<sup>th</sup>, 2016.
- Nutrition and meals for old adults. Symposium at Wageningen University and Research Centre, Wageningen, Holland. English Presentation: *Developing and testing delicious and nutritious meals for the old people*. October 13<sup>th</sup>, 2016.
- Creating good days. National Conference from the Danish Society for Gerontology (dansk Gerontologisk Selskab), Comwell Hotel, Middelfart, Denmark. Danish presentation and abstract: *A 12-week meal intervention for nursing home residents*. November 9<sup>th</sup>-10<sup>th</sup>, 2017.
- Future nutritional challenges for improving public health. The annual scientific theme meeting in the Danish Nutrition Society (selskabet for ernæringsforskning). Carlsberg Academy, Valby, Denmark. Danish presentation and abstract: *Testing a two-course optimized menu*. Awarded with the Abstract price. May 17<sup>th</sup>, 2018.

### Exchange project

- Internship on the project “Active Aging”. Supervisors Professor Karin Wendin and Senior lecturer Viktoria Olsson, the Research group MEAL, Food and Meals in everyday life, Kristianstad University, Sweden. Almond flour muffins for the old people. A pilot project testing different process conditions and ingredient adjustments of muffins. Developing and testing delicious ELDORADO-meals. A report was written for the MEAL department, available in Danish: *Mandelmel-muffins til ældre - Et pilotprojekt med tilberedning- og ingrediensjustering WP2 - Udvikling og afprøvning af herlige ELDORADO måltider*. February 2016.

## SUMMARY

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Nursing home residents is a population at high risk of undernutrition. This is costly not only for the society, but also for the individual who experience reduced health and quality of life. Undernutrition is caused by a reduced food intake due to internal and external factors in relation to the meal and the old adult, such as impaired senses, appetite regulation, the social setting during the meal and the meal itself. In nursing homes meals are often served through meals-on-wheels systems, which may reduce the sensory aspects of the meals and limit appetite stimulation. A way to combat the problem could be to suit these meals according to the sensory preferences of the target group. Different studies have investigated meal preferences in nursing home residents, and in most cases traditional, Danish and familiar meals were found. The overall aim of this thesis has been to investigate if a culinary improved two-course meals-on-wheels menu could affect health-related quality of life in nursing home residents. The thesis was basis on four studies, resulting in three papers in total.

In **paper I**, it was investigated, which in-between-meals were most accepted based on appearance and flavor. Twenty texture-modified in-between-meals were assessed by 30 nursing home residents with dysphagia. Those in-between-meals that were most accepted in relation to flavor, were also those with the highest fat and energy content. The evaluations of appearance and flavor were in accordance in 18 of 20 (90%) in-between-meals. Sensory characteristics of the most accepted in-between-meals were that they were frozen, cold and sweet. Similarly, forty main meals were evaluated on their *appearance*, *flavor* and *texture* by 29 old adults in **paper II**. The aim was to investigate main meal preferences of nursing home residents. These meals were divided in six meal type groups (mixed meat, beef, pork, fish, chicken, plant-based), and rated on three sensory aspects. The results showed that with respect to *appearance* pork was liked higher than beef, with respect to *flavor* the meals containing beef were liked higher than the plant-based meals. Lastly, regarding *texture* the meals containing fish were higher liked than meals containing beef or plants. From these pilot studies a selected amount of meals was chosen for a **culinary study** using culinary sessions with chefs from the Copenhagen House of Food to create a sensory improved intervention menu (which included a stimulating, novel twist). This menu was tested in **paper III**. The design was a cluster-randomized study, where 52 nursing home residents were randomized either to receive the control (n=32) or intervention menu (n=20) for 12 weeks. The results showed a reduction in health-related quality of life in the intervention group. The reason for this was possibly that the meals in this menu were less familiar than the meals the control group received. Overall, no effects were found in either the nutritional or functional parameters, which can be attributed the initial frailty of these old adults. Taken together the present PhD thesis suggest that familiarity and recognizability play crucial roles for meal acceptance in nursing home residents. Meal improvement should be done with minor adjustments and respect for meal preferences to increase appetite and quality of life in old adults.

## SAMMENDRAG (DANISH SUMMARY)

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Ældre mennesker på plejehjem er en gruppe, der er i stor risiko for underernæring. Underernæring er omkostningsfyldt for den enkelte, da det forværrer helbred og livskvalitet, hvilket igen fører til forøgede samfundsudgifter. Underernæringen skyldes først og fremmest nedsat kostindtag, hvilket sker på baggrund af fysiologiske faktorer og ydre faktorer, såsom svækkelse af kroppens sanser, appetitregulering, sociale omgivelser ved måltidet, og at maden serveres via udbringning. Madudbringning begrænser de sensoriske aspekter omkring måltidet, der ellers kan øge appetitten. En løsning kan være at identificere sensoriske måltidspræferencer hos ældre, så måltiderne i et måltidsudbringningssystem kan tilpasses målgruppen mere direkte. Forskellige studier har undersøgt præferencer for måltider hos ældre og fundet frem til at traditionelle, danske måltider, der er genkendelige er dem, de ældre foretrækker mest. Det overordnede formål med denne Ph.d.-afhandling var, at undersøge om en kulinarisk optimeret to-retters udbragt menu havde effekt på plejehjemsbeboeres helbredsrelaterede livskvalitet. Ph.d.-afhandlingen blev udarbejdet på basis af i alt fire studier, som resulterede i tre artikler. De tre artikler inkluderede to pilotstudier og et klynge-randomiseret studie. I **artikel 1** blev det undersøgt, hvilke mellemmåltider der var mest accepterede i forhold til deres smag. Tyve tekstur modificerede mellemmåltider blev vurderet af 30 plejehjemsbeboere med dysfagi på parametrene udseende og smag. Sensoriske karakteristika ved de højst accepterede mellemmåltider var, at de var frosne, kolde og søde. Desuden var de mellemmåltider, der var mest accepteret på smag også blandt dem, der havde det højeste fedt- og energiindhold. Der blev fundet god overensstemmelse mellem udseende og smagsvurderingerne i 18 ud af 20 mellemmåltider. Ligeledes blev 40 hovedretter vurderet på udseende, smag og tekstur af 29 ældre i **artikel 2**. Formålet var her, at undersøge plejehjemsbeboeres hovedmåltidspræferencer. Måltiderne blev opdelt i seks måltidsgrupper (blandet kød, oksekød, svinekød, fisk, kylling og plante-baserede), og liking blev vurderet på tre sensoriske aspekter. Resultaterne viste, at i forhold til *udseende* blev retterne med svinekød vurderet med højere liking end oksekødsretterne, med fokus på *smag* blev retterne, der indeholdt oksekød vurderet med højere liking end de plante-baserede. Desuden blev de retter, der indeholdt fisk vurderet med en højere liking i forhold til deres *tekstur* end retterne med oksekød og de plante-baserede.

Ud fra disse to studier udvalgte en mængde måltider til at danne grundlag for et **kulinarisk studie**. Via kulinariske sessioner med kokke fra Københavns Madhus resulterede dette studie i en interventionsmenu (som inkluderede et stimulerende nyt twist), der blev afprøvet i **artikel 3**. Designet var et klynge-randomiseret studie, hvor to-og-halvtreds plejehjemsbeboere blev randomiseret til enten at modtage kontrol (n=32) eller interventionsmenuen (n=20) i 12 uger. Det viste sig, at interventionsgruppen oplevede et fald i helbredsrelateret livskvalitet, som kan skyldes at måltiderne i denne menu var mindre genkendelige for de ældre, end de måltider, som kontrolgruppen modtog. Der blev ikke set nogen effekt på hverken ernærings- eller funktionelle parametre, hvilket tilskrives de ældre deltageres skrøbelighed fra starten af studiet. Alt i

alt viser resultaterne fra denne Ph.d.-afhandling, at genkendelighed spiller en afgørende rolle for måltidsaccept hos plejhjemsboere. Måltidsforbedring bør gøres med mindre justeringer og respekt for måltidspræferencer for at øge appetit og livskvalitet hos ældre.



## LIST OF ABBREVIATIONS

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BMI	Body Mass Index
EVS	Eating Validation Scheme
EQ5D3L	EuroQol-5Dimensions-3Levels
EQ-VAS	EuroQol-Visual Analog Scale
ESPEN	European Society for Clinical Nutrition and Metabolism
HGS	Hand Grip Strength
HRQOL	Health-Related Quality of Life
MEOF	Minimal Eating Observational Form
MMSE	Mini Mental State Examination
SWFL	Satisfaction with Food-related Quality of Life
TMF	Texture Modified Foods
WP	Work Package



# 1.0 Introduction

Worldwide, the proportion of the old population (people aged above 65 years) will nearly double to 22% in year 2050 WHO (2018). In Denmark 40.800 people live in nursing homes (Health 2016), and it has been estimated that among these, forty-two percent are at risk of undernutrition, due to weight loss (Beck 2012). The problem is highly multifactorial and caused by physical impairments. These include changes in the appetitive system (Rémond 2015), dysphagia (Wirth 2016) and frailty (Morley 2013), but also psychological issues including dementia and depression (Hickson 2006) are factors influencing the nutritional status negatively. Eventually, these health changes cause reduced quality of life in the old individual (Medicine 2000). The multifactorial origin of the problem of undernutrition is illustrated in the M3 model (Figure 1) by Heather Keller (2014). Besides the individual changes of the institutionalized old adult, the model shows how the quality of the meal, the meal access or the meal experience all are factors influencing the food intake. It is also seen that the target of intervention could be either at the individual (resident), the environmental (home) or political level (government).

The current PhD project was part of the ELDORADO project (Bredie 2015), and in its various Work Packages (WP) these factors of the M3 model were also in focus. Overall, the ELDORADO project aimed to establish knowledge on how to improve the nutritional status in nursing home residents and dwelling old adults receiving meals-on-wheels.

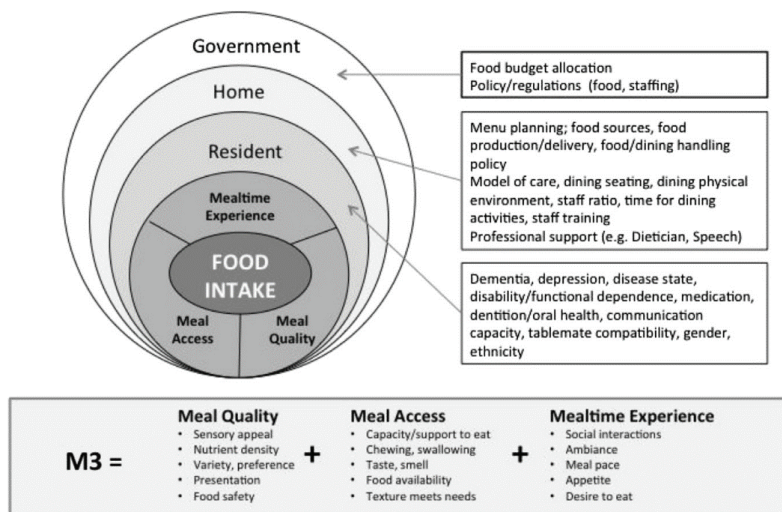


Figure 1. M3 model describing the relationship between meal quality, meal access and mealtime experience for the food intake (Keller, 2014). Used with permission from the Journal of Post-Acute and Long-Term Care Medicine (JAMDA).

Obviously, the meals delivered should follow the nutritional recommendations for old adults, regarding a defined high energy and protein content of the meals, due to the lower appetite and intake of meals in nursing home residents and institutionalized old adults (NNR 2012, Pedersen 2015). In addition to the nutritional aspects, sensory preferences are also crucial to make the meal a stimulating and satisfactory experience, and eventually enhance food intake (van der Meij 2015). These sensory preferences include the visual impression, flavor and texture of the meal. Different studies have investigated meal and sensory preferences in old adults and the results show high variability and heterogeneity (Delahunty 2004, Doets 2016, Song 2016). This is difficult to fit into a meals-on-wheels system, which due to practical and logistic reasons, often serve meals for nursing home residents, and therefore general and universal commonalities of a successful meal in nursing home residents were sought.

Universally, an optimal balance in the sensory elements of a meal is crucial (Klosse 2004), and meal familiarity is an important aspect in old adults (Edfors 2012, Nyberg 2014, Beelen 2017). Having secured the familiarity of the meal, however, in order not to create boredom, a meal should also include a culinary complex twist (Berlyne 1970). In this way the meal rises above the ordinary, and by stimulating the appetite this could be one way of combating the problem of undernutrition and reduced health-related quality of life.

The focus of the current PhD project (WP2) was to investigate if the health-related quality of life could be raised in nursing home residents by culinary improvements of a meals-on-wheels menu.

## 1.1 Aims and hypotheses

The overall aim of this thesis, was to investigate whether culinary improvements of familiar meals could lead to an increase in health-related quality of life in a population of nursing home residents. The culinary improvement was based on a selection process from meal preference studies in old adults and culinary sessions. Thus, the thesis was subdivided in four overall phases (resulting in three papers) aiming to:

1. Identify the most liked in-between-meals for nursing home residents with dysphagia based on flavor and appearance and describe the basic sensory characteristics of these in-between-meals (**paper I**, pilot study 1).

*Hypothesis 1 (H1):* Sensory commonalities of the most liked in-between-meals can be identified in nursing home residents.

2. Investigate main meal preferences of nursing home residents based on appearance, flavor and texture and describe the sensory commonalities of these main meals (**paper II**, pilot study 2).

*Hypothesis 2 (H2):* Sensory commonalities of main meal preferences for nursing home residents can be found.

3. Describe the culinary optimization method of a menu shaped towards sensory preferences of nursing home residents (culinary study).

No hypothesis relevant.

4. Increase health-related quality of life in nursing home residents receiving meals-on-wheels using a menu with favourite meals that was culinary and sensory improved by chefs as intervention (**paper III**, cluster-randomized intervention study).

*Hypothesis 3 (H3):* A menu improved towards sensory preferences of the nursing home residents can increase their health-related quality of life.