University of Hohenheim

Institute of Clinical Nutrition

Subinstitute of Molecular and Applied Nutritional Psychology (180d)

Effects of school-based cooking classes on healthy eating and underlying psychological determinants – a systematic review

Bachelor thesis for the acquisition of the academic degree Bachelor of Science in the field Nutritional Management and Dietetics

Supervisor: Prof. Nanette Ströbele-Benschop, PhD

Submitted by: Julia Wallenstein; 644932

Delivered on 18.07.2018

Summer term 2018

Table of contents

List of abbreviations

U.S.	United States
NHANES	National Health and Nutrition Examination Survey
COSI	European Childhood Obesity Surveillance Initiative
WHO	World Health Organization
EU	European
A.N.D.	Academy of Nutrition and Dietetics
SES	Socioeconomic status
DGE	Deutsche Gesellschaft für Ernährung e. V.
DGAC	Dietary Guidelines Advisory Committee
CAAS	Chefs Adopt a School Scheme
FSME	Free School Meal Entitlement
CWK	Cooking with Kids
TL	Taste Lessons
TLVM	Taste Lessons Vegetable Menu
LA	Los Angeles
FFQ	Food Frequency Questionnaire
SAKG	Stephanie Alexander Kitchen Garden Program
CS	Cookshop
FEL	Food and Environment Lessons
NCI-FFQ	National Cancer Institute Food Frequency Questionnaire
COOK	Intervention group with cooking element

List of figures

List of tables

1. Introduction

With the increasing prevalence of overweight and obesity, promoting healthy eating among children especially by increasing the consumption of vegetables, is noted as highly important. (High Level Group on Nutrition and Physical Activity, 2014) Involving children in cooking activities recently gained awareness as a potential strategy to prevent overweight among primary school aged children. (Nelson, Corbin, & Nickols-Richardson, 2013) This systematic literature review demonstrates the effectiveness of cooking interventions in primary schools based on available evidence.

1.1. Overweight and obesity prevalence

In Western countries, overweight and obesity rates are still increasing and account for the main health concerns of the twenty-first century in both the United States (U.S.) and Europe. (Center for Disease Control and Prevention, 2017); (World Health Organization - Regional Office for Europe, 2018) According to the National Health and Nutrition Examination Survey (NHANES), the obesity rates in both American youth and adults have been significantly increasing since 2000. In 2015-2016, 18.4% of children aged six to eleven years and 13.9% of the children aged two to five years were obese. (Center for Disease Control and Prevention, 2017) Similar findings were revealed in the European Childhood Obesity Surveillance Initiative (COSI) conducted by the World Health Organization (WHO). (World Health Organization - Regional Office for Europe, 2018) One in three European children aged six to nine years were overweight or obese in 2010. In 2008, this statistic was lower at one in four children. The percentages of each of the nineteen participating European countries can be found in the appendix. Promoting healthy lifestyles in schools is thus an important component of the EU Action Plan on Childhood Obesity 2014-2020. (High Level Group on Nutrition and Physical Activity, 2014)

COSI measures overweight and obesity trends for European children aged six to nine years. Every third year, around 300 000 children within the European region participate in the weight and height measurements among the European region. Because eating habits are highly related to the likelihood of becoming overweight or obese, COSI also assesses eating habits among primary school aged children. (World Health Organization - Regional Office for Europe, 2018) With the consumption of fruits and vegetables being inversely related to the likelihood of becoming obese, it is important that recommended daily intakes are met. (Ledoux, Hingle, & Baranowski, 2011). However, this is often not the case – children in Europe and the U.S. do

often not consume the recommended amount of fruits and vegetables per day: COSI 2015-2017 revealed that on average 46% of children eat fruits every day and only 34% of children eat vegetables daily. (World Health Organization - Regional Office for Europe, 2018) Likewise, a Position Paper reviewing eating habits of primary school aged children by the Academy of Nutrition and Dietetics (A.N.D.) states: "Many American children ages 2 to 11 years do not meet the minimum recommendations for the fruit, vegetable, grain, or dairy groups and exceed those for total and saturated fats." (Ogata & Hayes, 2014, p. 1271) Although various campaigns and interventions tried to enhance healthy eating among children in the U.S., the mean vegetable consumption did not increase from 2003 to 2010 on a national level. The consumption even decreased among African-American and Hispanic children. The mean fruit consumption increased slightly over years except among children of a low socioeconomic-status (SES). Between 2007 and 2010, around 60% of the children consumed fewer fruits than recommended, whereas the percentage for vegetables consumed was even lower with 93% not meeting the recommended intake. (Kim et al., 2014)

Short-term food choices and long-term eating habits are determined by multiple factors. One of those factors is the obesogenic environment in Western countries. The obesogenic environment refers to the great availability of energy-dense and simultaneously nutrient-poor food items which enhance weight gain among children. (Shepherd & Raats, 2006) To counteract this, the WHO recommends creating an environment which promotes a daily breakfast, fruit and vegetable consumption and a limited consumption of processed food and soft drinks. This may result in a reduced risk of developing overweight and obesity in children and is adopted by many schools across Europe. (World Health Organization - Regional Office for Europe, 2018) Concomitant with these findings in Europe, the A.N.D. adjudges the overconsumption of energy-dense and nutrient-poor food as the major contributor to the increasing prevalence of overweight children in the U.S. (Ogata & Hayes, 2014)

1.2. Health outcomes

Overweight and especially obesity come along with various long-term health and social consequences and are associated with a greater number of Disability-Adjusted Life Years as well as a higher chance of premature death. (World Health Organization - Regional Office for Europe, 2018) Long-term health outcomes include among others a higher risk to develop diet-related chronic diseases like type 2 diabetes or cardiovascular diseases early in life. (Ogata & Hayes, 2014)

Overweight and obesity are even more drastic for children than for adults, because children

who are overweight at a young age often stay overweight for the entirety of their life. Being overweight negatively affects their physical development, mobility and acceptance in peer groups. It often results in mobbing and increases the risk to develop diet-related disease later in life. Thus, it is important to teach children a healthy lifestyle as soon as possible. (Biesalski, Warmuth, & Domzalski, 2017)

Dietary habits developed during childhood are often stable and difficult to change. An early exposure to either fruits and vegetables or energy-dense food high in sugar and/or fat impacts the preferences and consumptions of those foods in adults. (Hill, Casswell, Maskill, Jones, & Wyllie, 1998) The earlier children learn to consume fruits and vegetables daily, the more likely it is that this eating behavior stays stable during their lives. Moreover, "age-appropriate energy and nutrient intakes are essential to support normal growth and development." (Ogata & Hayes, 2014, p. 1258) Therefore, it is important to encourage healthy eating as early as possible. According to major food and health-related organizations (WHO, DGE, DGAC), fruit and vegetable intake is associated with a reduction in the risk of non-communicable diseases like cardiovascular disease, type 2 diabetes mellitus and some types of cancer as well as the advantages of improved bone health and reduced likelihood of unhealthy weight gain. (EU Science Hub, 2016)

1.3. Healthy eating

Several health-related organizations worldwide recommend different dietary intake values for various macro- and micronutrients. Hence, the understanding of healthy eating may differ between countries and subpopulations. In this review, healthy eating is defined as the following: "Healthy eating is a diet which contains everything one needs for oneself and one's living situation (physical exposure, sports, pregnancy, disease etc.)." (Biesalski et al., 2017, p. 220)

Two important guidelines regarding dietary intake values are the WHO recommendations and the Dietary Guidelines for Americans by the U.S. Department of Agriculture and U.S. Department of Health and Human Services. The daily recommended servings of fruits and vegetables in the U.S. are: 1.0 cup-serving each for one- to three-year old children, 1.5 cup-serving each for four- to eight-year old children and 1.5 cup-serving serving of fruits and 2.5 cup-servings of vegetables for nine- to thirteen-year old children. (Ogata & Hayes, 2014)

WHO recommends adults (fifteen years and older) to consume more than 400 grams of fruits and vegetables per day. In Europe, the average recommendation varies between five (400 grams) and six servings (500 grams) daily. Although the dietary intake shows significant

differences across countries and between subpopulations, the European Commission concludes that most European citizens do not consume the recommended 400 grams per day. The mean daily intake of fruits and vegetables among three- to nine-year-old children shows a range between 150 grams in Finland (2003-2006) and 345 grams in Denmark (2011-2013). (EU Science Hub, 2016)

"Children and young people spend much of their day at school, typically consuming at least one meal a day there, either brought from home or provided by the school itself. Schools are therefore an essential environment to consider when tackling overweight and obesity in children and young people." (High Level Group on Nutrition and Physical Activity, 2014, p. 12) Thus, healthy eating needs to be promoted in schools to ensure that children are exposed to healthy lunch meals and that children learn about the daily requirements they should meet. Lately, various nutrition education programs have emerged in the school setting, following different strategies promoting healthy eating in children. These programs result in different impacts and claim to either change underlying psychological determinants like attitudes and preferences or actual behavior. (Hersch, Perdue, Ambroz, & Boucher, 2014) In particular, programs which involve hands-on activities increasing knowledge and skills are more likely to be effective than providing information through education strategies alone. Therefore, interventions with tasting, gardening and cooking components are gaining more popularity. (Perez-Rodrigo & Aranceta, 1997) By increasing the exposure and familiarity of various foods, those interventions might alter children's eating behavior into a constant healthier eating pattern.

1.4. Food neophobia and food preferences

Next to the obesogenic environment in general, food neophobia can be a possible explanation of the low vegetable intake among children. (Shepherd & Raats, 2006) Food neophobia is a personality trait which causes an avoidance of unfamiliar foods. Cooke et al. demonstrated in a study with two- to four-year-old children that food neophobia is associated with reduced vegetable liking resulting in a lower vegetable intake. (Cooke, Wardle, & Gibson, 2003) A clear association between high levels of neophobia and a lower fruit and vegetable consumption was found, whereas the consumption of unhealthy food items like sweet and fatty snack were not affected. These findings suggest that high levels of neophobia in children are related to a less healthy diet overall. (Cooke et al., 2003)

As human beings, everyone is born with innate taste biases – we naturally prefer sweet and avoid bitter. Bitter and sour tastes are found in vegetables which often makes enhancing the vegetable intake in children problematic due to innate dislike. (Shepherd & Raats, 2006) There

are not only different learning models including repeated exposure or conditioning, but also early childhood experiences with food which can alter and determine food preferences. Preference and acceptance of food are influenced by peers and by associative conditioning from direct food experiences. (Birch, 1999) Creating positive experience with unfamiliar food items can increase food preferences – for example for vegetables – and effectively reduce food neophobia among children. (Shepherd & Raats, 2006)

Individual food preferences can be enhanced through associating food with a positive context by reducing anxiety and increasing familiarity. Liquori et al. hypothesized that cooking vegetables in the positive social surrounding in the classroom, combined with a repeated exposure in the lunch meals, will reduce food neophobia and result in improved preferences for and consumption of vegetables. (Liquori, Koch, Ruth Contento, & Castle, 1998)

1.5. Underlying theories

Two commonly used theories in the design of school-based interventions are Ajzen's Theory of Planned Behavior and Bandura's Social Cognitive Theory.

According to the Theory of Planned Behaviour, the psychological determinants self-efficacy, attitude, subjective norm and intention will predict the likelihood of healthy eating of the individual. A strong self-efficacy, a positive attitude and a consistent subjective norm will predict the individual intention to perform a specific behaviour. The intention in turn will predict the likelihood of this specific behaviour. Many interventions aim to improve those psychological determinants in order to alter children's behaviour. (Ajzen, 1991) Many food choice models aiming to explain rational behavior are based on those intentions, beliefs and attitudes. The latter are considered as one of most important determinants on food choice. It is inaccessible to direct observation, thus, cognitive responses like awareness and knowledge and affective responses like preference and liking need to be measured. (Shepherd & Raats, 2006) On that account, the effects of cooking interventions on those determinants are examined in this systematic review.

The second theory on which many interventions are based on is the Social Cognitive Theory by Bandura. This theory emphasizes that behavioural, cognitive and environmental influences are in a status of continuous reciprocal interaction. An intervention therefore needs to address all three influences. Besides, the Social Cognitive Theory focuses more on the social influences of the environment compared to the Theory of Planned Behaviour. "Social influences operating in selected environments continue to promote certain competencies, values, and interests"

among individuals. (Bandura, 2001, p. 10) Choosing a school-based setting might increase the effectiveness of an intervention, as the school officiates as social environment and "children learn from and in the environment where they live." (Perez-Rodrigo & Aranceta, 1997, p. 271) Cooking and eating together might result in positive experiences, since atmosphere and context in which cooking and eating happen heavily impact the likes or dislikes of food. (Aldridge, Dovey, & Halford, 2009)

"Tell me and I'll forget; show me and I may remember; involve me and I'll understand."
(Chinese proverb)

In addition to attitudes and social environments, direct experiences lead more likely to a behavioral change than abstract education alone. A study based on Piaget's cognitive developmental theory applied to food in five- to eleven-year-old children about their thinking about food and eating revealed that nutrition education needs to provide direct food experiences rather than teaching about food in an abstract manner. (Contento, 1981)

1.6. Aim of this review

The aim of this systematic literature review is to assess the evidence on how cooking classes in primary schools affect healthy eating and its psychological determinants (attitude, preferences, self-efficacy) among children. Furthermore, it aims to compare the social setting in which the hands-on cooking activities are taught. It is not aimed at examining whether and which causality exists between cooking interventions and the behavioral change; only settings and outcomes are assessed. By informing public health practice, it helps close the knowledge gap between research and practice and may help public health professionals in developing and implementing school-based interventions aiming to promote healthy eating.

Public health professionals recommend school-based cooking programs to prevent and cope with the overweight and obesity challenge among children. Nelson et al. claim that cooking skills need to be integrated into the school curricula, since students could apply nutrition principles practically through food preparation. (Nelson et al., 2013) While public health professionals call to action, the research evidence on best practices are lacking. A systematic review and meta-analysis of school-based interventions on the fruit and vegetable intake in children aged five to twelve years concluded that school-interventions result in a moderate improvement of fruit consumption, whereas the vegetable intake is only minimally impacted. The result of the meta-analysis was that the twenty-one reviewed interventions increased the fruit intake by 0.24 portions and the vegetable intake by 0.07 portions. However, hands-on

activities like tasting or cooking classes were only implemented in three of the twenty-one interventions. The other interventions were limited to nutrition education programs and the free distribution of fruits and vegetables at the schools. (Evans, Christian, Cleghorn, Greenwood, & Cade, 2012)

Two systematic literature reviews of the current evidence on cooking interventions have been published previously:

- "Should we teach cooking in schools? A systematic review of the literature of school-based cooking interventions." (Caraher, Wu & Seeley, 2010)
- "The Impact of Cooking Classes on Food-Related Preferences, Attitudes, and Behaviors of School-Aged Children: A Systematic Review of the Evidence, 2003–2014" (Hersch et al., 2014)

The first review executed by Caraher et al. included four studies published between 1997 and 2007. The authors stated that an association between cooking activities and improved knowledge, preferences and confidence exists. Their overall conclusion on the other hand was that evidence on long-term effects and benefits are lacking. (Caraher et al., 2010) The second, recent systematic review by Hersch et al. identified eight studies (2003 to 2014) and pointed out that cooking interventions in primary schools have a positive impact on food-related preferences, attitudes and behaviors. Due to differences in study measurements and interventions components, best practices and long-term effects could not be assessed in this review. (Hersch et al., 2014)

This systematic review is unique, as it assesses the complete available evidence without being restricted to a time window. Besides, it is the first review evaluating and comparing the settings in which the interventions have been implemented. While the two previous reviews focused on the outcomes of included studies, this paper also identifies the social components of each intervention.

1.7. Hypotheses

It can be hypothesized that cooking interventions lead to healthy eating and an improved diet quality by improving underlying psychological determinants like preferences and attitudes. "Of all determinants, the availability and accessibility of fruits and vegetables and taste preferences were most consistently and most positively related to consumption." (Blanchette & Brug, n.d., p. 431) Due to this positive association, improving children's preferences towards fruits and vegetables is a promising strategy to enhance their intake. Through positive experiencing, food

neophobia in children might be decreased and children might show a higher willingness to taste novel food. This willingness to try novel food, especially vegetable-containing food items, might be increased by hands-on cooking activities due to the "I cooked it myself" effect. (Allirot, da Quinta, Chokupermal, & Urdaneta, 2016) That very "I cooked it myself" effect increases liking and consumption as evidenced in young adults by Dohle et al. In their study, they found that subjects who prepared a milkshake showed a higher rating of liking and a higher consumption of this milkshake than subjects who were not involved in its preparation. (Dohle, Rall, & Siegrist, 2014)

This argumentation is supported by the Social Cognitive Theory, since the classroom represents a social environment from which children learn. (Perez-Rodrigo & Aranceta, 1997) Through role modeling and the involvement of peers, school-based cooking interventions might stimulate healthy eating among school-children.

It has already been demonstrated in a study by Chu et al. that involving children in cooking activities can enhance healthy eating. The authors examined whether involvement in meal preparation at home is associated with diet quality in ten- to eleven-year old children. The authors concluded that the more children are involved in meal preparation at home, the higher is the consumption of fruits and vegetables and the better is the overall quality of their diet. Those children who were more involved in cooking at home showed higher preferences for fruits and vegetables and a higher self-efficacy for healthy eating. (Chu, Storey, & Veugelers, 2014) This literature review will examine whether this association can be transferred to the school setting.

2. Methods

2.1. Data sources

A systematic literature search was performed using the electronic databases PubMed and MedPilot. The databases were searched for primary research articles involving a cooking intervention in primary schools. The search was restricted to articles written in English and published until May 2018. As keywords and medical subject headings both “cooking school elementary intervention” and “cooking interventions schools children” were used. The hit rates for each term are depicted in figure 1. Besides, the two existing systematic reviews on this topic were searched by hand. The initial electronic database search resulted in 138 hits which were complemented by twelve articles included in previous systematic reviews.

2.2. Study selection

Publications containing a cooking intervention in primary schools (kindergarten through grade six or age of five to twelve years) were regarded as potentially relevant. Cooking interventions were defined as such if they included a hands-on food preparation component and if they were carried out in the school setting. Only randomized controlled trials or quasi-experimental study designs with the aim or objective to affect healthy eating and/or its underlying psychological determinants were considered for review. The adequate description of the cooking activities including frequency, duration and type of prepared meals was a further inclusion criterion. Articles not satisfying one of the inclusion criteria were not considered for review. After scanning titles and abstracts of the initial database search, 137 of 150 articles were excluded, because they either did not meet the inclusion criteria or they were duplicates. Two of the thirteen potentially relevant full-texts were not included in this systematic review, since the intervention did not proceed in a school setting or the study did not adequately describe the cooking activity. Eleven articles remained for full review.

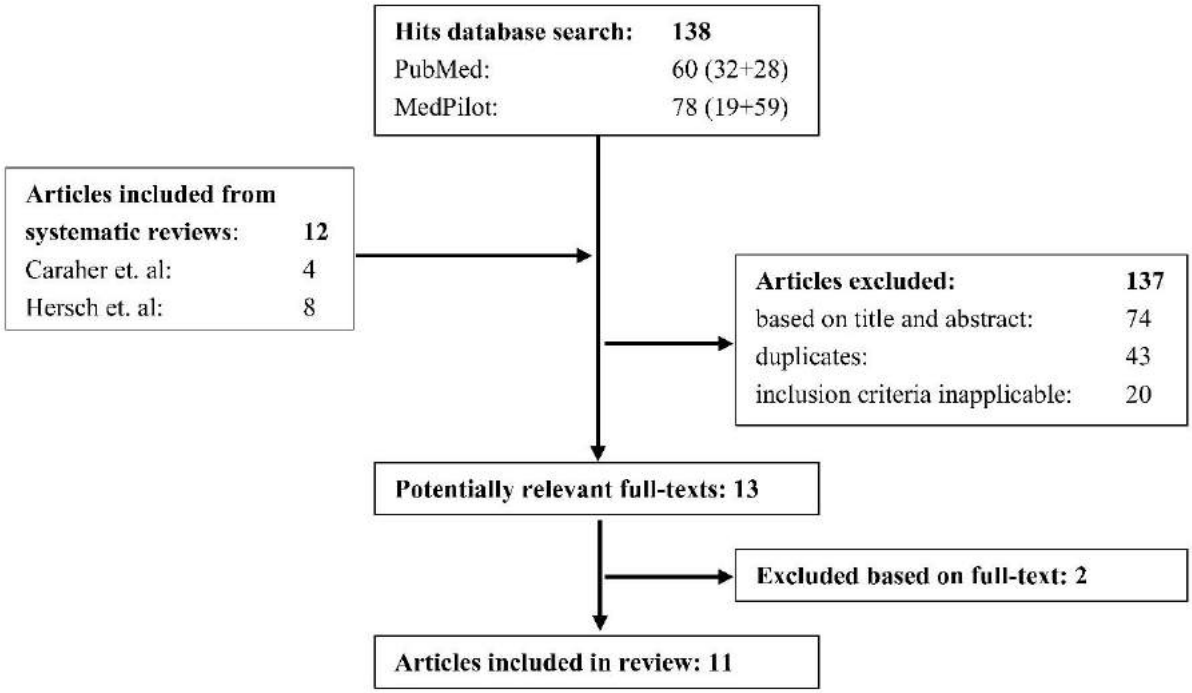

Figure 1. Flow diagram presenting the process of systematic literature search for cooking interventions in primary schools published until May 2018.

2.3. Data extraction

Only published information were adopted from the eleven remaining articles; study authors were not contacted. The data extraction included the following information: study aim, study design, location, sample size and age, duration, intervention components, outcome measurements as well as results and overall conclusion. Based on the interventions components, the studies were categorized into four groups: cooking only (three), tasting and cooking component (three), cooking and gardening component (two) and cooking with parental involvement (three).

2.4. Quality assessment

The quality of the evidence provided by each study was judged on the study design and the risk of bias. The evidence provided by randomized controlled trials were ranked higher than those provided by quasi-experimental settings. One arm pre-test post-test design was ranked the lowest, since the internal validity is low. Without control group, it cannot be concluded that study outcomes are caused by the intervention or a result of an effect modifier or other contextual factors outside the intervention. The quality of studies in which dietary intake was not directly assessed but guessed by visual observation also scored lower. Due to these criteria and the risk of biases, the quality of four of the eleven studies was rated as low.

3. Results

In the following, the eleven studies will be introduced and subsequently, the study outcomes (psychological determinants and dietary intake) will be compared. Of the eleven included studies, the majority was based in the U.S. (six), two were conducted in Spain and one each in Australia, the Netherlands and the United Kingdom. The sample size ranged from 137 to 1,230 subjects and the duration of the intervention ranged from a single one-hour session to weekly one-and-a-half-hour cooking lessons over two years. Outcomes of interests and outcome measurements varied between the studies. The same is true for the risk of confounding and biases. A summary of the eleven studies can be found in the attached table.

3.1. Introduction of the studies

3.1.1. Cooking only

The first category "Cooking only" comprises three studies: Caraher, Wu, Seeley and Lloyd (2013), Allirot et al. (2016) and Jarpe-Ratner, Folkens, Sharma, Daro and Edens (2016).

The aim of Caraher et al. was to assess the effectiveness of "Chefs Adopt a School Scheme" (CAAS) in increasing cooking confidence, preparation and consumption of included vegetables. CAAS consisted of up to three lessons per year in primary schools including nutrition education, cooking activities and if possible, a restaurant visit. This study looked at the effects of two sessions – nutrition and hygiene education in the first session and cooking in the second session in which children prepared a pasta salad with five vegetables (tomatoes, cucumber, celery, peas and red pepper).

A quasi-experimental, parallel arm pre-test post-test design was executed, but only pre-test post-test data of the intervention group were used in the analysis due to significant differences between the groups at the baseline measurement. One of these differences for instance was the confidence to follow a recipe with no or little help (82% in the intervention compared to 94% of the control group). The sample covered 169 children of which 86 were assigned to the intervention and 83 to the control group which received a delayed intervention. Each group was divided into four classes of twenty or more students. Each intervention school was matched with a control school of the same region with a similar rate in Free School Meal Entitlement (FSME). The outcomes were measured by a four-scale questionnaire on cooking confidence, vegetable consumption (consumption of vegetables included in the pasta salad were used as proxy for overall vegetable consumption) and children's confidence in asking for ingredients. FSME was found to be an effect modifier in the intervention group because of its inverse

relationship to the change in cooking confidence. Inclusion criteria were based on FSME school rates and not individual FSME status. Besides, the small dose of two sessions, the big groups and the limited standardization of the intervention were considered as limitations. Thus, the quality of provided evidence was ranked low.

Allirot et al. evaluated the effect of a one-hour cooking class on the willingness to taste novel foods, food neophobia, liking, intake and hunger compared to the effect of a creative workshop alone. The intervention consisted of two parts: the cooking session or creative workshop and an afternoon snack afterwards. During the cooking class, children prepared three unfamiliar food items containing vegetables (zucchini tortilla sandwich, spinach cookies and apple/ beetroot juice). The creative workshops included various cognitive tasks without any direct food experience. After that, children were asked to individually choose one snack of the following categories: tortilla sandwiches, cookies and juices. For each category, participants could choose between familiar or unfamiliar food items (as prepared in the previous cooking session). Subsequently, children ate their chosen snacks together and could try other snacks which they have not initially chosen.
The effectiveness was assessed by a randomized controlled trial with 137 participants. Four primary schools in two provinces were selected and each child assigned to a group of five. Each group was randomly allocated to the cook (69) or control condition (68). Food neophobia was assessed at the pre- and post-test using the Food Neophobia Score using a seven-point Likert rating scale. Further outcomes of interest were: willingness to try novel food, cooking and eating habits assessed by questionnaire; liking assessed by a five-point facial scale; food intake assessed by photographs; satiety scores before and after the workshop as well as after the afternoon snack assessed by Bennet and Blisset's "Teddy the Bear" scale for primary children. Because of the study design, the quality of evidence was judged as high. Limitations of the study comprised randomization by group and not by individuum, the short-term duration of only one session and the absence of direct assessment of dietary intake.

The effect of the "Common Threads Program" on liking and consumption of fruits and vegetables and associated short-term outcomes as well as the duration of the effect was assessed by Jarpe-Ratner et al. in low SES children. Common Threads is a chef-led cooking and nutrition education after-school program aiming to improve fruit and vegetable exposure among children. Students received one two-hour class per week over ten weeks (90 minutes cooking, 30 minutes education). It was executed in the school kitchen by chefs assisted by teachers with a student-instructor-ratio of 5:1. The teams were maintained throughout the ten weeks.

The effectiveness was evaluated by a quasi-experimental, one group pre-test post-test design with a sample size of 271 children (65% girls, 86% Hispanic or African American; 94% free or reduced-price lunch). Seventeen high-poverty primary schools and one middle school participated, and subjects were selected by school staff. Variable inclusion criteria like reward for good behavior was a limitation of this study. Outcome measurements consisted of children and parent questionnaires which assessed the following: changes in knowledge, cooking self-efficacy, fruit and vegetable liking and consumption, attitudes and communication about healthy eating. The quality of evidence was ranked low because of the study design and because consumption was measured by surveys asking for the number of times that fruits and vegetables were eaten and not the amount. Dietary intake and quality were not assessed, and the validity is limited to target groups with a low SES background.

3.1.2. Cooking and tasting

Interventions involving cooking and tasting sessions were investigated by Cunningham-Sabo and Lohse (2013, 2014) and Battjes-Fries et al. (2016).

The first study by Cunningham and Lohse assessed the external validity and the impact of Cooking with Kids (CWK) on attitudes and self-efficacy for food and cooking as well as on fruit and vegetable preferences. The cooking and tasting program was originally developed and implemented in low-income, predominantly Hispanic schools. Thus, Cunningham and Lohse aimed to evaluate whether CWK is effective in another setting and whether CWK has a greater impact on subjects without previous CWK exposure. Children participated in three two-hour cooking classes and three one-hour tasting sessions per school semester. Both were given by a graduate nutrition student assisted by a teacher. Three recipes containing culturally diverse food items and vegetables were prepared and tasted, but no information about the social setting were given.

This intervention was a randomized controlled trial with a sample of 257 children in four elementary schools. The random allocation resulted in 137 children in the intervention and 120 children in the control group. Each group was divided into three classes. The outcome measurements included: fruit and vegetable preferences, cooking self-efficacy and attitude which were assessed by a 35-item questionnaire. The quality of evidence provided was ranked high. The only limitations of this study design were the lack of dietary intake assessment and the lack of home environment assessment (as potential effect modifier), but the home environment was not assessed in any of the studies.

The second study carried out by Cunningham and Lohse compared the effect of CWK on attitudes, self-efficacy for food and cooking, and fruit and vegetable preferences to the effects of a tasting only program and a control group. The modified CWK program incorporated five two-hour cooking classes and five one-hour tasting sessions (fruits and vegetables) during a nine-month school year. The tasting only group received only the tasting session and the control group received no treatment at all. Parents could volunteer during cooking classes, but their actual participation was not monitored.

The effectiveness was evaluated by a quasi-experimental, three arm pre-test post-test design. The sample size was 1,230 children at eleven schools (84% Hispanic, 50% female). Four schools (539) were assigned to the CWK group, four (294) to the tasting only group and three (397) to the control group. Outcomes of interest were measured similarly to the previous study. The provided quality of evidence was classified as middle. The low external validity as well as the lack of dietary intake assessment were limitations of this study. Moreover, it is possible that children were previously exposed to the CWK program. Significant differences between the three groups were found at the baseline measurement. The cooking self-efficacy was significantly higher in both CWK and tasting only group compared to the control group. In the tasting only group, the attitude towards fruits and vegetables was significantly higher than in the control group.

Battjes-Fries et al. assessed the appreciation, feasibility and effect of the extended Taste Lessons program on the psychosocial determinants of vegetable consumption compared to the normal Taste Lessons (TL) and a control condition. TL is a national, school-based nutrition education program for primary schools aiming to improve knowledge and skills concerning healthy eating. The program consisted of five 45 minute lessons covering the themes of taste development, eating healthily, food production, consumer skills and cooking. It was extended to “Taste Lessons Vegetable Menu” (TLVM) by adding four additional activities to the program: a vegetable quiz, an excursion to a vegetable grower, a homework assignment carried out together with parents at the supermarket and cooking with dieticians and parents. The cooking lesson proceeded as followed: introductory group talk, cooking of healthy snacks, tasting, evaluation group talk and home assignment. Cooking classes were led by teachers in the TL condition and led by teachers, dieticians and parents in the TLVM condition.

A quasi-experimental, three arm pre-test post-test design was used for the evaluation. A sample of 800 children of thirty-four elementary schools completed both pre- and post-test and were included in the analysis. Eleven schools were allocated to the TLVM (417), eleven schools to the TL (285) and twelve schools (308) to the control group. Outcomes of interest included:

psychosocial determinants (self-efficacy, attitude, subjective norm, intention) assessed by a questionnaire with five-point scale as well as knowledge and awareness regarding taste, health, production and cooking assessed by multiple choice questions. Due to the study design and the great sample and dose, the quality of evidence was judged as high. One limitation of the study was the presence of different socio-demographic factors in the TLVM group compared to the other groups. Children of the TLVM group had younger, less educated mothers with more children and older and more experienced teachers which might have resulted in confounding.

3.1.3. Cooking and gardening

Two studies evaluated the effectiveness of cooking and gardening interventions – Davis, Ventura, Cook, Gyllenhammer and Gatto (2011) and Gibbs et al. (2013).

The aim of Davis et al. was to evaluate the effects of LA Sprouts on dietary intake and health outcomes among fourth- and fifth-grade Latino students compared to a control condition. LA Sprouts is an after-school gardening and cooking program over twelve weeks. The intervention included 45 minutes gardening and 45 minutes cooking per week. Through the gardening lessons, students were taught about planting, growing and harvesting organic fruits and vegetables by university staff. The lessons took place at a community garden two miles away from the school. The cooking lessons focused on increasing fruit and vegetable intake and emphasized culturally relevant food items like beans. Children prepared, cooked and ate various foods in teams of five – supervised by a graduate nutrient student and registered dietician – in the garden. Parents received a separate education program, but during this study only 25% of the invited parents participated.

The effectiveness was assessed through a quasi-experimental, parallel arm pre-test post-test design with a sample of 104 subjects. The intervention group consisted of 34 children who were enrolled in the after-school program. The remaining 70 students were designated as the control group. Almost every participant was overweight or obese at the baseline measurement (95%; 53% in the intervention and 61% in the control group). This study exceeded the other studies by directly measuring effects of dietary intake on health outcomes, such as blood pressure and body composition. Dietary intake of the last 24 hours was assessed by Block Food Screeners for Ages 2-17 (41-item Food Frequency Questionnaire (FFQ)). The quality of evidence provided by this study was ranked middle due to several limitations. The intervention and control group were recruited at the same school and the sample size was relatively small. Changes in health outcomes like the change in BMI were tested only on the short-term. Moreover, significant differences were found between intervention and control group regarding

gender distribution and dietary fiber intake. In the overweight subsample, 67% of the control group were boys compared to only 39% in the intervention group. The control group consumed 23% more dietary fiber than the intervention group at the baseline measurement. These limitations may suggest that a rather conservative assessment was made regarding the effectiveness of LA Sprouts.

Gibbs et al. assessed the feasibility, acceptability and effectiveness of the Stephanie Alexander Kitchen Garden Program (SAKG) on the appreciation of diverse, healthy food among children. SAKG is a celebrity-introduced nutrition and gardening program by the Australian cook and restaurateur Stephanie Alexander. During the two-year intervention, students received one 45 to 60 minute gardening and one 90 minute cooking class per week, both led by a specialist. Children prepared a three or four course meal with the produce from the garden and afterwards, ate it together with the staff.

A quasi-experimental, parallel arm pre-test post-test design was chosen, and 592 subjects were included in the analysis. Six interventions schools (352 subjects) were recruited representing various characteristics (location, school size, SES). Six control schools (240 subjects) with edible gardens were individually matched. This is the only study providing qualitative data (social impact, change in attitudes, etc.) which were obtained through focus groups with teachers, parents and children. For one focus group, teachers chose ten children who should represent a range of experience. Quantitative data regarding the willingness to try novel food were gained through parents and children questionnaires. The study by Gibbs et al. provides a low quality of evidence because of a high chance of several biases: response bias (increased recruitment due to celebrity involvement), participant recruitment bias (those with more positive attitudes are more likely participate in focus groups) and parents-reported bias (due to social desirability, parental recall). One of the control schools started its own cooking classes, making the comparison between intervention and control condition impossible.

3.1.4. Cooking with parental involvement

Three studies – Perez-Rodrigo and Aranceta (1997), Liquori et al. (1998) and Quinn, Horacek, Castle (2003) – involved parents either through separate workshops or through a newsletter informing about a healthy lifestyle.

The first study found on this topic is done by Perez-Rodrigo and Aranceta examining children of low SES. The study targeted especially Gypsy children, because for some of them school meals provide 70% of their daily energy intake. The authors assessed the effectiveness of a nutrition education program in promoting healthy eating, skill-development and self-

empowerment. The program consisted of a nutrition education, cooking and lunchroom component led by teachers who were assisted by social workers of the Gypsy community. Over five weeks, students were cooking together for two hours per week in groups of fifteen. As the program was based on the Social Learning Theory, role modeling was an important component and the prepared meals were consumed together with the teachers afterwards. "Objectives for the classroom focused on improving knowledge, developing skills for choosing healthy foods, and learning how to resist peer pressure." (Perez-Rodrigo & Aranceta, 1997, p. 268) Parents were invited to various meetings. The lunch meal was improved with the result that it supplied 35% of the Recommended Daily Allowances for energy, protein, calcium and iron.

This intervention was a one group cohort, pre-test post-test intervention over two years with a sample of 150 children (75% Gypsy, 25% Non-Gypsy). Outcome measurements consisted of: questionnaires assessing knowledge, skills and preferences; personal interviews about eating habits; visual estimation of plate waste assessing the lunch meal acceptance. The quality of evidence was judged as low due to a missing control group. It cannot be certainly concluded that outcomes are caused by the intervention. Besides, the sample size is relatively small and due to the specific target group, the study provides almost no generalizability to other settings.

Liquori et al. assessed the effectiveness of the Cookshop Program in improving preferences for and the consumption of whole grains and vegetables compared to a similar educational strategy without cooking and a control group. The Cookshop Program targeted urban, low-income children and promoted a plant-based diet, especially an increased consumption of minimally processed whole grains and vegetables. The Cookshop Program consisted of three components: a healthy school lunch, a classroom component and the parental involvement. Ten 60 to 90 minute long cooking classes were given by teachers, parents and college nutrition students. Each classroom was divided into three groups, each group supervised by one adult. In the school lunch, students were served food items they have previously prepared in the classroom ("Cookshop", CS) to increase the exposure to these foods. All parents received the monthly newsletter "Diets and Dollars" informing about CS food and its preparation. This experimental strategy was compared to food and environment lessons (FEL) as a cognitive learning strategy without any direct experiences with food. During 45 minute classes, students where taught why whole grain food and vegetables are the basis of a healthy diet.

The effectiveness was evaluated through a quasi-experimental, four arm pre-test post-test design. The sample of 590 children (85% African American, 15% Hispanic) were approximately equally distributed to four groups: CS only, FEL only, CS and FEL or control group which only received the healthy school lunch. The CS project director selected the control

groups together with the school principal. Outcome measurements were visual estimation of plate waste, questionnaires assessing preference, attitude, knowledge and self-efficacy regarding targeted food, healthy eating and cooking. The quality of evidence was ranked high, although the study design showed some limitations like the recruitment of control and intervention groups at the same school. Furthermore, the exposure to healthy school lunch and newsletter in every group might reduce the outcome difference between intervention and control group. The change in dietary intake might be not assessed correctly due to the use of visual estimation instead of weighing.

Quinn et al. evaluated the effect of the modified CS program on improving attitudes towards and consumption of fruits and vegetables among fifth grade students. The classroom component was extended to eleven CS sessions, but the healthy school lunch component was left out. The parental involvement was modified as well – parents were still invited to participate as instructors during the cooking classes and received the recipes for at home preparation. After each cooking class, the prepared meal was tasted together.
The sample of this quasi-experimental study were 149 children who participated in a parallel arm pre-test post-test; 81 children were assigned to the CS intervention group and 68 children to the control group. At pre- and post-test, the dietary intake was assessed by 24h recall and the National Cancer Institute Food Frequency Questionnaire (NCI-FFQ). Changes in knowledge, food exposure, eating habits and attitudes were examined by a children questionnaire; changes in eating and purchasing habits by a parent questionnaire. The provided quality of evidence was ranked middle, since only general dietary trends were assessed instead of quantitative intakes. Moreover, the results of the FFQ did not support the outcomes of the 24h recall. The significant difference in gender distribution (44% girls in the intervention and 62% girls in the control condition) as well as the limited parental participation and response rate are further limitations.

3.2. Findings

Since most of the studies were geared on the short-term, a change in psychological determinants instead of the actual behavior change was an outcome of interest. Six studies evaluated self-efficacy; five studies each assessed attitude, knowledge and preference; four studies examined the willingness to try novel food and eight studies the actual consumption of fruits and vegetables. One study looked also at the health outcomes. The key findings of each study are presented in the following table.

Table 1. Key findings of the eleven included studies on healthy eating and its underlying psychological determinants.

Category	**Cooking only**		
Study	Caraher et. al	Allirot et. al	Jarpe-Ratner et. al
Results	After the CAAS program cooking skills and confidence as well as the vegetable intake (+0.22) significantly increased. The confidence to ask parents for food items increased by 22%. The majority of children (89%) asked to have another session. 20 of 86 showed no or a negative change in cooking confidence.	COOK resulted in a higher number of novel food containing vegetables chosen and tasted and a higher liking for 2 of 3 self-prepared snacks. No difference in overall food intake and satiety score was found between both groups. The effects of COOK on actual intake of novel foods was modest (true for only 32 children).	CT program increased: self-efficacy, knowledge and exposure to novel food (+1 new item); fruit (+0.23), vegetable consumption (+0.20); communication about healthy eating and frequency of preparing dinner 6 months later. The willingness to try novel food decreased slightly. No effect on liking could be found.
Category	**Cooking and tasting**		
Study	Cunningham-Sabo and Lohse[1]	Cunningham-Sabo and Lohse[2]	Battjes-Fries
Results	CWK caused: significantly higher cooking self-efficacy (3x), fruit and vegetable preferences (3x higher for vegetables) and attitude towards cooking; higher pre-test post-test differences. No gender differences in preferences were found. The greatest effect on attitude and self-efficacy were reported in (male) non-cookers.	CWK caused the greatest improvement of cooking self-efficacy and fruit and vegetable preferences (for boys 2.5x higher than controls). Only vegetable preferences improved significantly in both intervention group. Non-cookers showed a greater increase in cooking attitude and self-efficacy (2.5x).	TLVM and TL caused a significantly higher increase in knowledge (+43% and +36%). TLVM resulted in a significantly higher improvement of the attitude towards tasting and eating vegetables and showed a slightly stronger effect on subjective norm and cooking self-efficacy than TL alone.
Category	**Cooking and gardening**		
Study	Davis et. al	Gibbs et. al	
Results	The effects of LA Sprouts were: 22% increase in dietary fiber intake, 5% decrease in diastolic blood pressure, 1% weight gain. Compared to the control group: 12% decrease dietary fiber intake, 3% decrease diastolic blood pressure, 4% weight gain. The program did not significantly reduce BMI percentiles.	SAKG caused: willingness to try novel food 2x greater than among controls; negative effect on actual intake: less children consume at least 2 servings of fruits (-4.4%) and 5 servings of vegetables (-0.4%). Qualitative findings suggest an increased appreciation and willingness to try novel, diverse food items.	
Category	**Cooking with parental involvement**		
Study	Perez-Rodrigo and Aranceta	Liquori et. al	Quinn et. al
Results	After post-test, 95% of the children showed an increase in knowledge and 65% prepared intervention meals again at home. The intervention caused: improved cooking skills; greater consumption of fruits, vegetables, fish, dairy products; gradual acceptance of novel food.	CS caused: improved knowledge, cooking self-efficacy, preferences for targeted food; greater change in behavioral intentions and dietary intake (~20% of targeted food consumed compared to ~5% in controls). Attitudes were not changed in any group. Effects were stronger in younger children.	CS resulted in: ~2mg more dietary fiber consumed than controls; greater exposure and willingness to try novel food; improved attitudes. Changes in dietary intake were modest: the consumption of fruit and vegetables increased slightly according to 44% of the parents.

3.2.1. Psychological determinants

Five of the six studies assessing cooking confidence or self-efficacy demonstrated a significant increase at the post-test of the intervention group in comparison with the baseline measurement (Battjes-Fries et al., 2016; Caraher et al., 2013; Cunningham-Sabo & Lohse, 2014; Jarpe-Ratner et al., 2016) or with the control group (Cunningham-Sabo & Lohse, 2013). Liquori et al. found a significant difference between pre- and post-test data only in older intervention children (grade four through six). (Liquori et al., 1998) Similarly, the cooking classes could significantly increase children's knowledge about healthy eating – either compared to pre-test data (Jarpe-Ratner et al., 2016; Liquori et al., 1998; Perez-Rodrigo & Aranceta, 1997) or compared to the control group (Battjes-Fries et al., 2016; Quinn et al., 2003).

The effects on children's willingness to try novel food were inconclusive. In the study of Jarpe-Ratner et al., children were slightly, but significantly less willing to try unfamiliar food items. (Jarpe-Ratner et al., 2016) On the other hand, a significant greater willingness in the intervention group compared to the baseline measurement (Gibbs et al., 2013) or compared to the control group (Quinn et al., 2003) was reported by two studies. Allirot et al. demonstrated a significantly higher willingness to try new foods (on average, 2.2 of three novel snacks were tasted), but the actual willingness to choose novel foods as an afternoon snack was comparatively low (on average, 0.55 of three novel snacks were chosen). (Allirot et al., 2016) Nevertheless, cooking classes affected subsequent food choice by increasing the chance that novel foods are chosen. Therefore, Allirot et al. concluded that cooking activities can reduce food neophobia in children at least on the short-term. (Allirot et al., 2016)

A clear improvement of attitudes was pointed out by four of five studies (Battjes-Fries et al., 2016; Cunningham-Sabo & Lohse, 2013, 2014; Quinn et al., 2003). Only Liquori et al. could not find any significant difference in attitudes between intervention and control group. (Liquori et al., 1998) Gibbs et al. found great improvements of attitudes through focus groups, but those strong qualitative findings could not be supported by quantitative data. Thus, they might reflect only radical individual changes instead of improvements at the population level. This could be the case if only children who showed lowest willingness to try novel food at baseline were included in the focus groups. (Gibbs et al., 2013) Nevertheless, effects observed at the school setting seemed to be transferable to the home environment. Caraher et al. reported an increase in confidence of asking parents for vegetables and suggest that this transmission of attitude may also result in a change in eating behavior at home. (Caraher et al., 2013) In line with this, Jarpe-Ratner et al. claimed that cooking interventions at schools influence meal preparation and eating habits at home. (Jarpe-Ratner et al., 2016) Gibbs et al. demonstrated on the other hand, that the

impact of cooking classes observed in the school setting was not transferred to the home environment. The willingness to try novel food at home seemed to have not changed after the intervention. (Gibbs et al., 2013)

Five studies examined the effectiveness of cooking classes on increasing fruit and vegetable preferences and liking. Whether this is the case or not, remained inconclusive. Nonsignificant improvements were found by Allirot et al. (2016) and Jarpe-Ratner et al. (2016). Significant improvements compared to control group (Cunningham-Sabo & Lohse, 2013) or the baseline measurement (Cunningham-Sabo & Lohse, 2014; Liquori et al., 1998) were, by contrast, revealed by two other studies. An improvement of preferences could not be caused by nutrition education alone. (Liquori et al., 1998) Instead, preferences for fruits and especially vegetables were improved by cooking and tasting sessions independent of previous cooking experiences. (Cunningham-Sabo & Lohse, 2013) Furthermore, a gender difference in fruit and vegetable preferences was found at baseline measurement. Boys tended to like fruits and vegetables less than girls at pre-tests and demonstrated a greater change in liking at post-test. Thus, it can be concluded that boys in particular profit from cooking activities at school. (Cunningham-Sabo & Lohse, 2014)

3.2.2. Dietary intake

The effects on improving children's dietary intake were changes of a more modest nature. A significant higher fruit and vegetable consumption at the post-test compared to the pre-test was demonstrated in four of seven studies which assessed dietary intake (Caraher et al., 2013; Jarpe-Ratner et al., 2016; Liquori et al., 1998; Perez-Rodrigo & Aranceta, 1997). However, the significant increase found by Liquori et al. applied only for the fruit intake of younger intervention children (kindergarten through grade 3). (Liquori et al., 1998) Gibbs et al. could not detect any significant change in intake. (Gibbs et al., 2013) Against this, a significant higher intake of dietary fiber in the intervention group than in the control group at post-test was detected by two studies (Davis et al., 2011; Quinn et al., 2003). Quinn et al. concluded that the cooking intervention did not result in an immediate change in overall dietary intake, but that a change in eating behavior might occur in the long-term. (Quinn et al., 2003) Even though not many significant differences could be determined in these studies, cooking classes seem to at least slightly improve fruit and vegetable intake among children. Liquori et al. found that cooking activities improved the intake of targeted foods, although only with a modest effect: children involved in cooking ate about 20% of targeted foods compared to the education group with about 10% consumed and the control group with almost 0% consumed. This finding

indicates that experimental strategies are more effective in bringing behavioral changes than cognitive strategies alone. (Liquori et al., 1998) Besides, cooking classes provide long-term effects on the frequency children help preparing dinner at home: even after six months, children were still more involved in dinner-preparation at home. (Jarpe-Ratner et al., 2016) A long-term result might be an improvement of health outcomes as demonstrated by Davis et al. (2011). Cooking interventions like the LA Sprouts program can affect long-term health outcomes like blood pressure which was significantly lower postintervention in comparison with the control group. In the overweight subsample, it could furthermore significantly reduce BMI and rate of weight gain among Latino children. (Davis et al., 2011)

4. Discussion

To combat the current overweight and obesity epidemic among children in Western countries, school-based cooking classes emerged as one strategy to promote healthy eating among children. (Nelson et al., 2013) This systematic literature review assessed the current evidence base on how cooking interventions impact children's healthy eating behavior and its underlying psychological determinants. With only eleven studies included in this review, the evidence base on how effective cooking classes are in enhancing healthy eating remains rather small.

Food neophobia was found to play a key role in children's willingness to try novel foods, especially those which contain vegetables. (Cooke et al., 2003) Looking at the short-term effects, three studies reported a significant increase in the willingness to try novel foods postintervention (Gibbs et al., 2013; Quinn et al., 2003; Allirot et al., 2016). Besides, each study revealed an improvement of at least one of the following psychological determinants: cooking self-efficacy, attitudes towards and preferences for fruits and vegetables. According to the Theory of Planned Behavior, those determinants are essential predictors for healthy eating. (Ajzen, 1991)

The overall immediate impact on dietary intake was modest. A significant improvement could only be demonstrated for dietary fiber. (Davis et al., 2011; Quinn et al., 2003) Changes of fruit and vegetable intake were nonsignificant. Even though this review was not successful in proving the hypothesis that cooking classes will lead to an improved fruit and vegetable consumption, it still turned out to be a promising strategy. By positively impacting children's health-related attitudes and preferences, it might improve their behaviors in the long-term. (Jarpe-Ratner et al., 2016) Attitudes and preferences observed at the school setting seem to be transferable to the home environment and "it may be possible to increase healthy behaviors such as home cooking, fruit and vegetable intake, and communication within the family about healthy eating" (Jarpe-Ratner et al., 2016, p. 704) All in all, boys and children without previous cooking interventions seem to profit the most from cooking intervention. They revealed the greatest gain in cooking self-efficacy as demonstrated in the one-year evaluation study by Cunningham and Lohse. (Cunningham-Sabo & Lohse, 2014)

4.1. Interpretation and reflection

As already concluded by Hersch et al., "generalizing the reviewed program's effectiveness at influencing food-related preferences, attitudes, and behaviors is challenging." (Hersch et al., 2014, p. 4) Large variations were not only found in intervention elements, but also in the

reliability of measurements. The difficulty to objectively assess behavioral or dietary change could be one explanation for why findings could not confirm the hypothesis. (Hersch et al., 2014) Another reason is the duration of the interventions and the lack of long-term follow-up. (Caraher et al., 2010) The only long-term outcome published was that children were more involved in dinner-preparation at home six months postintervention. (Jarpe-Ratner et al., 2016) However, behavioral change takes time and cannot be achieved on the short-term. A study by Connell et. al revealed that around fifteen hours are needed to change health knowledge compared to around fifty hours to change health-related behavior. This finding might explain why only significant changes in psychological determinants could be demonstrated in the included studies. Behavioral changes like healthy eating likely occur in the long-term after a longer exposure to the intervention rather than on the short-term. (Connell, Turner, & Mason, 1985) "Changing dietary habits is a slow and multifaceted process" – children need to learn to like vegetables before they can consume them on a regular basis. (Quinn et al., 2003, p. 47) Due to the overall improvement of vegetable preferences, cooking activities can be the first step in overcoming innate taste preferences and in learning to like vegetables. In the long-term, children might learn to like fruits and vegetables if they are exposed to cooking classes on a regular basis over a longer time. (Shepherd & Raats, 2006) This review revealed that – as suggested by Piaget's cognitive developmental theory – creating direct experiences with food is more effective in increasing food-related preferences, attitudes and behaviors than abstract nutrition education alone (Battjes-Fries et al., 2016)

The provision of food items which were previously prepared during cooking classes at the school lunch reinforces the message of the cooking component. Likewise, it is argued that only offering targeted food through school lunch is not enough, but that cooking and learning (as a cognitive element) must complement it. (Liquori et al., 1998)

4.2. Social settings

"Preparing food in small groups and eating food together in the classroom in an enjoyable atmosphere, along with cognitive learning experiences, may be an important ingredient in nutrition education that aims to change children's food preferences and eating behaviors." (Liquori et al., 1998, p. 311)

The qualitative findings of Gibbs et al. suggest that children's increased willingness to try novel foods might be caused by the social environment in which the intervention takes place. (Gibbs et al., 2013) Children reported enjoying harvesting and preparing vegetables with their classmates and that they could taste the "freshness" of those vegetables. Overall, positive

statements like “I just like to know that you’re eating your own stuff that you’ve been growing and to be able to try new things that you’ve never tried before” or “This tastes better than Maccas [McDonalds]” indicated the successfulness of this cooking intervention. (Gibbs et al., 2013, p. 142) Children's enthusiasm about the cooking activities was also reported by Liquori et al. “The experience of having fun working together in small groups and enjoying eating what they have personally produced may have been important ingredients contributing to the effectiveness of CS in enhancing preferences for targeted foods” (Liquori et al., 1998, p. 310)

On the other hand, cooking activities can possibly cause a decrease in cooking as findings by Caraher et al. demonstrate. After the cooking intervention, around 23% of the students showed no change or a negative change in their confidence to cook. This seems to be the case if students are inexperienced cookers. When comparing themselves or due to overextension, they can become aware of their lack of skills, resulting in a negative experience with cooking. (Caraher et al., 2013) This was the only study which reported this finding.

Other studies revealed that inexperienced cookers benefit more from cooking classes. (Cunningham-Sabo & Lohse, 2013, 2014) Especially male non-cookers demonstrated the highest increase in cooking attitude and self-efficacy, especially for male students without previous cooking experiences. (Cunningham-Sabo & Lohse, 2013) To reduce the risk of overextension, lower student-instructor-ratios can be a possible solution. Cooking in smaller groups might increase the likelihood of positive, direct food experiences and might cause a higher engagement in cooking. (Glass, 1982) In four of the eleven studies children cooked in groups with around five to eight fellow students (Allirot et al., 2016; Jarpe-Ratner et al., 2016; Liquori et al., 1998; Quinn et al., 2003).

“Examples of programs that have a lasting impact on diet-related behavior are those that offer children the opportunity to engage with food in a different way—addressing these other factors such as experiential and contextual knowledge and incorporating social networks, including family members.” (Jarpe-Ratner et al., 2016, p. 703) Involving parents and professionals in cooking classes seems to raise the effectiveness of interventions. (Perez-Rodrigo & Aranceta, 1997)

According to the Social Cognitive Theory, social environment and role modeling play an important role in every learning process. (Bandura, 2001) Battjes-Fries et al. concluded for instance that the additional experiential learning activities of TLVM resulted in slightly higher increases in knowledge and self-efficacy than normal TL alone. The “impact of higher dose, professionally delivered activities and higher parental involvement” could be one possible

explanation for this finding. (Battjes-Fries et al., 2016, p. 524) The education by professionals (dietician, vegetable grower) resulted in significantly higher increase in self-efficacy for cooking skills. (Battjes-Fries et. al, 2016) The involvement of professionals contributes further to the appreciation of cooking activities. The majority of students showed a positive attitude towards the chef-led cooking program in the UK and 89% wished to receive another cooking class with the chef. (Caraher et al., 2013) However, it might not always be possible to include professionals or parents in cooking activities. Overall, the reported parental participation was low. In the study by Quinn et al., only one third of the parents fulfilled post-test questionnaires. (Quinn et al., 2003)

4.3. Whole School Approach

Already the first systematic review by Caraher et al. concluded that cooking classes need to be "one of a myriad of approaches rather than a single intervention" when it comes to promoting healthy eating among school children. (Caraher et al., 2010, p. 17) Moreover, they suggest that every school-based intervention aiming to enhance fruit and vegetable consumption in children should be based on a Whole School Approach. This approach comprises a healthy meal component, parental involvement, nutrition education and hands-on tasting and cooking activities. (Caraher et al., 2010) The Whole School Approach was adopted by two interventions included in this review (Liquori et al., 1998; Perez-Rodrigo & Aranceta, 1997). Liquori et al. concluded that a threefold approach including nutrition education, cooking classes and parental involvement is the most effective in promoting behavioral change in children. (Liquori et al., 1998) Similarly, a review of garden-based interventions by Robinson-Brien et al. demonstrated that interventions which include nutrition education, gardening and cooking activities show a greater effectiveness in increasing the intake of fruits and vegetables in children than educational strategies without any hands-on activities. (Robinson-O'Brien, Story, & Heim, 2009) Thus, to change dietary behaviors and promote fruit and vegetable consumption among children, a multifaceted, experimental approach is needed. One component which is often forgotten but which has a rather large impact on every school child is the daily school lunch. The significant improvements in fruit and vegetable consumption as demonstrated by Perez-Rodrigo and Aranceta were mainly caused by the circumstance that vegetables were included in the improved school meals. (Perez-Rodrigo & Aranceta, 1997)

4.4. Knowledge gaps

Collectively, Ajzen's Theory of Planned Behaviour works well in explaining intentions and single rational behaviour. Attitudes and intentions remain one of the most important

determinants of specific behaviours. (Godin & Kok, 1996) A longitudinal study in Norwegian children of grade six and seven demonstrated that preferences for fruits and vegetables are the strongest determinants of their consumption. (Bere, Brug, & Klepp, 2008) Due to the exclusion of intuitions and emotions, Ajzen's assumption that intentions predict a specific behaviour is inconclusive. On the contrary, it is claimed that one does not always act according to one's intentions and that "health behavior change encompasses a variety of social, emotional, and cognitive factors". (Schwarzer, 2008, p. 2) More research is needed on how those latter determinants impact children's behaviours.

Due to the large range of outcomes of interests and outcome measurements, determining best practices proved difficult. The frequency and duration of cooking interventions varied largely, thus comparing outcomes which are also highly influenced by the target group is challenging. A longer exposure to cooking classes seems to be positively related to more significant outcomes. However, no conclusions about the sustainability of these outcomes can be drawn. The studies showed a significant short-term improvement of psychological determinants, but whether those can be sustained in the long-term is unknown. Moreover, the intervention components differed which makes it difficult to evaluate whether significant changes were caused by cooking alone or by other program components like gardening. More research needs to be done on the following program elements: frequency and duration of exposure, ideal instructors (teacher, chef, celebrity, dietitian etc.), role of social and home environment, parental involvement, and complementation with other elements like tasting and gardening. Furthermore, it is necessary to examine different settings (country, SES, ethnicity, etc.) using both quantitative and qualitative data to assess best practices. (Hersch et al., 2014) Additionally, follow-up measurements and evaluation of long-term impacts and outcomes needs to be conducted for each intervention which aims to bring behavior change. (Caraher et al., 2010)

4.5. Limitations

Selection and publication biases might occur as limitations of this systematic literature review. Although the database search was conducted extensively, the chance exists that not every relevant, available study is included in this review. Studies which did not describe the cooking activities appropriately were directly excluded from review without contacting study authors. However, the study might have been relevant for review.

The findings published in this review might be biased by positive significant outcomes of the studies. Nevertheless, the key findings of each study regardless of their significance are provided in the attached table.

4.6. Conclusion

Nutrition education alone is not enough, and knowledge alone is not enough to ensure that dietary intake recommendations are met. “Rather, there is a need to move from knowledge about *what* (i.e. food) to knowledge about *how* (i.e. cooking).” (Caraher et al., 2010, p. 15)

Different designs and evaluation methods as well as the combination of various intervention components proved it difficult to determine best practices. Important determinants of the success of nutrition education interventions are fun and involvement of peers as well as “consistent messages from the cafeteria and the classroom”. (Liquori et al., 1998, p. 312) More research is needed on how experimental learning strategies can complement classical nutrition education and how the two together can promote healthy eating among children.

Although this review could not demonstrate a direct behavioral change towards healthy eating and an improved diet quality, it could prove the effectiveness of cooking classes in improving underlying psychological determinants at least on the short-term. The evidence on the long-term impact is still lacking and the majority of studies reviewed provide only limited external validity. The evidence base is insufficient to generally answer the research question how cooking classes affect children’s eating behavior in the long-term. (Caraher et al., 2010)

5. Abstract

Introduction – Due to the increasing prevalence of overweight and obesity among children, promoting healthy eating is noted as highly important in the school setting. With the consumption of fruits and vegetables being inversely related to the likelihood of becoming obese, it is essential that recommended daily intakes are met. This systematic literature review assesses the evidence on how cooking classes in primary schools affect healthy eating and its psychosocial determinants (attitude, preferences, self-efficacy) among children. Furthermore, this paper also identifies the social components of each intervention.

Methods – PubMed and MedPilot databases were systematically searched for primary research articles published until May 2018 involving a cooking intervention in primary schools. Inclusion criteria were study design (randomized controlled trial or quasi-experimental), study aim (to affect healthy eating and/or underlying psychological determinants) and an adequate description of the cooking activities. The quality of the evidence provided by each study was judged on the study design and the risk of bias.

Results –The sample size of the eleven reviewed studies ranged from 137 to 1,230 subjects and the duration of the intervention ranged from a single one-hour session to weekly one-and-a-half-hour cooking lessons over two years. Outcomes of interests and outcome measurements varied between the studies. Five of the six studies assessing self-efficacy demonstrated a significant improvement. A clear improvement of attitudes towards fruits and vegetables was pointed out by four of five studies. Inconclusive findings were revealed in children's willingness to try novel food and in the improvement of fruit and vegetable preferences. A significant improvement of dietary intake could only be demonstrated for dietary fiber in one of eight studies. Small groups as well as the involvement of parents and professionals seemed to raise the effectiveness of interventions.

Conclusions – The combination of various intervention components proved it difficult to determine the best practices. A direct behavioral change towards healthy eating could not be demonstrated, but by positively impacting children's health-related attitudes and preferences, cooking classes might improve their behaviors in the long-term. Important determinants of the successfulness are fun and involvement of peers. To change dietary behaviors and promote fruit and vegetable consumption among children, a multifaceted, experimental approach is required. More research needs to be done on the long-term effects of cooking interventions.

6. Zusammenfassung

Einleitung – Aufgrund der wachsenden Anzahl übergewichtiger und adipöser Kinder wird die Vermittlung einer gesunden Ernährungsweise als wichtig erachtet. Da mit steigendem Verzehr von Obst und Gemüse das Risiko für Übergewicht sinkt, ist es bedeutend, dass tägliche Zufuhrempfehlungen getroffen werden. Diese systematische Literaturrecherche untersucht, wie sich Kochunterricht an Grundschulen auf ein gesundes Ernährungsverhalten und dessen zugrundliegende psychologischen Determinanten (Grundhaltung, Präferenz, Selbsteffizienz) auswirkt. Soziale Komponenten der Programme werden ebenfalls untersucht.

Methoden – Die beiden Datenbanken PubMed und MedPilot wurden systematisch nach Primärforschung durchsucht, die bis Mai 2018 publiziert wurde und die Wirkung von Kochunterricht an Grundschulen untersucht. Einschlusskriterien waren Studiendesign (randomisierte kontrollierte Studie oder quasi-experimentell), Studienziel (Verbesserung der Ernährungsweise/ Determinanten) und eine adäquate Beschreibung des Kochunterrichts. Die Beweiskraft der Studien wurde nach Studiendesign sowie Risiko auf Verzerrung beurteilt.

Ergebnisse – Die Stichprobengröße der elf einbezogenen Studien variierte zwischen 137 und 1,230 Probanden; die Länge der Programme reichte von einer Stunde bis zu wöchentlichen 90 Minuten über zwei Jahre. Die erwarteten Ergebnisse und deren Messungen unterschieden sich ebenfalls. Fünf der sechs Studien, die Selfeffizienz untersucht haben, berichten eine signifikante Verbesserung. Die Grundhaltung wurde laut vier von fünf Studien verbessert. Kein eindeutiges Ergebnis konnte erzielt werden für die Auswirkungen auf die Bereitwilligkeit, unbekannte Nahrungsmittel zu probieren, und auf Obst- und Gemüsepräferenzen. Auswirkungen auf das Ernährungsverhalten waren gering. Alleine der Verzehr von Ballaststoffen wurde signifikant in einer von acht Studien gesteigert. Kleine Gruppen und das Mitwirken von Eltern und Fachkräften scheinen den Erfolg zu erhöhen.

Fazit – Die Kombination von verschiedenen Programmelementen machte es schwierig zu bestimmen, welches Programm am effektivsten ist. Eine direkte Verbesserung in Richtung eines gesünderen Ernährungsverhaltens konnte nicht gezeigt werden. Allerdings kann das Verhalten möglicherweise langfristig verbessert werden und zwar dadurch, dass sich Kochunterricht positiv auf die Grundhaltung und Präferenzen von Kindern auswirkt. Begünstigende Faktoren sind Spaß und das Einbeziehen von Gleichaltrigen. Um den Obst- und Gemüseverzehr von Kindern zu verbessern, wird ein vielseitiger, experimenteller Ansatz benötigt. Weitere wissenschaftliche Untersuchungen zu den Langzeiteffekten sind erforderlich.

7. References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Aldridge, V., Dovey, T. M., & Halford, J. C.G. (2009). The role of familiarity in dietary development. *Developmental Review*, *29*(1), 32–44. https://doi.org/10.1016/j.dr.2008.11.001

Allirot, X., da Quinta, N., Chokupermal, K., & Urdaneta, E. (2016). Involving children in cooking activities: A potential strategy for directing food choices toward novel foods containing vegetables. *Appetite*, *103*, 275–285. https://doi.org/10.1016/j.appet.2016.04.031

Bandura, A. (2001). Social cognitive theory: an agentic perspective. *Annual Review of Psychology*, *52*, 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Battjes-Fries, M. C. E., Haveman-Nies, A., van Dongen, E. J. I., Meester, H. J., van den Top-Pullen, R., Graaf, K. de, & van 't Veer, P. (2016). Effectiveness of Taste Lessons with and without additional experiential learning activities on children's psychosocial determinants of vegetables consumption. *Appetite*, *105*, 519–526. https://doi.org/10.1016/j.appet.2016.06.016

Bere, E., Brug, J., & Klepp, K.-I. (2008). Why do boys eat less fruit and vegetables than girls? *Public Health Nutrition*, *11*(3), 321–325. https://doi.org/10.1017/S1368980007000729

Biesalski, H.-K., Warmuth, S., & Domzalski, O. T. (2017). *Unsere Ernährungsbiografie: Wer sie kennt, lebt gesünder* (1. Auflage). München: Knaus.

Birch, L. L. (1999). Development of food preferences. *Annual Review of Nutrition*, *19*, 41–62. https://doi.org/10.1146/annurev.nutr.19.1.41

Blanchette, L., & Brug, J. (n.d.). Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. *Journal of Human Nutrition and Dietetics*, *18*(6), 431–443. https://doi.org/10.1111/j.1365-277X.2005.00648.x

Caraher, M., Seeley, A., Wu, M., & Lloyd, S. (2013). When chefs adopt a school? An evaluation of a cooking intervention in English primary schools. *Appetite*, *62*, 50–59. https://doi.org/10.1016/j.appet.2012.11.007

Caraher, M., Wu, M. & Seeley, A. (2010). Should we teach cooking in schools? A systematic review of the literature of school-based cooking interventions. *Journal of the Home Economics Institute of Australia*. (17), 10–18.

Center for Disease Control and Prevention. (2017). National Health and Nutrition Examination Survey. Retrieved from https://www.cdc.gov/nchs/data/factsheets/factsheet_nhanes.pdf

Chu, Y. L., Storey, K. E., & Veugelers, P. J. (2014). Involvement in Meal Preparation at Home Is Associated With Better Diet Quality Among Canadian Children. *Journal of Nutrition Education and Behavior*, *46*(4), 304–308. https://doi.org/10.1016/j.jneb.2013.10.003

Connell, D. B., Turner, R. R., & Mason, E. F. (1985). Summary of findings of the School Health Education Evaluation: health promotion effectiveness, implementation, and costs. *The Journal of School Health*, *55*(8), 316–321.

Contento, I. (1981). Children's Thinking about Food and Eating--A Piagetian-Based Study. *Journal of Nutrition Education*, *13*(1), 90.

Cooke, L., Wardle, J., & Gibson, E.L. (2003). Relationship between parental report of food neophobia and everyday food consumption in 2–6-year-old children. *Appetite*, *41*(2), 205–206. https://doi.org/10.1016/S0195-6663(03)00048-5

Cunningham-Sabo, L., & Lohse, B. (2013). Cooking with Kids positively affects fourth graders' vegetable preferences and attitudes and self-efficacy for food and cooking. *Childhood Obesity (Print)*, *9*(6), 549–556. https://doi.org/10.1089/chi.2013.0076

Cunningham-Sabo, L., & Lohse, B. (2014). Impact of a school-based cooking curriculum for fourth-grade students on attitudes and behaviors is influenced by gender and prior cooking experience. *Journal of Nutrition Education and Behavior*, *46*(2), 110–120. https://doi.org/10.1016/j.jneb.2013.09.007

Davis, J. N., Ventura, E. E., Cook, L. T., Gyllenhammer, L. E., & Gatto, N. M. (2011). LA Sprouts: a gardening, nutrition, and cooking intervention for Latino youth improves diet and reduces obesity. *Journal of the American Dietetic Association*, *111*(8), 1224–1230. https://doi.org/10.1016/j.jada.2011.05.009

Dohle, S., Rall, S., & Siegrist, M. (2014). I cooked it myself: Preparing food increases liking and consumption. *Food Quality and Preference*, *33*, 14–16. https://doi.org/10.1016/j.foodqual.2013.11.001

EU Science Hub. (2016). Health Promotion and Disease Prevention - Knowledge Gateway: Fruit and Vegetables.

Evans, C. E. L., Christian, M. S., Cleghorn, C. L., Greenwood, D. C., & Cade, J. E. (2012). Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. *The American Journal of Clinical Nutrition*, *96*(4), 889–901. https://doi.org/10.3945/ajcn.111.030270

Gibbs, L., Staiger, P. K., Johnson, B., Block, K., Macfarlane, S., Gold, L.,. . . Ukoumunne, O. (2013). Expanding children's food experiences: the impact of a school-based kitchen garden program. *Journal of Nutrition Education and Behavior*, *45*(2), 137–146. https://doi.org/10.1016/j.jneb.2012.09.004

Glass, G. V.|. O. (1982). *School Class Size: Research and Policy*: Sage Publications, Inc., 275 South Beverly Drive, Beverly Hills, CA 90212 ($17.95).

Godin, G., & Kok, G. (1996). The theory of planned behavior: a review of its applications to health-related behaviors. *American Journal of Health Promotion : AJHP*, *11*(2), 87–98. https://doi.org/10.4278/0890-1171-11.2.87

Hersch, D., Perdue, L., Ambroz, T., & Boucher, J. L. (2014). The impact of cooking classes on food-related preferences, attitudes, and behaviors of school-aged children: a systematic review of the evidence, 2003-2014. *Preventing Chronic Disease*, *11*, E193. https://doi.org/10.5888/pcd11.140267

High Level Group on Nutrition and Physical Activity. (2014). EU Action Plan on Childhood Obesity 2014-2020.

Hill, L., Casswell, S., Maskill, C., Jones, S., & Wyllie, A. (1998). Fruit and Vegetables as Adolescent Food Choices in New Zealand. *Health Promotion International*, *13*(1), 55–65. https://doi.org/10.1093/heapro/13.1.55

Jarpe-Ratner, E., Folkens, S., Sharma, S., Daro, D., & Edens, N. K. (2016). An Experiential Cooking and Nutrition Education Program Increases Cooking Self-Efficacy and Vegetable Consumption in Children in Grades 3-8. *Journal of Nutrition Education and Behavior*, *48*(10), 697-705.e1. https://doi.org/10.1016/j.jneb.2016.07.021

Kim, S. A., Moore, L. V., Galuska, D., Wright, A. P., Harris, D., Grummer-Strawn, L. M.,. . . Rhodes, D. G. (2014). Vital signs: fruit and vegetable intake among children - United States, 2003-2010: Vital Signs: Fruit and Vegetable Intake Among Children — United States, 2003–2010. *MMWR. Morbidity and Mortality Weekly Report*, *63*(31), 671–676. Retrieved from http://europepmc.org/articles/pmc4584658?pdf=render

Ledoux, T. A., Hingle, M. D., & Baranowski, T. (2011). Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obesity Reviews : an Official Journal of the International Association for the Study of Obesity*, *12*(5), e143-50. https://doi.org/10.1111/j.1467-789X.2010.00786.x

Liquori, T., Koch, P. D., Ruth Contento, I., & Castle, J. (1998). The Cookshop Program: Outcome Evaluation of a Nutrition Education Program Linking Lunchroom Food Experiences with Classroom Cooking Experiences. *Journal of Nutrition Education*, *30*(5), 302–313. https://doi.org/10.1016/S0022-3182(98)70339-5

Nelson, S. A., Corbin, M. A., & Nickols-Richardson, S. M. (2013). A call for culinary skills education in childhood obesity-prevention interventions: current status and peer influences. *Journal of the Academy of Nutrition and Dietetics*, *113*(8), 1031–1036. https://doi.org/10.1016/j.jand.2013.05.002

Ogata, B. N., & Hayes, D. (2014). Position of the Academy of Nutrition and Dietetics: nutrition guidance for healthy children ages 2 to 11 years. *Journal of the Academy of Nutrition and Dietetics*, *114*(8), 1257–1276. https://doi.org/10.1016/j.jand.2014.06.001

Perez-Rodrigo, C., & Aranceta, J. (1997). Nutrition Education for Schoolchildren Living in a Low-Income Urban Area in Spain. *Journal of Nutrition Education*, *29*(5), 267–273. https://doi.org/10.1016/S0022-3182(97)70216-4

Quinn, L. J., Horacek, T. M., & Castle, J. (2003). The Impact of CookshopTM on the Dietary Habits and Attitudes of Fifth Graders. *Topics in Clinical Nutrition*, *18*(1), 42–48. https://doi.org/10.1097/00008486-200301000-00006

Robinson-O'Brien, R., Story, M., & Heim, S. (2009). Impact of Garden-Based Youth Nutrition Intervention Programs: A Review. *Journal of the American Dietetic Association*, *109*(2), 273–280. https://doi.org/10.1016/j.jada.2008.10.051

Schwarzer, R. (2008). Modeling Health Behavior Change: How to Predict and Modify the Adoption and Maintenance of Health Behaviors. *Applied Psychology*, *57*(1), 1–29. https://doi.org/10.1111/j.1464-0597.2007.00325.x

Shepherd, R., & Raats, M. (2006). *The psychology of food choice*. Wallingford: CABI.

World Health Organization - Regional Office for Europe. (2018). Childhood Obesity Surveillance Initiative HIGHLIGHTS 2015-17: Preliminary data.

Appendix

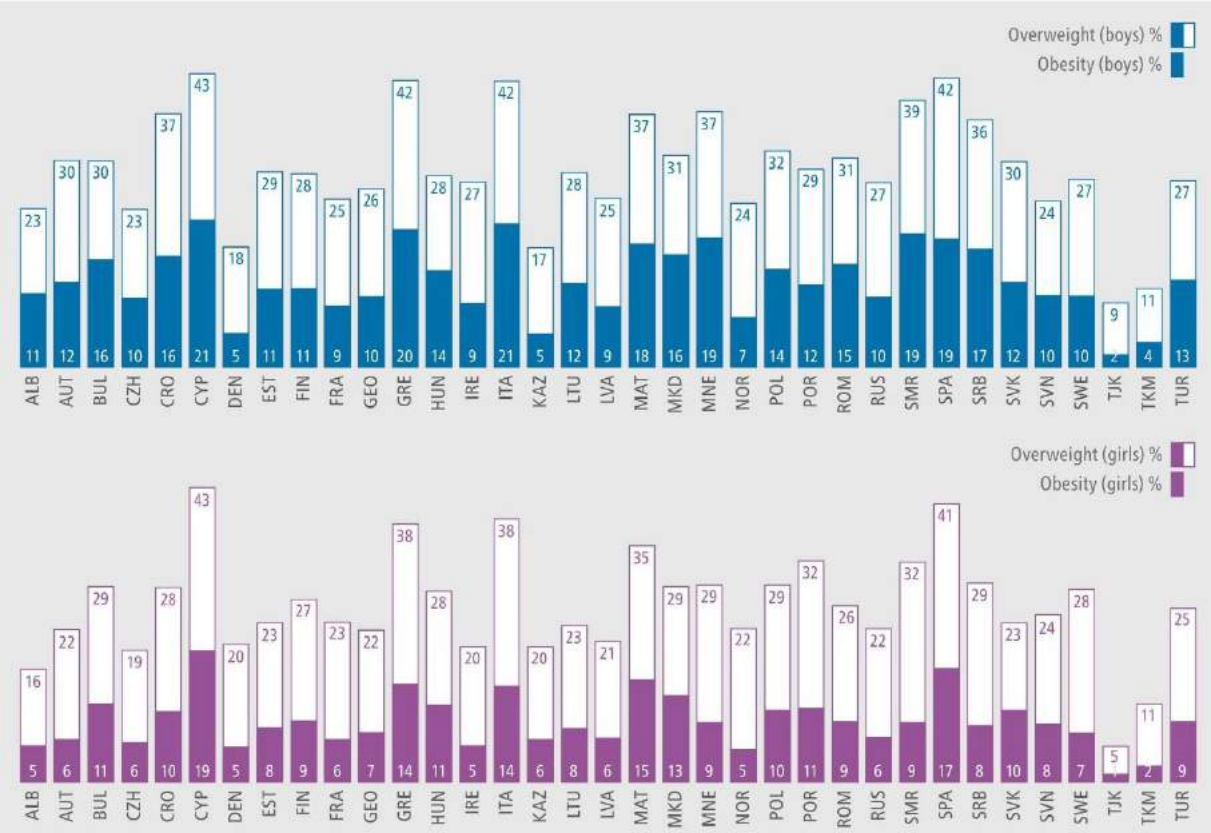

Figure 2. Overweight and obesity prevalence values in the European region based on WHO definition (%); COSI 2015-2017 (World Health Organization - Regional Office for Europe, 2018, p. 3)

Table 2. Summary of the included studies (n = 11)

Study Aim	Author	Year	Country	Age	Study Design	Sample Size	Duration
Assess the effect of cooking activities on the willingness to taste novel foods, food neophobia, liking, intake and hunger	Allirot et al (1)	2016	ES	7 to 11	experimental; between-subject design	n = 137 intervention group n = 69 control group = 68	1hr single session
Assess the appreciation, feasibility and effect of Taste Lessons extended by involvement of professionals on the psychosocial determinants of vegetable consumption	Battjes-Fries et al (2)	2016	NL	8 to 11	quasi-experimental; three arm pre-test post-test design	n = 800 TL group n = 285 TLVM group n = 417 control group n = 308	TL group: Five 45min lessons per grade TLVM group: Five lessons + three added activities
Assess the effectiveness of cooking with chefs in increasing cooking confidence, preparation and consumption of included vegetables	Caraher et al (3)	2012	UK	9 to 11	quasi-experimental; parallel arm pre-test post-test design, but only pre-test post-test data of intervention group used	n= 169 intervention group n = 86 control group n = 83	Two sessions
Assess the external validity and the impact of Cooking with Kids on attitudes and self-efficacy for food and cooking as well as on fruit and vegetable preferences	Cunningham-Sabo and Lohse (4)	2013	USA	4th grade	experimental	n = 257 intervention group n = 137 control group n = 120	Three 2hrs cooking classes and three 1hr tasting sessions per school semester
Compare the effect of the programs cooking-tasting and tasting-only on attitudes, self-efficacy for food and cooking and fruit and vegetable preferences	Cunningham-Sabo and Lohse (5)	2014	USA	4th grade	quasi-experimental; three arm pre-test post-test design	n = 1230 cooking and tasting n = 539 only tasting n = 294 control group n = 397	Five 2hrs cooking classes and five 1hr tasting sessions during a 9-month school year
Assess the effects of an after-school gardening and cooking program on dietary intake and health outcomes in Latino children in Los Angeles	Davis et al (6)	2011	USA	grade 4-5	quasi-experimental; parallel arm pre-test post-test design	n = 104 intervention group n = 34 control group n = 70	Twelve 45min nutrition and cooking lessons and twelve 45min gardening lessons over 12 weeks

Study Aim	Author	Year	Country	Age	Study Design	Sample Size	Duration
Assess the feasibility, acceptability and effect of a nutrition and gardening program on the appreciation of diverse, healthy food and the willingness to try novel foods	Gibbs et al (7)	2013	AU	grade 3-6	quasi-experimental; parallel arm pre-test post-test design	included in analysis: n = 592 intervention group n = 352 control group n = 240	One 45-60min gardening and 90min cooking class per week two years school intervention
Assess the effect and its duration of cooking with chefs on liking and consumption of fruits and vegetables and associated short-term outcomes in children of low SES	Jarpe-Ratner et al (8)	2016	USA	grade 3-8	quasi-experimental; one group pre-test post-test design	n = 271	One 2hrs class per week over 10 weeks (90min cooking, 30min education)
Assess effectiveness of cooking classes in improving preferences for and the consumption of whole grains and vegetables compared to a similar educational strategy without cooking	Liquori et al (9)	1998	USA	kinder-garden - 6th grade	quasi-experimental; four arm pre-test post-test design	n = 590 approximately equally distributed to 4 groups (CS only, FEL only, CS+FEL, comparison)	FEL: Ten 45min lessons, 17 class trips to community gardens CS: Ten 60-90min cooking classes
Assess the effectiveness of the nutrition education program in promoting healthy eating, skill-development and self-empowerment in children with low SES.	Perez-Rodrigo and Aranceta (10)	1997	ES	8 to 12	quasi-experimental; one group pre-test post-test design	n = 150	2hrs cooking classes per week over five weeks
Assess the effectiveness of the modified Cookshop program (Liquori) in improving attitudes towards and consumption of fruits and vegetables among fifth grade students	Quinn et al (11)	2003	USA	5th grade	quasi-experimental; parallel arm pre-test post-test design	n = 149 intervention group n = 81 control group n = 68	Eleven sessions

Components	Outcome Measurement	Results	Conclusion	Limitations
(1) cooking workshop creative workshop afternoon snack	Willingness to try novel food, cooking and eating habits assessed by questionnaire; liking assessed by 5-point facial scale; food intake assessed by photographs; satiety scores, FNS	Intervention group: higher number of novel food chosen and tasted; higher liking for two of three self-prepared snacks no difference in overall food intake and satiety score between both groups	A single cooking session influences the subsequent eating behavior and increases the willingness to try novel food containing vegetables.	randomization by group; satiety score developed in UK; experimental setting; single session
(2) TL: tasting, cooking; TLVM: garden excursion, vegetable quiz, supermarket task, cooking with dietician, parents	Self-efficacy, attitude, subjective norm, intention, awareness, socio-demographic factors assessed by questionnaire, knowledge by multiple choice questions; implementation, appreciation by process evaluation questionnaire	TLVM significantly higher increase in knowledge, attitude and subjective norm of teacher, TL only significantly higher increase in knowledge than control group; subjective norm and cooking self-efficacy higher in TLVM than in TL	The additional hand-on activities result in a slightly stronger effect on the psychosocial determinants of vegetable consumption.	different demographic characteristics; financial support of teachers
(3) cooking classes nutrition and hygiene education	Cooking confidence, consumption of included vegetables, confidence to ask for ingredients assessed by 3/4-point-scale questionnaire	Both groups: increased cooking confidence; intervention group: increase in vegetable consumption, confidence in preparing the pasta salad and asking for its ingredients	Cooking with chefs can increase motivation and confidence to cook in general and at home at least on the short-term.	baseline differences; no 24h recall; small dose; big groups (20+); limited standardization; FSME as effect modifier
(4) cooking classes tasting sessions	Fruit & vegetable preferences, cooking self-efficacy and attitude assessed by 35-item questionnaire with five response options	Intervention group: higher improvements in attitudes, fruit preference, vegetable preference (even higher), cooking self-efficacy; higher difference in baseline to follow-up n those three parameters than control group	CWK is generalizable to other settings and can result in healthy eating by changing preferences and attitudes, especially for non-cookers.	no assessment of dietary intake and home environment (potential effect modifier)
(5) cooking classes tasting sessions	Fruit & vegetable preferences, cooking self-efficacy and attitude assessed by 37-item questionnaire with five response options	Cooking and tasting intervention: greatest improvement in cooking self-efficacy, greater changes in fruit & vegetable preferences than in control group (also boys > girls); significantly improved vegetable preferences only in both intervention groups, not control group	Experimental education can improve the cognitive behavior mediating healthy food choices, especially in male non-cookers.	possibility of prior CWK exposure; cognitive developmental growth not monitored; low external validity; no assessment of dietary intake
(6) cooking classes nutrition education gardening lessons	Health outcomes measured by anthropometrics, body composition, blood pressure; dietary intake of last 24h assessed by 41-item FFQ	Intervention group: 22% increase in dietary fiber intake, 5% decrease in diastolic blood pressure, less weight gain; improved BMI in overweight children; control group: 12% decrease dietary fiber intake, 3% decrease diastolic blood pressure	All components together can improve the dietary intake and stop weight gain in, especially overweight, Latino children.	both groups collected at same school; small sample size; short-term; FFQ screener; no significant BMI reduction

Components	Outcome Measurement	Results	Conclusion	Limitations
(7) cooking classes gardening lessons	Willingness to try novel food assessed by 3-item questionnaire; ability to describe foods assessed 4-point scale; change in attitudes assessed in focus groups	Intervention group: higher increase in willingness to try a novel food (never tried/ cooked/ grown it before) than control group; no effect on ability to describe food; less children consume at least 2 servings of fruits and 5 servings of vegetables	The SAKG kitchen garden program may increase the willingness to try novel food and the appreciation of diverse, healthy food.	response, participant-recruitment and parents-reported bias; one control group started cooking classes
(8) cooking classes nutrition and cultural education	Changes in knowledge, cooking self-efficacy, fruit & vegetable liking and consumption, communication about healthy eating assessed by questionnaires; completed by parent questionnaire	Increase in fruit & vegetable consumption; increased self-efficacy, knowledge and exposure to novel food (+1 new item, but slightly reduced willingness to try); no effect on liking; increased communication about healthy eating and frequency preparing dinner six months afterwards	Chef-instructor-led cooking classes can increase healthy behavior in low-income families, lasting until the post-test six months afterwards.	no assessment of dietary intake/ quality, number of times not amount of fruits & vegetables; low external validity; variable inclusion criteria into program
(9) food and environment lessons cooking classes school meals parents component	Intake of targeted food by visual estimation of plate waste; questionnaires (preferences for plant food, attitude, knowledge, self-efficacy, behavioral intentions to eat plant foods assessed by 5-scale questionnaire	CS classes: improved preferences, self-efficacy (FEL alone no effect), greater change in intentions in younger children; CS + FEL intervention: for both increase in knowledge; intake of targeted food highest in CS+FEL group; attitude changed in none of the groups	Cooking and eating with peers improves short-term outcomes like preferences (especially for young children), but showed modest impact on the consumption of targeted food.	recruitment of intervention and control at same school; everyone exposed to school lunch and weekly newsletter; visual estimation of plate waste (no weighing)
(10) cooking classes; nutrition education; healthy schools meal; provision of toothbrushes	Knowledge and skills assessed by MC questions; eating habits assessed by personal interviews; menu acceptance assessed by visual estimation of plate waste; Likert-type scales for preferences	Significant increase in knowledge, cooking and consumer skills; repeated meal preparation at home; increase in consumption of fruits and vegetables; gradual acceptance of novel food; 80% able to use knife and fork	The three components together can improve skills and knowledge, they stimulate healthy eating habits and home-based cooking in low-income children.	no use of control group; relatively small sample size; almost no generalizability to other settings
(11) cooking classes; nutrition education	Dietary intake assessed by 24h recall and NCI-FFQ; knowledge, food exposure, shopping, eating habits, attitudes assessed by questionnaire; changes in eating and purchasing habits assessed by parent questionnaire	Intervention group: higher consumption of fiber than control group; improved intake of folate, fruit, and milk; greater knowledge, exposure and willingness to try novel food in intervention group compared to control group; slightly increased consumption of fruit and vegetables	The modified intervention can promote improved attitudes towards fruits and vegetables, rather than result in an immediate dietary change.	limited parental involve-ment and response; 24h recall instead 72h record; general dietary trends instead of quantitative intake; conflict FFQ and 24h recall

Erklärung*

Hiermit erkläre ich,

Name, Vorname Wallenstein, Julia

Matrikelnummer 644932

dass ich bei der vorliegenden

☒ Bachelor-Arbeit ☐ Master-Thesis/Master-Arbeit

☐ Seminararbeit ☐ Diplomarbeit

die Regeln guter wissenschaftlicher Praxis eingehalten habe. Ich habe diese Arbeit selbständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt und die wörtlich oder inhaltlich übernommenen Stellen als solche kenntlich gemacht.

Betreuende/r Dozent/in Prof. Nanette Ströbele-Benschop, PhD

Thema der Arbeit Effects of school-based cooking classes on healthy eating and underlying psychological determinants - a systematic review

Semester Sommersemester 2018

Ich erkläre weiterhin, dass das unverschlüsselte digitale Textdokument der Arbeit übermittelt wurde, das in Inhalt und Wortlaut ausnahmslos der gedruckten Ausfertigung entspricht. Ich bin damit einverstanden, dass diese elektronische Form anhand einer Analyse-Software auf Plagiate überprüft wird.

Rüdesheim, den 18.07.2018

Ort, Datum, Unterschrift

* Diese Erklärung ist der eigenständig erstellten Arbeit als Anhang beizufügen. Arbeiten ohne diese Erklärung werden nicht angenommen.