Understanding the Effects of Communication and Engagement in a Social Marketing Intervention on Children's Eating Behavior: Design, Measurement and Evaluation

A dissertation presented by
Natalie Rangelov

Supervised by
Prof. Dr. L. Suzanne Suggs

Submitted to the
Faculty of Communication Sciences
Università della Svizzera italiana

for the degree of
Ph.D. in Communication Sciences

July 2017

Board

Prof. Dr. L. Suzanne Suggs, Università della Svizzera italiana, Switzerland

Prof. Dr. Julia Dratva, Zürcher Hochschule für Angewandte Wissenschaften, Switzerland

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Dedicated to Kiki

Protagonista nei ricordi,
Complice nel presente,
Ho la certezza che anche nel futuro
Il nostro legame sarà indissolubile.

Abstract

Background

The prevalence of overweight and obesity represents a serious health problem, and is a risk factor for several non-communicable diseases. Poor nutrition and lack of regular physical activity are among the primary determinants of overweight and obesity. Data show that overweight and obesity rates are high in Switzerland and in Canton Ticino, and that the Swiss population does not adhere to the nutritional guidelines provided by the Swiss Society for Nutrition, nor to the physical activity guidelines provided by the Swiss Federal Office of Public Health.

To address and counteract the issue of overweight and obesity, effective interventions are needed. Social Marketing is a framework grounded on Marketing concepts that focuses on behavior and aims at benefiting society by enhancing the social good. It seeks to integrate theory, best practice, insight and research with the goal of developing and implementing effective, efficient and ethical social change programs. The evidence shows that the Social Marketing framework has been widely and effectively used in interventions aiming at changing different health behaviors, with different populations, including overweight and obesity in children. Several policy documents recommend the use of the Social Marketing framework to promote healthy nutrition and physical activity, with the aim of preventing nutrition-related non-communicable diseases, obesity, and with the aim of improving the health and well-being of populations.

While criteria exist to define interventions as Social Marketing, studies have shown that the reporting of how the Social Marketing benchmark criteria are operationalized is often missing or incomplete. Hence, the evidence on the use of Social Marketing and its impact on intervention effectiveness needs to be enhanced. Indeed, it is imperative to understand what makes interventions work, and what, on the contrary, impedes their success. In particular, there is need to build up the evidence base on Social Marketing use in Europe. Hence it is critical to develop and implement Social Marketing interventions and to share consistently methodologies and results, in particular by

operationalizing the Social Marketing benchmark criteria, and by reporting behavioral outcomes. This will improve knowledge and build evidence about research and practice in Social Marketing.

The Department of Health and Social Affairs of Canton Ticino addressed the issue of overweight and obese children by developing a policy initiative called "Healthy Body Weight". Promoting healthy nutrition and regular physical activity to children is important since behaviors developed during childhood tend to persist into adulthood. The initiative included several interventions targeted primarily at children, and secondarily at stakeholders, including teachers, parents, school directors, and canteen managers. "Famiglia, Attività fisica, Nutrizione" (FAN) was one of those interventions, and it was developed in collaboration with the BeCHANGE Research Group at the Università della Svizzera italiana.

FAN was developed following the Social Marketing framework, and it was addressed to families with school-aged children, and delivered to parents via Web, e-mail, SMS and via print letters to children. The Website was divided into three sections: Family, Nutrition, and Physical Activity, and updated weekly over the duration of the intervention (eight weeks). The communication via e-mail, SMS and print was also delivered once a week.

While essential for any study aiming at understanding children's food consumption, the collection of accurate children's food consumption data remains challenging. Issues of recall, accuracy, understanding of the task, and portion size estimation are common difficulties that children face. Since no validated tool existed to collect children's food consumption data in Switzerland, a new instrument was developed and tested.

The ultimate goal of the FAN intervention was to help children and their parents eat healthy and practice regular physical activity. Previous studies have shown that Web, e-mail and SMS interventions are effective in changing participants' behavior. Studies have also suggested that the more participants are involved in an intervention, the better the behavioral outcomes are.

This dissertation includes five complementary papers about measuring and improving children's eating behaviors. The first chapter describes the FAN intervention and the Social Marketing benchmark framework. Next, two chapters address the issue of measuring children's eating behavior. Finally, two chapters present behavioral outcomes, and specifically the extent to which the FAN intervention improved children's eating behavior. In the first of these, the influence of the communication channels used in FAN is described. In the second one, the role of engagement with the intervention in such behavior change is examined.

Methods

This dissertation includes five articles, each published in, or submitted to, a relevant scientific peer-reviewed journal in the field of Social Marketing or Public Health research. Each article presents the examination and discussion of one of the following four aspects related to the promotion of healthy nutrition in the FAN Social Marketing intervention:

1) The operationalization and implementation of Social Marketing;
2) The measurement of children's food consumption;
3) The role of different communication channel bundles;
4) The role of engagement.

The articles presented in this dissertation examine eight research questions organized according to these four aspects. To address the first aspect, the FAN intervention with the operationalization of the Social Marketing benchmark Criteria is described. Rates of participation and satisfaction with the intervention are also presented (**Chapter II**).

To examine the second aspect, agreement between parents and their children in reporting the child's food consumption was assessed, using two different instruments. The instruments differed in length of data collection (7-day vs. 2-day), as well as data collection method. The 7-day instrument was a food diary, requiring children to write by hand what they ate at every meal for seven consecutive days. The 2-day instrument was a food record, requiring children to tick a box indicating the foods they ate, from a list of

categories, on two random days of the week (consecutive or nonconsecutive). These were then compared, to assess which one was more reliable with this population (**Chapter III** and **Chapter IV**).

The third aspect examined the role of Web plus e-mail and Web plus SMS communication compared to Web-only communication using a Randomized Controlled Trial design. The study assessed children's food consumption at pre- and post-intervention, by group assignment in the FAN intervention (**Chapter V**). Finally, to examine the fourth aspect, the role of online versus offline engagement in FAN was assessed using data from a self-reported questionnaire and data from a log of the FAN Website (**Chapter VI**).

Results

The description of the FAN intervention with the operationalization of the Social Marketing benchmark criteria helps to build the evidence on Social Marketing, defining how each benchmark was operationalized and allowing comparisons across studies. It showed a high involvement of the Ticino community, with high participation and retention rates compared to other similar studies. With more than 500 families participating, the recruitment goal of 250 families was far surpassed. Most of the parents and children were highly satisfied with the intervention and with the communication content and channels used. They also expressed their willingness to participate again if the program were to be offered in the future.

The analyses conducted in the second study, presented in **Chapter III** and **Chapter IV**, demonstrate that children are accurate reporters of their food consumption. They agree with their parents when reporting their own food consumption, regardless of the instrument used (7-day food diary or 2-day food record). Agreement was high for all children, regardless of school grade and gender. However, when using the 2-day food record, children in lower grades had higher agreement with their parents than when using the 7-day food diary. Therefore, both instruments showed to be reliable, with the 2-day food record being slightly more advantageous, in that it showed higher agreement for

children in lower grades and was shorter and simpler to complete. Furthermore, it was less resource intensive to code and enter the data.

The effects of the communication channels show that FAN had an overall positive effect on food consumption behavior, and in particular on that of fruit and sweets (see **Chapter V**). No statistically significant differences were found when comparing the effect of the communication delivered via Web, and that delivered via Web and supplemented with e-mail or SMS communication. Only the consumption of vegetables showed positive change in the Web plus SMS group compared to the Web-only group, and fat meat and fat fish consumption was slightly improved in the Web plus e-mail group compared to the Web-only group (although the latter results were not statistically significant).

The analyses of the role of engagement in intervention outcomes suggest that improved consumption of fruit, sweets and sugar drinks was associated with engagement (**Chapter VI**). The more parents visited the Website (in terms of number of "clicks", or "page views"), the more children increased their consumption of fruit. In particular, the more pages parents viewed on the Nutrition section, the higher children's consumption of fruit was. Children who read the letters received from FAN with their siblings or their friends, and those who spoke with them about the letters, decreased their consumption of sweets and sugar drinks, and increased that of fruit. Parental engagement in looking for information about healthy eating was associated with a decrease in the consumption of sugar drinks. Parental engagement in encouraging a healthy diet was associated with an increase in children's consumption of sweets. Hence, both offline and online engagement were associated with changes in behavior.

Conclusion

Based on the findings of this dissertation, the following conclusions can be drawn. First, adhering to the eight benchmark criteria resulted in an intervention that was appropriate and relevant to the participants, and that had a positive effect on participation, retention, satisfaction rates, and behavior change. Future online interventions promoting healthy food consumption should adhere to the Social Marketing framework. The

benchmark criteria should be operationalized and described in detail, and thorough descriptions of the development, implementation and evaluation should be reported. This would also increase comparability across studies, allowing best practice to be extended and generalized to other populations and settings.

Second, to collect food consumption behavior for children, and when food choice is the aim rather than nutrients or portion sizes, it may be a rather straight forward task. Ask the children directly. Children seem to be as accurate as their parents in reporting the child's food consumption. Indeed, both the 7-day and the 2-day food assessment tools showed statistically significant agreement between food consumption reported by children and that reported by their parents. The 2-day food record seems slightly more advantageous in that it showed higher parent-child agreement also for children in lower grades at school.

Third, for this population, if the aim of an intervention is to improve the consumption of fruit and sweets, it might be enough to develop a Social Marketing intervention that is delivered online to parents using only a Website supplemented with print letters for children, without including e-mail or SMS communication. If the aim is to promote the consumption of vegetables, SMS might be used in addition to Web-based communication. This means that depending on which food the focus of an intervention is, a different channel might be more advantageous.

Finally, positive behavior change was associated with higher engagement in the social marketing intervention. The results show the importance of offline engagement activities in an online program. Thus, to better understand which characteristics of an intervention and which activities promoted in the program are related to behavior change, measurement of both online and offline engagement is needed when evaluating an online behavior change program.

To conclude, the world is facing a variety of health-related challenges that result from choices on nutrition, physical activity, smoking, alcohol consumption and other behaviors, and that negatively impact populations' health, as well as health, social and economic systems and welfare. Among those, the prevalence of overweight and obesity needs urgent attention. Indeed, despite some efforts to decrease them, the rates of

overweight and obesity are still high. Hence, cost-effective and urgent solutions are required. Various approaches have been attempted, such as Health Communication or Health Education. However, there is limited evidence that supports that health behavior change is associated with communication-based approaches alone. Social Marketing offers a systematic and detailed guide for developing, implementing, managing, and evaluating health behavior interventions. The operationalization of the benchmarks can help the understanding of the frameworks' use, as well as understanding of what works and what does not, to avoid future mistakes. Indeed, as health and social problems evolve and social and economic conditions vary within populations, it is necessary to understand and to update the knowledge about what makes interventions successful or, on the contrary, makes them fail. Evidence so far shows that Social Marketing has been effectively used in different settings, with different populations and for different health behaviors (including nutrition). This framework is also recommended in policy documents. However, the evidence on its use and effectiveness, in particular in Europe, still needs to be built up.

The research described above tested two different food consumption measurement tools designed for children, to address the issue of gathering data about children's food consumption, which is particularly difficult. The results suggest that children can provide accurate and useful data. The research also emphasizes the need to incorporate different complementary communication channels and that promoting engagement in a social marketing campaign can make a positive contribution to behavior change. All things considered, this research contributes to building knowledge and evidence about Social Marketing's use and the promotion and measurement of healthy food consumption in children. The results provide an optimistic foundation that can be used and extended to other populations, behaviors and settings.

Keywords Social Marketing; Health Behavior; Eating Behavior; Nutrition; Food Consumption; Dietary Assessment; Food Record; Food Diaries; Agreement; e-Health; Internet; Web; e-mail; SMS; Participation; Engagement; Child; Parents.

Acknowledgements

I threw myself in the world of Social Marketing headlong, after the first or maybe second class of the Social Marketing Master course at USI. I loved the content, and I loved the Professor's enthusiasm. I was having a little crisis as I had not decided my Master thesis topic, yet, and then suddenly, here it was the study area, the Professor, and the passion. I started and finished an internship working on the FAN project, I wrote my Master thesis and then I embarked on a new adventure: a road trip to my PhD degree. I visited lands of joy and heaths of pain, met interesting people and some uninteresting ones, as well. This adventure is almost over, but after so many years, I still love Social Marketing, I still admire my Professor, and I still have the passion, just a million times bigger!

When eating bamboo sprouts, remember the man who planted them.
(Chinese Proverb)

Now that I am eating my bamboo sprout, I would like to thank all those that in a way or another, helped me to get here and beyond!

The learnings, experiences and achievements in the past six years would not have been possible without my Professor and Mentor, Dr. L. Suzanne Suggs. She welcomed me as a student, and helped me grow into an independent researcher. She gave me her trust and pushed me to go beyond my limits. We spent full days and nights in the office, working, enjoying the successes and coping with the failures, laughing, smiling, and being frustrated together. Thank you for allowing me to work with you, for believing in me, for the encouragements and advice. Thank you for letting me grow and finding my way, always guiding me, but without ever stifling my flair.

As doctoral student and as doctoral students' representative I had the possibility to get to know the Faculty Professors. I would like to thank those that showed interest in my research and that supported and encouraged me. In particular, I would like to thank Prof. Bertil Cottier and Prof. Jean-Patrick Villeneuve, from the Institute for Public

Communication, Prof. Gabriele Balbi from the Institute for Media and Journalism, and Prof. Michael Gibbert from the Institute of Marketing and Communication Management. I also had the opportunity to meet great colleagues, from different fields of work, institutes and faculties (ICP, IMeG, IMCA, ISI, Faculty of Informatics and Faculty of Economics), and to work with amazing people in the BeCHANGE Research Group. Thank you all for the knowledge-sharing, problem solving and coffee/tea/ice-cream breaks! I am grateful to Salvatore and Sara D.B. who helped me with the statistical aspects of the two final articles included in this dissertation. Special thanks go to Gabriele, Gigi, Gloria, Eleonora, Maria and Zhan, who adopted me as one of theirs, cheered me up in tough times and celebrated my successes. Finally, a big thanks to USIVoices, and in particular to Antti, Candice, Giosia, Giuseppe, Igor, Laura, Luca, Marco and Susann, who through songs, beers and fun provided me with a safe space where to vent and recharge my batteries after long hours in the office.

Conferences and invited lectures where the occasion to meet and exchange ideas, notions, and experience with academics and practitioners with similar interests. I am thankful for all those encounters, as they all somehow left a mark. I hope the exchange was mutual. I would like to express my gratitude in particular to a few special people that made the difference. First, a huge thank you goes to Prof. Pedro Marques-Vidal, my co-author and excellent Mentor. Thank you for the guidance, learnings and for the tips you provided me, and for the very efficient and productive meetings! Thank you also for coming to Lugano, making it easier for us (although I would have loved a trip to the wonderful city of Lausanne…maybe next time!). Second, I would like to thank Prof. Bent Egberg Mikkelsen, my Shadowing Mentor, who showed huge interest in my research, introduced me to and gave me the opportunity to spend some time with his research team to collaborate on projects and conferences. Thank you for all these unforgettable experiences! Third, my gratitude goes to Prof. Jeff French, who, in a more indirect way, and often next to a good dinner, encouraged my work in the Social Marketing field. Finally, I have two partners in crime, Dr. Alessandra Lafranconi and Dr. Nadina Luca. I met Alessandra on the first day of the 5th European Public Health Conference: my very first academic conference as doctoral student. Both enthusiastic, a bit lost among all the

important people that later became our colleagues or even friends, very ambitious and determined to succeed. Thank you, Ale, for all these years of great work and fun! Nadina accompanied me on my Social Marketing adventures: it's been a pleasure to share the experiences at the 1st European Social Marketing Conference in Lisbon, and at the World Social Marketing Conferences (in particular in Toronto, were the two of us hit it off!). Thank you for the support, the company, and the sightseeing!

During my PhD road trip, I had the opportunity to work on several research topics and projects, and I got involved in many activities bridging the academic and the policy worlds. I am immensely thankful to Dr. João Breda and Dr. Gauden Galea who allowed me to work with them and their team at the Division of Noncommunicable Diseases and Life-Course at WHO/Europe. Thank you to Jo, Nathaly, Liza, Tina, Astrid, Janneke, Léa, and to all the other colleagues and interns for their learnings and friendships. I am also thankful for the opportunity I have at the Food and Nutrition Section of the European Public Health Association. Thank you, Bent, for taking me to my first section meeting ever (where I somehow got immediately elected as executive member!), and thank you, Chris B., for the opportunities within the section, as well as for offering me the position of Vice-President (and President, which I declined, but I am appreciative for). Thank you Ale, Carl, Enni, Lise, Sirpa, and Tatjana for the work together, for the great and productive meetings, and for your encouragements and understanding!

I also had the opportunity to assist and teach several bachelor and master courses. This allowed me to understand how much I actually learned myself, as one can teach well only when their knowledge on the subject is deep. Experience and the look at my students' faces (some bored, but most passionate) helped me to improve my teaching and to switch from presenting Social Marketing to teaching it. Thank you to all the students for unconsciously helping in this part of my journey.

In the past year I discovered the world of volunteering, through the Service Civil International. Not that I did not have enough work already, but doing a different and more manual work (I cut wood with a chainsaw, planted trees in Italy, and built a school in Kenya!) helped me to keep my mind clear, fresh and focused. For that I am immeasurably grateful to Riccardo, who introduced me to this world. Three other people I met at the

camps became really good friends and supporters: Ivana, Iisa, and Samantha. Thank you girls for getting me back on track! Lastly, thank you to the Murisengo and Kiburanga communities. I thought I was coming to assist you, but in the end, I think you helped me more than I did aid you.

This dissertation would have not been possible without all the children and parents that participated in FAN and in the study on child-parent agreement. Thank you for showing such interest in this research, and for providing us with your data, by completing the surveys and food diaries, even if they were long and we asked you to complete them right before the Christmas holidays. Also thank you for helping us during the formative research: without your help, we would have not created such a wonderful project. Finally, thank you for your enthusiasm and your words of encouragement. Without those, the nights spent in the office would have been much more difficult! I would also like to thank Health Promotion Switzerland and the Department of Health and Social Affairs (DSS), in particular Antonella Branchi, Alessia Antonietti and Rubina Bianchetti from the Servizio di promozione e valutazione sanitaria, for their collaboration in FAN. Thank you also to Christian M. and the e-Lab team for helping with the FAN tech aspects, for your jokes and funny brainstorming sessions! Another deserved thanks goes to the Department of Education, Culture and Sport (DECS), and all the school directors and teachers that helped us promoting the project and the research in Ticino.

Speaking of teachers, I would like to thank my schoolteachers and my professors. I was not born with all the knowledge and skills, and if I got where I am now, it is also thanks to you, who taught me several topics, but most importantly, taught me how to learn and study, and how to reflect and reason. Grazie ai miei maestri Mauro Piazza, Franco Galetti, Daniele Rebsamen, Carlo Gambaudo, Tazio Manzocchi, e ai miei professori Elena Salvadé-Ceppi, Mario Jametti e Gianfranco Domenighetti. I still remember some tough lessons (and even some bad grades!). Thank you for those and for pushing me to always do better!

Similarly, I need to thank those who took their time to read, comment on and criticize this dissertation. First of all, Prof. Suggs. I am ambitious, and you know that. Thank you for finding the flaws and for helping me to fix them and to insist I hand in a

dissertation I am proud of. Second, I would like to thank Dr. Chris McIntyre. Thank you so much for your valuable feedback, for your comments and suggestions, and for making me look at my own work from a slightly different standpoint. I am also thankful to Clio Herrmann, who found some silly mistakes that I had not noticed even after several revisions. I am extremely grateful to Stefano Maggi, who read the dissertation multiple times and who, beyond fixing typos and style, gave me an external reader's perspective, helping me to improve the clarity of my work. Finally, I would like to thank Professors Julia Dratva and Carl Lachat for reviewing this dissertation and serving as jury members at the oral defense.

As Albert Schweitzer said: "at times, our own light goes out and is rekindled by a spark from another person. Each of us has cause to think with deep gratitude of those who have lighted the flame within us". I am lucky to have wonderful people in my life, who help me light my flame when the winds blow too strong. First, my boys Ste, Luca, Andy, Orly, Mitch and Tiago, and my girls Michela and Sara V.: a thousand words of appreciation and gratefulness would not be sufficient to express how much I love you and how much I feel lucky to know you. Thank you for always standing by my side, no matter what, and for accepting this weird crazy person I am! Second, my parents. Needless to say that I would not be here without you. Thank you for your endless and unconditional love and support. I have always been stubborn, ambitious, and sensitive. Thank you for allowing me to study, for accepting my mood swings, for understanding all the declined family dinners, and for encouraging me all these years. I hope I made you proud. Finally, the deepest "thank you" goes to the most important and special person in my life: Christian. I have no words to tell how much I love you and how much I am grateful to have you as my brother. You never doubted me and always saw my highest potential, even when I was not able to see it. Thank you for opening my eyes, for handling my temper, my crises and me. I would have never made it without your support. Thank you for your infinite love. I am happy to share this success with you!

Table of Contents

List of Tables

List of Figures

List of Supplementary Tables

List of Supplementary Figures

List of Abbreviations

BL: Baseline

BMI: Body Mass Index

FAN: Famiglia, Attività fisica, Nutrizione (Family, physical Activity, Nutrition)

FUP: Follow Up

G1: Group 1 (Web-only)

G2: Group 2 (Web + e-mail)

G3: Group 3 (Web + SMS)

PA: Physical Activity

RCT: Randomized Controlled Trial

RQs: Research Questions

SMS: Short Messaging Service

List of Relevant Swiss Organizations and Departments

Federal Offices

- **Federal Office of Public Health**
  (Bundesamt für Gesundheit (BAG) / Office Fédéral de la Santé Publique (OFSP) / Ufficio Federale della Sanità Pubblica (UFSP) – https://www.bag.admin.ch/)
- **Health Promotion Switzerland**
  (Gesundheitsförderung Schweiz / Promotion Santé Suisse / Promozione Salute Svizzera – PSS – https://promotionsante.ch)
- **Swiss Society for Nutrition**
  (Schweizerische Gesellschaft für Ernährung (SGE) / Société Suisse de Nutrition (SSN) / Società Svizzera di Nutrizione (SSN) – http://www.sge-ssn.ch)

Canton Ticino Offices

- **Department of Education, Culture and Sport**
  (Dipartimento dell'educazione, della cultura e dello sport – DECS – https://www4.ti.ch/decs/dipartimento)
- **Department of Health and Social Affairs**
  (Dipartimento della sanità e della socialità – DSS – https://www4.ti.ch/dss/dipartimento/)
- **Health Promotion and Evaluation Service**
  (Servizio di promozione e valutazione sanitaria – SPVS – https://www4.ti.ch/dss/dsp/upvs/ufficio/)

Definitions

Body Mass Index (BMI)

The Body Mass Index (BMI) is defined calculating a person's weight in kilograms divided by the square of his/her height in meters (kg/m^2). The standard-value obtained result is used to classify a person's body weight into the following categories: underweight, normal weight, overweight and obesity. Since it represents a standard categorization, it is the same for both sexes and ages of adults, it is commonly used in international comparisons. However, while used globally and providing meaningful information about individual's body weight, BMI is not an accurate measure as it "does not distinguish between excess fat, muscle or bone mass"(Centers for Disease Control and Prevention, 2011).

The calculation for BMI in children depends on sex and age. Children's height and weight, as well as their body fatness, change during development and as such children's BMI are interpreted compared to other children of the same sex and age. Therefore, BMI is compared to z-scores or percentiles based on children's sex and age (Centers for Disease Control and Prevention, 2015).

Several BMI categorizations exist, such as the classifications based on growth charts from 1) the International Obesity Task Force (IOTF) (Cole, Bellizzi, Flegal, & Dietz, 2000; Cole & Lobstein, 2012), 2) the World Health Organization (World Health Organization, 2017a), and 3) the U.S. Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2011). Growth charts are established to better monitor children's growth, and serve the purpose of categorizing BMI. The IOTF established cut-offs that are matching adult's cut-offs of a BMI of 25 or 30, with the aim of allowing international comparisons. The WHO growth charts are based on how children should grow ideally. The CDC growth charts are based on United States representative data (Flegal & Ogden, 2011).

In this dissertation, the classification of children's BMI was based on the U.S. Centers for Disease Control and Prevention, which was validated for Swiss Children

(Zimmermann, Gübeli, Püntener, & Molinari, 2004). According to this classification, underweight is defined as a BMI under the 5th percentile; normal weight is between the 5th and the 84.99th percentiles; overweight is between the 85th and 94.99th percentiles and for a percentile of 95 or more, children are considered as obese (Centers for Disease Control and Prevention, 2015).

Engagement

The term engagement refers to the involvement of participants in an intervention. Other terms used in the literature are "exposure", "adherence", or "usage" (Crutzen et al., 2011; Cugelman, Thelwall, & Dawes, 2011; Danaher, Boles, Akers, Gordon, & Severson, 2006; Neil, Batterham, Christensen, Bennett, & Griffiths, 2009; Schubart, Stuckey, Ganeshamoorthy, & Sciamanna, 2011).

Healthy Diet

A healthy diet benefits physical and mental wellbeing, and helps prevent the onset of overweight and obesity (see definitions below). A healthy diet consists of a varied and balanced food consumption that meets the necessary food requirements, according to the age range of the person. A healthy diet includes foods from all nutritional categories (hence, there are no forbidden foods), however, different amounts for each are recommended. To guide the population towards a healthy nutrition, the Swiss Society for Nutrition developed a Food Pyramid that indicates the food categories and the quantity proportions that should be consumed. Foods in the higher part of the pyramid (fat, sweets, sugar drinks) should be consumed with moderation, while those in the lower part (water, fruit and vegetables) should be consumed in larger quantities (Swiss Society for Nutrition, 2015).

Figure A. Swiss Food Pyramid by the Swiss Society for Nutrition

Specific guidelines for a healthy diet by age exist. This research is based on the guidelines for children valid in 2010 and summarized below (Swiss Society for Nutrition, 2010). The quantities are referred to daily consumption, except for protein intake (meat, fish, eggs and vegetable proteins), which is stated in terms of quantities per week. The guidelines have been updated in 2016 (Swiss Society for Nutrition, 2016).

Children 4-6 years of age

- Drink 0.8 l of water or sugar free tea.
- Eat 1.5-2 portions a day of fruit and 1.5-2 portions a day of vegetables. One portion can be substituted by 100% fruit or vegetable non sugared juice.
- Eat 3-4 portions of starchy foods, preferring whole grains.
- Eat 3.5 portions of dairy products.
- Eat 2-3 portions of meat; 1-2 portions of fish; 2 eggs (quantities *per week*).
- Take a maximum of 3 teaspoons of olive oil or canola and 1 teaspoon of butter or crème. Eat 1 portion of NOT salty oleaginous fruits (nuts, almonds, hazelnuts, pecans).
- Eat a maximum of 1 portion of sweets or sugar drinks (to be consumed occasionally, and with moderation), and 10 g (or 2.5 cubes) of sugar (honey or jam).

Children 7-9 years of age

- Drink 0.9 l of water or sugar free tea.
- Eat 2 portions a day of fruit and 2 portions a day of vegetables. One portion can be substituted by 100% fruit or vegetable non sugared juice.
- Eat 3-4 portions of starchy foods, preferring whole grains.
- Eat 4 portions of dairy products.
- Eat 2-3 portion of meat; 2 portions of fish; 2 eggs; 1 portion of legumes (quantities *per week*).
- Take 4 teaspoons of olive oil or canola and maximum 1 teaspoon of butter or crème. Eat 1 portion of NOT salty oleaginous fruits (nuts, almonds, hazelnuts, pecans).
- Eat a maximum of 1 portion of sweets or sugar drinks (to be consumed occasionally, and with moderation), and 10 g (or 2.5 cubes) of sugar (honey or jam).

Children 10-12 years of age

- Drink 1 l of water or sugar free tea.
- Eat 2-3 portions a day of fruit and 2-3 portions a day of vegetables. One portion can be substituted by 100% fruit or vegetable non sugared juice.
- Eat 3-4 portions of starchy foods, preferring whole grains.
- Eat 2-3 portions of dairy products.
- Eat 4 portion of meat; 2 portions of fish; 2-3 eggs; 1 portion of legumes (quantities *per week*).
- Take 4 teaspoons of olive oil or canola and maximum 2 teaspoon of butter or crème. Eat 1 portion of NOT salty oleaginous fruits (nuts, almonds, hazelnuts, pecans).
- Eat a maximum of 1 portion of sweets or sugar drinks (to be consumed occasionally, and with moderation), and 10 g (or 2.5 cubes) of sugar (honey or jam).

Overweight and Obesity

The World Health Organization defines overweight and obesity as "abnormal or excessive fat accumulation that may impair health" (World Health Organization, 2016). For adults, a person with a BMI equal to or higher than 25 is considered overweight, while with a BMI equal to or higher than 30 is considered obese. For children, specific cut-off points are defined based on gender and age (Centers for Disease Control and Prevention, 2015; Cole et al., 2000; World Health Organization (WHO), 2014).

The cut off points validated with Swiss children (Zimmermann et al., 2004) are as follows: less than the 5th percentile children are considered as underweight; between the 5th and the 84.99th percentiles they are classified as normal weight; overweight is between the 85th and 94.99th percentiles and for a percentile of 95 or more, children are considered as obese (Centers for Disease Control and Prevention, 2015).

Randomized Controlled Trial (RCT)

In studies with a randomized controlled design, participants are randomly assigned to one of two or more different study groups. The experimental groups receives the intervention that is being tested (if more than two groups, different interventions for each), while the control group receives no intervention, or an alternative intervention. The different groups are followed up, and to assess the effectiveness of the intervention, the effects of the experimental groups are compared with the effects of the control group (Kabisch, Ruckes, Seibert-Grafe, & Blettner, 2011; J. M. Kendall, 2003). The randomization of participants across groups is intended to "ensure that all potential confounding factors are divided equally among the groups that will later be compared (structural equivalence)" (Kabisch et al., 2011).

Social Marketing

The boards of the International Social Marketing Association, the European Social Marketing Association, and the Australian Association of Social Marketing endorse the following definition of Social Marketing:

"Social Marketing seeks to develop and integrate marketing concepts with other approaches to influence behaviours that benefit individuals and communities for the greater social good.

Social Marketing practice is guided by ethical principles. It seeks to integrate research, best practice, theory, audience and partnership insight, to inform the delivery of competition sensitive and segmented social change programmes that are effective, efficient, equitable and sustainable" (Tapp et al., 2013). For further details about Social Marketing see **Chapter I**, **Section 1.2**.

Social Marketing Benchmark Criteria

The Social Marketing benchmarks are a set of criteria developed by French and Blair-Stevens in 2006 aimed at guiding the design, development and implementation of Social Marketing interventions (French & Blair-Stevens, 2006). The criteria are based on

Andreasen's work (Andreasen, 2002), and have been lastly updated in 2012 (French, 2012). The eight Social Marketing benchmark criteria (French, 2012) are: 1) customer orientation, 2) behavior, 3) theory, 4) insight, 5) exchange value, 6) competition, 7) segmentation, and 8) methods mix. For further details see **Chapter I**, **Section 1.2**.

Chapter I

Introduction

1.1 Overweight and Obesity

The prevalence of overweight and obesity represents a serious health problem. A systematic analysis of the prevalence of overweight and obesity in 188 countries showed that in 2013, 2.1 billion people were obese, compared to 921 million people in 1980 (Finucane et al., 2011; Ng et al., 2014; Stevens et al., 2012). The findings show that globally, in the past thirty years, the rates for overweight and obesity have increased for both adults and children by 27.5% and by 47.1% respectively irrespective of gender (Ng et al., 2014). Similar results were found in other studies assessing the trends in global overweight and obesity (Finucane et al., 2011; NCD Risk Factor Collaboration (NCD-RisC), 2016; Stevens et al., 2012). Children's rates of overweight and obesity in developed countries increased from 16.9% in 1980 to 23.8% in 2013 for boys and from 16.2% in 1980 to 22.6% in 2013 for girls (Ng et al., 2014).

European data show that in 2014 there were 35.7% overweight adults and 15.9% obese adults in the European Union (European Commission, 2016). A study of eight European countries showed that the prevalence of overweight in children was 12.8%, and of obesity was 7% (Ahrens et al., 2014). Swiss data show that overweight and obesity have also increased and are high in Switzerland. Indeed, in 2012, 30.7% of adults and 15% of children were overweight, and 12.7% of adults and 5% of children were obese, meaning approximately 43% of the adult population and 20% of the child population in Switzerland had a higher Body Mass Index (BMI) than recommended (Bochud, Chatelan, Blanco, & Beer-Borst, 2017; Federal Office of Public Health (FOPH), 2014b, 2014a; Lamprecht & Stamm, 2012). Data collected between 2014 and 2015 showed that in the Italian-speaking southern Canton of Switzerland (Ticino), the situation was similar, with 30.1% of the population above 15 years of age being overweight, and 15.6% being obese (Bochud et al., 2017).

Being overweight and obese is associated with an increased risk for several non-communicable diseases, such as high cholesterol, type 2 diabetes, cardio-vascular diseases, myocardial infarction, hypertension, ictus, certain types of cancer (e.g. breast and colon tumors), asthma, back pain, and musculoskeletal disorders (Federal Office of

Public Health (FOPH), 2014c; World Health Organization, 2011, 2014). Obesity is also associated with low self-esteem and other psychological problems (Reilly et al., 2003; Reilly & Kelly, 2011). Finally, studies have shown that childhood obesity is also associated with poorer cognitive skills and lower school achievements, when comparing overweight and obese children to healthy weight peers (Booth et al., 2014; Liang, Matheson, Kaye, & Boutelle, 2014; A. Martin et al., 2016; Reilly et al., 2003; Sahoo et al., 2015; Schwimmer, Burwinkle, & Varni, 2003; Vassiloudis, Yiannakouris, Panagiotakos, Apostolopoulos, & Costarelli, 2014).

Poor nutrition and inadequate levels of physical activity are among the determinants of overweight and obesity. Among Swiss adults, roughly 30% did not meet the Swiss Federal Office of Public Health recommendations of a minimum of 150 minutes of physical activity per week (Federal Office of Public Health (FOPH), 2014b; Federal Statistical Office (FSO), 2014; Federal Statistical Office (FSO) & Federal Department of Home Affairs (FDHA), 2016). A Swiss study using objective measures of physical activity showed that 91.2% of Swiss girls and 88.7% of Swiss boys were not regularly active (Bringolf-Isler, Probst-Hensch, Kayser, & Suggs, 2016).

Adherence to nutritional guidelines is also low in Switzerland. In 2012 fruit and vegetable consumption was low for both adults and children: less than 20% of adults consumed the 5-a-day recommended portions of fruit and vegetables (Federal Statistical Office (FSO), 2014), while less than 50% of girls and 40% of boys ate fruit and vegetables daily (Federal Office of Public Health (FOPH), 2014b; Lamprecht & Stamm, 2012). On the contrary, meat consumption was higher than recommended: the average meat consumption was 780 grams per week per person, that is, more than three times higher than recommended (240 grams per week per person) (Federal Food Safety and Veterinary Office (FFSVO), 2017b, 2017a). Findings from a study conducted in Ticino among school-aged children showed low adherence to Swiss nutritional guidelines (Suggs, Della Bella, & Marques-Vidal, 2016). In particular, only 10.4% of children adhered to the recommendations for fruit consumption, 0% to those for vegetables, and 9.5% adhered to the guidelines for sweets, snacks and soft drinks. For this last category, non-adherent children over-consumed sweets, snacks and soft drinks. Regarding meat consumption,

26.9% of children adhered to the guidelines, 72.7% were over-consumers (similarly to adults), and a small minority of children were under-consumers (0.4%) (Suggs et al., 2016).

Determinants towards healthy eating can be found at the individual, environmental and policy levels. Among individual determinants knowledge about and attitudes, intentions and motivation towards healthy eating, as well as taste preference and individual skills can be cited (Brug, 2008; Mazarello Paes et al., 2015; Nepper & Chai, 2016; Shepherd et al., 2006). Environmental determinants for healthy eating include the physical environment (i.e. healthy food availability at home, school, workplace, including restaurants, cafeterias and vending machines), the economic environment (i.e. the cost and perceived cost of healthy and unhealthy food), as well as the socio-cultural environment (i.e. social and cultural norms that influence and support or discourage healthy eating behavior) (Brug, 2008; Mazarello Paes et al., 2015; Nepper & Chai, 2016; Shepherd et al., 2006; Swinburn, Egger, & Raza, 1999). Finally, policy determinants relate to the regulations around food policies, such as school and workplace nutritional policies, taxation, food advertisement policies, but also family rules (Brug, 2008; Mazarello Paes et al., 2015).

Nepper and Chai (2016) conducted a study aiming at understanding which barriers parents face when promoting healthy eating to their school-aged children. They identified six main barriers: 1) time and energy: due to their busy schedules, parents had limited time and lacked of energy to look for new ideas for healthy diets and to prepare healthy meals; 2) cost and availability of healthy foods; 3) children's frequent requests of unhealthy food (i.e. junk food); 4) children's and partners' food preference, which made eating healthy at home challenging; 5) children's exposure to unhealthy foods at young age, developing unhealthy habits; and 6) lack of support from their partners in healthy eating practices (Nepper & Chai, 2016). Finally, they found that both parents of normal weight children and parents of overweight or obese children had the same concerns, apart from the sixth barrier (partner's support), which was faced by overweight or obese children's parents only (Nepper & Chai, 2016).

Some studies suggest that the increase of overweight and obesity rates slowed down in the last decade (Murer, Saarsalu, Zimmermann, & Aeberli, 2013; Rokholm, Baker, & Sørensen, 2010), suggesting a positive trend in addressing the overweight and obesity issues (Murer et al., 2013; Ng et al., 2014). This may suggest that country policies and intervention studies have successfully contributed to promote healthy lifestyles, with the aim of preventing unhealthy weight both in adults and children (Carins & Rundle-Thiele, 2014; World Health Organization, 2015, 2017b). However, in their systematic analysis of the prevalence of overweight and obesity, Ng and colleagues did not find any country that experienced a significant decline of these rates in the past 30 years (Ng et al., 2014).

Therefore, while some positive trends exist, it appears that the efforts to reduce the prevalence of overweight and obesity and its increase are not enough, yet. More effective interventions that address the issue of overweight and obesity are needed. In particular, since habits and behaviors established during childhood persist into adulthood, it is important to promote healthy food consumption and regular physical activity to children (The, Suchindran, North, Popkin, & Gordon-Larsen, 2010).

1.2 Social Marketing

Social Marketing is a framework grounded on Marketing concepts. It is focused on "behavior" and aims at benefiting society by enhancing the social good (Andreasen, 1994; Kotler & Zaltman, 1971; Tapp et al., 2013). It is characterized by the integration of research, best practice, theory, audience and partnership insight, and it pursues the goal of informing "the delivery of competition sensitive and segmented social change programmes that are effective, efficient, equitable and sustainable" (Tapp et al., 2013).

To be consistent with its principles, a Social Marketing intervention needs to adhere to eight Social Marketing benchmark criteria developed by French and Blair-Stevens in 2006, updated in 2009 and 2012 (French, 2012; French & Blair-Stevens, 2006) and informed by the criteria developed by Andreasen in 2002 (Andreasen, 2002). These criteria help the design, development and implementation of interventions that reflect the

core principles of Social Marketing. The eight Social Marketing benchmark criteria (French, 2012) are:

1) *Citizen Orientation*: Social Marketing interventions are based on a deep understanding of the audience. To do so, social marketers conduct in depth consumer research, using both primary and secondary data.
2) *Behavior*: the focus of Social Marketing initiatives is behavior change. The analysis and understanding of the target behavior (and its counter-behavior) inform the development of clear behavioral goals and SMART (Specific, Measurable, Attainable, Relevant, and Time-bound) objectives.
3) *Theory*: Social Marketing initiatives are based on theory that guides the development of the intervention and its evaluation.
4) *Insight*: social marketers gain a deep understanding of the key elements that influence behavior (or non-behavior). They identify what motivates the target audience to perform the behavior, and what constitutes a barrier to it.
5) *Exchange value*: this benchmark refers to the analysis of the perceived and actual costs and benefits for the audience to perform the desired behavior.
6) *Competition*: social marketers assess the competition to understand what competes for the time and for the attention of the audience. They analyze internal and external factors, and develop strategies to minimize the impact of competition on the target behavior.
7) *Segmentation*: the understanding of the audience allows the implementation of a tailored approach. For each identified segment, an appropriate strategy based on their needs, values and wants is used to prompt behavior change.
8) *Methods mix*: Social Marketing initiatives use a mix of methods (rather than relying on a single method), to enhance their impact on the behavior of the audience. It also includes the extended *Marketing Mix* (Product, Place, Price, Promotion, Partnership, and Policy).

Despite the existence of these criteria that should facilitate the development of interventions according to the Social Marketing framework, and help their identification as Social Marketing, studies have shown that the operationalization of the Social

Marketing benchmark criteria is not commonly reported, and that different authors interpret the framework in different ways (Luca & Suggs, 2012; McDermott, Stead, & Hastings, 2005). Studies often report the effects of the intervention, without specifying how the intervention was developed, nor whether the Social Marketing framework was used. When they do, the reporting of the benchmark criteria is rare, and often incomplete (Luca & Suggs, 2012; Wettstein & Suggs, 2016; Wettstein, Suggs, & Lellig, 2012). Overall, studies have shown that some benchmarks (i.e. behavior, insight and methods mix) are used more than others, and that some fundamental benchmarks are often entirely absent (i.e. segmentation, competition, theory) (Bulut, 2016; Luca & Suggs, 2012; McDermott et al., 2005; Wettstein et al., 2012). The reasons for this are to be found in restricted budgets, policy decisions, limited resources (including people, time, and material), and management issues (French & Russell-Bennett, 2015). On the other hand, there are interventions that are not labeled as Social Marketing, but that in fact present Social Marketing characteristics (Bulut, 2016; McDermott et al., 2005). Thus, reviews of Social Marketing studies might include interventions that do not fully adhere to the benchmark criteria solely because they are labeled as Social Marketing, but might exclude others that do adhere to the criteria, but are not labeled as such. Hence, the evidence about Social Marketing could be misleading, beyond being incomplete, as it might not attribute positive effects to Social Marketing, or it might attribute negative effects when in fact it is the lack of Social Marketing that negatively impacts an intervention.

The evidence so far showed that the Social Marketing framework has been widely and effectively used in interventions aiming at changing different health behaviors, with different populations, and in different settings (Gordon, McDermott, Stead, & Angus, 2006; Luca & Suggs, 2012; Stead, Gordon, Angus, & McDermott, 2007; Stead, Hastings, & McDermott, 2007). Positive effects were found in Social Marketing interventions aimed at preventing and counteracting overweight and obesity (Evans, Christoffel, Necheles, & Becker, 2010; Stead, Gordon, et al., 2007), and interventions promoting regular physical activity and healthy nutrition behaviors and related factors, including attitude, self-efficacy and knowledge (Carins & Rundle-Thiele, 2014; Evans et al., 2010; Gordon et al., 2006; Stead, Gordon, et al., 2007).

In addition to research evidence, health and public policy support using Social Marketing interventions to promote healthy nutrition and physical activity, with the aim of preventing nutrition-related non-communicable diseases and obesity, and improving the health and well-being of populations. Policy documents, such as the World Health Organization's (WHO) "Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020", the "WHO European Action Plan for Food and Nutrition Policy 2007-2012", and the "Health 2020: a European policy framework supporting action across government and society for health and well-being" (World Health Organization, 2008, 2013; World Health Organization (WHO), 2012) endorse the use of the Social Marketing framework.

While the scientific evidence is overall positive, and the framework is recommended by policy documents, the evidence on Social Marketing use and its impact on intervention effectiveness needs to be enhanced and continuously updated. As health and social problems evolve and social and economic conditions change within populations, it is imperative to understand what makes interventions work, and what, on the contrary, impedes their success (French & Russell-Bennett, 2015; Wettstein & Suggs, 2016). In particular, there is a lack of evidence regarding Social Marketing nutrition interventions in Europe. For example, in an attempt to review Social Marketing evidence, McDermott and colleagues found no European studies to include (McDermott et al., 2005). Just over a decade later, a review of European based Social Marketing studies aimed to improve nutrition found twenty-five studies, with thirteen of those coming from the United Kingdom (Bulut, 2016). The remaining studies came from the Netherlands, Spain, Greece, Italy, Turkey, Norway, and Iceland, showing a low diversification across countries (Bulut, 2016). While this review reported that the majority of the studies did seemingly adhere to seven or eight of the Social Marketing benchmarks, it was also noted that the goal and the focus of the intervention were not always clear, that the benchmarks were not always explicitly defined and operationalized, and that the behavioral outcomes were not always reported (Bulut, 2016).

In addition to these twenty-five nutrition Social Marketing studies, several other study protocols reporting the use of Social Marketing were identified during the search

process, but excluded from the review for lack of reporting any outcomes (Bulut, 2016). This suggests that there is an increase in the use of Social Marketing for health nutrition promotion in Europe in the last decade. Hence it is critical to develop and implement Social Marketing interventions and to consistently share methodologies and results, in particular by operationalizing the Social Marketing benchmark criteria, and by reporting behavioral outcomes. This will improve knowledge and build evidence about research and practice in Social Marketing.

1.3 Family Interventions

Human behavior is shaped and defined during childhood. Children often observe and imitate their parents, who function as role models and as such the development of children's habits is also a consequence of what they see and perceive as a habit in the home environment (Golan & Crow, 2004; Golley, Hendrie, Slater, & Corsini, 2011; Hingle, O'Connor, Dave, & Baranowski, 2010; Miller, Hering, Cothran, Croteau, & Dunlap, 2012; Tyler & Horner, 2008; Verloigne, Van Lippevelde, Maes, Brug, & De Bourdeaudhuij, 2012; Wolcott, Huberty, McIlvain, Rosenkranz, & Stacy, 2011; Wolfenden et al., 2012). However, childhood obesity prevention interventions often take place in school-settings, are addressed to children, and require limited family involvement (Hingle et al., 2010; Stice, Shaw, & Marti, 2006; Wolfenden et al., 2012).

Non-school based studies aimed at improving children's nutrition and physical activity habits often address the parents and communicate exclusively with them (Golley et al., 2011). Family-centered interventions, that is interventions that focus on the needs of both children and parents (Briar-Lawson, Lawson, Hennon, & Jones, 2001; Davison, Lawson, & Coatsworth, 2012; Dunst, Johanson, Trivette, & Hamby, 1991), are rarely used in obesity prevention, contrary to weight loss or weight management interventions (Davison et al., 2012; McLean, Griffin, Toney, & Hardeman, 2003; Tyler & Horner, 2008; Wolcott et al., 2011). While parents play an important role in the development of their children's behaviors, their involvement in interventions is often indirect, and mainly aimed at supporting their children's behavior change or their children's participation in the

program (for example by assisting them in completing a survey) (Davison, Jurkowski, Kaigang, Kranz, & Lawson, 2013).

Despite these common practices, evidence supports the implementation of interventions that include a parental involvement component (Davison et al., 2013, 2012; Stice et al., 2006). Family member support seems to positively affect nutrition and physical activity behavior change (Wolcott et al., 2011; Zecevic, Tremblay, Lovsin, & Michel, 2010). Findings from several studies have shown an association between parent and child behavior for both nutrition and physical activity (Golley et al., 2011; Hingle et al., 2010; Miller et al., 2012; Verloigne et al., 2012). Further, when children and parents practice those behaviors together, children achieve better outcomes and are less likely to become overweight or obese (Dong et al., 2016; Golan & Crow, 2004; Hingle et al., 2010; Miller et al., 2012; Raynor, Jelalian, Vivier, Hart, & Wing, 2009; Verloigne et al., 2012; Wolcott et al., 2011).

According to Miller and colleagues, spending time with the family can also have negative outcomes, such as increased sedentary activities with increased screen-time (Miller et al., 2012). Indeed, children reported that "spending time with family was a major reason they engaged in screen-related activities" (Miller et al., 2012). Hence, promoting social interactions is not enough, as "being together" is not a sufficient motivation to engage in healthy habits. Thus, to achieve more positive outcomes families should participate in interventions with the aim of changing their *family* behavior (compared to the behavior of the child or the parents only) (Wolcott et al., 2011). Given their influence on children, parents should engage in healthy behaviors, and not function as supervisors only or as promoters of unhealthy behaviors (i.e. sedentary behavior and unhealthy food consumption). There is need to develop and implement programs that promote healthy nutrition, regular physical activity, and social interactions, within the family (Golley et al., 2011; Hingle et al., 2010; Miller et al., 2012; Wolcott et al., 2011; Wolfenden et al., 2012).

1.4 E-health Interventions

The diffusion of e-health behavior change interventions was facilitated by technology developments (Evers, 2006; Kohl, Crutzen, & de Vries, 2013; Marcus, Lewis,

Williams, & et al, 2007; Norman et al., 2007; Suggs, 2006; Suggs, Rangelov, et al., 2015; Suggs & Ratzan, 2012). These interventions have been delivered through CD-ROMs, Websites, e-mails, Short Messaging Service (SMS), online games, and combinations thereof (Hutchesson et al., 2015; Lustria et al., 2013; Lustria & Cortese, 2009; Nguyen, Kornman, & Baur, 2011; Norman et al., 2007).

Wolfenden and colleagues showed that parents whose children did not consume enough fruit and vegetables, or did not engage in sufficient physical activity, often participated in Internet-based interventions (Wolfenden et al., 2012). Positive effects of e-health interventions were found for different behaviors, including physical activity and nutrition (Ahern, Phalen, Le, & Goldman, 2007; Kohl et al., 2013; Krebs, Prochaska, & Rossi, 2010; Kroeze, Werkman, & Brug, 2006; Lau, Lau, Wong, & Ransdell, 2011). Web-based interventions were effective in changing behavior (Broekhuizen, Kroeze, Poppel, Oenema, & Brug, 2012; Olson, 2016). Moreover, behavior change has been positively supported by reminders and cues to action sent by SMS or e-mails (Hutchesson et al., 2015; Webb, Joseph, Yardley, & Michie, 2010). Hence, the use of Internet-based interventions and SMS and e-mail reminders has great potential in changing nutrition behavior. Nonetheless, it is still unclear whether and to what extent communication sent by SMS or e-mails to parents has a positive effect on children's behavior.

1.5 Engagement in Interventions

Many interventions are designed to be initiated and completed by the participants. Participants who complete intervention programs they enroll in are more likely to change their nutrition and physical activity behaviors than those who do not complete it (Brouwer et al., 2011; Donkin et al., 2013; Robroek, Brouwer, Lindeboom, Oenema, & Burdorf, 2010; Robroek, Lindeboom, & Burdorf, 2012; Strecher et al., 2008). Better behavioral outcomes are achieved by participants with a high level of engagement and long term use of the intervention (Brouwer et al., 2011; Norman et al., 2007; Robroek et al., 2010, 2012). However, while evidence suggests that a higher level of participant engagement is required for behavior change to occur, previous studies suggest that

participant engagement is often lower than expected or than desirable (Eysenbach, 2005; Glasgow et al., 2007; Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012).

In previous research, measures such as number of visits and usage, including clicks on a Website, frequency of visits, length of visits and pages visited have been used to assess online engagement (Brouwer et al., 2011; Crutzen et al., 2011; Donkin et al., 2013). However, findings from the literature are mixed. While overall there is a consensus that engagement in online interventions should be measured through the activities that take place online, it is not clear what measures should be used to assess engagement, and which ones have an impact on behavior (Crutzen et al., 2011; Donkin et al., 2013).Therefore, it is suggested that studies track and report multiple engagement measures (Crutzen et al., 2011).

e-Health nutrition and physical activity interventions often promote activities that are to be performed *offline* (such as cooking or walking). While past research focused on measuring online engagement, according to Donkin and colleagues, long-term positive behavior change was related to the completion of offline activities (Donkin et al., 2013). Hence, it is appropriate to include measures of offline engagement in those analyses, and to study the association of those activities with behavior change (Donkin et al., 2013). Additionally, research is needed to understand to what extent the different types of engagement of a parent impact a child's behavior (Hingle et al., 2010; Zecevic et al., 2010).

1.6 Measuring Children's Food Consumption

One of the challenges that researchers and practitioners confront in the field of public health nutrition is the collection of accurate food consumption data. Clinical measurements (biomarkers) and direct observation provide reliable indicators, but they are not always feasible. Further, while researchers have used multiple instruments to measure children's eating behavior, validated tools are limited (Burrows et al., 2012; McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000). The most common tools used to measure eating behavior are Food Frequency Questionnaires (FFQ), 24-hour recall methods, and Food records or diaries (Baranowski, 2013; Johnson, 2002; Kolodziejczyk,

Merchant, & Norman, 2012). FFQs have typically been used in large cohort studies with the aim of collecting population patterns of dietary intake over time (typically 6 or 12 months). Food diaries and 24-hour recall methods have usually been used to collect data about the current dietary intake on one day (24-hour recall) or over a period of days (usually three to seven for the food diaries) (Johnson, 2002).

While appropriate for certain purposes, these data collection instruments present some weaknesses. For instance, FFQs contain a list of specific foods that are consumed in that culture, and participants are asked to identify the ones they ate, and how much and how often they consumed them (Johnson, 2002). Challenges include the ability to accurately report food, and in particular to capture mixed foods (Johnson, 2002; Johnson-Taylor & Everhart, 2006). Food records help overcome this problem, by asking participants to specify the food they ate (Collins, Watson, & Burrows, 2010; Kolodziejczyk et al., 2012). Also, since they should be completed immediately after each meal, recall issues recall can be minimized, compared to the 24-hour recall or the FFQs (Baranowski, 2013; Shim, Oh, & Kim, 2014).

Depending on the aim of the dietary assessment, portion size estimation might be requested. This remains a challenge, and under-reporting has been noted in previous studies (Johnson, 2002). It is suggested that participants should be trained to correctly estimate portions, and use helping tools, such as bowls, cups, or scales, to increase accuracy of reporting (Baranowski, 2013; Shim et al., 2014). When the aim of the study is to determine the frequency of consumption of foods or food groups, or to examine eating patterns, food diaries without portion sizes can be used (Baranowski, 2013).

Another factor influencing the collection of accurate data is the length of the measurement. It has been suggested that data collection should take place for at least a 7-day period (Baranowski, Mâsse, Ragan, & Welk, 2008; Ortega, Pérez-Rodrigo, & López-Sobaler, 2015). Although this timeframe would help to overcome the "observation effect" (usually wearing off in 2-3 days) (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), and provide data about dietary patterns, collecting data for seven days may be problematic from a practical perspective (Baranowski et al., 2008). Hence, FFQs and Food diaries allow the collection of more data, but they are usually long and burdensome to complete,

and require motivated participants (Collins et al., 2010; Johnson, 2002; Kolodziejczyk et al., 2012; Ortega et al., 2015). On the other hand, 24-hour recall methods are relatively brief, collect detailed data of current intake and have a small respondent burden (Johnson, 2002; Johnson-Taylor & Everhart, 2006; Shim et al., 2014). In **Table 1.1** a summary of strengths and weaknesses of FFQs, Food records and 24-hour recall methods is presented.

Table 1.1 Summary of Strengths and Weaknesses of Food Consumption Data Collection Methods.

	Strengths	**Weaknesses**
FFQs	- Describes intake over a longer period (i.e. 6-12 months) - Trends in food consumption	- Ability to capture mixed foods - Variety of food listed - Recall bias
Food records	- Increased accuracy of reporting - Detailed intake reported	- Burden of completing them - Require a motivated population - Possible bias due to completion
24h recall	- Brief - No/small respondent burden	- Do not allow for a description of a 'typical diet' - Recall bias - Requires an interviewer

When asked to report their food consumption, children are often confronted with two main challenges: 1) recalling the food they ate; and 2) estimating portion size (Kolodziejczyk et al., 2012; Livingstone & Robson, 2000; Livingstone, Robson, & Wallace, 2004; R. J. Martin & Collins, 2010; McPherson et al., 2000). First, data collection methods need to be designed for children, who are not a homogeneous group in terms of reading ability (Baranowski, 2013; Collins et al., 2010; Kolodziejczyk et al., 2012; Thiagarajah et al., 2008). Second, the longer the gap between the time of consuming food and the time of reporting the food consumption is, the more children experience difficulties in recalling what they ate (i.e. when asking to recall what they ate in the previous month)

(Baranowski & Domel, 1994; Collins et al., 2010; Kolodziejczyk et al., 2012; Thiagarajah et al., 2008). Finally, quantity estimation, and thus portion size estimation are also a common challenge for school-aged children, who are not reliable in reporting accurate measures (Collins et al., 2010; Kolodziejczyk et al., 2012; Spook, Paulussen, Kok, & Van Empelen, 2013; Thiagarajah et al., 2008).

It is thus important to find an effective and efficient method to accurately measure children's eating behavior, and where possible, test the use of the data collection method in other settings and with other populations. This would not only provide knowledge about children's food intake, but also allow for comparison across settings and samples.

1.7 Study Design – the FAN Intervention

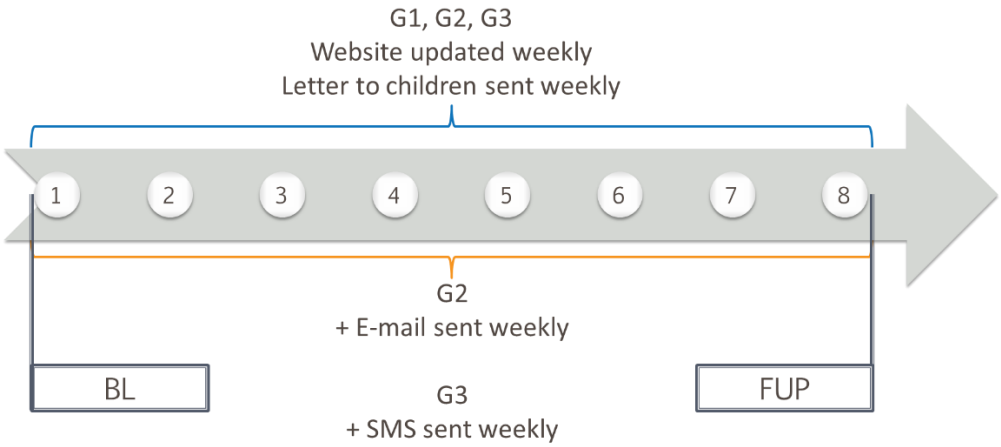
The research presented in this dissertation uses data from and for the *Famiglia, Attività fisica, Nutrizione* (Family, physical Activity, Nutrition – FAN) intervention. FAN was developed in collaboration with the Cantonal Department of Health and Social Affairs, and Health Promotion Switzerland, within the "Peso Corporeo Sano" ("Healthy Body Weight") obesity prevention policy initiative between 2008 and 2016. FAN was a healthy diet and physical activity Social Marketing program addressed to Ticino families with children attending elementary school or the first two grades of middle school.

Print, Web and mobile phone technologies were used to communicate directly with parents and children about methods to improve and maintain healthy diet habits and regular physical activity levels. All communication was tailored to the participants, based on their role in the family (parent or child), their gender, the number of the children in the household, participant children's school grade, and according to the behavior (physical activity or eating healthy) that parents and children perceived as being the most difficult to perform (assessed at baseline).

FAN was launched for the first time in October 2010 and again in 2012. The intervention lasted eight weeks, during which families were given access to a Website, specifically developed for the FAN intervention. Once a week all children received a tailored printed letter by mail. In order to prompt participants to access the Website, e-

mail and SMS reminders were sent weekly to some participants. The communication content consisted of theoretical and practical information about healthy nutrition and regular physical activity. FAN was developed as a family intervention, with communication directed to both parents and children. Although separate channels were used, the communication content provided suggestions on how to achieve and maintain a healthy nutrition and regular physical activity and on how to cope with the barriers associated with these behaviors collectively within the family. The goal was to prompt both children and parents to eat healthy and practice physical activity, and to try to do so together.

Figure 1.1 FAN Intervention Timeline



FAN was developed following the Social Marketing framework, which suggests that programs should be designed for the target population. In order to design an intervention that best suited the needs and wants of Ticino families, formative research was conducted. Within these activities, interviews and focus groups with parents and children from the target population were organized, and were focused on discussing communication strategies and communication content.

The results of the focus groups showed that parents approved of Web and e-mail communication, while their approval for mobile phone communication was slightly lower.

Parents stated they used Web, e-mail and SMS (almost) daily, but also that the use of these channels was often related to their professional life. However, being very busy and thus not available for frequent face-to-face meetings, these channels appeared to be suitable for a physical activity and healthy nutrition promotion intervention with this target audience. To communicate directly with children, parents showed a preference towards the use of print letters sent weekly, from FAN, via post mail. The reason why parents welcomed a piece of communication via print in an online intervention was twofold: first, according to them and to the children themselves, children like to receive letters addressed to them; second, young children from this target audience usually did not use the Internet.

The results from the focus groups and interviews were consistent with other research. Indeed, Robroek and colleagues (2010) argue that people deciding to participate in an online intervention may not be ready to rely solely on an Internet delivered program (Robroek et al., 2010). Hence, FAN was designed to primarily use online communication channels for parents and printed material for children. The letters could also be seen as a prompt for parents to be engaged in FAN. Hence, FAN was an online intervention that included an offline component.

The full baseline sample used in this dissertation included 543 parents and 735 children. Parents were primarily women (86%), married (82%) and of Swiss nationality (86%). The mean age was 41 years (range = 27 to 61, SD = 5.09). Most parents had a professional school degree (54%), were working part-time (54%) or full-time (13%), and had a monthly income between 0 and 3'500 Swiss francs (45%), the median monthly income being 5'000 Swiss francs in 2010 (Ticino Statistical Office (USTAT), 2012). Most parents defined their health status as being good (51%) or very good (16%); the rest defined it as normal (9%) or poor (3%). The weight distribution of parents included 6% obese, 22% overweight, 66% normal weight, and 5% underweight. Children were equally distributed among genders, and their mean age was 8.5 years (range = 6 to 16, SD = 1.91). Most children were attending elementary school (83.5%). The weight distribution of children included 6% obese, 12% overweight, 72% normal weight, and 10% underweight. More details about the FAN intervention and sample can be found in **Chapter II**.

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1.8 Aim, Research Questions and Organization of the Study

This dissertation consists of five articles, each published in, or submitted to, a relevant scientific peer-reviewed journal in the field of Social Marketing or Public Health research. Each study was also presented at national and/or international conferences. All the studies were conducted in the BeCHANGE Research Group, Institute for Public Communication at Università della Svizzera italiana, between 2011 and 2017.

The individual studies included in this dissertation examine eight research questions organized according to the following aspects related to the promotion of healthy nutrition in a Social Marketing intervention:

1) *The operationalization and implementation of Social Marketing;*
2) *The measurement of children's food consumption;*
3) *The role of different communication channel bundles;*
4) *The role of engagement.*

Examining these aspects contributes to a better understanding of the following areas in healthy nutrition promotion interventions:

1) How to design and develop a successful Social Marketing intervention;
2) How to reliably measure children's food consumption;
3) What communication strategies and channels are effective in a family based social marketing intervention;
4) What type of engagement (offline and/or online) and what features of a social marketing intervention are associated with behavioral outcomes.

Taken together, the studies contribute to the main aim of this research, which is to understand how to measure and improve children's food consumption behavior. While both physical activity and nutrition behaviors are important to weight management and were both addressed in the FAN intervention, the focus of this dissertation is on children's nutrition behavior. The reason for this focus is twofold. First, when asked at baseline "Which behavior is more difficult for you to perform: regular physical activity or eating healthy?", most children answered "eating healthy". Second, as habits acquired in

childhood tend to persist into adulthood, it is highly relevant to address children's food consumption. Therefore, in this dissertation the data about physical activity in the FAN intervention are disregarded. The Research Questions (RQs) for the individual studies are presented below.

The study presented in **Chapter II**, "*Using Strategic Social Marketing to Promote Healthy Nutrition and Physical Activity Behaviors to Parents and Children in Switzerland: The Development of FAN*", is a case study that describes the development of the Social Marketing FAN intervention. The data presented were collected during the formative research, implementation and post-intervention phases of FAN, and include process outcomes and satisfaction outcomes from participants. The Social Marketing benchmark criteria were operationalized and implemented in the development of the intervention, and used to describe it in the light of Social Marketing (see RQ 1 and 2).

RQ 1. To what extent does the FAN intervention adhere to the eight Social Marketing benchmark criteria?

RQ 2. To what extent does adhering to the Social Marketing benchmark criteria positively affect rates of participation and satisfaction with the intervention?

The study presented in **Chapter III,** "*I did eat my vegetables. Agreement between parent and child food intake diaries*", addresses the challenge of measuring food consumption in children. In this cross-sectional study, the level of agreement between children's and their parents' reporting of the child's food consumption was assessed. The data were collected from children and their parents using the 7-day food diary developed for and used in FAN that allowed listing all the foods and drinks that children consumed at each meal (breakfast, snack in the morning, lunch, snack in the afternoon, dinner, and snack after dinner). This study answers RQ3.

RQ 3. What is the level of agreement between children and their parents in reporting children's food consumption when using a 7-day food diary?

The study presented in **Chapter IV**, "*Let's trust the kids! Children are reliable food reporters*", is an assessment of parent-child agreement when assessing a child's food reporting using a 2-day food record. It compares the level of agreement between children and their parents assessed using the 7-day food diary with the level of agreement assessed when using a 2-day food record. This second instrument was similar to the previous one, but addressed the limitations of the 7-day food diary and was used in the second edition of FAN. The aim was to test whether the 2-day food record was a more appropriate instrument to measure children's food consumption, by comparing the two instruments. The goal was to identify which instrument was more reliable (see RQs 4 and 5).

RQ 4. What is the level of agreement between children and their parents in reporting children's food consumption when using a 2-day food record?

RQ 5. Is a 7-day food diary or a 2-day food record more reliable to collect data about children's food consumption?

Chapter V, "*Does additional support provided through e-mail or SMS in a Web-based Social Marketing program improve children's food consumption? A Randomized Controlled Trial*", focuses on the role of the communication channels (Web-only, Web + e-mail, and Web + SMS) used to deliver the FAN communication to the parents. The effect of the communication channels on children's food consumption was tested using a Randomized Controlled Trial (RCT). The data were collected using pre and post surveys and the 7-day food diaries to assess children's food consumption. The aim of the study was to examine whether the effects of the intervention differed by intervention group, defined by the communication channels used (see RQ 6).

RQ 6. Does additional support sent to parents through e-mail or SMS result in additional behavior change of their child over that of the Web communication only?

Chapter VI, "*e-Health Interventions: is all Engagement Equal in Association with Children's Food Choice?*", examines online and offline measures of engagement in FAN. It also assesses the association of engagement with changes in children's consumption of food from pre- to post-intervention. The data were collected through surveys and a log of accesses stored on the FAN Website server. This study aims to understand whether there is a difference in outcomes when measuring online and offline engagement, and which type of engagement is related to positive behavior change in FAN. This study answers RQs 7 and 8.

RQ 7. Does measuring engagement from an offline point of view lead to different behavioral outcomes than measuring it through objective computer logs?

RQ 8. Which type of engagement is associated with positive behavior change outcomes?

The contribution of this body of research is discussed in **Chapter VII** followed with an overview of the strengths and limitations of the studies. Finally, directions for future research are suggested.

Chapter II

Using Strategic Social Marketing to Promote Healthy Nutrition and Physical Activity Behaviors to Parents and Children in Switzerland: The Development of FAN

Published Manuscript

Rangelov, N., & Suggs, L. S. (2015). Using Strategic Social Marketing to Promote Healthy Nutrition and Physical Activity Behaviors to Parents and Children in Switzerland: The Development of FAN. Cases in Public Health Communication & Marketing, 8, 27–50.

Note: the paper and in particular table numbers have been reformatted to fit the format of this dissertation. The original article is shown in Appendix 1.

Abstract

Background. Poor nutrition and physical inactivity are among the primary determinants of overweight and obesity. Childhood overweight and obesity are the highest in Switzerland's most southern state (Canton Ticino). One policy initiative to address the problem was the "Healthy Weight Program" sponsored by the Ticino Cantonal Department of Health and Social Affairs. The program included several school and community based initiatives, including a community-based, Social Marketing initiative called "Famiglia, Attività fisica, Nutrizione" (FAN).

Methods. This case study presents data collected from the FAN project during the formative research, implementation, and post-intervention phases of a larger randomized controlled trial. Results presented describe the development process of the program in accordance with Social Marketing benchmark criteria, participation and retention rates, and program satisfaction.

Results. The Social Marketing benchmark criteria were operationalized and implemented in the development of FAN. The recruitment goal of 250 families was exceeded, with 555 families enrolled and 543 deemed eligible. Seventy-two percent completed the immediate post-program evaluation questionnaire. Almost 85% of parents evaluated FAN positively. The majority stated that FAN met their expectations (65%), motivated them to eat healthier (60%), and engage in more physical activity (40%). The majority of parents and children were satisfied with the various components of the program and found them useful.

Conclusions. Co-creation activities and following the Social Marketing framework were considered to be instrumental in achieving high levels of consumer participation and satisfaction with this community-based program. The time necessary to do strategic Social Marketing was time well spent.

Keywords: Social Marketing; Body weight; Child; Parents; Health behavior; Physical activity; Nutrition.

2.1 Introduction

Poor nutrition and physical inactivity can contribute to overweight and obesity. In Switzerland, only 19% of the population consumed at least five portions a day of fruit and vegetables (Federal Statistical Office (FSO), 2014), and about 60% was completely inactive or only moderately physically active (one to two times per week) (Federal Office of Public Health (FOPH), 2010; Lamprecht & Stamm, 2012). Children in Switzerland have low fruit and vegetable consumption with roughly 55% of girls and 40% of boys consuming fruit and vegetables daily. Only 26% of girls and 45% of boys engaged in physical activity for more than four hours per week (Lamprecht & Stamm, 2012). Roughly 30% of adults in Switzerland were overweight and 10% were obese, (Federal Statistical Office (FSO), 2014; Lamprecht & Stamm, 2012) and approximately 15% of children were overweight and 5% were obese in 2010-2011 (Lamprecht & Stamm, 2012; OECD, 2011). The southern region of Switzerland (Canton Ticino, the only one of the 26 Swiss cantons or states where Italian is the sole official language) had the highest rates of adult overweight and obesity (39.9% versus 38.9% in the German part and 38.8% in the French part), and of childhood overweight (17%) and obesity (6%) (Aeberli, Ammann, Knabenhans, Molinari, & Zimmermann, 2010; Aeberli, Henschen, Molinari, & Zimmermann, 2010; Observatoire suisse la santé (Obsan) & Dipartimento della sanità e della socialità del Cantone Ticino, 2010; Repubblica e Cantone Ticino, DSS, sezione sanitaria, 2009a). Canton Ticino also had the lowest rates of physical activity in Switzerland, with 48% of the population being inactive (Lamprecht & Stamm, 2012; Repubblica e Cantone Ticino, DSS, sezione sanitaria, 2009b).

Being overweight or obese in childhood increases the likelihood to stay overweight or obese in adulthood, and thus the likelihood to develop chronic diseases (World Health Organization (WHO), 2014). Lifestyle habits developed in childhood are highly correlated with behaviors in adulthood (Krebs et al., 2010; World Health Organization (WHO), 2014). Hence, it is of great importance to focus on behavior change, as well as on maintenance of healthy behaviors in childhood (Bazillier, Verlhiac, Mallet, & Rouëssé, 2011). Famiglia, Attività fisica, Nutrizione (FAN), was a physical activity and healthy diet Social Marketing program for families in Ticino that had children attending

elementary school or the first two grades of middle school (ages 6 to 12). FAN communicated directly with children and parents through print, Web, e-mail, and mobile phones about the importance of healthy eating and physical activity, and ways in which to improve or maintain healthy eating behaviors and physical activity levels. Communications were tailored to the role in the family (parent or child), gender, number of children, child's grade in school, and which behavior (eating or physical activity) each participant perceived to be the most difficult for them (Suggs, McIntyre, Warburton, Henderson, & Howitt, 2015; Suggs, Rangelov, Rangel Garcia, & Aguirre Sanchez, 2013a).

The objectives of FAN were to reach a representative sample ($\geq$ 250 families) of families from diverse social-economic groups across the Canton Ticino, improve or maintain healthy eating and activity behaviors (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a), serve as a communication instigator in the family, and be appreciated by the population. A final objective was to integrate research into a public service by establishing a public-public partnership between the Canton Ticino and the Università della Svizzera italiana.

In this paper, we describe the use of the Social Marketing framework in developing a program for healthy eating and physical activity behaviors of children and parents. We describe participants' satisfaction with the FAN program, participation and retention rates, and we present lessons learned that may assist other planners in developing health programs that reach a large percentage of the population and one that the participants are satisfied with.

2.2 Background

The Ticino Cantonal Department of Health and Social Affairs' "Peso Corporeo Sano" ("Healthy Body Weight") program aimed to raise awareness and provide information about physical activity and nutrition topics, increase awareness about nutrition related policy, and facilitate networking between stakeholders (Repubblica e Cantone Ticino, DSS, Ufficio del medico cantonale, Servizio di promozione e di valutazione sanitaria, 2011). The "Healthy Body Weight" program included several school and

community based initiatives for infants, children, parents, teachers, health care providers, and the general population. FAN was one of the projects offered within the "Healthy Body Weight" program (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a), in collaboration with the BeCHANGE Research Group at the local University, and was the only project that communicated directly with families in the home setting. FAN was offered free of charge to families.

Social Marketing to Improve Physical Activity & Eating Behaviors

Social Marketing "seeks to develop and integrate marketing concepts with other approaches to influence behaviors that benefit individuals and communities for the greater social good" (Tapp et al., 2013). In this recently published definition, the authors also underline that "Social Marketing practice is guided by ethical principles. It seeks to integrate research, best practice, theory, audience and partnership insight, to inform the delivery of competition sensitive and segmented social change programmes that are effective, efficient, equitable and sustainable" (Tapp et al., 2013). The key concepts of Social Marketing are that it is based on Commercial Marketing principles, it focuses on behavior, and aims to enhance the public good, and thus benefit society (Donovan, 2011; French, 2011; Lefebvre, 2011, 2012; McKay-Nesbitt, DeMoranville, & McNally, 2012).

Social Marketing is an effective approach in countering and preventing obesity and overweight (Evans et al., 2010; Stead, Gordon, et al., 2007). Positive results are found in the academic literature and several policy documents, where Social Marketing is highlighted as the recommended approach for promoting physical activity and healthy eating behaviors (World Health Organization, 2008; World Health Organization (WHO), 2011a, 2012). The evidence of its utility has been documented across settings, countries and behaviors (Evans et al., 2010; Gordon et al., 2006; Luca & Suggs, 2012; Stead, Hastings, et al., 2007). Social Marketing programs have positively influenced nutrition and physical activity knowledge and behaviors (Carins & Rundle-Thiele, 2014; Gordon et al., 2006; Stead, Gordon, et al., 2007; Stead, Hastings, et al., 2007), as well as psychosocial variables (attitudes and self-efficacy) (Gordon et al., 2006). Methods used to influence nutrition and physical activity behavior include educational approaches promoting a healthy diet, peer modeling, meetings with dietary consultants, gym classes in the school

curriculum, and the creation of walking and cycling paths (Carins & Rundle-Thiele, 2014; Dobbins, DeCorby, Robeson, Husson, & Tirillis, 2009; Evans et al., 2010; Gordon et al., 2006; Luckner, Moss, & Gericke, 2011; Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Stead, Gordon, et al., 2007). Some interventions have also promoted policy and environmental changes to increase opportunities to be physically active (Evans et al., 2010; Gordon et al., 2006; Michie et al., 2009).

Interventions targeting children that involve parents both in the development and the implementation of the intervention seem to have good outcomes (Davison et al., 2013, 2012). Community-based Social Marketing programs have demonstrated success in changing nutrition and physical activity behaviors as well as in recruitment and retention (Bock, Jarczok, & Litaker, 2014; Evans et al., 2010; Keller et al., 2012; Wolfenden et al., 2014). This study builds off of these previous successes by involving parents and children in the development of the intervention, and setting a first example of such a program in Canton Ticino, Switzerland.

2.3 Methods

Study Design

This case study presents data collected during the formative research, implementation, and post-intervention phase of a larger, randomized controlled trial. The study design is pre-experimental; that is, no pretest to posttest results are presented and there are no comparison or control groups. The results presented are immediately post-intervention only, descriptive, and include a description of how the program was developed in accordance with the Social Marketing benchmark criteria, participation and retention rates, and program satisfaction. The local Ethics Review Committee reviewed the study and deemed it exempt in accordance with Swiss law for research with human subjects.

Sample & Sample Recruitment

This study was conducted in the Canton Ticino, Switzerland, a Canton with one of the highest rates of obesity and overweight among adults and children (Aeberli, Ammann, et al., 2010; Aeberli, Henschen, et al., 2010; Observatoire suisse la santé

(Obsan) & Dipartimento della sanità e della socialità del Cantone Ticino, 2010; Repubblica e Cantone Ticino, DSS, sezione sanitaria, 2009a). The target audience was families of elementary and middle school aged children. However, this was not a school-based intervention. Instead, parents were recruited to participate through schools and other venues, but the program was delivered directly to parents and children in their home environment.

Formative Research Sample and Recruitment. Formative research was done in order to gather information about participants' behavior and preferences related to nutrition and physical activity, insight about their expectations and needs, but also to pretest some of the materials developed. To recruit participants for the interviews and focus groups, the research team contacted a sample of schools in Ticino and published press releases in the local newspapers, inviting parents of children aged 6 to 12 to participate in the formative research, the pretest, and co-creation activities. A total of 12 parents and 13 children responded to the invitation to participate in the pretest activities. Another 14 parents and 25 children agreed to participate in the co-creation activities. Two dieticians, several school directors and teachers, and the Department of Health and Social Affairs also participated in various formative research activities.

Intervention Sample and Recruitment. FAN program recruitment began in May and ended in September of 2010, with September being the period of major effort. The objective was to recruit a sample of at least 250 families from across the Canton Ticino to participate in the intervention, including those who were overweight, healthy weight, and underweight, those who needed to improve behaviors, as well as those who needed to maintain them. Recruitment was conducted through brochures and posters, and media outlets. A total of 488 posters and 19,337 brochures were distributed to schools. Six press releases were developed and one interview was published in the local newspaper and on radio.

All promotional materials provided an Internet link to a Website for registration. In order to register, parents had to complete an online form on the FAN Website, indicating their and their children's personal data (name, last name, gender, date of birth, grade at school), their family's contact information (e-mails, phone numbers, mailing address), as

well as providing parental consent for their family and child to participate. The research team then contacted the families, sent a link to the online baseline survey to parents, and mailed a print version for children to complete. In order to be enrolled, parents had to provide consent and complete the baseline survey; the child's completion of the baseline survey was not a criteria for inclusion.

Six hundred ninety-five families registered for the program and 555 families (80%) completed the enrollment procedures. This included 556 parents (one family had two parents subscribed) and 750 children (Suggs et al., 2013a). After excluding ineligible cases (i.e., families that provided wrong information, enrolled children in kindergarten or in higher grades at school) and those that did not receive the online content because of technical problems (e.g., service providers were not working or other technical issues), the final baseline sample consisted of 543 parents and 735 children. The retention rate was 71.5% for parents and 50.3% for children at the immediate posttest program evaluation interval (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a).

FAN Program Development & Implementation

Program Development. FAN was developed in collaboration with the Department of Health and Social Affairs in Canton Ticino, the BeCHANGE Research Group at the Università della Svizzera italiana, teachers from elementary and middle schools, parents, and children. The program was developed using the Social Marketing framework, which suggests that programs should adhere to a set of eight benchmark criteria, including: 1) citizen orientation, 2) behavior, 3) theory, 4) insight, 5) exchange value, 6) competition, 7) segmentation, and 8) methods mix (Andreasen, 2002; Carins & Rundle-Thiele, 2014; French, 2012; French & Blair-Stevens, 2006; Luca & Suggs, 2012). The benchmark criteria were closely followed during FAN program development and implementation process. A summary of how the eight benchmark criteria were used is illustrated in **Table 2.1**.

Table 2.1 Social Marketing Benchmark Criteria and FAN Process.

Benchmark Criteria	**Definition**	**FAN Implementation**
Customer orientation	Conduct formative research to understand the behaviors, the attitudes and beliefs, wants and perceived needs of the target audience.	• Desk research. • 4 Focus groups and 10 interviews were conducted. • Co-creation activities, including 20 videos. • 26 parents and 38 children were involved. • The program was developed for families' reported needs and wants.
Behavior	Social Marketing interventions focus on a specific behavior, setting specific goals, and measurable objectives.	• Physical activity (goal: improve or maintain PA levels). • Nutrition (goal: increase or maintain fruit and vegetable consumption).
Theory	Theory is used to guide the development of Social Marketing programs. Different theories and models can be used for different interventions, depending on the situation, population, and topic of the intervention. The first benchmark helps the identification of the theory to be used.	• The Theory of Planned Behavior guided the development of the communication content. • Perceived behavioral control, attitudes, social norms and intention were addressed.
Insight	Insight refers to the understanding of the motivators toward a behavior, as well as other elements that influence the behavior of the target audience.	• Formative research (focus groups and interviews, see benchmark 1) allowed understanding Ticino families' motivators and barriers towards adopting or maintaining the desired behaviors.
Exchange Value	Value exchange is about understanding the costs and the benefits associated with the desired behavior. It also includes creation of value for the audience through rewards and incentives.	• Healthy diet and regular physical activity were positioned as achievable behaviors for all and as more beneficial than competing behaviors. • Barriers were addressed. • Benefits were highlighted in the communication.

Competition	Internal and external analysis should be conducted to better understand what competes for the attention, time, and behavior of the target audience, and also to plan properly, in order to reduce the impact of these factors.	• SWOT Analysis was conducted to identify competitive behaviors and barriers (sedentary occupations, lack of facilities, time, unhealthy food promotion, price, etc.). • Competitive behaviors and barriers were analyzed and the communication was designed to help families overcome them.
Segmentation	Identification of the people that share similar characteristics, views, and behaviors is needed to plan and tailor the intervention so that is meets the needs and wants of the target population.	• Parents segmented according to: their gender, behavioral difficulty, number and gender of children, and child's behavioral difficulty. • Children segmented according to gender and grade at school. • Content was tailored to all participants.

Methods mix	Develop the appropriate mix of methods that will influence the behavior. This means the marketing mix, including product, price, place, promotion, partnership, and policy.	• Strategies for all six P's were developed in the marketing mix.
		• Product
		  • Core: better health
		  • Actual: healthy diet and physical activity
		  • Augmented: Website, e-mail, SMS, letters, forum, dietary consultant, video, recipes, etc.
		• Place: home environment
		• Price: non-monetary costs (time and effort); participation free of charge.
		• Promotion: fliers and posters sent to schools; press releases and interviews published in the local media outlets.
		• Policy: FAN was part of the "Healthy Body Weight" cantonal program and was funded as part of a strategic policy decision of the Canton.
		• Partnerships: collaboration among the Canton, the University, the national health promotion office, teachers, dieticians, and the target audience.

Co-creation and desk research guided the program's content. Content was based on materials from other campaigns and interventions promoted by the Canton Ticino and the Swiss national office for health promotion, Health Promotion Switzerland. Letters for children, as well as Website, e-mails, and Short Message Service (SMS) content were developed with parents' and children's input (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a). During the focus groups and interviews, examples of materials were pretested with the target audience. Participants provided oral feedback and suggested ways to improve the materials. Children wrote and drew directly on the letters, indicating what they liked, but also what was not clear to them, and then provided additional feedback verbally.

To illustrate and model behaviors, short videos about physical activity and nutrition were produced with the community. Additionally, graphics portraying a family modeling healthy nutrition and physical activity behaviors were designed specifically to visually represent and complement the communication content. The videos and final graphics were based on the results of the formative research, however they were not pretested. The FAN program content, all text, videos, and graphics were approved by the Department of Health and Social Affairs and Health Promotion Switzerland prior to implementation.

Program Implementation. FAN was offered free of charge to families and the program provided eight weeks of tailored communications designed to help families improve or maintain nutrition and physical activity behaviors. Every week, parents received online, e-mail, and mobile phone-based communications, while children received printed letters sent by post each week (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a). The program intervention lasted eight weeks, between October 2010 and December 2010.

Data Collection & Measures

Formative Research. The formative research was conducted between October 2009 and August 2010. Formative research activities started with desk research that provided evidence about programs that work. A literature review was conducted in order to understand the situation in Ticino regarding physical activity and nutrition behaviors, as well as to collect additional evidence about existing programs in the Canton.

To gather information about the factors influencing dietary and physical activity behaviors, four focus groups were held (two with parents and two with children) with a total of 7 parents and 8 children. Ten structured interviews with 5 parents and 5 children were conducted separately. Two trained moderators led the focus groups and interviews, which were also audiotaped with participant's consent. Both the interviews and the focus groups lasted about one hour each, and consisted of questions related to nutrition and physical activity behaviors and preferences, expectations from a project promoting healthy diet and regular physical activity, as well as to the satisfaction and understanding of a sample of program materials (brand, content, assessments). To enhance our understanding of the audience, the Department of Health and Social Affairs specified information on physical activity and nutrition rates, habits, and needs in Canton Ticino.

Additional formative research activities included co-creation activities with members from the community, including 14 parents, 25 children, teachers, school administrators, dieticians, and students in a masters level course on Social Marketing, who helped to inform the brand, program timeline, data collection instruments, communication content and channels, and message timing. The dieticians provided insight regarding the nutrition related content and recommendations, and the school directors and teachers provided input regarding the content for children.

Post-Implementation Data Collection. As part of the enrollment, baseline surveys were completed between September 13th and September 22nd 2010. Immediately post-intervention, between November 29th and December 5th 2010, follow-up questionnaires were used to evaluate participant satisfaction with the program. Questionnaires were sent online to parents and by mail to children. As an incentive to participate in the follow-up assessments, a lottery was organized at the end of the study, for all participants that completed all assessments.

Satisfaction measures included 19 items, commonly used in measuring satisfaction with Social Marketing and community-based programs, such as "did you like the program?," "was the Website useful?," "would you like to participate again?" These questions were then adapted for this context (Kattelmann et al., 2014; McKenzie, Neiger, & Thackeray, 2013; Neumark-Sztainer, Story, Hannan, & Rex, 2003). Data collected from

parents reflected the following: global satisfaction with the program; how much FAN met participants' expectations; easiness in finding information on the Website; whether FAN motivated parents and their children to practice physical activity and eat healthy; parents' satisfaction with children's letters; parents' satisfaction with the language used in children's letters; usefulness of the Website; usefulness of the forum; usefulness of the video; satisfaction with the videos; satisfaction with the weekly e-mail and SMS messages; usefulness of e-mails and SMS as reminders to visit the Website; likelihood of participating again in FAN; likelihood of participating in similar projects; and other positive and other negative aspects. Data collected from children reflected the following: overall satisfaction with FAN, satisfaction with the letters, satisfaction with the videos, and the likelihood of participating again in FAN.

The data collection instruments were tested with students of the university's Social Marketing course (which included some parents of young children), followed by parents and children from Canton Ticino. Existing questionnaires used in other studies, such as the PACE study, IPAQ short form, and the "Diamoci una Mossa" questionnaire, from the Italian Union Sport for All were used as a starting point (Craig et al., 2003; Lucidi, 2014; Norman, Sallis, & Gaskins, 2005). After issues of format, ease of completion, and wording were addressed with the students in the Social Marketing course, parents and children completed and reviewed the assessment tools and suggested solutions for improvement.

Analysis

The results from the focus groups and interviews, as well as information collected informally (through discussions, phone calls, etc.), were stored and analyzed qualitatively. The research team reviewed the answers provided by the participants (both children and parents), and carefully considered the information provided by the other community members. The information and feedback received was then used to develop the materials for FAN.

Satisfaction measures were collected through an immediate post-intervention follow-up survey. Quantitative data were analyzed with SPSS (IBM SPSS Statistics 21.0), while qualitative data were analyzed with Atlas.ti. Descriptive statistics and frequencies

were performed and included means and percentages for the responding parents and children.

2.4 Results

The process for development of the program using the Social Marketing benchmark criteria is described below, followed by program participant characteristics, motivation, and satisfaction results.

The Social Marketing Framework & FAN

Citizen orientation. To design a project that best suited the needs and the interest of Canton Ticino families, their involvement in the development of FAN was crucial. The brand (name and logo of the project) was developed through brainstorming sessions with the researchers and the target audience. The goal was that the brand would represent the key components and objectives of the program, while being appealing, recognizable, and rememberable by both adults and children. In brainstorming sessions among the researchers at the University and students from the Social Marketing class, terms referring to the key components of the program were developed. Associations were made with terms such as: family, parents, children, healthy nutrition, regular physical activity, health, lifestyle, fun, etc. Several names were chosen and pretested with researchers, stakeholders, and families.

The name that was considered to be the most appropriate, appealing, recognizable, and rememberable was the acronym FAN, which stood for "Famiglia, Attività fisica, Nutrizione" (in English, Family, Physical Activity, Nutrition). The design and development of the logo occurred in a similar fashion. Again, the criteria of appeal, recognition, memorability, and association with the key components were considered. The research team developed logo designs and pretested the options with the target audience.

The timeline for the FAN program was determined based on consensus between participants, partners' requirements, and researchers. Research suggests that similar programs span at least 12 weeks (Fjeldsoe, Neuhaus, Winkler, & Eakin, 2011; Michie et al., 2009; Neve, Morgan, Jones, & Collins, 2010; Sung-Chan, Sung, Zhao, & Brownson, 2013). Stakeholders were hesitant to enroll in a three-month program, due to the perceived

burden and time commitment. They informed us that eight weeks was more reasonable and might allow us to reach more of the target population. Furthermore, a longer program would mean that the program overlapped with winter holidays and may have led to lower participation and retention rates. Thus, FAN spanned a period of eight weeks.

Parents indicated that Internet, e-mail, and SMS were acceptable and preferred channels for this program, as they allowed families to access the program at times most convenient to them. However, parents did not want any communications directed toward children to be online and preferred to have printed materials mailed out for children. They also informed us that they preferred to get new, updated information only once per week, rather than more often. Thus, a weekly thematic scheme was developed, in accordance with nutrition and physical activity recommendations (Swiss Society for Nutrition, WHO) guided by theories of behavior change, and participant input, and new content was added each week (see **Table 2.2**). Once new content was available, parents received an e-mail or a SMS with a brief summary of the content and a prompt to visit the Website, and children received a printed, tailored letter in the mail.

The content was organized according to the FAN weekly themes, and it was adapted to the local community. Parents reported wanting easy access to information about the behavior they were having the most difficulty with. Thus, the content of the Website was divided into two behavior sections: "Attività fisica" (physical activity), and "Nutrizione" (nutrition). Parents wanted to know about ways to improve their own behaviors, but also those of their family, so practical examples relating to both adult and child behavior were included in the weekly content of the nutrition and physical activity sections. Parents who were already eating in a healthy way and/or were practicing an adequate amount of physical activity, asked for more support and encouragement to maintain their behavior. They requested more examples and practical tips (e.g., recipes, concrete physical activities, and events) to be able to maintain their healthy behaviors, but also to encourage their children to do the same. A third section was added and called "Famiglia" (family). This section gave advice on how to introduce and maintain behaviors in the family environment, thus promoting collective family engagement in healthy lifestyle activities. It also reinforced parents' role modeling, and promoted the activities

that were proposed in the forum both from FAN, and from the parents directly, hence including participants ongoing co-creation activities.

Parents also wanted to be able to speak with a dietary consultant about problems in getting their children to eat healthier; hence, a forum with a weekly appointment with a local dietician was implemented on the FAN Website. To address privacy concerns, each parent was assigned a pseudonym and given a unique login ID and password. Parents were also able to contact the dietician via a private message by e-mail. Parents also told us they needed recipes for healthy meals that were quick, inexpensive, and appealing to children. So, we created an online recipe library and suggested specific recipes each week on the Website, as well as in the letters to children.

Table 2.2 Weekly Themes for FAN Content.

Week	Themes for Nutrition	Themes for Physical Activity
1	Chi ben comincia… è a metà dell'opera! *[You are off to a good start and that is half the battle!]*	Chi ben comincia… è a metà dell'opera! *[You are off to a good start and that is half the battle!]*
2	Il ruolo dei genitori *[Modeling behavior]*	Il ruolo dei genitori *[Modeling behavior]*
3	La colazione *[Breakfast]*	Al chiuso o all'aperto, basta fare movimento *[Indoor or outdoor, the important is to practice PA]*
4	Piccoli passi per grandi risultati *[Small steps for big results]*	Da soli o in compagnia, tante occasioni per muoversi *[Alone or together, lots of opportunities to do PA]*
5	Pranzo e merenda con fantasia *[Lunch and snacks with imagination]*	Sani in tutta flessibilità *[Flexibly healthy]*
6	È tutta una questione di strategia *[It is all about strategy]*	È tutta una questione di strategia *[It is all about strategy]*
7	Ogni stagione offre nuove opportunità *[Every season offers new opportunities]*	Piove, piove, la gatta non si muove… ma io sì *[It rains, the cat does not move, but I do]*
8	Non c'è vita senza acqua *[There is no life without water]*	Non c'è vita senza acqua *[There is no life without water]*

Behavior. The behavioral goal of FAN was to encourage initiation, improvements, and/or maintenance of healthy nutrition and adequate amounts of physical activity. In particular, the focus of FAN was to promote the recommended amount of physical activity each day and to encourage adherence to nutrition guidelines, in particular regarding fruit and vegetable consumption, sugar and fat consumption, as well as water consumption.

Theory. FAN content was informed by the Theory of Planned Behavior (TPB) (Ajzen, 1991). TPB suggests that perceived behavioral control, attitudes, and subjective norms predict intentions to engage in a specific behavior, and intentions, in turn, predict behavior. These concepts were considered for the framing of the communication content delivered weekly to parents and children. To address and increase perceived behavioral control, the content included suggestions on how to cope with barriers (such as time, weather, prices, and difficulty). The content also reinforced positive behaviors.

In order to positively influence attitudes, ideas about ways to eat healthy and practice regular physical activity were suggested, highlighting the benefits and positive aspects (such as having fun, being with the family, improve health, and many others). To promote positive subjective norms towards healthy eating and regular physical activity, parents were encouraged to model healthy behaviors and to explicitly encourage their child to engage in these behaviors. Communications reinforced healthy behaviors as being the norm, and thus expected behavior. Finally, to improve behavioral intentions, strategies were suggested for planning behaviors, such as scheduling physical activity, preparing shopping lists, and preparing for difficult and/or unexpected situations (i.e., seasonal variability of fruits and vegetables, rainy and snowy weather).

Insight. During the focus groups and interviews, barriers such as time, costs, or efforts, and motivators such as the health of their children, physical and mental fitness, were also gathered. Program content was developed to address perceived barriers. The information on the Website, the e-mails, the SMS, and the letters provided suggestions of ways to better cope with barriers, but also to reduce perceptions that these factors were hindering healthy behaviors. In the weekly communications, FAN underlined the motives that parents expressed as being important, such as the health of their children, their own

health, weight control, wellness post-workout, feelings of wellbeing after a healthy meal, being a role model for their children, dedicating time to the family, and many others.

Exchange value. According to Sutton and colleagues "Creating & maintaining 'fair exchanges' is the heart of marketing" (Sutton, Balch, & Lefebvre, 1995). To convey the message that following a healthy diet and practicing regular physical activity are fair exchanges for competing time demands and behaviors, the program positioned healthy diet and regular physical activity as achievable behaviors for all, and as more beneficial than competing behaviors. Ideas were also provided about ways to introduce behavior change in a feasible manner by taking small steps, selecting affordable options, and using time management techniques.

Competition. A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was conducted, to identify competitive behaviors and barriers to adopting or maintaining a healthy diet and regular physical activity. Competitors to regular physical activity included sedentary occupations, computer use, television watching, time spent sitting at work or school, lack of sport facilities, public transportation fees, and time. Competition to eating a healthy diet included the temptation of unhealthy food promoted in grocery shops, on TV, billboards, or packages for children, the high price of healthy food options, and lack of time to prepare healthy dishes that appealed to the whole family.

Segmentation. The content of FAN was designed for several target audience segments, including mothers, fathers, and children in elementary school and the first two grades of middle school. Within the child segment, further segmentation included the child's gender and grade level. With assistance from a schoolteacher, content was targeted for cognitive skills and reading level (such as vocabulary, number of words, font type and size, graphics, and videos). Furthermore, communication was gender-specific because of Italian grammar rules for addressing the gender of the child by using appropriate endings as shown in the following example (e.g., "Ciao Maria, sei andata al parco?" vs. "Ciao Mario, sei andato al parco?"; "Hello Maria/Mario, did you go to the park?"). Parents were segmented according to their gender, which behaviors were most difficult for them to perform (i.e., physical activity, diet or both), the number of children, gender of children,

and their child's behavioral difficulty (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a). Examples of messages for the different segments are shown in **Table 2.3**.

Table 2.3 Examples of Tailored Messages.

Segmentation and tailoring variables	**Message**	**Message translated into English**
Mother (difficulty = physical activity), with 1 boy (difficulty = diet)	"*Gentile Signora Rossi*, andare al lavoro a piedi è un ottimo modo per aggiungere un po' di attività nella sua quotidianità! Quando prepara la merenda per *suo figlio*, pensi ai diversi tipi di frutta che *gli* può proporre."	"*Dear Mrs. Rossi*, walking to work is a great way to add some physical activity in your everyday life! When you prepare the afternoon snack for *your son*, think about the different fruits you can propose to *him*"
Mother (difficulty = physical activity), with 1 girl (difficulty = diet)	"*Gentile Signora Rossi*, andare al lavoro a piedi è un ottimo modo per aggiungere un po' di attività nella sua quotidianità! Quando prepara la merenda per *sua figlia*, pensi ai diversi tipi di frutta che *le* può proporre."	"*Dear Mrs. Rossi*, walking to work is a great way to add some physical activity in your everyday life! When you prepare the afternoon snack for *your daughter*, think about the different fruits you can propose to *her*"
Mother (difficulty = diet), with 2 girls (difficulty = physical activity)	"*Gentile Signora Bianchi*, non si dimentichi di consumare frutta e verdure in abbondanza! Se le *sue figlie* non hanno voglia di fare attività fisica, *le* stimoli accompagnandole a fare un percorso vitae."	"*Dear Mrs. Bianchi*, do not forget to eat enough fruits and vegetables! If *your daughters* do not want to practice physical activity, encourage *them* by going with *them* to do a trail run"

Methods' mix. FAN addressed all six P's of the Social Marketing mix: product, place, price, promotion, partnership, and policy.

Product. FAN used the full product platform with three levels of product: core, actual, and augmented. The core product of FAN was better health. The actual product was practicing physical activity for at least 30 minutes per day for adults and for at least 60 minutes per day for children, and to consume a healthy diet, which included eating five portions of fruit and vegetable per day. FAN also promoted having breakfast every day, drinking the recommended amount of water, getting some warm up before physical activities and stretching at the end of it. FAN provided several augmented products,

including a Website, short messaging service (SMS), e-mails, and letters, each designed to support the actual product.

The Website supported behavior improvement and maintenance within the whole family. Every week, a new theme for nutrition and for physical activity were introduced. A forum feature was available for parents, where they could discuss concerns or strategies that worked well for them. Recipes and practical examples for healthy menus, and physical activity were also provided. A dietary consultant was available for parents, and reachable through the forum or via private message. Videos were included, that promoted healthy behaviors and provided suggestions for implementation. Further, to remind the participants about the new, weekly updated content, tailored prompts were sent via SMS and e-mail, directing families to the Website. Tailored letters were sent directly to children each week, to support the core product.

Place. FAN was a community-based intervention that complemented and reinforced other interventions of the "Healthy Body Weight" cantonal program that took place at schools, in canteens and restaurants, and households. FAN specifically targeted the home environment.

Price. The costs to participants were primarily of a non-monetary nature. No participation fee was charged. An investment in time and effort was needed to read the provided content, complete the assessments, as well as to practice physical activity and prepare healthy meals. FAN tried to minimize the non-monetary costs of adopting the actual product, for example by providing short communication, and suggestions on better time management.

Promotion. To maximize reach, FAN was promoted through the schools, and the media. Teachers sent fliers home to every child in the school, and several articles and radio interviews were published in local media outlets.

Policy. FAN was funded as part of a strategic policy decision of the Canton Ticino. The "Healthy Body Weight" cantonal program included 11 healthy diet and physical activity promotion projects, including FAN (Repubblica e Cantone Ticino, DSS, Ufficio del medico cantonale, Servizio di promozione e di valutazione sanitaria, 2011).

Partnership. FAN was developed in a collaborative partnership between the Canton Ticino, the University, the national health promotion office, teachers, dieticians, and the target audience. The co-creation activities previously described, reinforced and strengthened partnerships among parties.

FAN Program Participant Characteristics & Satisfaction

Participant characteristics. The majority of adult participants were women (86.2%) and of Swiss nationality (84.9%). The mean age was 41 years (range = 27 to 61, SD = 5.09). The weight distribution of adult participants included 6.3% obese, 21.5% overweight, 65.0% healthy weight, and 5.3 % underweight, with a mean BMI of 23.4 (SD = 4.13). Male and female children were equally represented in the sample. The majority of children (83.5%) were attending elementary school, while the rest attended secondary school. The mean age was 8.5 years of age. Almost all participants (95.8%) heard about FAN through the brochures distributed in schools. Some participants heard about FAN through an online newspaper (1.5%), through the University Website (0.7%), through a search engine (0.4%), or through a local newspaper (0.4%). The rest heard about FAN through word-of-mouth, parents meetings and other sources.

Participant satisfaction. **Table 2.4** and

Table 2.5 summarize participants' satisfaction with the program. The majority of parents who completed the immediate post-intervention questionnaire were "positive" or "very positive" about the FAN program (83.7%) (Suggs et al., 2013a). Sixty-five percent agreed that the project met their family's expectations and 74.4% said that it was easy to find the information they needed on the FAN Website. Some 42.3% of parents stated that FAN motivated them to practice more physical activity, and 60.1% of parents said FAN motivated them to eat in a healthier way. Parents also reported that FAN motivated their children to eat healthier foods (58.0%) and engage in physical activity (42.8%). Many parents (86.7%) also expressed interest in nutrition, physical activity, and other health-related programs delivered using similar Information and Communication Technologies (ICTs) in the future.

With regard to specific FAN components, most parents (81.0%) were satisfied with the letters sent to the children and most children (83.1%) liked them as well; 98.4%

of parents stated that the language used in the letters was "adequate" for their children. The majority of the parents stated that the Website (78.8%) and the forum (65.9%) were "very" or "quite" useful. Ninety-four percent of parents liked the videos, and nearly as many (91.6%) stated that the videos were useful. The majority of parents liked receiving the FAN e-mails (85.2%) and the SMS messages (84.8%). Most parents (87.3%) also found the e-mail reminders to visit the Website useful, but slightly fewer (71.2%) thought the SMS reminders were useful.

Sixty-eight percent of children stated that they liked the FAN program, while 26.8% said that they liked it "so-so." Most children (64.5%) liked the videos shown on the Website (15.7% answered "so-so" and 19.8% said "no"). More children (68.0%) than parents (41.1%) expressed interest in participating again in FAN (**Table 2.4** and

Table 2.5).

Among the different reasons for satisfaction, promoting health, and in particular physical activity and nutrition, was of major importance for parents. Moreover, the innovative use of ICTs in Canton Ticino was perceived as fundamental in meeting busy parents' needs. Participants also appreciated the structure, regularity, and punctuality of FAN. Some parents stated that they felt cared about, and liked this feeling. Furthermore, they liked the topics and the content both online and in print. Parents particularly appreciated the direct contact of FAN with their children, through the weekly letters. They stated that FAN provided an external source of education and encouragement that was consistent with what they wanted their children to learn and do.

The main reason for dissatisfaction was the burden of the questionnaires, in particular the children's surveys that, despite being tested with the audience, were still perceived as being too long to complete. Some parents also stated that they were unable to exactly express their opinion in the questionnaires, as many were close-ended questions. Another reason for dissatisfaction among some parents and children was the use of a cursive font style for children in fourth and fifth grade (Suggs et al., 2013a). While using the cursive font style was common in school, children had some difficulties in reading the font typeface chosen for FAN. Some families found FAN too theoretical, and wished for even more practical examples. Finally, parents stated that often the problem was not the

program materials, content, or requested activities specifically, but their lack of time to read all FAN content, and put into practice the advice that was given.

Table 2.4 Parents' Satisfaction with FAN (n = 389).

	%
Overall perceptions of the FAN program	
Very Positive	17.7%
Positive	66.0%
Not positive nor negative	16.1%
Negative	0.3%
Specific perceptions of the FAN program	
Met family expectations	64.9%
Easy to find information Website	74.4%
Motivated adult to PA	42.3%
Motivated adult to eat healthy	60.1%
Motivated child to PA	42.8%
Motivated child to eat healthy	58.0%
Satisfaction with the letters to children	
Very satisfied	40.9%
Quite satisfied	40.1%
Neither satisfied nor unsatisfied	13.6%
Quite unsatisfied	4.1%
Very unsatisfied	1.4%
Language in letters to child was adequate	
Yes	98.4%
No	1.6%
Usefulness of the Website	
Yes, it was very useful	18.4%
Yes, it was useful	60.4%
No, it was not useful	21.2%
Usefulness of the forum	
Yes, it was very useful	15.3%
Yes, it was useful	50.6%
No, it was not useful	34.1%
Liked the videos	
Yes	94.0%
No	6.0%
Usefulness of the videos	
Yes	91.6%
No	8.4%
Liked the e-mails	
Yes	85.2%
No	3.7%
I never received the e-mails	11.1%
Usefulness of the e-mails	
Yes, I visited the Website immediately	32.0%
Yes, I visited the Website later	55.3%
No	12.6%

Liked the SMS	
Yes	84.8%
No	12.8%
I never received the SMS	2.4%
Usefulness of the SMS	
Yes, I visited the Website immediately	12.8%
Yes, I visited the Website later	58.4%
No	28.8%
Interest in participating in FAN again[a]	
Yes, for sure	41.1%
I do not know	41.3%
It depends…	9.1%
No, I am not interested	6.5%
Interest in another similar project	
Yes, about nutrition and physical activity	39.8%
Yes, about nutrition only	6.6%
Yes, about physical activity only	1.7%
Yes, about other themes	38.6%
No	13.3%

[a]Those saying "it depends" provided reasons why they would participate in FAN; 2% (not shown) said "Other."

Table 2.5 Children's Satisfaction with FAN (n = 370).

	%
Liked the FAN program?	
Yes	67.6%
So-so	26.8%
No	5.6%
Liked the letters?	
Yes	83.1%
So-so	10.7%
No	6.2%
Liked the videos?	
Yes	64.5%
So-so	15.7%
No	19.8%
Interested in participating in FAN again?	
Yes	68.0%
No	32.0%

2.5 Discussion

Key Findings

The Ticino community was involved in most of the aspects of the development of FAN. Following the recommended Social Marketing framework and co-creation activities facilitated community involvement, high participation and retention rates, and high levels of satisfaction with the program (Carins & Rundle-Thiele, 2014; Kattelmann et al., 2014). By being customer-oriented and examining insights, the research team was better able to understand the target audience. During the formative research, families from the target audience contributed by emphasizing what their needs, expectations, and actual behaviors were, complementing the desk literature research previously conducted. This allowed for a deeper understanding of the target audience and the creation of a program that was best adapted to the participants. Not only did families participate in the development of FAN, but teachers and other stakeholders provided feedback, which further contributed to our understanding of the target audience and their needs. This resulted in a program that was adapted to the real and perceived needs of participants. Focusing on the behavioral difficulty perceptions of participants allowed for the development of a communication strategy that was relevant to them. Adhering to the whole marketing mix increased the opportunities of creating a successful program. For instance, the decision to deliver the content of FAN through ICTs and not through face-to-face meetings was a key finding of the formative research. Parents stated they wanted to know more about healthy nutrition and physical activity, but did not have the time to participate in meetings. Hence, we provided them with an online intervention that reached them when and where it was most convenient for them.

This was possible in Switzerland, where the use of ICTs was high. Indeed, Switzerland ranked 7th in international comparisons of home Internet access, with 85% of households having Internet access in 2010 (Federal Statistical Office (FSO), 2011a). In 2010, the Internet was used regularly by 40% of people with an income of less than 4’000 CHF per month (NET-metrix, 2011), the medium salary being 4’983 CHF per month. Regarding mobile phones, the penetration rate was 120 subscriptions per 100 inhabitants (Federal Statistical Office (FSO), 2011b). Although using ICTs for promoting health was

quite new, looking for health information ranked 4th among the different reasons for using the Internet (e.g., communication through e-mail, news reading, interaction with public administration, shopping, movies, etc.) (Federal Statistical Office (FSO), 2010). That said, it is possible that these data were slightly overinflated, as they measured subscriptions, and not the number of cellphones used or unique users. Indeed it could be that people have more than one subscription, but do not use more than one at a time, or on the contrary that they use more than one phone at a time, as well as they could share their phone with another family member, for example.

Most parents and children expressed satisfaction with the FAN program and the various program components, and found them to be useful. Many parents said that FAN served as motivator for them and for their children to eat healthier. Some parents stated that FAN motivated them and their children to be physically active. Reasons for satisfaction varied, but all comments highlighted the importance of creating a program that suited both the needs and the wants of the target audience. Listening to the families allowed us to create such a program, one that was thus appealing to them. Even when expressing their dissatisfaction, parents and children were providing insightful and constructive feedback and suggestions on how to improve FAN (i.e., use the e-mail and SMS as content-delivery channels, rather than just as a reminder, or decreasing the amount of information delivered per week, so that they would have more time to process it). The uniqueness of FAN, coupled with an in-depth analysis of the target audience, involving parents and children in the process of developing the program, contributed to its success.

The recruitment goal of 250 families was far exceeded, with more than 500 parents and more than 700 children taking part (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a). Furthermore, retention rates in the program and assessment completion immediately post-intervention (over 70% for parents and 50% for children) (Suggs, McIntyre, et al., 2015; Suggs et al., 2013a) were comparable with or higher than other similar studies (Fjeldsoe et al., 2011; Keller et al., 2012; Neville, O'Hara, & Milat, 2009; Suggs, McIntyre, et al., 2015). This can be attributed, at least partially, to the formative research and the co-creation activities conducted in the development phase of FAN.

Lessons Learned

Developing successful Social Marketing campaigns requires ample preparation time, and this was time well spent. Program developers need to be flexible, and able to consolidate scientific evidence with the real and perceived needs of the target population, and other stakeholders (Strolla, Gans, & Risica, 2006; Thompson, Cullen, Boushey, & Konzelmann, 2012). In the case of FAN, a two-month intervention, roughly ten months were dedicated to program planning and development. Furthermore, based on existing scientific evidence, programs with similar objectives have typically been implemented for at least three months in duration (Fjeldsoe et al., 2011; Michie et al., 2009; Neve et al., 2010; Sung-Chan et al., 2013). However, two months were selected as a compromise between establishing a program based upon a customer orientation and best practice (Golley et al., 2011).

Another lesson learned from FAN was that social marketers and program planners need to keep their eyes and their ears always open. While formative research was conducted with the target population and other stakeholders, valuable input was also provided to the research team in an ongoing manner throughout the program implementation phase. Such feedback was incorporated into the program when possible and appropriate. For example, families requested that FAN include recipes that children could prepare in the weekly letters addressed to children, which was a recommendation that was adopted mid-program implementation.

Immediate post-study results also provide insights that can be incorporated into future program revisions. As the results showed, overall, FAN met participants' expectations. For example, looking at the usefulness of both e-mail and SMS reminders, it can be noted that they did function as reminders to visit the FAN Website. From the results, it appears that most parents visited the Website later, when they had time. Hence, this appeared to be in sync with the objectives of FAN, as being accessible whenever and wherever parents preferred.

Nonetheless, improvements to program components and the promotion of the program should be made based upon posttest debriefing assessments to better understand participant experiences, as reported in survey findings. Increasing the participation in co-

creation activities, both initially, during, and in post-program debriefings, would likely result in a program that is liked even more by the population and may be more effective in the long term.

Limitations

The development of FAN was not without challenges. FAN was developed in a State where several other programs with similar aims, but separately targeting adults or children existed. Resources were scarce, which resulted in limited human resources working on the development of FAN, with high workloads and long working hours for relatively few people. This necessitated the scaling back of some of the initial plans for FAN (e.g., Website features, for which a higher-level programmer was needed) (Suggs et al., 2013a). Recruiting a larger sample for the pre-testing phase would have provided further insight on the development of FAN and the materials used, which could have limited some of the dissatisfaction expressed by some parents and children (Suggs et al., 2013a). Furthermore, it is plausible that some participants were involved in one or more of the other cantonal programs, which could have influenced their satisfaction with or expectations from FAN. Finally, while we would expect little variation in the interpretation of our measures of program satisfaction, we did not test the validity of these items in this study. And, although we did measure changes in behavior over time as part of the larger trial, the findings included in this paper were limited to participant perceptions of the program, satisfaction with various components, and motivation to make behavioral changes. Having included behavioral measures certainly might have helped to verify the self-reported changes in motivation for engaging in physical activity and healthier eating, however that was not the intent of this paper.

Implications for Research & Practice

Previous studies suggested that using a Social Marketing approach to develop programs promoting healthy diet and physical activity behavior can be effective (Evans et al., 2010; Stead, Gordon, et al., 2007; World Health Organization, 2008; World Health Organization (WHO), 2011a, 2012). Our study highlighted the importance of the formative research and the co-creation activities. By listening to and understanding the needs of the target audience, the research team developed a program that reached high

participation, retention, and satisfaction rates. The FAN case study also showed the importance of establishing good partnerships with stakeholders, seen for example through the promotion activity that took place through the schools.

Future projects aimed to promote dietary and physical activity behaviors for families, should use the Social Marketing framework. The development of such programs should be described in detail and shared among practitioners and researchers, in order to clarify exactly what was done and create further evidence of best practice. Program developers should also devote enough time and effort during the formative research phase, in order to create programs that are customer oriented, and are better able to incorporate or adapt scientific evidence to the needs of the target audience, in order to increase likelihood of success.

Conclusions

Social Marketing was a useful framework that provided guidance for designing a community-based healthy diet and physical activity promotion program for families. Addressing each of the eight consistency criteria allowed us to fully consider factors that helped us reach the population with a program that parents and children were willing to participate in and were ultimately very satisfied with. Elements of FAN success were the co-creation activities conducted with the population and the decision to address the family environment, by delivering the product to each member (parents and children). Hence, we recommend that community health promotion programs adopt the aforementioned Social Marketing framework.

2.6 Acknowledgements

Funding/Support: FAN was funded by the Health Promotion and Evaluation Service, of the Cantonal Doctor's Office, in the Department of Health and Social Affairs of Canton Ticino (Servizio di promozione e di valutazione sanitaria, Ufficio del medico cantonale, Dipartimento della sanità e della socialità, Repubblica e Cantone Ticino) and Health Promotion Switzerland (Promotion Sante Suisse) as part of the Canton Ticino "Healthy Body Weight" ("Peso Corporeo Sano") program. The materials and content

expressed herein are those of the authors and do not necessarily reflect the official views of the funding agencies.

Additional Contributions: The authors thank the following individuals and agencies for their invaluable contributions to the FAN project: Health Promotion Switzerland; Antonella Branchi, Alessia Antonietti, and Rubina Bianchetti at the Health Promotion and Evaluation Service, Cantonal Doctor's Office, in the Department of Health and Social Affairs of Canton Ticino (Servizio di promozione e di valutazione sanitaria, Ufficio del medico cantonale, Dipartimento della sanità e della socialità, Repubblica e Cantone Ticino); the Offices of Primary and Middle School Education, in the Department of Education, Culture and Sports of Canton Ticino (Ufficio delle scuole comunali e Ufficio dell'insegnamento medio, Dipartimento dell'educazione, della cultura e dello sport, Repubblica e Cantone Ticino); the dieticians, teachers, and school directors who contributed to the program development and recruitment; and all the parents and children who participated in the formative research and in the FAN program intervention.

Chapter III

I did eat my Vegetables. Agreement between Parent and Child Food Intake Diaries

Published Manuscript

Rangelov, N., Suggs, L. S., & Marques-Vidal, P. (2016). I did eat my vegetables. Agreement between parent and child food intake diaries. Public Health Nutrition, 19(17), 3106–3113. https://doi.org/10.1017/S1368980016001488

Note: the paper and in particular table and figure numbers have been reformatted to fit the format of this dissertation. The original article was published in British English. The original article can be found in Appendix 2.

Abstract

Objective. To assess the level of agreement between children and their parents when reporting a child's food consumption.

Design. Cross-sectional study in which children and parents independently completed 7 d food diaries describing the foods and drinks the child consumed at every meal and snack. The association between child and parent reporting was assessed for nineteen food groups using Kendall's tau-b non-parametric correlations, Spearman's rank correlations, kappa coefficients and Lin's concordance measure of agreement. Results were also stratified by gender of the child and his/her grade at school.

Setting. Households in Ticino, Switzerland, April–June 2014.

Subjects. Two hundred and ninety-nine children aged 6–12 years and one of their parents participated, with 264 providing complete data (35% completion rate).

Results. Results showed a high level of agreement between child and parent reporting. Spearman correlations ranged from 0.55 (sauces) and 0.57 (fatty meat) to 0.80 (fruit), 0.83 (starchy foods) and 0.84 (pastries). All nineteen Spearman correlations were significant at the 0.001 level. Kendall's tau-b correlations ranged from 0.44 (fat meat) to 0.81 (puff pastry). Kappa values showed low to high levels of agreement, ranging from 0.15 (sweets) to 0.77 (puff pastry). Lin's concordance correlation coefficients ranged from 0.39 (whole grains) to 0.86 (puff pastry).

Conclusions. When assessing the eating behavior of children using a 7 d food diary, children's reports might be as reliable as their parents'.

Keywords: Dietary Assessment; Food Record; Food Consumption; Children; Switzerland.

3.1 Introduction

Childhood eating behaviors establish lifelong eating habits. Poor eating behavior in childhood is a risk factor for overweight and obesity, cancer, type 2 diabetes and many other non-communicable conditions in adulthood (The et al., 2010). Yet, measuring children's eating behavior is riddled with challenges stemming from accuracy in recall, correct portion sizes, observation effects and participant burden (Kolodziejczyk et al., 2012; Livingstone & Robson, 2000; Livingstone et al., 2004; R. J. Martin & Collins, 2010; McPherson et al., 2000).

Eating habits of children and adults are most commonly measured using FFQ, food diaries and 24 h recall methods (Kolodziejczyk et al., 2012). While there are many variations, adults are often asked to indicate, from a list of items, the frequency of those foods consumed over the past 6 or 12 months. FFQ are most appropriate for epidemiological studies with large samples as they can help identify risk factors for disease and dietary patterns. Still, FFQ are limited by the variety of food items listed, accuracy in food consumption recall and the ability to accurately capture mixed foods (i.e. lasagne) (Johnson, 2002; Johnson-Taylor & Everhart, 2006).

Food diaries are thought to increase accuracy of reporting as they are completed daily. They are typically recommended for a motivated population, due to the burden of completing them (Collins et al., 2010; Kolodziejczyk et al., 2012). However, some literature reports inaccuracies when comparing food records with biomarkers and suggest using a mix of assessment methods to collect more precise food intake data (Bokhof et al., 2012; Kolodziejczyk et al., 2012; R. J. Martin & Collins, 2010). Twenty-four hour recall methods are brief and easy to administer, but do not allow for a description of a 'typical diet' as they represent a single day (Johnson, 2002; Johnson-Taylor & Everhart, 2006). A study conducted in a sample of university students found that food diaries and 24 h recalls captured different information (Frankenfeld, Poudrier, Waters, Gillevet, & Xu, 2012). Another study found overall weaker associations of parent–child diet similarity when using FFQ than with food diaries (Wang, Beydoun, Li, Liu, & Moreno, 2011).

Children can face difficulty in recalling the foods that they consumed when the time gap between reporting and food consumption is long (Baranowski & Domel, 1994;

Collins et al., 2010; Kolodziejczyk et al., 2012; Thiagarajah et al., 2008). Additionally, in the age range from 6 to 10 years, their reading abilities can differ extensively and portion size estimation represents a common challenge (Collins et al., 2010; Kolodziejczyk et al., 2012; Spook et al., 2013; Thiagarajah et al., 2008). While direct observation and clinical measures can serve as indicators of food consumption, they are not always feasible for public health practice and research. Hence, we are left with a conundrum on effective and efficient ways to measure children's food consumption outside controlled settings. One possible solution could be to ask children to report it directly, but little is known regarding their ability to accurately complete a food diary. There is also some disagreement on whether children or their parents should provide the information (Collins et al., 2010; Kolodziejczyk et al., 2012). A review of studies assessing the validity of child/adolescent FFQ compared with biomarkers and/or other assessment method (i.e. 24 h recall) showed that studies where the FFQ were completed by the parents instead of children, and studies where FFQ were completed by children assisted by their parents or teacher, had weak to moderate validity (Kolodziejczyk et al., 2012).

Studies measuring agreement between children and parents outside the food consumption domain show that children and parents often differ in their reporting of food insecurity (Fram, Frongillo, Draper, & Fishbein, 2013), health-related quality of life (Lim, Velozo, & Bendixen, 2014) and engagement in physical activity by children with disabilities (McDougall, Bedell, & Wright, 2013). These studies suggest that parents are not always aware of children's precise attitudes and perceptions about their own health and health behaviors. As food consumption reporting may be less susceptible to perceptions, assuming portion sizes are not the object of measurement, we hypothesize that children and parents may both be able to report in an accurate way what a child eats, especially when the child eats in the presence of the parent. Hence, the purpose of the present paper was to assess the level of agreement between children and their parents when reporting a child's food consumption over a 7 d period using a food diary. A second aim was to assess the level of agreement between children and their parents according to children's gender and grade in school. As there is currently no validated measure for eating behavior of children in Switzerland, a new instrument was developed.

3.2 Methods

Study Setting and Sampling

A cross-sectional study with children attending elementary and middle schools (aged 6–12 years) and one of their parents was conducted between April and June 2014. To be included, families (parent–child dyads) had to live in Ticino, Switzerland, and be able to complete the study in Italian. The Cantonal Department of Education, Culture and Sport (DECS) agreed to the study and identified four elementary schools and four middle schools that were representative of schools in Ticino. Directors of these schools were contacted and they agreed to include their school in the project. The directors recruited teachers and asked them to invite every child in their class, along with their parents, to participate in the study. They sent a package to each child–parent dyad that contained a letter describing the study, a consent form to be signed by the child's parent, two copies of the weekly food diary, a short questionnaire, and instructions with an example of how to complete the diary. Teachers also provided oral instructions to children on how to complete the diary and collected them at the end of the week of completion. The diaries were then sent back to the research team at the university.

The Ethics Committee of Canton Ticino reviewed the study and judged it exempt from full review. In accordance with the Helsinki Declaration, participants were fully informed of the study purpose and all parents provided their written informed consent before participating.

Questionnaires and Data Collected

The questionnaire collected the age and gender of the parent and the child, height and weight of the child, and the child's class at school. Children and parents separately completed a daily diary of foods and beverages the child consumed at breakfast, lunch and dinner, and during snack breaks (morning, afternoon and after dinner), every day for seven consecutive days. In Ticino, school lunches are not provided in most schools and the majority of children go home for lunch. As such, most meals were consumed primarily at home, excluding the morning snack, and parents were present during most of their child's meals. For each meal and snack time, the participant wrote exactly what the child ate in an open form text box on paper. No portion size was asked for given the known challenges

of accurate reporting and that assessing portion size does not necessarily increase validity (Kolodziejczyk et al., 2012). Consistent with studies which suggest that children younger than 8 years of age face difficulties in estimating portions, and studies that found weak to moderate correlations when portions were assessed with children younger than 12 years of age (Kolodziejczyk et al., 2012; Michels et al., 2008; Neuhouser, Lilley, Lund, & Johnson, 2009; Thiagarajah et al., 2008), our study did not measure portion sizes.

Two versions of the food diary were used: one for elementary-school children and one for middle-school children. The versions differed only in the size of font and the space allowed for data entry. Middle-school children used a one-page diary for the full week, whereas children in elementary school reported each day on a separate page (see online supplementary material, **Supplementary Figure 3.1** and **Supplementary Figure 3.2**). Parents were asked to not help the children recall what they ate and to help their children only if they needed assistance in understanding what the diary asked them to do and where to write their answers. Parents and children were asked to write *'*I do not know*'* when they did not know or did not remember what was consumed. The importance of honest information and completing the diary after each meal and snack was stressed.

Once the data were collected, three researchers independently coded the diaries. First, the food items were divided in groups according to the Swiss food pyramid (Swiss Society for Nutrition, 2015). A dietitian helped to develop subgroups of food items and mixed foods. A second coder then double-checked a random sample of food diaries. Food groups are shown in the online supplementary material, **Supplementary Table 3.1**. Food items were coded as dichotomous variables for each day and each meal (0 = did not eat a food from that (sub) group; 1 = did eat a food from that (sub)group).

Statistical Analysis

Statistical analyses were conducted using the statistical software package IBM SPSS Statistics Version 21.0. Descriptive results were expressed as number and frequency of participants for categorical variables and as range or mean and standard deviation for continuous variables. The weekly proportion of eating a certain food was computed for nineteen food groups consumed, using the total count (range 0–42 times per week) of each group consumed in a week and dividing it by the number of completed entries in a week

(range 0–7 d completed). Given that the number of meal occasions in which parents or children wrote *'I do not know'* was very low, these data were coded and treated as missing data. The analyses in the present study were performed only among children-parents pairs that completed the diary for all seven days.

Associations between children's and parents' results were assessed using Spearman's non-parametric correlations (ρ), Lin's level of agreement statistics and Kendall's tau-b (τB) non-parametric correlations. Spearman's rank correlations were used to test order and to compare with the results of the literature; ρ values between 0.10 and 0.29 indicate a small correlation, between 0.30 and 0.49 a medium correlation, and between 0.50 and 1.00 a large correlation (Cohen, 1988). Lin's statistics were used to test how well the two sets fit a 45° line. As the algorithm assessing Spearman's correlation in IBM SPSS Statistics did not take into account tied values, Kendall's τB correlations were computed, using the same methodology as Spearman's correlations, as they are appropriate to use with tied data (M. G. Kendall & Gibbons, 1990).

Consistent with Thiagarajah et al.'s validation study of a food intake questionnaire (Thiagarajah et al., 2008), Cohen's kappa (κ) was used to test the agreement between children's and parents' reporting of weekly consumption occasions. The lower bound of the 95% CI of the κ estimate was used to categorize agreement and the same categorization of κ values as performed by Thiagarajah et al. (Thiagarajah et al., 2008) was applied (Munoz & Bangdiwala, 1997) to allow comparison. Thus, κ values between 0.20 and 0.45 indicate moderate agreement, κ values higher than 0.45 and lower than 0.75 indicate substantial agreement, and κ values equal to or higher than 0.75 indicate very good agreement (Munoz & Bangdiwala, 1997; Thiagarajah et al., 2008). Finally, the level of agreement between children and their parents was analyzed stratifying by gender and grade in school. Although no test was conducted to compare ρ values by gender or school grade, the 95% CI of the κ estimates are provided to allow for a *'side by side'* comparison.

3.3 Results

Sample Characteristics

Of the 745 children invited to participate by the teachers in eight classrooms, 299 consent forms, food diary pairs and questionnaires were returned to the research team (40% participation rate). After excluding children-parent pairs that did not complete the diaries for all seven days, a total of 264 children and parent pairs were included in the analysis (35% of the families invited, 88% of the consenting parents). Fifty-two per cent of children were female and their age ranged between 7 and 14 years (mean 10.0 (SD 1.7) years). The percentage of children attending 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} grade of elementary school was 10, 11, 19, 23 and 15%, respectively; 15% attended 1^{st} grade of middle school and 6% attended 2^{nd} grade. Participating parents were mostly female (95%) and aged between 28 and 62 years (mean 41.2 (SD 5.3) years).

Association between Children's and Parents' Reporting

Food consumption reported by children and their parents, and the proportion of consumption at meals, are summarized in the online supplementary material, **Supplementary Table 3.2**. The total count and percentage of 'I do not know' answers are shown in **Supplementary Table 3.3**. The associations between children's and parents' reporting are summarized in **Table 3.1** Kendall's τB correlation between parents' and children's answers ranged from 0.44 for fat meat to 0.81 for puff pastry, indicating medium to large correlations for all foods analyzed. Spearman's ρ between parents' and children's answers ranged from 0.55 for sauces and dressings to 0.84 for puff pastry, indicating large correlations for all foods analyzed (see **Supplementary Table 3.4**). Values of κ showed low to high levels of agreement, ranging from 0.15 for sweets to 0.77 for puff pastry. Considering the lower bound of the CI, fair agreement ($\kappa < 0.20$) was found for water, fruit, vegetables, starchy foods, meat, dairy products, fats and oils, and sweets. Moderate agreement ($\kappa = 0.20–0.45$) was found for whole grains, fish, fat meat, sauces and dressings, junk food, sugar drinks and coffee. Strong agreement ($\kappa > 0.45$) was found for eggs, legumes, tofu and quorn, fast food and puff pastry. Finally, Lin's correlation coefficients ranged from 0.39 for whole grains to 0.86 for puff pastry (see **Table 3.1**).

Kendall's τB correlations between children's and parents' reporting of food by meal are summarized in **Table 3.2** Kendall's τB values ranged from 0.20 for sugar drinks after dinner to 1.00 for coffee at lunch and dinner, and for eggs after dinner. Vegetables at breakfast, meat at morning snack and puff pastry at afternoon snack showed non-significant results. During some meal occasions, some foods were not consumed or the sample size was too small. Hence, the correlation analysis was not performed (e.g. fish and fast food at breakfast and morning snack). Spearman's ρ between children's and parents' reporting of food by meal are summarized in the online supplementary material, **Supplementary Table 3.4**.

Table 3.1 Association between Food Items Logged by Children and Food Items Logged by Parents in a Week (N=264).

Food item	Kendall's τB	κ	95% CI	Lin's coefficient	95% CI
Water	0.49	0.20	0.15 - 0.25	0.65	0.58 - 0.71
Fruit	0.64	0.25	0.19 - 0.31	0.77	0.72 - 0.81
Vegetables	0.54	0.19	0.14 - 0.25	0.59	0.53 - 0.66
Starchy foods	0.66	0.18	0.13 - 0.23	0.78	0.73 - 0.82
Whole grains	0.57	0.37	0.20 - 0.54	0.39	0.32 - 0.46
Meat	0.47	0.23	0.17 - 0.30	0.61	0.54 - 0.68
Fish	0.58	0.50	0.42 - 0.58	0.79	0.74 - 0.83
Eggs	0.64	0.58	0.50 - 0.66	0.74	0.69 - 0.79
Legumes, tofu, quorn	0.64	0.59	0.50 - 0.68	0.75	0.69 - 0.80
Dairy products	0.61	0.16	0.11 - 0.21	0.73	0.67 - 0.78
Fats & oils	0.52	0.17	0.11 - 0.23	0.66	0.60 - 0.73
Sauces & dressings	0.49	0.42	0.33 - 0.51	0.56	0.48 - 0.64
Fat meat	0.44	0.31	0.24 - 0.38	0.53	0.45 - 0.61
Fast food	0.58	0.55	0.47 - 0.63	0.67	0.60 - 0.73
Junk food	0.64	0.50	0.42 - 0.58	0.80	0.76 - 0.85
Sweets	0.58	0.15	0.10 - 0.20	0.71	0.65 - 0.76
Sugar drinks	0.59	0.32	0.26 - 0.38	0.70	0.64 - 0.76
Puff pastry	0.81	0.77	0.68 - 0.86	0.86	0.84 - 0.89
Coffee	0.62	0.56	0.36 - 0.76	0.57	0.49 - 0.65

All values are significant at $p<0.01$.

Table 3.2 Associations between Food Items Logged by Children Aged 6-12 Years and Food Items Logged by Their Parents in a Week (N=264) by Meal, using Kendall's τB Coefficient; Ticino, Switzerland, April – June 2014.

	Meal					
Food item	**Breakfast**	**Morning snack**	**Lunch**	**Afternoon snack**	**Dinner**	**After dinner**
n	264	261	264	263	262	263
Water	0.78	0.31	0.45	0.56	0.48	0.60
Fruit	0.74	0.63	0.60	0.67	0.65	0.69
Vegetables	-0.004^{NS}	0.71	0.56	0.44	0.56	0.30
Starchy foods	0.83	0.75	0.60	0.65	0.63	0.64
Whole grains	0.58	0.71	0.31	0.82	0.54	NA
Meat	0.65	-0.009^{NS}	0.60	0.64	0.55	NA
Fish	NA	NA	0.68	NA	0.75	NA
Eggs	0.85	0.81	0.71	0.57	0.75	1.00
Legumes, tofu, quorn	NA	NA	0.64	NA	0.73	NA
Dairy products	0.72	0.58	0.59	0.68	0.53	0.65
Fats & oils	0.78	0.67	0.52	0.38	0.53	0.32
Sauces & dressings	NA	NA	0.49	NA	0.62	NA
Fat meat	0.86	0.70	0.50	0.48	0.53	0.50
Fast food	NA	NA	0.66	0.40	0.64	NA
Junk food	0.69	0.76	0.47	0.74	0.41	0.60
Sweets	0.74	0.67	0.52	0.57	0.54	0.63
Sugar drinks	0.83	0.64	0.6	0.59	0.63	0.20
Puff pastry	NA	NA	0.83	-0.004^{NS}	0.86	NA
Coffee	0.59	NA	1.00	0.32	1.00	NA

NA, food not consumed/sample size too small.

Values are significant at $p<0.01$ except those marked NS.

Association According to Gender and Grade at School

For boys and girls, agreement between parents' and children's reporting was similar for most foods. Kendall's τB correlations between boys and their parents ranged from 0.41 for sauces and dressings to 0.77 for puff pastry, indicating medium to high correlations. Between girls and their parents, Kendall's τB ranged from 0.46 for fat meat to 0.84 for puff pastry, indicating medium to high correlations. Kendall's τB for fruit was 0.65 for boys and 0.63 for girls; for puff pastry it was 0.77 for boys and 0.84 for girls; and for starchy foods it was 0.62 for boys and 0.72 for girls. Kendall's τB correlation coefficients for all food groups according to gender are summarized in **Table 3.3**.

Spearman's rank correlations are described in the online supplementary material, **Supplementary Table 3.5**.

For boys κ values ranged from 0.11 for sweets to 0.73 for puff pastry, while for girls κ ranged from 0.18 for fats and oils to 0.80 for puff pastry, showing low to high agreement for both genders. The κ (95% CI) for sweets was 0.11 (0.05, 0.18) for boys and 0.20 (0.12, 0.28) for girls; for vegetables it was 0.18 (0.10, 0.26) for boys and 0.19 (0.11, 0.27) for girls; for puff pastry it was 0.73 (0.58, 0.88) for boys and 0.80 (0.68, 0.92) for girls; and for fruit it was 0.21 (0.13, 0.29) for boys and 0.29 (0.20, 0.38) for girls. See **Table 3.3** for all food groups according to gender.

Table 3.3 Kendall's τB and κ Values for Food Items Logged by Children Aged 6-12 Years and Food Items Logged by Their Parents in a Week (N=264), by Gender; Ticino, Switzerland, April – June 2014.

	Kendall's τB		**κ**			
	Boys	**Girls**	**Boys**	**95% CI**	**Girls**	**95% CI**
n	127	137	127	-	137	-
Water	0.44	0.53	0.16	0.09 - 0.23	0.24	0.17 - 0.31
Fruit	0.65	0.63	0.21	0.13 - 0.29	0.29	0.20 - 0.38
Vegetables	0.45	0.61	0.18	0.10 - 0.26	0.19	0.11 - 0.27
Starchy foods	0.62	0.72	0.14	0.07 - 0.21	0.22	0.14 - 0.30
Whole grains	0.74	0.48	0.53	0.24 - 0.82	0.28	0.08 - 0.48
Meat	0.46	0.47	0.16	0.07 - 0.25	0.30	0.21 - 0.39
Fish	0.54	0.63	0.44	0.32 - 0.56	0.54	0.43 - 0.65
Eggs	0.68	0.60	0.53	0.42 - 0.64	0.62	0.51 - 0.73
Legumes, tofu, quorn	0.67	0.62	0.65	0.51 - 0.79	0.55	0.42 - 0.68
Dairy products	0.61	0.60	0.13	0.06 - 0.20	0.19	0.11 - 0.27
Fats & oils	0.48	0.56	0.16	0.08 - 0.24	0.18	0.10 - 0.26
Sauces & dressings	0.41	0.57	0.39	0.25 - 0.53	0.44	0.31 - 0.57
Fat meat	0.43	0.46	0.27	0.17 - 0.37	0.34	0.24 - 0.44
Fast food	0.57	0.60	0.54	0.43 - 0.65	0.55	0.44 - 0.66
Junk food	0.72	0.61	0.61	0.49 - 0.73	0.41	0.30 - 0.52
Sweets	0.60	0.57	0.11	0.05 - 0.18	0.20	0.12 - 0.28
Sugar drinks	0.53	0.65	0.31	0.22 - 0.40	0.33	0.24 - 0.42
Puff pastry	0.77	0.84	0.73	0.58 - 0.88	0.80	0.68 - 0.92
Coffee	0.73	0.50	0.67	0.42 - 0.92	0.44	0.14 - 0.74

All values are significant at $p<0.01$.

Overall, there was higher agreement between children in middle school and their parents, than between children in elementary school and their parents, with few exceptions. Kendall's τB correlations ranged from 0.006 (meat) for children in 1st grade of elementary school to 1.00 (coffee) for children in middle school. Kendall's τB and κ values are summarized in **Table 3.4** and **Table 3.5**.

Table 3.4 Kendall's τB Values of Food Items Logged by Children Aged 6–12 Years and Food Items Logged by Their Parents in a Week (N=264), by Class at School; Ticino, Switzerland, April–June 2014.

Education	**Elementary school**					**Middle school**	
Grade	**1st**	**2nd**	**3rd**	**4th**	**5th**	**1st**	**2nd**
n	26	30	51	60	40	39	15
Water	0·41**	0·52**	0·38**	0·52**	0·71**	0·48**	0·78**
Fruit	0·48**	0·77**	0·63**	0·61**	0·68**	0·75**	0·93**
Vegetables	0·14	0·43**	0·57**	0·59**	0·54**	0·68**	0·66**
Starchy foods	0·50**	0·62**	0·70**	0·67**	0·61**	0·80**	0·82**
Whole grains	NA	NA	0·83**	0·61**	0·71**	0·39**	NA
Meat	0·006	0·40**	0·51**	0·70**	0·36**	0·65**	0·42**
Fish	0·29	0·40**	0·69**	0·50**	0·65**	0·71**	0·80**
Eggs	0·39*	0·64**	0·60**	0·60**	0·69**	0·81**	0·76**
Legumes, tofu, quorn	0·44*	0·49**	0·63**	0·81**	0·50**	0·76**	0·37
Dairy products	0·51**	0·50**	0·51**	0·59**	0·72**	0·74**	0·86**
Fats & oils	0·35*	0·45**	0·51**	0·60**	0·55**	0·51**	0·53**
Sauces & dressings	0·16	0·29	0·68**	0·49**	0·57**	0·56**	0·53*
Fat meat	0·20	0·39**	0·44**	0·48**	0·61**	0·53**	0·75**
Fast food	0·42**	0·71**	0·56**	0·49**	0·74**	0·66**	0·73**
Junk food	0·75**	0·52**	0·60**	0·68**	0·61**	0·67**	0·87**
Sweets	0·30*	0·52**	0·64**	0·65**	0·65**	0·60**	0·82**
Sugar drinks	0·07	0·49**	0·67**	0·61**	0·65**	0·79**	0·85**
Puff pastry	0·71**	0·76**	0·72**	0·93**	0·86**	0·92**	0·79**
Coffee	0·39*	NA	0·55**	0·69**	0·54**	1·00**	1·00**

NA, not assessable as no child in the class reported having eaten this food.

*p<0.05, ** p<0.01.

Table 3.5 K Values of Food Items Logged by Children Aged 6–12 Years and Food Items Logged by Their Parents in a Week (N=264), by Class at School; Ticino, Switzerland, April–June 2014.

Education	**Elementary school**					**Middle school**	
Grade	**1st**	**2nd**	**3rd**	**4th**	**5th**	**1st**	**2nd**
n	26	30	51	60	40	39	15
Water	0.04	0.13 **	0.21 **	0.19 **	0.21 **	0.24 **	0.52 **
Fruit	0.08	0.17 **	0.15 **	0.19 **	0.40 **	0.38 **	0.61 **
Vegetables	-0.06	0.22 **	0.18 **	0.18 **	0.28 **	0.26 **	0.13
Starchy foods	0.12**	0.16**	0.11**	0.16**	0.22**	0.26**	0.30**
Whole grains	NA	NA	0.55**	0.42**	0.66**	0.17	NA
Meat	0.02	0.19**	0.12*	0.30**	0.19**	0.52**	0.22*
Fish	0.09	0.32**	0.60**	0.44**	0.52**	0.69**	0.71**
Eggs	0.31*	0.37**	0.68**	0.49**	0.61**	0.79**	0.72**
Legumes, tofu, quorn	0.38**	0.44**	0.58**	0.70**	0.45**	0.75**	0.32
Dairy products	0.08*	0.03	0.00	0.19**	0.26**	0.32**	0.21**
Fats & oils	−0.06	0.01	0.11*	0.25**	0.23**	0.32**	0.15
Sauces & dressings	0.14	0.14	0.56**	0.36**	0.60**	0.52**	0.52**
Fat meat	0.07	0.21	0.28**	0.35**	0.29**	0.44**	0.49**
Fast food	0.57**	0.45**	0.45**	0.50**	0.57**	0.75**	0.71**
Junk food	0.53**	0.44**	0.34**	0.60**	0.39**	0.53**	0.83**
Sweets	0.07	0.04	0.13**	0.14**	0.18**	0.21**	0.50**
Sugar drinks	0.62	0.28**	0.20**	0.33**	0.32**	0.48**	0.74**
Puff pastry	0.57**	0.69**	0.64**	0.85**	0.83**	1.00**	0.83**
Coffee	0.37**	NA	0.49**	0.48**	0.55**	0.74**	1.00**

NA, not assessable as no child in the class reported having eaten this food.

*p<0.05, ** p<0.01.

3.4 Discussion

To our knowledge, the present study is one of the few comparing 7 d food diaries completed by children and parents. Our results showed a significant agreement between children's and parents' reported food consumption; furthermore, the agreement measures tended to be higher than found in the food consumption reporting literature (Thiagarajah et al., 2008). For example, the study conducted in 2004 by Thiagarajah et al. among 120 children attending 4th grade from five elementary schools in south-central Indiana (USA) validated the food behavior questions from the School Physical Activity and Nutrition questionnaire (Thiagarajah et al., 2008). The Spearman correlation coefficients are higher in our study compared with Thiagarajah et al. (i.e. 0.80 *v.* 0.40 for fruit, 0.71 *v.* 0.52 for sugar drinks and 0.57 *v.* 0.43 for fat/ fried meat, respectively), while the κ values are comparable (i.e. 0.25 *v.* 0.27 for fruit, 0.32 *v.* 0.38 for sugar drinks and 0.31 *v.* 0.38 for fat/fried meat, respectively).

Diaries completed by older children and their parents showed higher Spearman correlation coefficients and κ values, a finding consistent with previous studies (Baranowski et al., 2012; Thiagarajah et al., 2008). While younger children may encounter some difficulties in completing food diaries, several studies have shown that for children older than 8 years of age, validity is higher when the diaries are completed by the child rather than by a proxy (Collins et al., 2010; Kolodziejczyk et al., 2012). Further, a validation study conducted among children aged 9–11 years found that mixed foods had lower agreement scores than well-defined foods and foods consumed less frequently (Thiagarajah et al., 2008). Because of the coding system adopted for the present study (i.e. coding each of the foods in a mixed dish separately) our study partially solved this issue.

Studies with adults show women tend to report their dietary intake more accurately than men (Ovaskainen et al., 2007; Yokoyama et al., 2013); however, in our study, no differences were found between boys and girls and their level of agreement with their parents. Our results are consistent with those reported by Thiagarajah *et al*., who also found no gender differences in validity, except for a few items (gravy, French fries and chips), where a higher agreement was found in girls (Thiagarajah et al., 2008).

Strengths and Limitations

The methodology used in the current study could serve as reference for other studies assessing children's food intake. First, our analysis included basic food groups, which can be obtained for any study across the world. Second, specific cultural foods (i.e. peanut butter, gravy, noodles, etc.) can be easily included in the food categories identified for the study and processed similarly. Furthermore, observation effects were minimized due to the longevity of the data collection, seven consecutive days. One study showed that people typically revert to their normal behavior after the 'observation effect' wears off in 2–3 d (Podsakoff et al., 2003).

The primary limitation in the present study is the lack of a direct observation or biomarkers to compare with self-reporting. This was mostly due to feasibility reasons, as collecting blood or urine samples, or hiring staff to observe families, was far beyond our budget and would have likely resulted in a lower participation rate. Further, it cannot be excluded that children and parents completed the food diaries together, even though the importance of completing the diaries separately was stressed in the instructions. The relatively low completion rate of 35% is unfortunate, but is comparable to participation rates reported elsewhere (16–57% for men and 31–74% for women) (Tolonen et al., 2015). This is a challenge in food consumption reporting; the 7 d give a better picture of what children eat than a shorter period reporting, but it also increases respondent burden.

Although κ value is commonly used to assess agreement, it might not be appropriate to compare studies, as it depends on the prevalence of the findings and on the number of categories (Chen, Faris, Hemmelgarn, Walker, & Quan, 2009; Hoehler, 2000; Viera & Garrett, 2005). Additionally, as the thresholds to define the strength of agreement vary across the literature, our results might have been over- or under- estimated. Using the more stringent thresholds by Landis and Koch (Landis & Koch, 1977), the percentage of κ values showing moderate agreement increased from 33% to 43%, while the percentage of κ values showing substantial agreement decreased from 38% to 5%.

We also had to use a non-validated food diary, due to the lack of validated food diaries in Switzerland. Further, social desirability could play a factor in child or parent reporting. Finally, recall bias could not be completely ruled out, but we believe it was

minimized due to the requirement that eating behavior should be recorded immediately after each meal or snack.

3.5 Conclusion

Our study reports significant agreement between children's and parents' reported food consumption, when using 7 d diaries without reported portion sizes. When assessing children's eating behavior using a food diary completed each day, children may be just as able as their parents to reliably report what they ate.

3.6 Acknowledgements

Acknowledgements: The authors thank Ms. Maria Lagomarsino for her help with data entry. They also thank the parents and children who participated in this study and the teachers, school directors and DECS administration.

Financial support: This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of interest: None.

Authorship: Each author contributed equally to the design of this paper, including the research questions, study design, analysis plan and conduct, and writing the manuscript.

Ethics of human subject participation: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and was exempt from full ethics review by the Canton Ticino Ethics Review Committee, in accordance with Swiss Human Subjects Law. Written informed consent was obtained from all participants prior to any data collection.

3.7 Supplementary Material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980016001488

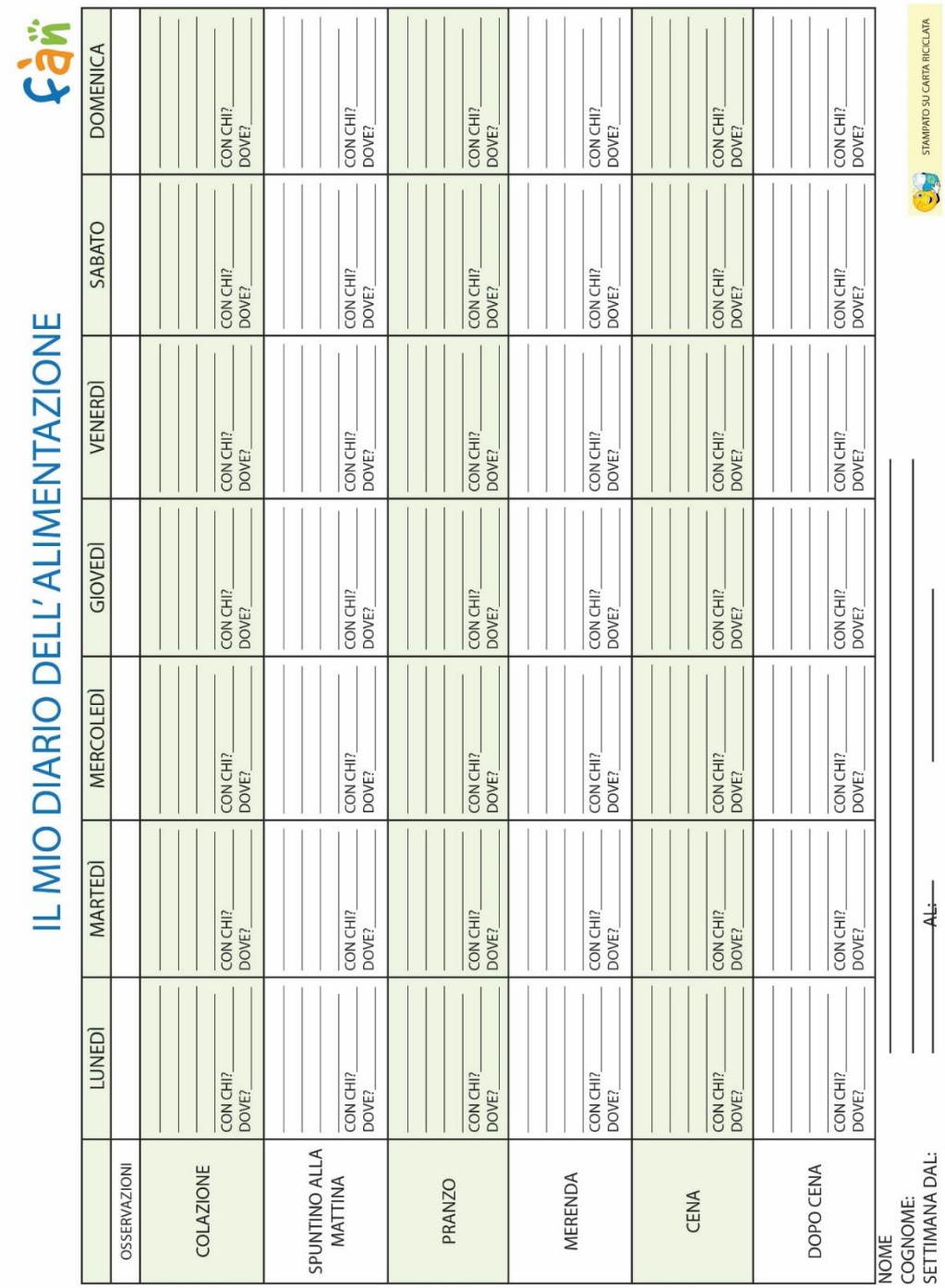
Supplementary Figure 3.1 Food Diary for Elementary School Aged Children

LUNEDÌ

COLAZIONE CON CHI?_____ DOVE? _____	COSA? _____ _____ _____ _____
SPUNTINO ALLA MATTINA CON CHI?_____ DOVE? _____	COSA? _____ _____ _____ _____
PRANZO CON CHI?_____ DOVE? _____	COSA? _____ _____ _____ _____
MERENDA CON CHI?_____ DOVE? _____	COSA? _____ _____ _____ _____
CENA CON CHI?_____ DOVE? _____	COSA? _____ _____ _____ _____
DOPO CENA CON CHI?_____ DOVE? _____	COSA? _____ _____ _____ _____
OSSERVAZIONI: _____ _____ _____	

Note: The elementary school aged children had one page per each day. This is the page for Monday

Supplementary Figure 3.2 Food Diary for Middle School Aged Children



Supplementary Table 3.1 Food Categories and Subcategories Used to Code the Food Diaries by Parents and Children.

1. Water: still and sparkling water, bouillon, sugar free tea and herbal tea, barley coffee
2. Fruit: fresh, dried or cooked; fruit juice 100%
3. Vegetables: raw or cooked; vegetable juice 100%; vegetable soup, salad, mushrooms
4. Starchy foods: pasta, pizza, rice, potatoes, porridge, cereals, corn, barley, millet, oats, dumplings, etc.)
   - 4.1. Starchy foods
   - 4.2. Whole grain starchy foods
5. Proteins
   - 5.1. Meat: beef, pork, horse, chicken, turkey, rabbit, ham, bresaola, beef jerky
   - 5.2. Fish and seafood
   - 5.3. Eggs
   - 5.4. Plant proteins: legumes – beans, chickpeas, lentils; tofu, quorn
6. Dairy: milk, yogurt, cottage cheese, cheese, white sauce, etc.
7. Fats: oil, butter, NOT salty oleaginous fruits (almonds, walnuts, hazelnuts, peanuts, cashews), cream, olives, avocado, etc.
8. Sugar and/or fatty food
   - 8.1. Sauces: mayonnaise, ketchup, mustard, cocktail sauce, quark sauce, and other sauces
   - 8.2. Fat meat and fish: salami, bacon, fleischkäse, lyoner, fried breaded meat, nuggets, bratwurst, wienerli, cervelat, breaded fish sticks, luganiga, fried fish, etc.
   - 8.3. Fast food: hamburgers, hot dogs, kebabs, falafel, fries, pizza (if from fast food), wrap, etc.
   - 8.4. Junk food: chips, popcorn, salty snacks, salted peanuts, etc.
   - 8.5. Sweet: jam, honey, Nutella®, biscuits, snacks, cakes, cream with hazelnuts, ice-cream
   - 8.6. Soft drinks: Coca-Cola®, Fanta®, Sprite®, Pepsi®, Rivella®, ice-tea, sweetened juices, syrup, etc.
   - 8.7. Puff pastry: quiche, vegetable cake, vol-au-vent, etc.
9. Coffee: coffee, Nescafe®, cappuccino, macchiato

Supplementary Table 3.2 Consumption of Foods Stated by Children (N=264) and Their Parents (N=264).

	Children (N=264)		Parents (N=264)	
	Consume it (%)	Proportion of consumption[a]	Consume it (%)	Proportion of consumption[a]
Water	219 (83%)	.19	228 (86%)	.23
Fruit	224 (85%)	.10	239 (91%)	.12
Vegetable	257 (97%)	.14	261 (99%)	.18
Starchy foods	264 (100%)	.37	264 (100%)	.40
Whole grain	10 (4%)	.00	23 (9%)	.00
Meat	261 (99%)	.11	262 (99%)	.13
Fish	163 (62%)	.02	185 (70%)	.03
Eggs	147 (56%)	.02	175 (66%)	.02
Legumes, tofu, quorn	77 (29%)	.01	87 (33%)	.01
Dairy products	264 (100%)	.24	264 (100%)	.28
Fats & oils	246 (93%)	.09	260 (98%)	.12
Sauces & dressings	84 (32%)	.01	107 (41%)	.02
Fat meat	215 (81%)	.04	232 (88%)	.05
Fast food	160 (61%)	.02	178 (67%)	.03
Junk food	111 (42%)	.02	101 (38%)	.02
Sweets	262 (99%)	.25	264 (100%)	.29
Sugar drinks	200 (76%)	.08	200 (76%)	.10
Puff pastry	42 (16%)	.00	57 (22%)	.01
Coffee	17 (6%)	.00	14 (5%)	.00

[a]The proportion was calculated by taking the total count of food (max 7 days x 6 meals = 42) and by dividing it by the number of days the diary was completed (max 7/7 days). Given that we only analyze the diaries that have 7/7 days completed, all total counts were divided by 7.

Supplementary Table 3.3 Total Count and Percentage of "I do not recall" Responses by Children (N=264) and Parents (N=264).

	Total (all meals included)		Breakfast		Morning Snack		Lunch		Afternoon Snack		Dinner		After Dinner	
	C	P	C	P	C	P	C	P	C	P	C	P	C	P
All meals reported	192 (72.7%)	202 (76.5%)	245 (92.8%)	256 (97.0%)	255 (96.6%)	231 (87.5%)	215 (81.4%)	243 (92.0%)	233 (88.3%)	228 (86.4%)	212 (80.3%)	248 (93.9%)	253 (95.8%)	254 (96.2%)
"I do not recall"														
for 1 meal	24 (9.1%)	12 (4.5%)	11 (4.2%)	7 (2.7%)	5 (1.9%)	2 (0.8%)	37 (14.0%)	13 (4.9%)	18 (6.8%)	12 (4.5%)	31 (11.7%)	13 (4.9%)	8 (3.0%)	4 (1.5%)
for 2 meals	13 (4.9%)	15 (5.7%)	6 (2.3%)	1 (0.4%)	1 (0.4%)	4 (1.5%)	9 (3.4%)	4 (1.5%)	8 (3.0%)	16 (6.1%)	11 (4.2%)	2 (0.8%)	1 (0.4%)	3 (1.1%)
for 3 meals	7 (2.7%)	5 (1.9%)	1 (0.4%)	-	2 (0.8%)	5 (1.9%)	2 (0.8%)	2 (0.8%)	2 (0.8%)	3 (1.1%)	7 (2.7%)	1 (0.4%)	-	1 (0.4%)
for 4 meals	9 (3.4%)	4 (1.5%)	1 (0.4%)	-	-	6 (2.3%)	-	1 (0.4%)	1 (0.4%)	2 (0.8%)	1 (0.4%)	-	-	1 (0.4%)
for 5 meals	6 (2.3%)	8 (3.0%)	-	-	1 (0.4%)	13 (4.9%)	-	1 (0.4%)	1 (0.4%)	2 (0.8%)	1 (0.4%)	-	2 (0.8%)	1 (0.4%)
for 6 meals	5 (1.9%)	5 (1.9%)	-	-	-	2 (0.8%)	1 (0.4%)	-	1 (0.4%)	1 (0.4%)	1 (0.4%)	-	-	-
for 7 meals	2 (0.8%)	1 (0.4%)	-	-	-	1 (0.4%)	-	-	-	-	-	-	-	-
for 8 meals	1 (0.4%)	2 (0.8%)												
for 9 meals	-	2 (0.8%)												
for 10 meals	1 (0.4%)	2 (0.8%)												
for 12 meals	1 (0.4%)	1 (0.4%)												
for 13 meals	-	1 (0.4%)												
for 14 meals	1 (0.4%)	2 (0.8%)												
for 17 meals	-	1 (0.4%)												
for 22 meals	-	-												
for 23 meals	-	1 (0.4%)												
for 32 meals	1 (0.4%)	-												

C=Children; P=Parents

Supplementary Table 3.4 Spearman's Correlation Coefficients Between Food Items Logged by Children and Food Items Logged by Parents in a Week, and by Meal.

Food item/Meal	All meals	Breakfast (n=264)	Morning Snack (n=261)	Lunch (n=264)	Afternoon Snack (n=263)	Dinner (n=262)	After Dinner (n=263)
Water	0.64	0.81	0.31	0.56	0.64	0.60	0.62
Fruit	0.80	0.75	0.65	0.66	0.77	0.71	0.71
Vegetables	0.69	-0.004 NS	0.72	0.68	0.44	0.68	0.30
Starchy foods	0.83	0.91	0.78	0.68	0.71	0.74	0.65
Whole grains	0.58	0.59	0.71	0.31	0.82	0.54	NA
Meat	0.61	0.65	-0.01 NS	0.70	0.65	0.68	NA
Fish	0.69	NA	NA	0.73	NA	0.78	NA
Eggs	0.74	0.86	0.81	0.75	0.57	0.79	1
Legumes, tofu, quorn	0.70	NA	NA	0.66	NA	0.75	NA
Dairy products	0.76	0.81	0.58	0.69	0.75	0.62	0.67
Fats & oils	0.67	0.82	0.67	0.63	0.39	0.62	0.33
Sauces & dressings	0.55	NA	NA	0.52	NA	0.65	NA
Fat meat	0.57	0.86	0.70	0.56	0.89	0.60	0.50
Fast food	0.68	NA	NA	0.71	0.40	0.67	NA
Junk food	0.72	0.67	0.78	0.47	0.78	0.42	0.60
Sweets	0.74	0.84	0.70	0.6	0.69	0.59	0.68
Sugar drinks	0.71	0.85	0.66	0.67	0.66	0.68	0.20
Puff pastry	0.84	NA	NA	0.83	-0.004 NS	0.88	NA
Coffee	0.63	0.59	NA	1.00	0.33	1.00	NA

Values are significant at $p<0.01$. NS=Value is not significant. NA=Food not consumed/sample size too small.

Supplementary Table 3.5 Spearman's Correlation Coefficients of Food Items Logged by Children and Food Items Logged by Parents in a Week, Stratified by Gender (N=264), and by Class at School (N=261).

	Gender		Elementary School					Middle School	
Meal	**Boys**	**Girls**	**1st**	**2nd**	**3rd**	**4th**	**5th**	**1st**	**2nd**
N	127	137	26	30	51	60	40	39	15
Water	0.58	0.69	0.56 **	0.70 **	0.51 **	0.65 **	0.85 **	0.60 **	0.90 **
Fruit	0.80	0.79	0.66 **	0.89 **	0.80 **	0.75 **	0.81 **	0.86 **	0.98 **
Vegetables	0.59	0.76	0.19	0.59 **	0.71 **	0.72 **	0.70 **	0.81 **	0.80 **
Starchy foods	0.78	0.88	0.66 **	0.77 **	0.88 **	0.84 **	0.73 **	0.92 **	0.93 **
Whole grains	0.74	0.49	NA	NA	0.85 **	0.63 **	0.72 **	0.40 *	NA
Meat	0.60	0.61	0.03	0.50 **	0.66 **	0.84 **	0.46 **	0.78 **	0.50
Fish	0.63	0.73	0.35	0.47 **	0.78 **	0.59 **	0.75 **	0.81 **	0.90 **
Eggs	0.78	0.70	0.45 *	0.75 **	0.73 **	0.69 **	0.79 **	0.91 **	0.85 **
Legumes, tofu, quorn	0.72	0.68	0.49 *	0.51 **	0.71 **	0.85 **	0.53 **	0.84 **	0.39
Dairy products	0.77	0.76	0.67 **	0.65 **	0.70 **	0.71 **	0.86 **	0.86 **	0.96 **
Fats & oils	0.61	0.71	0.50 **	0.63 **	0.65 **	0.75 **	0.66 **	0.62 **	0.68 **
Sauces & dressings	0.46	0.64	0.18	0.33	0.76 **	0.54 **	0.63 **	0.61 **	0.62 **
Fat meat	0.56	0.58	0.25	0.50 **	0.58 **	0.60 **	0.74 **	0.66 **	0.86 **
Fast food	0.65	0.70	0.50 **	0.81 **	0.67 **	0.56 **	0.85 **	0.74 **	0.74 **
Junk food	0.79	0.68	0.85 **	0.56 **	0.69 **	0.74 **	0.65 **	0.74 **	0.88 **
Sweets	0.76	0.73	0.41 *	0.71 **	0.80 **	0.81 **	0.82 **	0.71 **	0.92 **
Sugar drinks	0.65	0.77	0.08	0.60 **	0.82 **	0.73 **	0.80 **	0.90 **	0.91 **
Puff pastry	0.80	0.87	0.75 **	0.80 **	0.75 **	0.94 **	0.86 **	0.99 **	0.80 **
Coffee	0.74	0.51	0.40*	NA	0.55 **	0.69 **	0.55 **	1.00 **	1.00 **

NA, not assessable as no child in that class reported having eaten this food;*, $p<0.05$; **, $p<0.01$.

Chapter IV

Let's Trust the Kids! Children are Reliable Food Reporters

Manuscript under review

Rangelov, N., Suggs, L. S., & Marques-Vidal, P. (in review). Let's trust the kids! Children are reliable food reporters. Journal of Nutrition Education and Behavior.

Note: the paper and in particular table and figure numbers have been reformatted to fit the format of this dissertation.

Abstract

Objective. To measure the level of agreement between children and their parents when reporting a child's food consumption.

Methods. Cross-sectional study conducted in Switzerland (April–June 2014) among 290 children and one of their parents. Children and parents independently completed two-day food records indicating, from a list of foods, what the child ate at six eating occasions.

Results. 267 children (92%) provided complete data. Kendall's tau-b correlations ranged from 0.66 (whole grains) to 0.85 (proteins). Kappa values showed moderate to substantial agreement for all food categories, ranging from 0.47 for dairy products to 0.75 for fat meat and fast food. Agreement between child's and parent's reporting was similar for both genders. Large Kendall's tau-b and Spearman's correlations were found for almost all foods in all school grades.

Conclusions and Implications. A high agreement was found between parent and child reporting. This instrument could be used to reliably collect food intake directly from children.

Keywords: Dietary Records; Food Diaries; Agreement; Child; Switzerland.

4.1 Introduction

In Switzerland, 12% of children were overweight and 5% were obese in 2012 (Federal Office of Public Health (FOPH), 2016). Poor nutrition is one of the risk factors associated with overweight and obesity, and a study conducted in the Swiss Canton Ticino showed that children do not adhere to the guidelines developed by the Swiss Society for Nutrition (Suggs et al., 2016; Swiss Society for Nutrition, 2015, 2016). Assessing children's dietary intake is thus important for public health purposes, but its collection remains challenging. Limited validated tools exist (Burrows, Martin, & Collins, 2010; Livingstone et al., 2004; McPherson et al., 2000) and issues such as recall accurateness, portion size estimation and participant burden persist (Burrows et al., 2010; Livingstone et al., 2004; McPherson et al., 2000; Pérez-Rodrigo, Artiach Escauriaza, Artiach Escauriaza, & Polanco Allúe, 2015).

In a previous study, a seven-day food diary to assess eating behavior of children was developed (Rangelov, Suggs, & Marques-Vidal, 2016). The food diary required participants to write down everything the child ate, for three meals (breakfast, lunch, and dinner), and three snack moments (morning, afternoon, evening), over seven days. The study showed that children were as reliable as their parents for reporting dietary intake (Rangelov et al., 2016), but it also required considerable time for parents and children to complete (Rangelov & Suggs, 2015a). Further, the manual coding of the items and the data entry process represented an enormous burden in terms of time and human resources.

To try to overcome these challenges while maximizing reliability, a shorter, two-day food consumption record was developed to collect food consumption data, without focusing on portions or nutrients. It was also easier to apply and assess, as it required participants to tick boxes instead of manually writing down the items consumed. Thus, the aim of this paper was to measure the level of agreement between children and their parents when using this two-day instrument to report a child's food consumption, by comparing what children and parents wrote, to understand whether children are able to report in a reliable way what they consumed. Additionally, a "side-by-side" comparison of the agreement values for the two-day food record and the seven-day food diary tested previously (Rangelov et al., 2016) was conducted.

4.2 Methods

Study Setting and Sampling

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and was exempt from full ethics review by the Ethics Committee of Canton Ticino, in accordance with Swiss Human Subjects Law. Written informed consent was obtained from all parents and children prior to any data collection.

Child-parent dyads were recruited through elementary and middle schools in Ticino. The governing body of schools selected a representative sample of six elementary and middle schools that could be invited to participate. The teachers invited to participate in the study 450 children from the selected classrooms along with their parents. Of those, 290 signed the consent form, completed the two-day food record and the questionnaire (64.4% participation rate). After excluding cases for incomplete data, the sample consisted of 267 child-parent pairs (59.3% of the invited families, 92.1% of the consenting families).

Instruments and Data Collected

To gather demographic information about parents and children (age and gender), grade at school, weight and height of the child, parents completed a one page questionnaire. A two-day food record consisting of a list of eleven common food groups and six food consumption occasions (breakfast, morning snack, lunch, afternoon snack, dinner, after dinner snack) was developed with the help of a dietician. The food groups were selected based on the Swiss food pyramid (Swiss Society for Nutrition, 2015) and included: water; fruit; vegetables; starchy food; whole grain; dairy products; protein-rich foods; plant proteins; sweets and junk food; fat meat and fast food; and soft drinks. On the food record, examples of mixed foods and explanations of the food groups were presented (see **Supplementary Figure 4.1** and **Supplementary Figure 4.2**).

The food record required that children and parents indicated whether the child consumed a certain food or drink by answering "YES" or "NO" for each food consumption occasion on two random days in a week, decided by the family. Hence, some dyads completed it on consecutive days, other on nonconsecutive days, including weekdays and weekends. Children in this population consume most meals at home (Suggs, Della Bella, Rangelov, & Marques-Vidal, in review), with the presence of at least one parent. As

portion sizes vary considerably in this age group, and as children are inaccurate in reporting them, no information regarding portion size was collected, similar to other studies conducted among children (Burrows et al., 2010; Livingstone & Robson, 2000; Rangelov et al., 2016).

Parents were asked to only assist their children in understanding how to complete the food record and not in recalling what they ate. If participants did not remember or did not know what food was consumed, they were asked to write "I do not know".

Statistical Analysis

Only cases were both parent and child completed the food record for two days were used (N=267 child-parent pairs). The data were entered in an excel database and coded as dichotomous variables for each day and meal (0 = food not consumed, and 1 = food consumed). Given the low number of "I do not know" responses (maximum of 14 parents for lunchtime on day 2), these were treated as missing. The total count and percentage of 'I do not know' answers are shown in **Supplementary Table 4.1**. Statistical analyses were conducted using IBM SPSS Statistics version 23.0 (IBM Inc., Armonk, USA).

Children's and parents' reporting of children's food consumption was compared to understand whether children are able to report in a reliable way what they ate. Associations between children's and parents' results were assessed using Kendall's tau-b (τB) and Spearman's non-parametric correlations. Values between 0.10 and 0.29 indicate a small correlation; between 0.30 and 0.49 a medium correlation, and between 0.50 and 1.00 a large correlation (Cohen, 1988). Cohen's Kappa (κ) values were also assessed and the lower bound of the 95% confidence interval of κ was used to categorize agreement. The same categorization as in previous studies was applied: values below 0.20 indicate low agreement; between 0.21 and 0.45 indicate moderate agreement; between 0.46 and 0.75 show substantial agreement; and values above 0.75 indicate very good agreement (Munoz & Bangdiwala, 1997; Rangelov et al., 2016; Thiagarajah et al., 2008). Lin's concordance correlation coefficient and corresponding 95% confidence interval was also computed to assess agreement. This procedure was repeated after stratifying for children's gender and school grade. Finally, κ values and their corresponding 95% confidence

interval of the two-day record were compared "side-by-side" to those from the seven-day food diary used previously (Rangelov et al., 2016).

4.3 Results

Just over half of the children were female (54.3%) and their age ranged between 7 and 14 years (mean age = 10.2, SD = 2.1 years). Most of the children attended elementary school (66.8%). Parents were mainly women (84.5%) aged between 27 and 66 years (mean = 41.9, SD = 5.7 years).

Food consumption, as reported by children and their parents, is shown in **Supplementary Table 4.2**. Kendall's τB correlation coefficients ranged from 0.66 for whole grains to 0.85 for proteins (meat, fish, and eggs). Spearman's rank correlation coefficients ranged from 0.72 for whole grains to 0.90 for proteins, showing large correlations for all food categories. Lin's correlation coefficients ranged from 0.65 for whole grains to 0.90 for both water and proteins. K values showed moderate to substantial agreement for all food categories, ranging from 0.47 for dairy products to 0.75 for fat meat and fast food. Water; vegetables; starchy foods; whole grain; dairy products, and sweets and junk food showed moderate agreement. Fruits; proteins; legumes, tofu and quorn; fat meat and fast food, and soft drinks showed substantial agreement (see **Table 4.1**).

Table 4.1 Association between Food Items Recorded by Children and by Parents on Two Days (N=267).

Food item	**Kendall's τB**	**Spearman's coefficient**	**κ (95% CI)**	**Lin's coefficient (95% CI)**
Water	0.78	0.89	0.50 (0.42 - 0.58)	0.90 (0.87 - 0.93)
Fruits	0.77	0.85	0.60 (0.52 - 0.68)	0.85 (0.81 - 0.89)
Vegetables	0.74	0.81	0.51 (0.42 - 0.60)	0.79 (0.73 - 0.84)
Starchy foods	0.69	0.77	0.47 (0.39 - 0.55)	0.77 (0.72 - 0.83)
Whole grain	0.66	0.72	0.47 (0.38 - 0.56)	0.65 (0.56 - 0.73)
Dairy products	0.76	0.85	0.50 (0.42 - 0.58)	0.85 (0.81 - 0.88)
Proteins (meat, fish, eggs)	0.85	0.90	0.68 (0.60 - 0.76)	0.90 (0.87 - 0.93)
Legumes, tofu, quorn	0.75	0.78	0.60 (0.50 - 0.70)	0.74 (0.68 - 0.81)
Sweets and junk food	0.71	0.80	0.47 (0.39 - 0.55)	0.82 (0.77 - 0.87)
Fat meat and fast food	0.78	0.79	0.75 (0.66 - 0.84)	0.88 (0.85 - 0.91)
Soft drinks	0.79	0.86	0.57 (0.49 - 0.65)	0.88 (0.85 - 0.91)

All values are significant at $p<0.01$.

Agreement between child's and parent's reporting was similar for both genders. For boys, Kendall's τB coefficients ranged from 0.61 for starchy foods to 0.87 for proteins, showing high correlations for all food items. For girls, Kendall's τB correlations ranged from 0.65 for whole grain to 0.84 for fat meat and fast food, also showing high correlations for all food items. Kendall's τB correlations by grade at school ranged from 0.49 for whole grain (children in 1st grade of elementary school) to 1.00 for fast food and fatty meat (children in 4th grade of elementary school). Large correlations were found for almost all foods in all grades. The sole exception was whole grain among children in the 1st grade, which showed a medium correlation (Kendall's τB = 0.49).

K values and their corresponding 95% confidence interval for the two-day food record and those for the seven-day food record for water; fruit; vegetables; starchy foods; whole grain; dairy products; legumes, tofu, quorn; and soft drinks are shown in **Table 4.2.**

Table 4.2 Comparison of Level of Agreement Between Children and Parents When Using a Two-day Food Record and a Seven-day Food Diary.

Food item	**two-day food record** **κ (95% CI)**	**seven-day food diary[a]** **κ (95% CI)**
Water	0.50 (0.42 - 0.58)	0.20 (0.15 - 0.25)
Fruits	0.60 (0.52 - 0.69)	0.19 (0.14 - 0.25)
Vegetables	0.51 (0.42 - 0.60)	0.25 (0.19 - 0.31)
Starchy foods	0.47 (0.39 - 0.55)	0.18 (0.13 - 0.23)
Whole grain	0.47 (0.38 - 0.56)	0.37 (0.20 - 0.54)
Dairy products	0.50 (0.42 - 0.58)	0.16 (0.11 - 0.21)
Legumes, tofu, quorn	0.60 (0.50 - 0.70)	0.59 (0.50 - 0.68)
Soft drinks	0.57 (0.49 - 0.65)	0.32 (0.26 - 0.38)

[a](Rangelov et al., 2016)

4.4 Discussion

The aim of this study was to assess the level of agreement between children and their parents using a two-day food record to assess the child's food consumption. Results showed significant and high levels of agreement, compared to previous similar studies (Rangelov et al., 2016; Thiagarajah et al., 2008; van de Gaar, Jansen, van der Kleij, & Raat, 2016). For instance, κ values for fruit were 0.60 in this study, versus 0.19, 0.27 and 0.12 in Rangelov et al., Thiagarajah et al., and van de Gaar et al. For soft drinks, the values were 0.57, 0.32, 0.38, and 0.19 respectively (Rangelov et al., 2016; Thiagarajah et al., 2008; van de Gaar et al., 2016).

No substantial differences were found between boys and girls, a finding consistent with previous studies, including the one using the seven-day food diary (Rangelov et al., 2016; Thiagarajah et al., 2008). Interestingly, when using the two-day food record, no differences were found between school grades, contrary to the seven-day food diary, where older children had higher agreement with their parents (Rangelov et al., 2016). This study shows that the two-day food record allows collecting data directly from the children, without the need to ask parents.

The high levels of agreement using the two-day food record can be explained by its simplified data collection. Indeed, children were asked to select from a list the foods they ate, which is probably easier than writing out what they consumed. Further, providing children with a visual cue (the list of food categories) might have increased recall.

The findings indicate that the two-day food record is appropriate for both children in elementary school and in middle school. This is an advantage for dietary assessment in children, as having the same instrument enables comparisons across school grades. Using one common instrument would also be cost-effective (Freisling et al., 2014).

In this population, most meals, including lunches, were consumed at home (Suggs et al., in review), with the presence of at least one parent. Thus, it was possible to analyze the level of agreement for all meals. This differs from other studies, where children ate mostly out of home and parents were often unaware of the food consumed by their children (Freisling et al., 2014; Livingstone & Robson, 2000; Livingstone et al., 2004; Pérez-Rodrigo et al., 2015). Indeed, in this study, parents replied "I do not know" in only few instances.

Another strength is that the two-day food record could be easily adapted to other food cultures, by modifying the food categories. For studies that aim at assessing children's food consumption, and do not need to collect information about nutrients and portions, this two-day food record could be used to collect data directly from children. Indeed, it was not the aim of this study to collect information about portion sizes. Finally, no recoding of food items is required and data entering is simplified, as the data are provided in a dichotomous way (consumed/not consumed).

Limitations

While the characteristics of the two-day food record suggest that collaboration between parents and children might have been minimized, this possibility cannot be completely ruled out. Moreover as the participants could choose to complete the two-day food records on whatever days they preferred, they might have selected days where they ate differently (i.e. healthier) than usual. However, the majority of parents and children reported consuming sweets and snacks, soft drinks and fatty food, suggesting that this may not be a major problem in this sample. Furthermore, it was not the aim of this study to test

what foods children ate, but rather if parents and children were consistent in reporting the foods consumed.

The "side-by-side" comparison is limited as the seven-day food diary and the two-day food record differ both in length and in completing procedures. However, since the aim of both studies was to assess child-parent agreement, and that the two samples were selected from the same population, it makes sense to look at which instruments shows larger agreement values. Moreover, previous studies have shown that shorter alternatives of data collection are often preferred for feasibility reasons (Branscum, Sharma, Kaye, & Succop, 2010).

K values were used to compare studies. Using a different threshold could have resulted in slightly different values. However, as the lower bound of the CI were used, overestimation of results was likely avoided.

Finally, as there is a lack of validated food consumption instruments in Switzerland, the two-day food record was also a non-validated instrument. The lack of a biomarker or observation to compare the self-reports might constitute a limitation. However, the scope of this study was to test agreement between children and parents when using the same instrument, and thus this limitation is marginal.

4.5 Implications for research and practice

The two-day food record showed high agreement in reporting children's food intake, suggesting that it could be used to collect reliable food intake information directly from children, for studies where nutrients and portions are not imperative. Both instruments could be used to record children's food consumption, but using the two-day record resulted in higher agreement between parents and children, regardless of their gender and grade at school. Finally, the two-day food record tool simplifies data collection and data entry procedures, while providing reliable data about children's food intake.

Practice Points

- ✓ A 2-day food record provides reliable data about children's food consumption.
- ✓ Children are reliable reporters of their food consumption and no information from parents is needed.

- ✓ Using a 2-day food record tool simplifies the data collection and data entry.

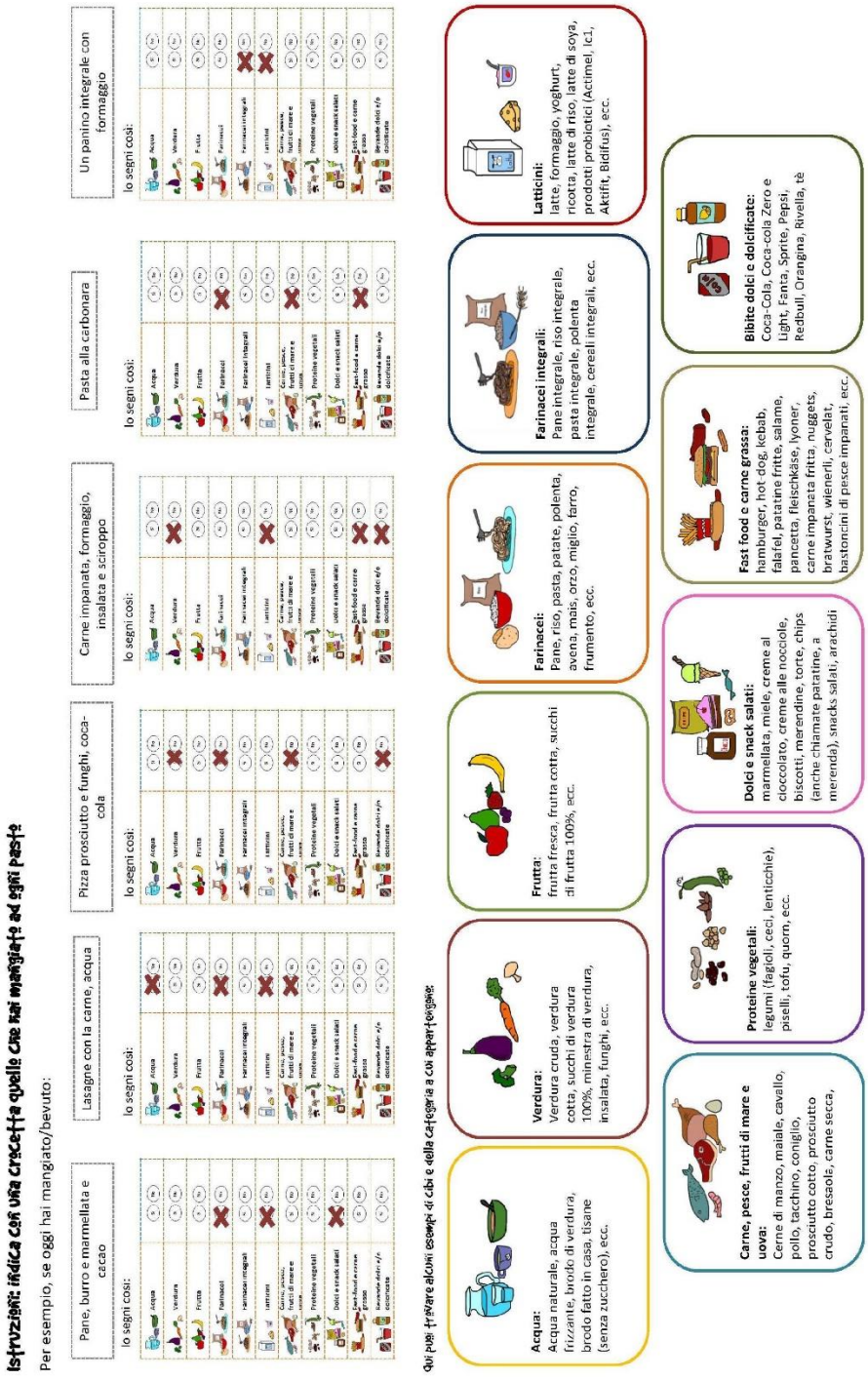
4.6 Acknowledgments

The authors thank the families that participated and provided the data for this study; the Department of Education, Culture and Sport of Canton Ticino, Switzerland, and all school directors and teachers for their support; as well as the student assistants and interns that helped with the data entry and double check of the data. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

4.7 Supplementary material

Supplementary Figure 4.1 The 2-Day Food Record – Front Page

Supplementary Figure 4.2 The 2-Day Food Record – Back Page



Supplementary Table 4.1 Total Count and Percentage of "I do not know" Answers by Children (N=267) and their Parents (N=267).

	Breakfast		Morning Snack		Lunch		Afternoon Snack		Dinner		After Dinner	
	C	P	C	P	C	P	C	P	C	P	C	P
All foods Day 1	0 (0%)	1 (0.4%)	0 (0%)	9 (4.3%)	1 (0.3%)	9 (4.3%)	0 (0%)	6 (2.3%)	1 (0.3%)	2 (0.8%)	0 (0%)	2 (0.8%)
Water	0 (0%)	1 (0.4%)	0 (0%)	8 (3.0%)	1 (0.4%)	8 (3.0%)	0 (0%)	6 (2.2%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Vegetables	0 (0%)	1 (0.4%)	0 (0%)	9 (3.4%)	1 (0.4%)	9 (3.3%)	0 (0%)	6 (2.2%)	1 (0.4%)	2 (0.7%)	0 (0%)	2 (0.7%)
Fruits	0 (0%)	1 (0.4%)	0 (0%)	9 (3.4%)	1 (0.4%)	9 (3.3%)	0 (0%)	6 (2.3%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Starchy foods	0 (0%)	1 (0.4%)	0 (0%)	9 (3.3%)	1 (0.4%)	9 (3.3%)	0 (0%)	6 (2.3%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Whole grain	0 (0%)	1 (0.4%)	0 (0%)	9 (3.3%)	1 (0.4%)	9 (3.4%)	0 (0%)	6 (2.3%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Dairy products	0 (0%)	1 (0.4%)	0 (0%)	9 (3.4%)	1 (0.4%)	9 (3.3%)	0 (0%)	6 (2.2%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Proteins (meat, fish, eggs)	0 (0%)	1 (0.4%)	0 (0%)	9 (3.4%)	1 (0.4%)	9 (3.3%)	0 (0%)	6 (2.3%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Legumes, tofu, quorn	0 (0%)	1 (0.4%)	0 (0%)	9 (3.4%)	1 (0.4%)	9 (3.4%)	0 (0%)	6 (2.3%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Sweets and junk food	0 (0%)	1 (0.4%)	0 (0%)	9 (3.4%)	1 (0.4%)	8 (3.0%)	0 (0%)	6 (2.2%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Fat meat and fast food	0 (0%)	1 (0.4%)	0 (0%)	9 (3.4%)	1 (0.4%)	8 (3.0%)	0 (0%)	6 (2.3%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
Soft drinks	0 (0%)	1 (0.4%)	0 (0%)	9 (3.3%)	1 (0.4%)	8 (3.0%)	0 (0%)	6 (2.3%)	0 (0%)	2 (0.7%)	0 (0%)	2 (0.7%)
All foods Day 2	1 (0.3%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	14 (5.3%)	0 (0%)	11 (4.2%)	0 (0%)	2 (0.8%)	0 (0%)	1 (0.4%)
Water	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	13 (4.8%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)
Vegetables	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	14 (5.2%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)
Fruits	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	14 (5.3%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.8%)	0 (0%)	1 (0.4%)
Starchy foods	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	13 (4.8%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)
Whole grain	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	13 (4.9%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.8%)	0 (0%)	1 (0.4%)
Dairy products	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	14 (5.3%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.8%)	0 (0%)	1 (0.4%)
Proteins (meat, fish, eggs)	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	14 (5.2%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)
Legumes, tofu, quorn	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	14 (5.2%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)
Sweets and junk food	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	13 (4.9%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)
Fat meat and fast food	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	13 (4.9%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)
Soft drinks	1 (0.4%)	1 (0.4%)	0 (0%)	6 (2.2%)	0 (0%)	13 (4.9%)	0 (0%)	11 (4.1%)	0 (0%)	2 (0.7%)	0 (0%)	1 (0.4%)

[a]C = Children; P = Parents

Supplementary Table 4.2 Consumption of Foods Stated by Children and their Parents.

Food item	Children (N=267)		Parents (N=267)	
	Consume it (%)	**Proportion of consumption a**	**Consume it (%)**	**Proportion of consumption a**
Water	246 (92.1%)	2.9 (± 1.5)	212 (79.4%)	3.0 (± 1.5)
Fruit	245 (91.8%)	1.3 (± 1.0)	207 (77.5%)	1.3 (± 1.0)
Vegetable	243 (91.0%)	1.2 (± 0.8)	209 (78.3%)	1.3 (± 0.7)
Starchy foods	243 (91.0%)	2.2 (± 1.0)	208 (77.9%)	2.3 (± 1.0)
Whole grain	241 (90.3%)	0.5 (± 0.7)	207 (77.5%)	0.5 (± 0.7)
Dairy products	243 (91.0%)	1.7 (± 0.9)	209 (78.3%)	1.8 (± 0.9)
Proteins (meat, fish, eggs)	237 (88.8%)	1.3 (± 0.7)	208 (77.9%)	1.4 (± 0.7)
Legumes, tofu, quorn	241 (90.3%)	0.3 (± 0.5)	209 (78.3%)	0.3 (± 0.5)
Sweets and junk food	244 (91.4%)	1.6 (± 1.0)	207 (77.5%)	1.6 (± 1.0)
Fat meat and fast food	241 (90.3%)	0.2 (± 0.4)	210 (78.7%)	0.2 (± 0.5)
Soft drinks	242 (90.6%)	0.7 (± 0.9)	208 (77.9%)	0.7 (± 1.0)

[a] The proportion was calculated by dividing the total count for each food category (max 2 days × 6 meals = 12) by the number of days the log was completed (max 2 days). As only logs with 2 days completed were analyzed, all total counts were divided by 2.

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Chapter V

Does Additional Support Provided Through e-Mail or SMS in a Web-based Social Marketing Program Improve Children's Food Consumption? A Randomized Controlled Trial

Manuscript under review

Rangelov, N., Della Bella, S., Marques-Vidal, P., & Suggs, L. S. (in review). Does additional support provided through e-mail or SMS in a Web-based Social Marketing program improve children's food consumption? A Randomized Controlled Trial. Nutrition Journal.

Note: the paper and in particular table numbers have been reformatted to fit the format of this dissertation.

Abstract

Background. The FAN Social Marketing program was developed to improve dietary and physical activity habits of families with children in Ticino, Switzerland. The aim of this study was to examine if the effects of the program on children's food intake differed by intervention group.

Methods. Effects of the FAN program were tested through a randomized controlled trial. The program lasted eight weeks, during which participants received tailored communication about nutrition and physical activity. Families were randomly allocated to one of three groups, where the parent received the intervention by the Web (G1), Web + e-mail (G2) or Web + SMS (G3). Children in all groups received tailored print letters by post. Children's food consumption was assessed at baseline and immediate post intervention using a 7-day food diary. Generalized linear mixed models with child as a random effect and with time, treatment group, and the time by treatment interaction as fixed effects were used to test the impact of the intervention.

Results. Analyses were conducted with a sample of 608 children. After participating in FAN the marginal means of daily consumption of fruit changed from 0.95 to 1.12 in G1, from 0.82 to 0.94 in G2, and from 0.93 to 1.18 in G3. The margins of the daily consumption of sweets decreased in each group (1.67 to 1.56 in G1, 1.71 to 1.49 in G2, and 1.72 to 1.62 in G3). The change in vegetable consumption observed from pre- to post- intervention in G3 (from 1.13 to 1.21) was significantly different from that observed in G1 (from 1.21 to 1.17).

Conclusions. A well-designed Web-based Social Marketing intervention complemented with print letters can help improve children's consumption of water, fruit, soft drinks, and sweets. The use of e-mail and SMS to support greater behavior change, in addition to Web-based communication, resulted only in a small positive change for selected food categories (i.e. vegetables and fat meat and fat fish). Hence, from our study, it appears that there is no one size fits all answer to the question: does e-mail or SMS provide additional benefits over Web?, as it depends on the food groups targeted.

Keywords: Nutrition; Children; RCT; Intervention; Web; e-mail; SMS; e-health; Eating Behavior; Social Marketing.

5.1 Background

There is low adherence to nutritional guidelines in both adults and children in Switzerland. Among the adult population, only 19% of men and women consume the recommended five portions of fruit and vegetables each day (Federal Statistical Office (FSO), 2014), and the average meat consumption (780 grams per week per person) far exceeds the recommended amount of 240 grams per week (Federal Food Safety and Veterinary Office (FFSVO), 2017a, 2017b). A study conducted in Canton Ticino, one of the 26 States in Switzerland, showed that less than 50% of the children were adherent to the national dietary guidelines (Suggs et al., 2016). As dietary habits acquired during childhood persist into adult life, and are leading factors for many health issues (The et al., 2010; World Health Organization (WHO), 2014), it is important to promote a healthy diet to children.

Health programs designed to influence children's diet are quite heterogeneous in that they have been conducted in different settings (schools, homes, communities), used different study designs (cohort studies, randomized control trials), were informed by different theories (e.g., Theory of Planned Behavior, Social Cognitive Theory) and followed different approaches (for instance Social Marketing or health promotion). Interventions aimed at changing children's food consumption have often involved parents, who, as role models and providers of food, exert a powerful influence on children's food consumption (Golley et al., 2011; Hingle et al., 2010; Van Lippevelde et al., 2012).

Social Marketing is a framework that integrates Marketing principles with other approaches to promote healthy behaviors, with the final aim of benefiting society. Social Marketing focuses on behavior and integrates best practice, theory, research, and a deep population analysis to develop effective behavior change interventions (Tapp et al., 2013). Social Marketing is the approach that is recommended by the World Health Organization to promote healthy nutrition and other lifestyle behaviors related to risks for non–communicable diseases (World Health Organization, 2013; World Health Organization Regional Office for Europe, 2013). Reviews of Social Marketing studies suggests that Social Marketing has been effectively used to change health-related behaviors (Gordon et

al., 2006; Gracia-Marco, Moreno, & Vicente-Rodríguez, 2012; Stead, Gordon, et al., 2007) and in promoting a healthier diet (Carins & Rundle-Thiele, 2014; Stead, Gordon, et al., 2007). The review conducted by Carins & Rundle-Thiele of Social Marketing studies for healthy eating showed that the majority of examined studies achieved positive behavior change. Further, the review showed that several healthy eating behaviors were improved, including fruit, vegetable, fat, and water intake (Carins & Rundle-Thiele, 2014).

Information and Communication Technology based programs for nutrition and healthy weight promotion can have positive effects in prompting and supporting behavior change (Hutchesson et al., 2015; Kohl et al., 2013; Lau et al., 2011; Webb et al., 2010). In particular, there is evidence that Web-based interventions are effective in changing behavior (Broekhuizen et al., 2012; Krebs et al., 2010; Olson, 2016; Suggs & Ratzan, 2012). Further, Short Messaging Service (SMS) and e-mails have been used as reminders and cues to action to improve engagement in interventions and to reinforce behavior change (Hutchesson et al., 2015; Webb et al., 2010). Results from a systematic review by Hutchesson and colleagues (2015) showed that obesity prevention e-interventions targeting different behaviors (i.e. nutrition, physical activity, weight maintenance) are primarily delivered through Websites, but that e-mail, SMS and other phone applications are increasingly being tested in isolation or in conjunction (Hutchesson et al., 2015). Another systematic review showed that using additional communication beyond a Web-only intervention increased the effectiveness of Web-based interventions, with SMS having a greater impact than e-mails (Webb et al., 2010).

Still, it is not clear to what extent SMS or e-mails directed to parents can improve children's eating behavior above and beyond a Web-based intervention. The aim of this study was thus to examine the effect of a Social Marketing healthy nutrition program on children's food intake. We aimed to assess if additional support parents received through e-mail or SMS translated into additional behavior change of their child over that of the Web-only group. The primary outcome was change in children's food consumption from pre- to post- intervention, according to intervention group.

The following hypotheses were tested:

1) Healthy food consumption would increase in all groups

2) Unhealthy food consumption would decrease in all groups

3) The e-mail group would show greater improvement than the Web-only group

4) The SMS group would show greater improvement than the Web-only group

5.2 Methods

The Web-based Social Marketing program called FAN "Famiglia, Attività fisica, Nutrizione" was designed to promote a healthy food consumption and regular physical activity among families living in Ticino, Switzerland (Rangelov & Suggs, 2015a; Suggs et al., 2013a). (Rangelov & Suggs, 2015b; Suggs, Rangelov, Rangel Garcia, & Aguirre Sanchez, 2013b). To develop FAN, the Social Marketing benchmarks (citizen orientation; behavior; theory; insight; exchange value; competition; segmentation; and methods mix) (The National Social Marketing Centre (The NSMC), 2010) were considered and followed (Rangelov & Suggs, 2015b; Suggs et al., 2013b). The methods mix includes the marketing mix: product, place, price, promotion, policy and partnership. All six were included in the development of FAN. Formative research was conducted with the target population (both children and their parents) to get to know and better understand their needs, but also their wants, regarding the content and the strategies for an intervention promoting healthy food consumption and physical activity. In particular, results of the focus groups and interviews conducted with the parents showed that while they used all three technologies daily (Web, e-mail, SMS), they were more keen to receive a Web-based intervention, compared to an e-mail or SMS intervention. Being very busy, they welcomed this approach, that would allow them to take the intervention anytime and anywhere, at their convenience. They also approved of e-mail and SMS, but only in case we used them with parsimony. Hence, we developed a Web-based intervention, using SMS and e-mail as reminders. Further details about the development of the study can be found in Rangelov and Suggs (2015) (Rangelov & Suggs, 2015b).

To be eligible to participate, families had to a) live in Ticino; b) be able to complete surveys in Italian; c) have Internet access, an e-mail address, and a mobile phone; and d) have a child attending elementary school, or first two grades of middle school. The

program was offered free of charge. Study procedures were reviewed by the Canton Ticino Ethics Committee and deemed exempt in accordance with Swiss law. In accordance with the recommendations of the Helsinki Declaration, both children and parents provided informed consent and voluntarily provided their data.

FAN was funded by the Department of Health and Social Affairs of Canton Ticino and Health Promotion Switzerland (see CONSORT Checklist) and all eligible families willing to participate were allowed to enroll. Parents were invited through a brochure and information letter distributed to children in all but four elementary and all middle schools of Canton Ticino between June 15th and September 15th 2010. Enrollment required two steps. First, families registered through the FAN program Website (http://edizione1.fanticino.ch/), providing their consent, contact information, their gender, the number of children, and their children's gender and grade at school. The baseline (BL) survey was sent to all those registered (see further information below) and had to be completed in the week of 13th-19th September. Parents that completed the BL were randomly assigned to one of three groups using Excel random draw command; Web-only (group G1), Web + e-mail (group G2) or Web + SMS (group G3).

The intervention lasted eight weeks, during which children and their parents received tailored information regarding nutrition and physical activity behaviors. Content was tailored based on gender of the parent, number and gender of the children, and based on the behavior that was perceived as being the most difficult to perform (physical activity or nutrition). All the delivered content was based on pre-existing material used in the Canton, and repackaged for the various communication channels used in this study. Every week, parents received new content on the password-protected Website and children received a personalized and tailored letter by post.

The Website was updated every Tuesday morning with a new theme related to nutrition. For example, the first week, titled "You are off to a good start and that is half the battle!" provided information about the recommendations for a healthy diet, while in the fifth week, theme called "Lunch and snacks with imagination", suggestions on how to cope with the lack of time to cook at lunch time and ideas for quick and healthy lunches and snacks were presented. Beyond providing information about the importance of healthy

nutrition, the Website provided practical advice including recipes and tips on how to eat better, how to introduce healthier food to the family, and how to deal with concerns. Content was shown in form of short text, pictures, and videos. A forum was also available to families where they could discuss things together and with a dietician.

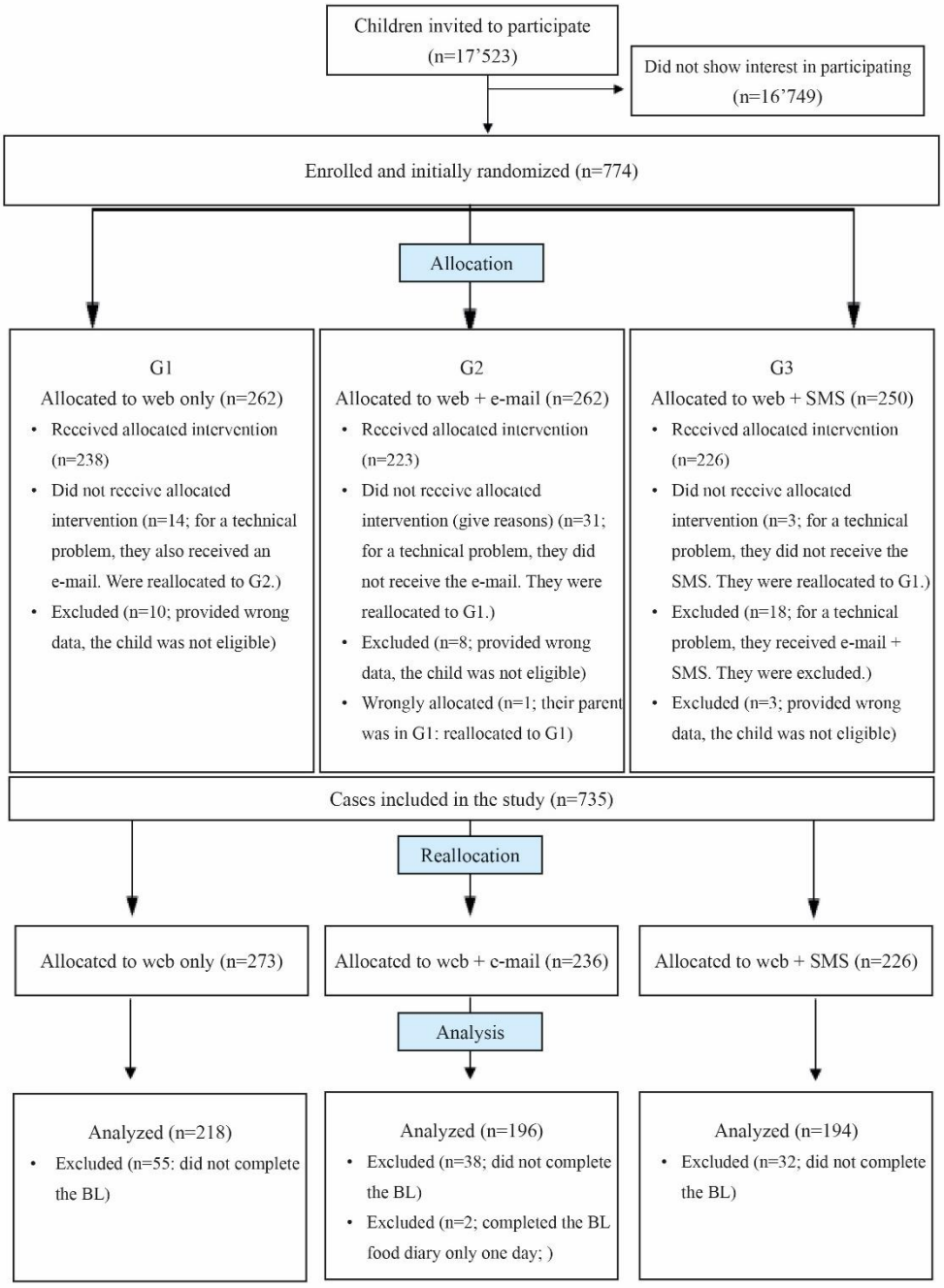
The e-mails and SMS were used as weekly reminders to prompt parents in G2 and G3 to visit the Website. In addition to providing a link to the Website, the e-mail provided a short summary of the weekly theme, in form of a short text, a main image on top of the text, and links to different pages on the Website at the bottom. For example, the text of the e-mail in the fifth week was: "Dear Ms. Rossi, Welcome back to FAN! This week we would like to show you some alternatives for a healthy lunch. […] Has it ever happened that you ate a sandwich or a hamburger, because it was easier, because you did not have time or because you did not find another healthier alternative? […] We suggest you a healthy recipe that is easy to prepare. The ingredients are: salad, tuna fish, olive oil, and… find the rest on the Website [link]! […]".

The SMS also included a link to the Website, along with a message aimed to stimulate motivation or provide support (e.g. "You do not have much time to cook over lunch time, but you'd like that your children eat healthy? Visit the FAN Website!"). These were sent every Tuesday morning, after the Website was updated. Further details about the communication and behavior change strategies can be found in Rangelov and Suggs (2015) (Rangelov & Suggs, 2015a).

After excluding children that were not eligible, and those that did not receive the allocated program, 735 children were included in the study. Since for technical problems some families did not receive the allocated intervention, these families were reallocated to the correct group. For instance, fourteen families allocated to G1 also received an e-mail: these families were reallocated to G2. Thirty-one families allocated in G2 did not receive the e-mail for technical issues, hence they were reallocated to G1. Finally, three families in G3 did not receive any SMS (issues with their mobile phone) and were reallocated to G1, and 18 families received the e-mail and the SMS, hence they were excluded from analyses. No parent or child withdrew from the program. Of those, 125 children were excluded from analyses as they did not complete the BL, and two were excluded as they

completed the BL food diary only one day. The final sample included 452 parents and 608 children, divided as follows: G1) Web-only (n=163 parents; n=218 children), G2) Web + e-mail (n=144 parents, n=196 children), and G3) Web + SMS (n=145 parents; n=194 children). There were 308 parents participating with one child, 133 parents with two children, 10 parents with three children and one parent with four. All children of the same parent were placed in the same group as their parent (for further details, see the CONSORT Flow Diagram). Since Web-based programs have shown to be effective in other studies and the program was available to all eligible families as part of the funding agreement, the Web-only group (G1) served as the control group, and the e-mail (G2) and SMS (G3) groups were expected to produce additional benefits.

CONSORT Flow Diagram



Gender, age, height and weight of the children were collected at baseline (BL) through a print survey completed by parents. Height and weight were used to calculate Body Mass Index (BMI). Age and gender-specific body mass index (BMI) cutoffs from the U.S. Centers for Disease Control and Prevention, validated for Swiss children, were applied (Zimmermann et al., 2004).

Food intake data were collected at both BL and at follow up (FUP - November 29th – December 5th). For each day of the week, children reported what they ate using a 7-day food diary (Rangelov et al., 2016).Based on the Swiss Society for Nutrition (SSN) (Swiss Society for Nutrition, 2010), 12 food categories were coded: water; fruit; vegetables; starchy foods; meat; fish; eggs; dairy products; fats; fat meat and fat fish; sweets; and soft drinks.Frequency of consumption of each food was recorded, and the mean of frequency of consumption was used as mean of daily intake (Rangelov et al., 2016). Portion sizes were not recorded as children of this age range have been shown to be unreliable in accurately quantifying their food intake (Collins et al., 2010; Foster, Adamson, Anderson, Barton, & Wrieden, 2009; Livingstone & Robson, 2000). All data were entered in a database and double checked to limit data entry errors. The database was stored on the University server, accessible to the research team only.

Bivariate comparisons were performed using one-way ANOVA or student's t-test for continuous variables. Intention to treat analyses were performed. The effect on food consumption for each intervention group was assessed using mixed models with pre and post intervention data. Continuous data (i.e. daily frequency of consumption) were analyzed using linear mixed models. Analyses were performed with cases that completed the food diary for at least four days out of seven at BL. A sensitivity analysis was performed including only participants who completed the food dairy for at least four days at both BL and FUP.

At the time of the study, there were no data available regarding food consumption among children in Ticino, nor information about possible effects of a social marketing campaign similar to ours on food consumption in children. Further, as this was an intervention at the cantonal level and in real-life setting, we could not limit our sample, nor we could make the intervention mandatory to participants. Hence, we could not

conduct a power analysis prior to the study, and we had to rely on the available sample size to conduct the analyses. The sample size was assessed post-hoc based on the results of the study and an alpha value of 5% and a power of 80% were used. All analyses were conducted using Stata version 14 (Stata Corp, College Station, TX, USA). All tests were two-sided and considered significant at the $p<0.05$ level.

5.3 Results

The mean age of children was 8.5 (SD = 1.9) and 49.3% were boys. The baseline characteristics and food consumption of the children are presented in **Table 5.1** and **Table 5.2**, respectively. The groups did not differ at BL for most variables, except for fish, and fat meat and fat fish consumption (see **Table 5.2**).

Table 5.1 Children's Characteristics at Baseline (Full Sample and by Intervention Group).

Characteristics at BL	Total (N=608)	Group 1 Web-only (n=218)	Group 2 Web + e-mail (n=196)	Group 3 Web + SMS (n=194)	p-value
Boys (%)	49.3	51.4	44.9	51.5	0.319
Age mean (SD)	8.5 (1.9)	8.4 (1.9)	8.7 (1.9)	8.4 (1.9)	0.170
	(N=587)	(n=212)	(n=184)	(n=189)	
BMI (%)					0.060
Underweight	10.4	14.6	8.1	7.9	
Healthy-weight	72.1	67.9	77.2	72.0	
Overweight or obese	17.5	17.5	14.7	20.1	

P-value from one-way ANOVA for continuous variable; χ^2-tests for categorical variables

Table 5.2 Daily Frequency of Consumption at Baseline by Intervention Group.

	Full sample (N=608)	Group 1 Web-only (n=218)	Group 2 Web + e-mail (n=196)	Group 3 Web + SMS (n=194)	p-value
FOC [mean (SD)]					
Water	1.49 (1.02)	1.42 (1.01)	1.54 (0.97)	1.51 (1.07)	0.63
Fruit	0.90 (0.62)	0.95 (0.62)	0.82 (0.59)	0.93 (0.65)	0.09
Vegetables	1.17 (0.45)	1.21 (0.43)	1.16 (0.45)	1.13 (0.47)	0.20
Starches	2.72 (0.57)	2.68 (0.58)	2.68 (0.55)	2.79 (0.57)	0.07
Meat	0.74 (0.31)	0.73 (0.28)	0.75 (0.34)	0.76 (0.31)	0.58
Fish	0.17 (0.17)	0.19 (0.17) [a]	0.18 (0.17)	0.15 (0.16) [a]	0.07
Eggs	0.15 (1.29)	0.15 (0.17)	0.15 (0.15)	0.15 (0.15)	0.99
Dairy products	1.71 (0.59)	1.67 (0.53)	1.75 (0.64)	1.71 (0.60)	0.37
Fat	0.84 (0.44)	0.82 (0.41)	0.82 (0.42)	0.88 (0.47)	0.30
Fat meat/fat fish	0.27 (0.22)	0.25 (0.21) [a]	0.30 (0.25) [a]	0.26 (0.20)	0.04
Sweets	1.70 (0.59)	1.67 (0.58)	1.71 (0.61)	1.72 (0.59)	0.64
Soft drinks	0.57 (0.61)	0.56 (0.57)	0.59 (0.63)	0.56 (0.64)	0.82

FOC, frequency of consumption. Statistical analysis for continuous variables by ANOVA with pairwise comparisons using Bonferroni method (or K-Wallis test plus Dunn's pairwise comparison for fish, eggs and water). Groups with a superscript differ significantly between them.

The marginal means of daily consumption of food and change between BL and FUP for the full sample and by group are presented in **Table 5.3**. The results of the generalized linear models estimating the effect of the intervention are presented in **Table 5.4**. The frequency of consumption of fruit significantly increased (+0.17) in G1 from BL to FUP. G2 and G3 did not significantly differ from G1 in terms of change in fruit consumption. In G1, the daily frequency of consumption of sweets decreased significantly by 0.11 in G1 **(Table 5.3)**. G2 and G3 did not significantly differ from G1 in terms of change in sweets consumption between BL and FUP. The frequency of vegetable consumption did not change significantly from BL to FUP for any group. However, the change from BL to FUP in G3 significantly differed (+0.08) compared to the change in G1 (-0.04). The intervention did not have other significant effects.

Table 5.3 Margins/Marginal Means of Daily Consumption of Food.

	Full sample (N=608)			Group 1 Web-only (n=218)			Group 2 Web + e-mail (n=196)			Group 3 Web + SMS (n=194)		
	BL	FUP	change	BL	FUP	change	BL	FUP	change	BL	FUP	change
Water	1.49 (0.05)	1.50 (0.06)	+0.01	1.42 (0.08)	1.45 (0.10)	+0.03	1.54 (0.08)	1.50 (0.11)	+0.04	1.51 (0.09)	1.57 (0.11)	+0.06
Fruit	0.90 (0.03)	1.08 (0.04)	+0.18	0.95 (0.05)	1.12 (0.08)	+0.17	0.82 (0.05)	0.94 (0.06)	+0.12	0.93 (0.06)	1.18 (0.07)	+0.25
Vegetables	1.17 (0.02)	1.16 (0.03)	-0.01	1.21 (0.03)	1.17 (0.04)	-0.04	1.16 (0.04)	1.09 (0.06)	-0.07	1.13 (0.04)	1.21 (0.04)	+0.08
Starchy foods	2.72 (0.03)	2.63 (0.03)	-0.09	2.68 (0.05)	2.62 (0.05)	-0.06	2.68 (0.04)	2.63 (0.06)	-0.05	2.79 (0.05)	2.66 (0.05)	-0.13
Meat	0.74 (0.01)	0.74 (0.02)	0.00	0.73 (0.02)	0.70 (0.03)	-0.03	0.75 (0.03)	0.77 (0.03)	+0.02	0.76 (0.02)	0.74 (0.03)	-0.02
Fish	0.17 (0.01)	0.16 (0.01)	-0.01	0.19 (0.01)	0.17 (0.01)	-0.02	0.18 (0.01)	0.16 (0.02)	-0.02	0.15 (0.01)	0.16 (0.02)	+0.01
Eggs	0.15 (0.01)	0.14 (0.01)	-0.01	0.15 (0.01)	0.13 (0.01)	-0.03	0.15 (0.01)	0.16 (0.02)	+0.01	0.15 (0.01)	0.13 (0.01)	-0.02
Dairy products	1.71 (0.03)	1.73 (0.03)	+0.02	1.67 (0.04)	1.71 (0.06)	+0.04	1.75 (0.06)	1.77 (0.06)	+0.02	1.71 (0.05)	1.72 (0.05)	+0.01
Fat	0.84 (0.02)	0.92 (0.03)	+0.08	0.82 (0.03)	0.90 (0.05)	+0.07	0.82 (0.04)	0.91 (0.04)	+0.09	0.88 (0.04)	0.97 (0.05)	+0.09
Fat meat/fat fish	0.27 (0.01)	0.27 (0.01)	0.00	0.25 (0.02)	0.28 (0.02)	+0.03	0.30 (0.02)	0.28 (0.04)	-0.02	0.26 (0.02)	0.26 (0.02)	0.00
Sweets	1.70 (0.03)	1.55 (0.03)	-0.15	1.67 (0.04)	1.56 (0.05)	-0.11	1.71 (0.05)	1.49 (0.07)	-0.22	1.72 (0.05)	1.62 (0.06)	-0.10
Soft drinks	0.57 (0.03)	0.44 (0.03)	-0.13	0.56 (0.04)	0.45 (0.07)	-0.11	0.59 (0.06)	0.46 (0.05)	-0.13	0.55 (0.05)	0.41 (0.05)	-0.14

Table 5.4 Effect of the Intervention on Daily Consumption of Food.

	Group 1 Web-only (n=218)	Group 2 Web + e-mail (n=196)	Group 3 Web + SMS (n=194)
Water	0.03 (0.09)	-0.07 (0.12)	0.02 (0.12)
Fruit	0.17* (0.07)	-0.06 (0.09)	0.08 (0.09)
Vegetables	-0.04 (0.04)	-0.03 (0.06)	0.12* (0.06)
Starchy foods	-0.06 (0.05)	-0.01 (0.07)	-0.07 (0.07)
Meat	-0.03 (0.03)	0.05 (0.05)	0.01 (0.05)
Fish	-0.02 (0.02)	0.00 (0.02)	0.03 (0.03)
Eggs	-0.03 (0.02)	0.03 (0.02)	0.01 (0.02)
Dairy products	0.04 (0.05)	-0.02 (0.07)	-0.03 (0.07)
Fat	0.07 (0.06)	-0.01 (0.07)	0.01 (0.07)
Fat meat/fat fish	0.03 (0.03)	-0.05 (0.05)	-0.03 (0.03)
Sweets	-0.11* (0.05)	-0.11 (0.07)	0.00 (0.08)
Soft drinks	-0.11 (0.06)	-0.02 (0.08)	-0.04 (0.08)

Results are presented as regression coefficients (Std. Errors).
*Significant at the $p<0.05$ level.

Sensitivity Analysis

Roughly 47% of children in G1, 43% in G2, and 41% in G3 did not complete the FUP or completed it for less than 4 days. Results of the sensitivity analysis show that children who did not complete the FUP, or completed it for less than 4 days, and children who completed the food dairy for at least four days out of seven at both BL and FUP were comparable in terms of BL characteristics (see **Table 5.5**), and food consumption. Children with complete data only differed in terms of a higher intake of fruit and dairy at BL. The effects of the intervention were also similar across the two samples.

Table 5.5 Baseline Characteristics of Children with Complete Data (at Least 4/7 Days at Both BL and FUP) and Children with Incomplete Data (less than 4/7 days at FUP).

	Children with complete data (n=341)	Children with incomplete data (n=267)	p-values
Gender (%)			
Boys	51.3	46.8	0.270
Mean Age (SD)	8.5 (1.9)	8.5 (1.9)	0.793

	Children with complete data (n=333)	Children with incomplete data (n=255)	
BMI (%)			0.337
Underweight	9.3	11.8	
Healthy-weight	74.5	69.0	
Overweight or obese	16.2	19.2	
	Children with complete data (n=341)	Children with incomplete data (n=267)	
Food consumption FOC [mean (SD)]			
Water	1.53 (0.97)	1.44 (1.07)	0.319
Fruit	0.94 (0.63)	0.84 (0.61)	0.048*
Vegetables	1.18 (0.46)	1.15 (0.43)	0.338
Starchy foods	2.77 (0.56)	2.65 (0.57)	0.009*
Meat	0.74 (0.30)	0.75 (0.31)	0.678
Fish	0.18 (0.17)	0.16 (0.17)	0.209
Eggs	0.15 (0.15)	0.15 (0.16)	0.889
Dairy products	1.78 (0.60)	1.61 (0.57)	<0.001**
Fat	0.87 (0.45)	0.81 (0.42)	0.113
Fat meat/fat fish	0.28 (0.23)	0.25 (0.21)	0.103
Sweets	1.75 (0.60)	1.64 (0.58)	0.027*
Soft drinks	0.63 (0.64)	0.49 (0.57)	0.007*

FOC, frequency of consumption. Results presented as means plus standard deviation (SD). T-test for continuous variables.
*Significant at $p<0.05$, ** significant at $p<0.001$

5.4 Discussion

The aim of this study was to test whether the effect of the FAN program differed by treatment group. The hypothesis was that children whose parents received weekly e-mails (G2) or SMS (G3) prompts, in addition to the Web intervention, would show more positive outcomes than G1. This study is unique in that the Web-intervention was for the parent and the behavior measured was that of the child.

Overall, the intervention effects were not different across groups. Children increased their daily consumption of fruit, and decreased that of sweets regardless of the group they were assigned. However, the effects of vegetable consumption were positive for those children whose parents received SMS prompts and were negative for G1 and G2, suggesting that to improve vegetable consumption, SMS prompts help. While not significant, the results obtained for G2 show that the e-mail had a positive effect on fat meat and fat fish, compared to G1 where it was a negative effect and to G3 where it did not change. Compared to G3, the effects in G2 for fruit, water, and soft drinks were slightly smaller, while they were larger for sweets.

A systematic review by Webb and colleagues (2010) including studies on several health topics (physical activity and nutrition among others), shows evidence to support the use of e-mail and SMS in addition to Web content (Webb et al., 2010). They found that using those additional modes of delivery increased the effects on behavior change, and that SMS use had larger effects, compared to e-mail use (Webb et al., 2010). Our results suggest that adding SMS reminders to parental communication only resulted in a small positive effect on the consumption of vegetables. As this is the first study, to our knowledge, that includes a tailored Web-based component for parents and a tailored print letter sent directly to children, further research is warranted.

Strengths and Limitations

This is the first study that was conducted with children and their parents in Ticino, Switzerland, and that assessed children's food consumption using a RCT design based on the communication delivered to parents. The sample was homogeneous in terms of baseline characteristics and analyses showed similar results when comparing children with complete data to children with incomplete data. However, a possible limitation is the sample size. Indeed, the power calculations suggested that a much bigger sample size was needed to detect meaningful differences in food consumption change between three groups (e.g. for fruit, N of 2544 per intervention group would be needed; for soft drinks N=3244 per group). This would require sampling approximately one fourth of the entire child

population aged 6-12 of the canton, which would require considerable financial and logistic resources.

The effects found might be due to the combination of the communication to the parent and the communication to the child, or solely due to the communication sent to the child. Future research should examine if interventions effects differ when the communication is sent to the child only, compared to parent only, and to both parent and child.

Moreover, it may be that the effects were partly due to other causes and not to the intervention per se. For example, children may have become more aware of their food choices and changed their behavior simply because they were asked to indicate what they ate. However, this is common in these types of studies, as noted by Macdiarmid and Blundell (1998) (Macdiarmid & Blundell, 1998). Finally, using a 7-day food diary allowed the accurate collection of data, while minimizing observation effects (Rangelov et al., 2016).

5.5 Conclusions

A Social Marketing tailored program for parents delivered through the Web and complemented with tailored letters directed to children might be enough to improve children's consumption of water, fruit, soft drinks and sweets. The beneficial use of e-mail and SMS to support greater behavior change beyond Web-based communication, is mixed. In the case of vegetable consumption, sending additional support through SMS to parents may be worth the investment, and e-mail may be useful to improve fat meat and fat fish consumption. Thus, from our study, it appears that there is no one size fits all answer to the question: does e-mail or SMS provide additional benefits over Web?, as it depends on the food groups targeted.

5.6 List of Abbreviations

BL = Baseline

FAN = Famiglia, Attività fisica, Nutrizione (Family, physical Activity, Nutrition)

FUP = Follow up

G1 = Group 1: Web-only

G2 = Group 2: Web + e-mail

G3 = Group 3: Web + SMS

RCT = Randomized Controlled Trial

SMS = Short Messaging Service

5.7 Declarations

Ethics Approval and Consent to Participate

Study procedures were reviewed by the Canton Ticino Ethics Committee and voted "exempt" from human research ethics approval in accordance with Swiss law. According to the recommendations of the Helsinki Declaration, all participants, both children and parents, provided informed consent and voluntarily provided their data.

Consent for Publication

Not applicable.

Availability of Data and Material

The data analyzed in the current study are available upon request.

Competing Interests

The authors declare no competing interests.

Funding

This study was funded by the Swiss National Science Foundation (Ref. n. CR131_156385 /1). The FAN intervention was funded by the Department of Health and Social Affairs of Canton Ticino and by Health Promotion Switzerland. The funders had no role in the decision to publish or in the preparation of the manuscript.

Author's Contributions

NR and SS formulated the research questions, designed and carried out the study. SDB analyzed the data. PMV helped in the data analysis. All authors wrote the article and approved the final manuscript.

Acknowledgements

The authors thank all the children and their families, who participated and provided the data for this study; the Department of Education, Cultura and Sport of Canton Ticino, Switzerland, and all school directors and teachers that helped with the recruitment. The authors also thank all the past research team that helped in the implementation of the study, and the data entry and coding process.

Chapter VI

e-Health Interventions: Is all Engagement Equal in Association with Children's Food Choice?

Manuscript under review

Rangelov, N. (in review). e-Health Interventions: Is all Engagement Equal in Association with Children's Food Choice? Health Education Research.

Note: the paper and in particular table numbers have been reformatted to fit the format of this dissertation.

Abstract

It is assumed that participant engagement is associated with behavioral outcomes. In e-health intervention research, these are primarily measured in association with online engagement measures. However, e-health interventions often promote offline behaviors that may also be associated with behavioral outcomes. This study examines engagement in an online Social Marketing intervention using both online and offline measures of engagement, and assesses the association with changes in children's food consumption. Offline engagement measures were collected through a survey; online engagement measures were retrieved from the Website visitor log. Over the intervention period of eight weeks, 22'259 clicks were registered (average of 114.15 clicks per parent). Tailored printed letters were sent to 333 children weekly. Reading and speaking about the letters with their siblings was associated with improved children's consumption of fruit and sweets at follow-up. Reading them with parents was associated with negative outcomes for fruit and sweets consumption. The total number of clicks was associated with improved fruit consumption. Some results support the hypothesis that higher engagement leads to more positive outcomes. Both online and offline measures were associated with some positive outcomes, and both should be measured in e-health interventions, as activities performed offline might explain positive behavior change.

Keywords: Child Health; Social Marketing; Health Communication; Nutrition, Internet; Technology; Participation.

6.1 Introduction

Overweight and obesity are two important global health issues. Data in Switzerland show about 40% of the adult population is overweight (30.7%) or obese (12.7%), and 2.4% is underweight (Bochud et al., 2017). The rates for childhood overweight and obesity are about 15% and 5% respectively (Federal Office of Public Health (FOPH), 2014a, 2014b; Lamprecht & Stamm, 2012). Among the many negative consequences of unhealthy body weight, diseases such as type 2 diabetes, high cholesterol, back pain, cardiovascular diseases, cancers, and low self-esteem can be cited (Federal Office of Public Health (FOPH) & Federal Department of Home Affairs (FDHA), 2008; Federal Office of Sports (UFSPO), Federal Office of Public Health (FOPH), & Promozione Salute Svizzera (PSS), 2009; Reilly et al., 2003; Reilly & Kelly, 2011; World Cancer Research Fund & American Institute for Cancer Research, 2007; World Health Organization, 2014; World Health Organization (WHO), 2011b). Poor nutrition and insufficient physical activity are among the determinants of overweight and obesity. Previous intervention studies successfully prompted physical activity (PA) and nutrition behavior change (Carins & Rundle-Thiele, 2014; Evans et al., 2010; Shive & Morris, 2006), contributing to the prevention of unhealthy weight in both adults and children.

Program features of successful interventions vary and include meetings with experts, letters or brochures delivered at home, phone-lines, events, workshops, and educational courses offered face to face and online (Carins & Rundle-Thiele, 2014; Wolfenden et al., 2014). However, technology developments have facilitated the diffusion of online health interventions aiming to improve healthy behaviors (Brouwer et al., 2009; Evers, 2006; Marcus et al., 2007; Norman et al., 2007; Van 't Riet, Crutzen, & De Vries, 2010). Technology-based interventions have been communicated through Websites, e-mails, interactive multi-media, online games, CD-ROMs, text messaging, and combinations of those (Hutchesson et al., 2015; Lustria et al., 2013; Lustria & Cortese, 2009; Nguyen et al., 2011; Norman et al., 2007).

While efforts have been made to promote the regular practice of physical activity and healthy eating (i.e. through national and cantonal programs, such as the "National

Program for Nutrition and Physical Activity 2008-2012"(Federal Office of Public Health (FOPH), 2014c), and the Ticino Cantonal Program "Healthy Body Weight" (Repubblica e Cantone Ticino, DSS, Ufficio del medico cantonale, Servizio di promozione e di valutazione sanitaria, 2011), most of the Swiss adult population (87.9% of men and 74% of women) still does not meet the 5-a-day recommendations for fruit and vegetable (F&V) consumption, and eats too much meat (780 grams per week per person, compared to the recommended 240 grams) (Federal Food Safety and Veterinary Office (FFSVO), 2017a; Federal Office of Public Health (FOPH), 2016; Federal Statistical Office (FSO), 2014; Federal Statistical Office (FSO) & Federal Department of Home Affairs (FDHA), 2016). Roughly 30% of the population does not practice PA for at least 150 minutes per week, as recommended by the Swiss Federal Office of Public Health (Federal Office of Public Health (FOPH), 2016; Federal Statistical Office (FSO), 2014; Federal Statistical Office (FSO) & Federal Department of Home Affairs (FDHA), 2016). Children's daily consumption of F&V is less than 50% for girls and 40% for boys (Federal Office of Public Health (FOPH) et al., 2012; Lamprecht & Stamm, 2012), and in general, children in Ticino have low adherence to Swiss nutritional guidelines (Suggs et al., 2016). Moreover, about 75% of girls and 55% of boys practices less than 7 hours per week of PA (Federal Office of Public Health (FOPH) et al., 2012; Lamprecht & Stamm, 2012). According to a study conducted among Swiss children using objective measures of PA, these percentages are even higher: 91.2% of girls and 88.7% of boys do not practice regular PA (Bringolf-Isler et al., 2016).

Behavioral Outcomes and Engagement in Interventions

The behavioral outcomes achieved by an intervention are influenced by intervention characteristics, relevance to the participants, program satisfaction, adherence to the intervention, and exposure to the intervention itself. Previous research has shown that participants who fully complete an intervention show more positive results in terms of behavior change than those who do not complete it (Cugelman et al., 2011; Danaher et al., 2006; Donkin et al., 2013; Schulz et al., 2012; Strecher et al., 2008; Verheijden, Jans, Hildebrandt, & Hopman-Rock, 2007). In interventions promoting physical activity and nutrition, a high level of engagement was associated with better behavioral outcomes

(Brouwer et al., 2011; Norman et al., 2007; Robroek et al., 2010, 2012). Hence, the hypothesis is that the more people are engaged in a health intervention, the more positive the behavioral outcomes will be (Danaher et al., 2006; Strecher et al., 2008). However, research has also shown that the actual engagement of participants in online interventions is often lower than is expected and suggested, as participants often leave the intervention Website before completing the intervention or do not follow the intervention as designed (Eysenbach, 2005; Glasgow et al., 2007; Kelders et al., 2012; Leslie, Marshall, Owen, & Bauman, 2005).

For online interventions, involvement of participants, defined as "engagement", "exposure", "adherence", or "usage" (Crutzen et al., 2011; Cugelman et al., 2011; Danaher et al., 2006; Neil et al., 2009; Schubart et al., 2011), is measured through the activities that take place online, although there is no specific agreement on what measures should be used to define these concepts (Bennet & Glasgow, 2009; Danaher et al., 2006; Demment, Graham, & Olson, 2014; Gold et al., 2012; Merchant et al., 2014; Strecher et al., 2008). Examples of measures used to assess participants' involvement are the number of clicks on a Website, pages or sections visited, frequency of visits, active or passive participation in online activities such as forums, games, and blogs (Brouwer et al., 2010, 2011; Couper et al., 2010; Crutzen et al., 2011; Danaher et al., 2006; Donkin et al., 2013; Leslie et al., 2005; Schulz et al., 2012; Wanner, Martin-Diener, Bauer, Braun-Fahrländer, & Martin, 2010).

However, while Web-based interventions are delivered online, they also promote behaviors that take place offline. For example, to change or maintain healthy diet behavior, online diet interventions do not only encourage participants to read information on a Website, participate in forums or watch online video. They also suggest preparing a new dish, counting the calories of meals, setting goals, setting rules around food consumption, or even to discuss weekly menus and the information obtained online within the family (van der Kruk, Kortekaas, Lucas, & Jager-Wittenaar, 2013). These activities are considered offline behaviors that aim at helping participants to change behavior.

Since research has shown that higher engagement with an intervention, as well as completing an intervention was associated with better behavioral outcomes (Brouwer

et al., 2011; Norman et al., 2007; Robroek et al., 2010, 2012), it is important to measure engagement in interventions. This would provide more insight as to what types of engagement and what levels of engagement are associated with desired outcomes. However, studies measuring engagement often report only a few select measures of online engagement. They also rarely examine the relationship that exists between the measures of engagement and the behavioral outcomes (Bennet & Glasgow, 2009; Donkin et al., 2013; Merchant et al., 2014). Further, according to Donkin et al. (2013), behavioral improvement has been related to the usage of program components (online engagement), but long-term improvements have been related to the completion of offline activities (Donkin et al., 2013). Thus, it is important to consider offline engagement when evaluating health interventions delivered online.

Finally, looking at e-interventions for obesity prevention and treatment targeted to children, research shows that very few studies include both children and their parents, while parents' involvement was shown to improve outcomes (Hingle et al., 2010; Nguyen et al., 2011; Stice et al., 2006; Wolfenden et al., 2012). As Hingle and colleagues (2010) point out, there is need to understand the impact of parental involvement on children's behavior change (Hingle et al., 2010).

This paper examines online and offline measures of engagement in an online Social Marketing intervention addressed to families and examines the association with change in children's food consumption. The findings of this research provide better understanding of what intervention features and what type of engagement (offline vs. online) are related to outcomes. This should inform the design and development of future nutrition related interventions and studies, as well as provide information about what aspects of engagement should be measured when assessing behavioral outcomes in online nutrition interventions.

6.2 Method

The FAN Social Marketing program was developed in Ticino, a Canton (or State) in Switzerland, with the aim of encouraging Ticino families to be more active and eat healthier. The intervention was addressed to families with children attending elementary

school or first two grades of middle school. It was offered free of charge and lasted eight weeks. The communication on healthy nutrition and regular physical activity was delivered through two main communication channels: a Website to parents and print letters to children. The study was reviewed by the Ticino Ethics Review Committee and deemed exempt in accordance with Swiss law. A detailed description of the FAN intervention can be found in Rangelov & Suggs (2015) (Rangelov & Suggs, 2015a).

The Website presented three main sections: one for "Family" related content, one for "Physical Activity" and one for "Nutrition" (http://edizione1.fanticino.ch/). The content of each section was a mix of theoretical information and practical advice on how to improve nutrition and physical activity behaviors, and how to do this within the family environment. The Website presented information in form of short pages with text content, videos featuring families performing healthy behaviors, and a forum discussion where parents could discuss issues with each other and ask a dietician or the FAN team for advice. The content was updated weekly, using a thematic schedule (i.e. Week 1 was about starting a healthy behavior, Week 2 about role modelling, Week 3 about breakfast, and indoor vs. outdoor PA) (see (Rangelov & Suggs, 2015a) for details). Parents also received a reminder about the weekly updates via e-mail or SMS. The reminders presented a short summary of the weekly theme, and prompted the parents to visit the Website at least once a week.

The content of the printed letters sent to the children was complementary to the content presented on the Website. It consisted of information about PA and nutrition, and games and activities related to these two behaviors. The aim was, on the one hand, to communicate with the children directly, and on the other hand to prompt communication between parents and children.

All materials were tailored to the participants based on evidence showing that interventions tailored to the participants needs tend to be more relevant and produce better outcomes than non-tailored ones (Campbell et al., 1994; Celis-Morales et al., 2016; Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008; Kohl et al., 2013; Krebs et al., 2010; Lustria et al., 2013; Noar, Benac, & Harris, 2007; Strecher, 1999; Suggs, 2006). The content on the Website was tailored to parents based on their gender, number and gender

of children, and their perceived most difficult behavior (physical activity or nutrition), which was assessed at baseline. The printed letters were tailored on the gender and the child's school grade. While the communication was tailored to the behavioral perceived difficulty of the participants, all the sections of the Website were open to all the participants, who were able to self-navigate through it.

In order to access the Website, parents were provided with a unique identification code and a password, so to guarantee anonymity and exclusive use of the Website by the participants in the program. A log of accesses and online activities in each session and by each individual was created through user authentication information. Data were stored on the Website server, including number of visits, number of clicks within the Website, pages visited, date and time of visits, length of stay, and activities conducted on the particular features of the Website. For example, the log collected data on whether the participants read the page about breakfast and when they did so.

Offline engagement was measured focusing on the letters to the children, the only offline communication material that was used in FAN, and on the offline activities that were promoted during the intervention period. Offline engagement data and children's online engagement data were collected immediately post-intervention via a self-report questionnaire. Online engagement of parents was measured using the data retrieved from the log of accesses stored in the Website server during the intervention. The variables used to measure offline and online engagement are presented in **Table 6.1.**

Behavioral outcomes were assessed by examining change in children's consumption of fruit, vegetables, sweets, water, and sugar drinks from pre to post survey. These data were collected through a weekly food diary completed at baseline and immediately post-intervention (Rangelov et al., 2016). The decision to consider these nutrition related behavioral outcomes was based on the data collected at baseline regarding which behavior between nutrition and physical activity children perceived as being the more difficult to improve or maintain. Further, the content of the letters sent to the children focused on these food categories. In **Table 6.1** the variables used for this study can be found.

Table 6.1 Summary of Analyzed Variables.

Measures	Variables	Method of collection	
		self-report questionnaire	Website log of access
Offline Engagement			
Child	The child did not read the letters	✓	
Child	The child read the letters alone	✓	
Child	The child read the letters with their parents	✓	
Child	The child read the letters with their siblings	✓	
Child	The child read the letters with their friends	✓	
Child	The child read the letters with other family members	✓	
Child	The child spoke about the letters with their parents	✓	
Child	The child spoke about the letters with siblings	✓	
Child	The child spoke about the letters with friends	✓	
Child	The child spoke about the letters with other family members	✓	
Child	The child spoke about the letters with teacher	✓	
Parent	The parent encouraged their children to eat healthy in the previous week	✓	
Parent	The parent looked for information about healthy nutrition in the previous month	✓	
Parent	The parent planned a healthy diet in the previous month	✓	
Online Engagement			
Child	Visited the Website (yes/no)	✓	
Child	Watched the videos (yes/no)	✓	
Parent	Total number of clicks		✓
Parent	Week of the first visit		✓
Parent	First visit occurs in week 1		✓
Parent	Weekly visit (8 times over 8 weeks)		✓
Parent	Mean of total visits per participant		✓
Parent	Average length of visits		✓
Behavioral Outcomes			
Child	Difference in child's proportion consumption of fruit	✓	
Child	Difference in child's proportion consumption of vegetable	✓	
Child	Difference in child's proportion consumption of sweets	✓	
Child	Difference in child's proportion consumption of water	✓	
Child	Difference in child's proportion consumption of sugar drinks	✓	

Analyses were conducted using STATA/MP 13.0 statistical software. The weekly consumption of foods was computed for both baseline and follow-up assessment, using the total count (range 0–42 times per week) of each food group consumed in a week and dividing it by the number of completed entries in a week (range 0–7 days completed). A paired-sample t-test was conducted to evaluate the difference in children's food consumption pre- to post-intervention. Regression analyses were performed to assess if there was a difference in food consumption according to the person that the children read or spoke about their letters with.

Only children that completed the food diary for all seven days for both baseline assessment and follow-up assessment were included. Offline data were analyzed using only cases that responded in a consistent way to both "read" activities, and "speak" activities. This means that children who answered both "I did not read the letters" and "I read the letters with X person", or that answered "I did not read the letters" and "I spoke about the letters with X person" were excluded from analyzes. Fourteen cases were deleted, because of inconsistent reporting. Online engagement data were analyzed using only cases for which Website usage data were available, and that visited the Website at least once during the eight week intervention.

A "click" is defined as "one visit to the corresponding Webpage". Exposure has been measured with regards to the overall Website and by thematic section. The number of clicks was summed to establish the number of total pages visited over the intervention period. The first visit date served to determine whether the participants entered the Website during the first week of the intervention, or later. The date of visits was also used to establish the level of adherence to the intervention timing; that is whether parents accessed the Website at least once per week during the intervention period.

A total of nine sections (Home, Family, Physical Activity, Nutrition, Useful Resources, Forum, Project Information, Contacts, and Not Categorized) were defined to classify the Website pages. The pages that were not classifiable into one section, because of the ambiguous title saved by the Website log, were placed in the "Not Categorized" section (i.e. pages named "recommendations", since it was not clear whether it referred to Nutrition or PA recommendations).

6.3 Results

Offline Engagement

After excluding cases where parents or children were not eligible or data were missing, the sample for the offline engagement analyses was composed of 248 parents (87.9% female) and 333 children (51.0 male; mean age 8.49, SD = 0.11). Most children (82.6%) attended elementary school, and 17.4% attended middle school. For 64.1% of parents PA was the most difficult behavior to engage in, while for 84.4% of children the most difficult behavior was eating healthy. The frequencies of engagement in offline activities are presented in **Table 6.2**.

Table 6.2 Offline Exposure Outcomes Frequencies in Percentages.

Reading the letters	n children=319
Children read the letters alone*	42.3
Children read the letters with their parents*	79.0
Children read the letters with their siblings*	22.6
Children read the letters with their friends*	1.2
Children read the letters with other family members*	2.2
Children did not read the letters *	2.2
Speaking about the letters	n children=310
Children spoke about the letters with their parents*	62.3
Children spoke about the letters with their siblings*	26.1
Children spoke about the letters with their friends*	12.6
Children spoke about the letters with other family members*	5.8
Children spoke about the letters with their teacher*	4.2
Children did not speak about the letters*	27.4
Encouraging their children to eat healthy in the past week	n parents=223
Parents encouraged their children to eat healthy everyday	54.6
Parents encouraged their children to eat healthy on 5-6 days	28.8
Parents encouraged their children to eat healthy on 3-4 days	11.9
Parents encouraged their children to eat healthy on 1-2 days	2.9
Parents never encouraged their children to eat healthy	1.6
Searching for information about healthy nutrition in the previous month	n parents =226
Parents searched for information about healthy nutrition – Always	7.2
Parents searched for information about healthy nutrition – Almost always	11.8
Parents searched for information about healthy nutrition – Sometimes	44.9
Parents searched for information about healthy nutrition – Almost never	15.7
Parents searched for information about healthy nutrition – Never	20.3
Planning for a healthy diet in the previous month	n parents=223
Parents planned for a healthy diet – Always	16.6

Parents planned for a healthy diet – Almost always	28.9
Parents planned for a healthy diet – Sometimes	29.9
Parents planned for a healthy diet – Almost never	12.9
Parents planned for a healthy diet – Never	11.6

*These categories are not mutually exclusive: some children read the letters or spoke about them with more than one person/category.

Results from a paired-sample t-test showed significant changes from BL to FUP for fruit (BL M=0.944, SD = 0.628; FUP M=1.122, SD=0.698, t(332) = 5.79, p<0.000), sweets (BL M=1.748, SD=0.591; FUP M=1.584, SD=0.586, t(332) = -5.21, p<0.000), and sugar drinks (BL M=0.622, SD=0.635; FUP M=0.475, SD=0.562, t(332) = -5.15, p<0.000) consumption. Regression analyses were run to assess whether reading the letters by themselves, or with a specific person, and whether speaking about the letters was associated with children's food consumption. Results show that reading the letters with their siblings was associated with a significant reduction in the consumption of sweets β = -.153, t (306) = -2.14, p<0.05, while reading them with their parents was associated with a significant increase β = .174, t (306) = 1.78, p<0.10. The models assessing the effect of the "speak" variable showed no significant results.

Regression analyses were run, adding parents' offline behaviors to the "read" and variables in the models. Significant results were obtained for the model with consumption of sweets. Reading the letters with their siblings was associated with a decrease in the consumption of sweets β = -.184, *t* (262) = -2.48, p<0.05, while encouraging children to eat healthy was associated with a significant increase in the consumption of sweets β = .110, *t* (262) = 3.26, p<0.01. Results of these regressions are summarized in **Table 6.3**.

Table 6.3 The Influence of Reading the Letters With Another Person and the Influence of Parents' Offline Behavior on Fruit, Sweets, and Sugar Drinks Consumption.

	Fruit	Sweets*	Sugar Drinks
read alone	.039 (.077)	-.033 (.089)	-.131 (.083)
read with parents	.075 (.096)	.154 (.098)	-.164* (.086)
read with siblings	.102 (.074)	-.184** (.074)	.028 (.100)
read with friends	-.391 (.293)	.146 (.235)	.116 (.173)
read with other family members	-.302 (.242)	-.452 (.346)	-.024 (.094)
parent encouraging their child	.017 (.032)	-.110*** (.034)	-.022 (.055)
parent looking for information	.006 (.031)	.034 (.031)	-.035 (.031)
parent planning a healthy diet	.044 (.030)	-.037 (.029)	.024 (.026)
_cons	-0.118 (.175)	-.223 (.104)	.154 (.024)
N	271	271	271
F (8, 262)	1.17	2.51	1.17
R-squared	0.0317	0.0783	0.0239

Results are presented as β coefficients (Standard error)

* p<0.10, **p<0.05, ***p<0.01

Parents' offline behavior activities were added to the model with the "speak" variables. Findings showed significant results for fruit, sweets and sugar drinks consumption. Speaking about the letters with their siblings was associated with a significant increase in the consumption of fruit β = -.242, t (190) = 3.06, p<0.01. Encouraging children to eat healthy was associated with a significant increase of consumption of sweets β = .097, t (190) = 2.74, p<0.01. Speaking about the letters with their friends and looking for information about a healthy diet were associated with a significant decrease of sugar drinks consumption β = -.167, t (190) = -1.68, p<0.10 and β = -.0.71, t (190) = -1.76, p<0.10 respectively. Results are presented in **Table 6.4**.

Table 6.4 The Influence of Speaking About the Letters with Another Person and the Influence of Parents' Offline Behavior on Fruit, Sweets, and Sugar Drinks Consumption.

	Fruit**	Sweets**	Sugar Drinks
spoke with parents	-.0.86 (.152)	-0.96 (.126)	.072 (.101)
spoke with siblings	.242*** (.079)	.039 (.079)	-.149 (.098)
spoke with friends	-0.20 (.130)	.120 (.135)	-.167* (.100)
spoke with other family members	-.087 (.162)	-.206 (.165)	-.106 (.101)
spoke with teacher	-.041 (.153)	-.304 (.191)	.146 (.096)
parent encouraging their child	-.021 (.038)	.097*** (.036)	-.063 (.068)
parent looking for information	.030 (.036)	.026 (.035)	-.071* (.040)
parent planning a healthy diet	.040 (.034)	-.021 (.034)	.047 (.035)
_cons	.060 (.236)	-.478 (.215)	.202 (.258)
N	199	199	199
F (8, 190)	1.99	1.99	1.98
R-squared	0.0602	0.0677	0.0610

Standard errors in parentheses

* p<0.10, **p<0.05, ***p<0.01

Online Engagement

After excluding cases for which Website use data were not available, and those that did not visited the Website during the eight weeks of intervention (i.e. visited it only after), the sample for these analyses consisted of 195 parents (88.2% female) and 261 children (51.7% male; mean age 8.39, SD = 0.11). Most children (84.3%) attended elementary school while the other 15.7% attended middle school. For 63.7% of parents PA was the most difficult behavior to engage in, while for 86.1% of children the most difficult behavior was eating healthy.

Over the intervention period (eight weeks), 22'259 clicks were registered on the Website, with the majority of clicks on the "Nutrition" section (n=9'815 clicks, 44%). The average of total clicks per family was 114.15 clicks. The average length of visits was 24.7 seconds (Std Error = 3.26, 95% CI = 16.31-29.16) per session. The number of clicks on each section and on the pages visited most frequently are listed in ascending order in **Table 6.5**.

Table 6.5 Number of Clicks on the Website Sections and on the First 15* Pages in Ascending Order.

	Number of clicks (N=22'259)	Percentage
Website section		
Nutrition	9'815	44.09
Physical Activity	5,567	25.01
Useful Resources	2,140	9.61
Family	1,863	8.37
Home	1,781	8.00
Not categorized	407	1.83
Forum	343	1.54
Project information	245	1.10
Contacts	98	0.44
Website page		
Home	1,739	7.81
Nutrition – week 1	1,122	5.04
Nutrition section home	891	4.00
Nutrition – theme of the week index	834	3.75
Nutrition – recipes	798	3.59
Videos	737	3.31
Physical Activity section home	658	2.96
Physical Activity – week 1	604	2.71
Physical Activity – theme of the week index	599	2.69
Nutrition – week 3	515	2.31
Family – Parents home	513	2.30
Nutrition – recommendations	460	2.07
Physical Activity – recommendations	456	2.05
Family section home	445	2.00
Not Categorized	407	1.83

* Convenience sample of 15 pages, the total being 207.

The number of visits per week diminished over time, with the most visits happening in week 1, and the least number of visits in weeks 5 and 8 (see **Table 6.6** for frequencies and percentages for each week). For the majority of participants, the first visit occurred during week 1 (74.9%) or week 2 (15.9%). In both cases, the majority of cases accessed the Website on Tuesday, when it was updated with new content (58.2% in week

1 and 45.1% in week 2). Roughly 31% of parents visited the Website at least once over the 8-week intervention period; 48% visited it at least once on two to four separate weeks, 18% visited it at least once on five to seven separate weeks, and 3% visited it at least once every week during the intervention.

Table 6.6 Number of Clicks on the Website by Week in Ascending Order.

Week	Number of clicks (N=22'259)	Percentage
1	5'419	24.35
2	3'285	14.76
3	3'104	13.94
4	2'823	12.68
6	2'508	11.27
7	2'018	9.07
5	1'577	7.08
8	1'525	6.85

Regression analyses were performed to assess whether the number of clicks on the FAN Website influenced children's food consumption. Results show that the number of clicks was associated with a significant increase in fruit consumption $\beta = .0002$, $t(259) = 2.02$, $p<0.05$. Regressions were also run to test whether the number of clicks on the nutrition section or the length of visits on the Website had an influence on children's food consumption. The higher number of clicks on the nutrition section pages was associated with significant increase in fruit consumption $\beta = .0004$, $t(259) = 4.73$, $p<0.05$. The length of visits did not have any significant association with food consumption. Results of the regressions run to test whether the fact that children visited the Website or that they watched the videos influenced their food consumption were not significant.

6.4 Discussion

Offline Engagement

Interestingly, and contrary to expectations, there was a negative association between encouraging children to eat a healthy diet and consumption of sweets. Indeed, in both models (reading and speaking), encouraging children to eat healthy was significantly

associated with an increase in the consumption of sweets (β = .110, t (262) = 3.26, p<0.01 for the model with reading, and β = .097, t (190) = 2.74, p<0.01 for the model with speaking). Also reading the letters with their parents was negatively associated with the consumption of sweets, which increased, and talking about the letters with the parents was not associated with significant behavioral changes.

This could be explained by the fact that children tend to challenge parental authority, that they are willing to exert their own power over food decisions, and that they may perceive parental encouragement as pressure, which result in eating more unhealthy foods, and less healthy ones (Galloway, Fiorito, Lee, & Birch, 2005; Galloway, Fiorito, Francis, & Birch, 2006; Walton, Kuczynski, Haycraft, Breen, & Haines, 2017). Both parents and children liked reading the letters, and parents were appreciative of the direct contact that FAN had with their children (Rangelov & Suggs, 2015a). Parents felt that FAN was supporting them in educating their children. However, it is not clear how parents and children read and discussed the letters, nor for how long or how often they did it. It is also not known what strategies of encouragement parents used to promote healthy eating to their children. In addition, research should be conducted to see how parents define a healthy diet, so to understand whether the issue could be in the encouragement activities, or in the content of what they perceive as being a healthy diet. For instance, looking for information about healthy eating was associated with a decrease in sugar drinks consumption.

On the contrary, there was a positive association between reading the letters with their siblings and children's consumption of sweets, as well as between speaking about them with their siblings and with their friends, and children's consumption of fruit, which increased, and sweets and sugar drinks consumption, which decreased. Previous research confirms that children are particularly influenced by their peers (Houldcroft, Haycraft, & Farrow, 2014), hence these findings are in line with what is already known. This suggests that future family interventions should focus on the relationship between and role of siblings.

Online Engagement

The number of clicks on the FAN Website (22'259) was high, compared for example to that found in another 8-week online intervention on physical activity (4'114) (Leslie et al., 2005). Other studies also report lower means of total visits per participants than those described in our study. Donkin et al. (2013) indicate an average of 18.7 log-ins (SD=8.3), and Robroek et al. (2012) a median of 3 visits per participant (Donkin et al., 2013; Robroek et al., 2012). However, considering the weekly visits over time, the number of participants visiting the Website decreased, and only 3% of the sample adhered to the intervention as recommended, that is visiting it at least once every week. This is consistent with other studies, that reported decreasing participation rates over the course of an online intervention and low adherence (Danaher et al., 2006; Eysenbach, 2005; Leslie et al., 2005; Merchant et al., 2014; Ware et al., 2008). The low regular visits might be due to the fact that although the content was updated every week, old content was not removed from the Website. Parents were thus able to read more themes in a week.

Parents went to the Website in order to look for information about Nutrition (9'815 clicks). A reason for parents' choice to visit the nutrition section more than the PA one could be that parents might have subscribed to FAN in order to retrieve information that could help them improve their children's food consumption behavior. Indeed, most of the children perceived to have difficulties in eating healthy. Parents stated that nutrition was an easier behavior to change compared to physical activity, especially in the family setting, where they were in charge of family meals.

The information stored in the log showed that most participants did not complete the intervention as designed. Further, the analyses of online engagement suggest that there is no link between parental visits on the FAN Website and children's behavior, apart from fruit consumption, that was associated with a higher number of clicks on the Website. While the coefficient appears to be small (β = .0002), it should be noted that its value has to be considered in relation to the wide ranging number of clicks. Hence, rescaling the unit of measure to 100 clicks (instead of 10'000), it is possible to see that by increasing by 100 the number of clicks, the consumption of fruit increased by 2%.

The FAN Website was addressed to parents, and not to children. The online engagement analyses, however, included two self-reported items by children (visited the Website and watched the videos). While these results were not significant in this study, future studies should include specific online features addressed to children to test the effect of children's online engagement on their food consumption.

Limitations and Future Recommendations

It might be argued that the number of clicks, although objective, is not a thorough measure of active participation or reading the Website. Hence, future studies should include complementary measures or even composite measures to better define the active online participation of participants. Similarly, new measures of offline engagement should be explored in association to behavior change. Indeed, some offline engagement data were self-reported by both parents and children, and more offline activities were suggested during the program implementation (PA activities, cooking, discussion, games, etc.). Future studies should explore additional measures of offline engagement, and whenever possible objective ones, and study their association to behavior.

Motives for participating in FAN have been hypothesized, but not analyzed in this study. Assumptions on the reasons for parents to read children's letters have been made based on the stated perceived difficulty. Learning and understanding more about the reasons for participating in such interventions, might inform the outcomes related to engagement and behavior.

Finally, for the time being, a comparison with other studies is rather difficult, given that the results commonly reported across studies differ. To better understand what specific content is related to positive behavioral outcomes, engagement measured through different points of view is needed.

Conclusions

This study compares typical online measures with measures of engagement in offline program related activities. Some of the results support the hypothesis that engagement is associated with improved food consumption behaviors. In programs that mainly take place online and promote healthy diet within the family, offline behaviors should also be promoted and evaluated. Future studies would benefit from measures of

participants' engagement in the offline components in addition to online engagement, in order to better understand what characteristics and components of such interventions are key to behavior change.

6.5 Funding

This study received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. The FAN intervention was supported by the Department of Health and Social Affairs of Canton Ticino; and by Health Promotion Switzerland. The funders had no role in the decision to publish or in the preparation of the manuscript.

6.6 Acknowledgements

The author thanks Mr. Salvatore Maione for the guidance on the statistical analyses, and all the parents and children that participated in FAN.

Chapter VII

Discussion

7.1 Summary of the Findings

The common underlying theme between the individual studies conducted and incorporated in this dissertation is the understanding of how to design, develop and evaluate effective Social Marketing interventions, aiming at promoting healthy food consumption among families with children attending elementary or middle school in Ticino. To do so, the development and communication strategies, as well as the food consumption evaluation instruments used in FAN were analyzed and discussed. In particular, the following aspects were examined:

1) *The operationalization and implementation of Social Marketing;*
2) *The measurement of children's food consumption;*
3) *The role of different communication channel bundles;*
4) *The role of engagement.*

The first two research questions were: 1) *"To what extent does the FAN intervention adhere to the eight Social Marketing benchmark criteria?"*, and 2) *"To what extent does adhering to the Social Marketing benchmark criteria positively affect rates of participation and satisfaction with the intervention?"*. The study in **Chapter II**

described process outcomes and demonstrated that FAN adhered to all eight Social Marketing benchmark criteria. This resulted in the involvement of the Ticino community in the development of FAN, which also contributed to high participation and retention rates, compared to other similar studies (Fjeldsoe et al., 2011; Keller et al., 2012; Neville et al., 2009; Suggs, McIntyre, et al., 2015).

Adhering to the benchmarks "*Citizen Orientation*" and "*Insight*" lead to the development of FAN according to the target population's needs, which resulted in high levels of appreciation of the intervention, by both parents and children (Carins & Rundle-Thiele, 2014; Kattelmann et al., 2014). Focusing on the "*Behavior*" and analyzing the "*Competition*" benchmarks, allowed the development of a program that was relevant and adapted to the participants. Developing the communication using "*Theory*", focusing on the "*Exchange value*", and tailoring the communication adhering to the "*Segmentation*" benchmark, also contributed to create appropriate communication content, delivered directly to each participant. Finally, adhering to the full "*Marketing Mix*" contributed to the success of FAN, since families were provided with an online intervention that they considered appealing and that reached them at their convenience in terms of both time and place.

Most parents and children expressed a high level of satisfaction with FAN and its communication content. They indicated that FAN met their expectations, and suited their needs and wants. Families conveyed a sense of being involved in the development of FAN and its success, and when expressing criticism, they provided insightful feedback that could be used to improve FAN. Participants also expressed interest in participating again in similar interventions, with a similar design.

The next research questions focused on understanding how to best measure children's food consumption, and how to collect reliable data while minimizing participant and researcher burden. Research questions 3 and 4 considered *"what is the level of agreement between children and their parents in reporting children's food consumption when using a 7-day food diary"* (RQ 3) and "*using a 2-day food record?*" (RQ 4) to understand whether children provide reliable reports of food consumption, using these two types of instruments. The fifth research question (RQ 5), "*Which instrument between the*

7-day food diary and the 2-day food record is more reliable to collect data about children's food consumption?", focused on understanding whether the compact version of the food consumption instrument would be more appropriate for this sample, or if the extended instrument should be used. Regardless of the instrument used, results of the study presented in **Chapter IV** showed statistically significant high levels of agreement between parents and children in reporting children's food consumption. Moreover, compared to previous studies, the 7-day food diary and the 2-day food record showed higher correlation coefficients (Thiagarajah et al., 2008; van de Gaar et al., 2016).

Consistent with Thiagarajah (2008), the analyses by gender showed no statistically significant differences in agreement between parent and child for both the 7-day food diary and the 2-day food record (Thiagarajah et al., 2008). On the contrary, a difference between the two assessment tools was found according to the children's school grade. When using the 7-day food diary, children in higher school grades showed larger correlation coefficients compared to children in lower grades. When using the 2-day food record children had similar agreement coefficients in all school grades. This could be explained by the fact that the 2-day instrument was shorter and required that children only tick the food categories they consumed rather than write out what they ate.

These findings suggest that both instruments were appropriate for use with children in elementary and middle schools in Ticino, and that children can provide reliable reports of their food consumption. However, comparing the two instruments, the findings suggest that the 2-day food record is slightly more advantageous, as overall, higher levels of agreement were found when using the 2-day food record compared to the 7-day food diary. Depending on their specific aim (estimating usual intake over time or current dietary intake), future studies can extend and further test the utilization of either of the two instruments to collect reliable data from children.

Two further studies examined the communication strategies and channels that were used to communicate the FAN program to participants, and the type of engagement related to outcomes in food consumption. Specifically, the study reported in **Chapter V** answered the following research question (RQ 6): "*Does additional support sent to parents through e-mail or SMS result in additional behavior change of their child over*

that of the Web communication only?". The study tested whether the effect of FAN on children's food consumption differed by treatment group, based on the channels of communication used to deliver the FAN communication to parents: Web-only, Web + e-mail and Web + SMS.

Based on previous research, it was hypothesized that the SMS group would show more positive results than the Web-only and e-mail groups, and that the e-mail group would show better results than Web-only group (Webb et al., 2010). Despite the systematic review by Webb and colleagues (2010) that suggests e-mail and SMS in addition to Web have positive effects on behavior, the results in this study showed overall similar effects for all three treatment groups. In particular, FAN had a positive effect on the consumption of fruit, which increased at post-intervention, and on the consumption of sweets, which decreased. Adding e-mail and SMS resulted only in small positive effects for selected food categories (i.e. vegetables, fat meat and fat fish). This study did not test the communication channels used to deliver the content to the parents compared to the communication channel used directly with children (print letters), so it could be that the effects were due to the communication sent to the children only, or due to a combination of the two. Hence, further research is needed in this domain to understand whether e-mail and SMS communication directed to parents has an additional effect on children's food consumption outcomes compared to Web communication only.

The final study described in **Chapter VI** focused on engagement in online interventions, and answered these two research questions: "*Does measuring engagement from an offline point of view lead to different behavioral outcomes than measuring it through objective computer logs?*" (RQ 7) and "*Which type of engagement is associated with positive behavior change outcomes?*" (RQ 8). The hypotheses predicted that higher levels of engagement would be associated with better food consumption outcomes, and that both offline and online engagement would show positive results.

The findings from this study support both hypotheses. Specifically, children who read the FAN letters and spoke about them with their siblings or their friends increased their consumption of fruit, and decreased their consumption of sweets and sugar drinks, which is consistent with previous studies showing that children are influenced by their

peers (Houldcroft et al., 2014). Further, looking at online engagement, the more parents visited the Website, in terms of number of pages viewed, the more children increased their consumption of fruit. In particular, the more they visited the pages in the Nutrition section, the higher children's fruit consumption was. Hence, both offline and online engagement were related to positive behavior change outcomes. However, there were some exceptions. For offline engagement, higher parental engagement in encouraging a healthy diet was associated with an increase in the consumption of sweets. Since the data collected did not allow the examination of which encouragement activities parents implemented or how they did it (i.e. did they just impose the diet "do not eat sweet!" or did they explain their children the reasons and instead of forbidding they limited the amount consumed?), this should be further researched. Another exception was the negative associations between reading the letters with their parents and children's consumption of sweets. More research is needed to better understand how parents and children read and discussed the letters. Finally, the length of parents' visits on the Website and children's online engagement (visiting the Website or watching the videos) were not associated with any behavior change.

Another important finding was that the number of pages viewed on the FAN website was high compared to other studies (Donkin et al., 2013; Leslie et al., 2005). Additionally and consistent with other studies, only a minority of the sample visited the website every week and weekly visits decreased over time (Danaher et al., 2006; Eysenbach, 2005; Leslie et al., 2005; Merchant et al., 2014; Ware et al., 2008). This could be explained by the fact that once content was uploaded on the Website, it was not removed in the following weeks. Thus, parents could read past weekly themes and pages later (i.e. in week 3, reading the content from week 3, but also from weeks 1 and 2).

In conclusion, the FAN Social Marketing intervention was successful in terms of participant satisfaction as well as for some behavior change outcomes. Adhering to the Social Marketing framework, and specifically, involving, listening to, and understanding the study population during the development and implementation of the intervention was a key element of its success. Overall, children improved their food consumption from pre- to post-intervention, regardless of the communication channels used to communicate with

their parents, with slightly more positive results for vegetable consumption when SMS communication was used. Participants' engagement with the intervention was high compared to other studies (Leslie et al., 2005). Specific types of engagement (i.e. reading the letters with the siblings, and visiting the FAN Website and specifically the Nutrition section) lead to improvements in children's consumption of fruit, sweets and sugar drinks. Other types of engagement (i.e. reading about the letters with parents, and encouraging children to eat healthy) were associated with negative outcomes. Finally, both food consumption assessment tools (2-day and 7-day) provided reliable data about children's food consumption.

7.2 Strengths, Limitations and Future Directions

As discussed in the previous chapters, each study had strengths and limitations. In this section, the principal strengths and limitations of this dissertation are highlighted. The operationalization of the Social Marketing benchmark criteria in FAN showed that using the Social Marketing framework to design and develop the intervention was an appropriate and effective strategy. Understanding the sample participants and focusing on them and their behaviors contributed to high participation, retention and satisfaction rates, and to positive behavior change found in children's food consumption, in particular fruit and sweets. Future projects aimed at improving children's food consumption should consider using the Social Marketing framework.

While built on Marketing concepts, Social Marketing is not limited to those, and it seeks to integrate theory, best practice, insight and research with the goal of developing and implementing effective, efficient and ethical social change programs (French & Russell-Bennett, 2015; Tapp et al., 2013). The accurate description of FAN with the operationalization of the benchmark criteria helps build evidence on Social Marketing, showing which benchmark criteria were used and their role in the development and implementation of the intervention. Indeed, there is a need to describe the focus and implementation of Social Marketing, but also to understand the techniques used (French & Russell-Bennett, 2015). If future studies were to do the same, rigorously describing the development, implementation and evaluation of the interventions, evidence of best

practice would be more easily and accurately built, and mistakes could be avoided. Further, clearly labeling Social Marketing interventions would help include all relevant studies when reviewing interventions with the aim of understanding their effectiveness and sharing this knowledge. Finally, comparability across studies would be increased, allowing best practice to be extended and generalized to other populations and settings.

Overall, the samples used in the different studies were homogenous in terms of baseline characteristics, and all studies were a first in Switzerland and Ticino, and with this population (school-aged children and their parents). Assessing children's food consumption also in relation to parents' behavior (such as encouragement to eat healthy, visiting the website, reading the letters) was a noteworthy element, and was justified by the fact that most parents reported participating in FAN for the health of their family, that is their own and their children's health (Rangelov, in review, 2011).

Another factor that reinforces the usefulness of targeting this population is that children in Ticino eat mostly at home with their parents (Suggs et al., in review). Hence, it was possible to collect and assess reliable data on children's food consumption for all meals, including lunch and snacks. The fact that the majority of participants (parents and children) also reported the consumption of unhealthy food (sweets, soft drinks, snacks, etc.), suggests that the desirability bias and observation effects were minimized. Moreover, the methodology used to assess agreement between children and parents in reporting the child's food consumption could be generalized and applied in other settings and with different foods as well.

A limitation regarding the data collection was the use of non-validated food consumption assessment tools (because of the lack of validated ones for Swiss children). However, the studies about parent-child agreement showed that while not validated, the data collection instruments used to collect the food consumption data of children participating in FAN are reliable. Being beyond the scope of this research, portion sizes were not measured. The decision to not collect data about portion size was taken based on past research showing that children are not able to accurately report portion sizes (Collins et al., 2010; McPherson et al., 2000). The question about how to collect reliable nutrition

data including portion sizes remains unanswered, and future research is needed to find other appropriate ways to quantifiably assess children's food consumption.

Further, the measures selected for use in this research (such as website use, length of visits, reading and speaking about the letters, among others) may not represent the full range of potential measures. While appropriate for this study, in the future, other measures of engagement should be combined with the current ones. In addition, future research should report similar measures of engagement, to help comparison across studies and for a better understanding of the evidence in this area.

While some effects of the intervention were detected, power calculations suggest that the sample used in the study assessing differences between channels of communication may have been too small to detect meaningful differences. Further, the effect of the combination of communication delivered to parents and communication delivered to children was not tested. Indeed, it may be that children improved their nutrition as a result of the FAN program as a whole, and not as a result of the separate communication strategies. Future research should test whether the effects differ if the communication is sent to both, or to only one of the two participants (children or parents).

While the findings suggest that the relationship among siblings, and their role within the family unit, may play an important and positive role in children's food consumption, this was not further examined. Future studies could examine the role of the family as a unit, and whether the participation of all family members is associated with better behavioral outcomes, compared to the participation of only part of the family unit.

The next step for future studies aimed at assessing children's food consumption should be to test the 7-day food diary and the 2-day food record with children of the same age group from other Swiss Cantons, in order to evaluate their use and the possibility to generalize it across Switzerland. Further, a validation study should be conducted, also testing their reliability in terms of actual food consumption (for example, by using biomarkers or observation methods).

As FAN promoted various activities such as sharing information, discussing the topic and planning ahead, and watching videos, future studies using a similar approach should consider including these specific measures of online engagement for children and

examine their effect on children's food consumption. They may also include reasons for participating in such interventions. Indeed, these were not examined in this study, but they may influence engagement with an intervention, and thus be related to outcomes of engagement and behavior.

7.3 Conclusion

Based on the findings of this dissertation, the following conclusions can be drawn, with regard to the four examined aspects:

1) *The operationalization and implementation of Social Marketing*

   Adhering to the eight benchmark criteria resulted in an intervention that was appropriate and relevant for the participants, and that had a positive effect on participation, retention and satisfaction rates. Interventions promoting healthy food consumption should adhere to the Social Marketing framework and be reported in detail in papers. Additionally, the development, implementation and evaluation of future Social Marketing interventions should be thoroughly described and documented. This would allow to compare the interventions, helping to create evidence of best practice and to extend methodologies to other settings and populations.

2) *The measurement of children's food consumption*

   Both the 7-day and the 2-day food assessment tools showed significant agreement between parents and children when reporting the latter's food consumption. Hence, children seem to be as accurate and able as their parents to report what they ate. The 2-day food record seems slightly more advantageous in that it is shorter and simpler to complete, while showing a high level of agreement also with children in lower grades at school. Finally, from a researchers' perspective, it was also less resource intensive to enter and code the data, compared to the 7-day food diary.

3) The role of different communication channel bundles

For this population, an online Social Marketing intervention delivered through a Website for the parents, with an offline component (print letters) for the children may be enough to improve children's food consumption, in particular that of fruit and sweets. Support sent by e-mail and SMS showed mixed results. It appears that the additional benefit of these two channels depends on the food groups that are targeted. With SMS and email showing greater improvement in vegetable, and fat meat and fat fish consumption.

4) The role of engagement

Engagement appears to be associated with behavior change. Thus to understand which activities promoted in the program are related to behavior change, measuring online and offline engagement is important and recommended. The findings reinforce the importance of measuring the offline engagement that a program promotes in addition to online engagement in e-health interventions.

The world is confronted with a variety of health-related challenges that result from choices on nutrition, physical activity, smoking, alcohol consumption and other behaviors. Among those, overweight and obesity, both associated with higher risk for non-communicable diseases, represent some of the most pressing, cross cutting threats. Despite some evidence of positive trends, prevalence rates of overweight and obesity remain high. Thus, it is pressing to develop and implement effective interventions that address these issues, and that do so in a cost-effective way.

On the one hand, the solution to that is not likely to be found in patented, profit producing products or services and thus will not attract sufficient policy attention nor the requisite amount of funding. On the other hand, while many strategies and approaches have been put in place to counteract these challenges (i.e. Health Education and Health Communication), and while some were effective, there is limited evidence that supports the proposition that health behavior changes are associated with solely communication-based approaches and strategies. This is also due to the relative novelty of these

approaches and to a lack of educated and trained health communication specialists, resulting in well-intentioned but ineffective efforts.

Social Marketing is a flexible framework that guides in detail the development, implementation, management and evaluation of health interventions. Overall, evidence has shown that this framework has been successfully used in different settings, with different populations and for different health behaviors (including nutrition), and that it has been widely supported at policy levels. However, despite the fact that there is an increase in the use of Social Marketing for health promotion, that the scientific evidence shows its potential, that a set of criteria exists that should facilitate the development and implementation of Social Marketing interventions, and that the framework is recommended by policy documents, the evidence on Social Marketing use and its impact on intervention effectiveness is not evident, particularly in Europe. To help build the evidence on Social Marketing research and practice, and reduce mistakes and waste of resources, methodologies need to be shared, and the Social Marketing benchmark criteria need to be systematically operationalized. As health and social problems evolve and social and economic conditions vary within populations, it is necessary to understand and to update the knowledge about what makes interventions successful or, on the contrary, makes them fail.

The Social Marketing framework focuses on knowing and deeply understanding the target population, developing a product that suits the populations' needs, and promoting an exchange that is fair and that helps and motivates the adoption or maintenance of healthy behaviors. However, this is challenging in food consumption research, especially involving children. The research described above tested two different food consumption measurement tools designed for children. The food diaries and records completed by children were compared to those completed by their parents, and the results suggest that even relatively young children can provide accurate and useful data. Further, FAN was developed after carefully listening to the target population needs, and taking into consideration previous research and the team's and the stakeholders' expertise. Since research suggests that given the influence on children, parents should engage in healthy behaviors, and families should participate in programs that promote family behavior

change, both parents and children where targeted, and behavior change within the family was promoted. This research highlights the importance of incorporating different communication channels, with complementary communication content. It also shows that cultivating engagement in a social marketing campaign can make a positive contribution to behavior change.

All things considered, this research contributes to building knowledge and evidence about Social Marketing use and promotion of healthy food consumption in children. The results provide an optimistic foundation that can be used and extended to other populations, behaviors and settings. Despite the difficulty to change behaviors, the positive results obtained when using the Social Marketing framework provide hope and optimism among health promoters, health care providers, policy makers, and other involved actors.

Appendices

Appendix 1. Published Paper Presented in Chapter II

Rangelov, N., & Suggs, L. S. (2015). Using Strategic Social Marketing to Promote Healthy Nutrition and Physical Activity Behaviors to Parents and Children in Switzerland: The Development of FAN. *Cases in Public Health Communication & Marketing*, *8*, 27–50.

CASES IN PUBLIC HEALTH COMMUNICATION & MARKETING
Volume 8, Winter 2015

Using Strategic Social Marketing to Promote Healthy Nutrition and Physical Activity Behaviors to Parents and Children in Switzerland: The Development of FAN

Natalie Rangelov, MA [1]

L. Suzanne Suggs, PhD, MS, CHES [2]

[1] BeCHANGE Research Group, Institute for Public Communication, Faculty of Communication Sciences, Università della Svizzera italiana.

[2] BeCHANGE Research Group, Institute for Public Communication, Faculty of Communication Sciences, Università della Svizzera italiana and Visiting Reader, Institute of Global Health Innovation, Faculty of Medicine, Imperial College London.

Corresponding Author: Natalie Rangelov, MA; Università della Svizzera italiana, ICP Via G. Buffi 13, CH – 6900 Lugano. Telephone: +41-58-666-42-94; E-mail: natalie.rangelov@gmail.com.

Suggested Citation: Rangelov N, Suggs LS. Using strategic social marketing to promote healthy nutrition and physical activity behaviors to parents and children in Switzerland: the development of FAN. *Cases in Public Health Communication & Marketing.* 2015;8:27-50.
Available from: www.casesjournal.org/volume8.

www.casesjournal.org

Milken Institute School of Public Health
THE GEORGE WASHINGTON UNIVERSITY

Peer-Reviewed Case Study

Abstract

Background. Poor nutrition and physical inactivity are among the primary determinants of overweight and obesity. Childhood overweight and obesity are the highest in Switzerland's most southern state (Canton Ticino). One policy initiative to address the problem was the "Healthy Weight Program" sponsored by the Ticino Cantonal Department of Health and Social Affairs. The program included several school and community based initiatives, including a community-based, social marketing initiative called "Famiglia, Attività fisica, Nutrizione" (FAN).

Methods. This case study presents data collected from the FAN project during the formative research, implementation, and post-intervention phases of a larger randomized controlled trial. Results presented describe the development process of the program in accordance with social marketing benchmark criteria, participation and retention rates, and program satisfaction.

Results. The social marketing benchmark criteria were operationalized and implemented in the development of FAN. The recruitment goal of 250 families was exceeded, with 555 families enrolled and 543 deemed eligible. Seventy-two percent completed the immediate post-program evaluation questionnaire. Almost 85% of parents evaluated FAN positively. The majority stated that FAN met their expectations (65%), motivated them to eat healthier (60%), and engage in more physical activity (40%). The majority of parents and children were satisfied with the various components of the program and found them useful.

Conclusions. Co-creation activities and following the social marketing framework were considered to be instrumental in achieving high levels of consumer participation and satisfaction with this community-based program. The time necessary to do strategic social marketing, was time well spent.

Keywords: Social marketing, Body weight, Child, Parents, Health behavior, Physical activity, Nutrition.

Introduction

Poor nutrition and physical inactivity can contribute to overweight and obesity. In Switzerland, only 19% of the population consumed at least five portions a day of fruit and vegetables,[1] and about 60% was completely inactive or only moderately physically active (one to two times per week).[2,3] Children in Switzerland have low fruit and vegetable consumption with roughly 55% of girls and 40% of boys consuming fruit and vegetables daily. Only 26% of girls and 45% of boys engaged in physical activity for more than four hours per week.[2] Roughly 30% of adults in Switzerland were overweight and 10% were obese,[1,2] and approximately 15% of children were overweight and 5% were obese in 2010-2011.[2,4] The southern region of Switzerland (Canton Ticino, the only one of the 26 Swiss cantons or states where Italian is the sole official language) had the highest rates of adult overweight and obesity (39.9% versus 38.9% in the German part and 38.8% in the French part), and of childhood overweight (17%) and obesity (6%).[5–8] Canton Ticino also had the lowest rates of physical activity in Switzerland, with 48% of the population being inactive.[2,9]

Being overweight or obese in childhood increases the likelihood to stay overweight or obese in adulthood, and thus the likelihood to develop chronic diseases.[10] Lifestyle habits developed in childhood are highly correlated with behaviors in adulthood.[10,11] Hence, it is of great importance to focus on behavior change, as well as on maintenance of healthy behaviors in childhood.[12] Famiglia, Attività fisica, Nutrizione (FAN), was a physical activity and healthy diet social marketing program for families in Ticino that had children attending elementary school or the first two grades of middle school (ages 6 to 12). FAN communicated directly with children and parents through print, web, e-mail, and mobile phones about the importance of healthy eating and physical activity, and ways in which to improve or maintain healthy eating behaviors and physical activity levels. Communications were tailored to the role in the family (parent or child), gender, number of children, child's grade in school, and which behavior (eating or physical activity) each participant perceived to be the most difficult for them.[13,14]

The objectives of FAN were to reach a representative sample ($\geq$ 250 families) of families from diverse social-economic groups across the Canton Ticino, improve or maintain healthy eating and activity behaviors,[13,14] serve as a communication instigator in the family, and be appreciated by the population. A final objective was to integrate research into a public service by establishing a public-public partnership between the Canton Ticino and the Università della Svizzera italiana.

In this paper, we describe the use of the social marketing framework in developing a program for healthy eating and physical activity behaviors of children and parents. We describe participants' satisfaction with the FAN program, participation and retention rates, and we present lessons learned that may assist other planners in developing health programs that reach a large percentage of the population and one that the participants are satisfied with.

Background

The Ticino Cantonal Department of Health and Social Affairs' "Peso Corporeo Sano" ("Healthy Body Weight") program aimed to raise awareness and provide information about physical activity and nutrition topics, increase awareness about nutrition related policy, and facilitate networking between stakeholders.[15] The "Healthy Body Weight" program included several school and community based initiatives for infants, children, parents, teachers, health care providers, and the general population. FAN was one of the projects offered within the "Healthy Body Weight" program,[13,14] in collaboration with the BeCHANGE Research Group at the local University, and was the only project that communicated directly with families in the home setting. FAN was offered free of charge to families.

Social Marketing to Improve Physical Activity & Eating Behaviors

Social marketing "seeks to develop and integrate marketing concepts with other approaches to influence behaviours that benefit individuals and communities for the greater social good."[16] In this recently published definition, the authors also underline that "Social Marketing practice is guided by ethical principles. It seeks to integrate research, best practice, theory, audience and partnership insight, to inform the delivery of competition sensitive and segmented social change programmes that are effective, efficient, equitable and sustainable."[16] The key concepts of social marketing are that it is based on commercial marketing principles, it focuses on behavior, and aims to enhance the public good, and thus benefit society.[17-21]

Social marketing is an effective approach in countering and preventing obesity and overweight.[22-23] Positive results are found in the academic literature and several policy documents, where social marketing is highlighted as the recommended approach for promoting physical activity and healthy eating behaviors.[24-26] The evidence of its utility has been documented across settings, countries and behaviors.[22,27-29] Social marketing programs have positively influenced nutrition and physical activity knowledge and behaviors,[23,27,28,30] as well as psychosocial variables (attitudes and self-efficacy).[27] Methods used to influence nutrition and physical activity behavior include educational approaches promoting a healthy diet, peer modeling, meetings with dietary consultants, gym classes in the school curriculum, and the creation of walking and cycling paths.[22,23,27,30-33] Some interventions have also promoted policy and environmental changes to increase opportunities to be physically active.[22,27,32]

Interventions targeting children that involve parents both in the development and the implementation of the intervention seem to have good outcomes.[34,35] Community-based social marketing programs have demonstrated success in changing nutrition and physical activity behaviors as well as in recruitment and retention.[22,36-38] This study builds off of these previous successes by involving parents and children in the development of the intervention, and setting a first example of such a program in Canton Ticino, Switzerland.

Methods

Study Design

This case study presents data collected during the formative research, implementation, and post-intervention phase of a larger, randomized controlled trial. The study design is pre-experimental; that is, no pretest to posttest results are presented and there are no comparison or control groups. The results presented are immediately post-intervention only, descriptive, and include a description of how the program was developed in accordance with the social marketing benchmark criteria, participation and retention rates, and program satisfaction. The local Ethics Review Committee reviewed the study and deemed it exempt in accordance with Swiss law for research with human subjects.

Sample & Sample Recruitment

This study was conducted in the Canton Ticino, Switzerland, a Canton with one of the highest rates of obesity and overweight among adults and children.[5-8] The target audience was families of elementary and middle school aged children. However, this was not a school-based intervention. Instead, parents were recruited to participate through schools and other venues, but the program was delivered directly to parents and children in their home environment.

Formative Research Sample and Recruitment. Formative research was done in order to gather information about participants' behavior and preferences related to nutrition and physical activity, insight about their expectations and needs, but also to pretest some of the materials developed. To recruit participants for the interviews and focus groups, the research team contacted a sample of schools in Ticino and published press releases in the local newspapers, inviting parents of children aged 6 to 12 to participate in the formative research, the pretest, and co-creation activities. A total of 12 parents and 13 children responded to the invitation to participate in the pretest activities. Another 14 parents and 25 children agreed to participate in the co-creation activities. Two dieticians, several school directors and teachers, and the Department of Health and Social Affairs also participated in various formative research activities.

Intervention Sample and Recruitment. FAN program recruitment began in May and ended in September of 2010, with September being the period of major effort. The objective was to recruit a sample of at least 250 families from across the Canton Ticino to participate in the intervention, including those who were overweight, healthy weight, and underweight, those who needed to improve behaviors, as well as those who needed to maintain them. Recruitment was conducted through brochures and posters, and media outlets. A total of 488 posters and 19,337 brochures were distributed to schools. Six press releases were developed and one interview was published in the local newspaper and on radio.

All promotional materials provided an Internet link to a website for registration. In order to register, parents had to complete an online form on the FAN website, indicating their and their children's personal data (name, last name, gender, date of birth, grade at school), their family's contact information (e-mails, phone numbers, mailing address), as well as providing parental consent for their family and child to participate. The research team then contacted the

families, sent a link to the online baseline survey to parents, and mailed a print version for children to complete. In order to be enrolled, parents had to provide consent and complete the baseline survey; the child's completion of the baseline survey was not a criteria for inclusion.

Six hundred ninety-five families registered for the program and 555 families (80%) completed the enrollment procedures. This included 556 parents (one family had two parents subscribed) and 750 children.[13] After excluding ineligible cases (ie, families that provided wrong information, enrolled children in kindergarten or in higher grades at school) and those that did not receive the online content because of technical problems (eg, service providers were not working or other technical issues), the final baseline sample consisted of 543 parents and 735 children. The retention rate was 71.5% for parents and 50.3% for children at the immediate posttest program evaluation interval.[13,14]

FAN Program Development & Implementation

Program Development. FAN was developed in collaboration with the Department of Health and Social Affairs in Canton Ticino, the BeCHANGE Research Group at the Università della Svizzera italiana, teachers from elementary and middle schools, parents, and children. The program was developed using the social marketing framework, which suggests that programs should adhere to a set of eight benchmark criteria, including: 1) citizen orientation, 2) behavior, 3) theory, 4) insight, 5) exchange value, 6) competition, 7) segmentation, and 8) methods mix.[29,30,39-41] The benchmark criteria were closely followed during FAN program development and implementation process. A summary of how the eight benchmark criteria were used is illustrated in Table 1.

Co-creation and desk research guided the program's content. Content was based on materials from other campaigns and interventions promoted by the Canton Ticino and the Swiss national office for health promotion, Health Promotion Switzerland. Letters for children, as well as website, e-mails, and Short Message Service (SMS) content were developed with parents' and children's input.[13,14] During the focus groups and interviews, examples of materials were pretested with the target audience. Participants provided oral feedback and suggested ways to improve the materials. Children wrote and drew directly on the letters, indicating what they liked, but also what was not clear to them, and then provided additional feedback verbally.

To illustrate and model behaviors, short videos about physical activity and nutrition were produced with the community. Additionally, graphics portraying a family modeling healthy nutrition and physical activity behaviors were designed specifically to visually represent and complement the communication content. The videos and final graphics were based on the results of the formative research, however they were not pretested. The FAN program content, all text, videos, and graphics were approved by the the Department of Health and Social Affairs and Health Promotion Switzerland prior to implementation.

Program Implementation. FAN was offered free of charge to families and the program provided eight weeks of tailored communications designed to help families improve or maintain nutrition and physical activity behaviors. Every week, parents received online, e-mail, and mobile phone-based communications, while children received printed letters sent by post each week.[13,14] The program intervention lasted eight weeks, between September 2010 and December 2010.

Table 1. Social Marketing Benchmark Criteria and FAN Process.

Benchmark Criteria	Definition	FAN Implementation
Customer Orientation	Conduct formative research to understand the behaviors, the attitudes and beliefs, wants and perceived needs of the target audience.	• Desk research • 4 Focus groups and 10 interviews were conducted. • Co-creation activities, including 20 videos. • 26 parents and 38 children were involved. • The program was developed for families' reported needs and wants.
Behavior	Social marketing interventions focus on a specific behavior, setting specific goals, and measurable objectives.	• Physical activity (goal: improve or maintain PA levels). • Nutrition (goal: increase or maintain fruit and vegetable consumption).
Theory	Theory is used to guide the development of social marketing programs. Different theories and models can be used for different interventions, depending on the situation, population, and topic of the intervention. The first benchmark helps the identification of the theory to be used.	• The Theory of Planned Behavior guided the development of the communication content. • Perceived behavioral control, attitudes, social norms, and intention were addressed.
Insight	Insight refers to the understanding of the motivators toward a behavior, as well as other elements that influence the behavior of the target audience.	• Formative research (focus groups and interviews, see benchmark 1) allowed understanding Ticino families' motivators and barriers towards adopting or maintaining the desired behaviors.
Exchange Value	Value exchange is about understanding the costs and the benefits associated with the desired behavior. It also includes creation of value for the audience through rewards and incentives.	• Healthy diet and regular physical activity were positioned as achievable behaviors for all and as more beneficial than competing behaviors. • Barriers were addressed. • Benefits were highlighted in the communication.
Competition	Internal and external analysis should be conducted to better understand what competes for the attention, time, and behavior of the target audience, and also to plan properly, in order to reduce the impact of these factors.	• SWOT Analysis was conducted to identify competitive behaviors and barriers (sedentary occupations, lack of facilities, time, unhealthy food promotion, price, etc.). • Competitive behaviors and barriers were analyzed and the communication was designed to help families overcome them.
Segmentation	Identification of the people that share similar characteristics, views, and behaviors is needed to plan and tailor the intervention so that is meets the needs and wants of the target population.	• Parents segmented according to: their gender, behavioral difficulty, number and gender of children, and child's behavioral difficulty. • Children segmented according to gender and grade at school. • Content was tailored to all participants.
Methods mix	Develop the appropriate mix of methods that will influence the behavior. This means the marketing mix, including product, price, place, promotion, partnership, and policy.	• Strategies for all six P's were developed in the marketing mix. • Product o Core: better health o Actual: healthy diet and physical activity o Augmented: website, e-mail, SMS, letters, forum, dietary consultant, video, recipes, etc. • Place: home environment • Price: non-monetary costs (time and effort); participation free of charge. • Promotion: fliers and posters sent to schools; press releases and interviews published in the local media outlets. • Policy: FAN was part of the "Healthy Body Weight" cantonal program and was funded as part of a strategic policy decision of the Canton. • Partnerships: collaboration among the Canton, the University, the national health promotion office, teachers, dieticians, and the target audience.

Data Collection & Measures

Formative Research. The formative research was conducted between October 2009 and August 2010. Formative research activities started with desk research that provided evidence about programs that work. A literature review was conducted in order to understand the situation in Ticino regarding physical activity and nutrition behaviors, as well as to collect additional evidence about existing programs in the Canton.

To gather information about the factors influencing dietary and physical activity behaviors, four focus groups were held (two with parents and two with children) with a total of 7 parents and 8 children. Ten structured interviews with 5 parents and 5 children were conducted separately. Two trained moderators led the focus groups and interviews, which were also audiotaped with participant's consent. Both the interviews and the focus groups lasted about one hour each, and consisted of questions related to nutrition and physical activity behaviors and preferences, expectations from a project promoting healthy diet and regular physical activity, as well as to the satisfaction and understanding of a sample of program materials (brand, content, assessments). To enhance our understanding of the audience, the Department of Health and Social Affairs specified information on physical activity and nutrition rates, habits, and needs in Canton Ticino.

Additional formative research activities included co-creation activities with members from the community, including 14 parents, 25 children, teachers, school administrators, dieticians, and students in a masters level course on social marketing, who helped to inform the brand, program timeline, data collection instruments, communication content and channels, and message timing. The dieticians provided insight regarding the nutrition related content and recommendations, and the school directors and teachers provided input regarding the content for children.

Post-Implementation Data Collection. As part of the enrollment, baseline surveys were completed between September 13th and September 22nd 2010. Immediately post-intervention, between November 29th and December 5th 2010, follow-up questionnaires were used to evaluate participant satisfaction with the program. Questionnaires were sent online to parents and by mail to children. As an incentive to participate in the follow-up assessments, a lottery was organized at the end of the study, for all participants that completed all assessments.

Satisfaction measures included 19 items, commonly used in measuring satisfaction with social marketing and community-based programs, such as "did you like the program?," "was the website useful?," "would you like to participate again?" These questions were then adapted for this context.[42-44] Data collected from parents reflected the following: global satisfaction with the program; how much FAN met participants' expectations; easiness in finding information on the website; whether FAN motivated parents and their children to practice physical activity and eat healthy; parents' satisfaction with children's letters; parents' satisfaction with the language used in children's letters; usefulness of the website; usefulness of the forum; usefulness of the video; satisfaction with the videos; satisfaction with the weekly e-mail and SMS messages; usefulness of e-mails and SMS as reminders to visit the website; likelihood of participating again in FAN; likelihood of participating in similar projects; and other positive and other negative aspects. Data collected from children reflected the following: overall satisfaction with FAN, satisfaction with the letters, satisfaction with the videos, and the likelihood of participating again in FAN.

The data collection instruments were tested with students of the university's social marketing course (which included some parents of young children), followed by parents and children from Canton Ticino. Existing questionnaires used in other studies, such as the PACE study, IPAQ short form, and the "Diamoci una Mossa" questionnaire, from the Italian Union Sport for All were used as a starting point.[45-47] After issues of format, ease of completion, and wording were addressed with the students in the social marketing course, parents and children completed and reviewed the assessment tools and suggested solutions for improvement.

Analysis

The results from the focus groups and interviews, as well as information collected informally (through discussions, phone calls, etc.), was stored and analyzed qualitatively. The research team reviewed the answers provided by the participants (both children and parents), and carefully considered the information provided by the other community members. The information and feedback received was then used to develop the materials for FAN.

Satisfaction measures were collected through an immediate post-intervention follow-up survey. Quantitative data were analyzed with SPSS (IBM SPSS Statistics 21.0), while qualitative data were analyzed with Atlas.ti. Descriptive statistics and frequencies were performed and included means and percentages for the responding parents and children.

Results

The process for development of the program using the social marketing benchmark criteria is described below, followed by program participant characteristics, motivation, and satisfaction results.

The Social Marketing Framework & FAN

Citizen orientation. To design a project that best suited the needs and the interest of Canton Ticino families, their involvement in the development of FAN was crucial. The brand (name and logo of the project) was developed through brainstorming sessions with the researchers and the target audience. The goal was that the brand would represent the key components and objectives of the program, while being appealing, recognizable, and rememberable by both adults and children. In brainstorming sessions among the researchers at the University and students from the social marketing class, terms referring to the key components of the program were developed. Associations were made with terms such as: family, parents, children, healthy nutrition, regular physical activity, health, lifestyle, fun, etc. Several names were chosen and pretested with researchers, stakeholders, and families.

The name that was considered to be the most appropriate, appealing, recognizable, and rememberable was the acronym FAN, which stood for "Famiglia, Attività fisica, Nutrizione" (in English, Family, Physical Activity, Nutrition). The design and development of the logo occurred in a similar fashion. Again, the criteria of appeal, recognition, memorability, and association with the

key components were considered. The research team developed logo designs and pretested the options with the target audience.

The timeline for the FAN program was determined based on consensus between participants, partners' requirements, and researchers. Research suggests that similar programs span at least 12 weeks.[32,48-50] Stakeholders were hesitant to enroll in a three-month program, due to the perceived burden and time commitment. They informed us that eight weeks was more reasonable and might allow us to reach more of the target population. Furthermore, a longer program would mean that the program overlapped with winter holidays and may have led to lower participation and retention rates. Thus, FAN spanned a period of eight weeks.

Parents indicated that Internet, e-mail, and SMS were acceptable and preferred channels for this program, as they allowed families to access the program at times most convenient to them. However, parents did not want any communications directed toward children to be online and preferred to have printed materials mailed out for children. They also informed us that they preferred to get new, updated information only once per week, rather than more often. Thus, a weekly thematic scheme was developed, in accordance with nutrition and physical activity recommendations (Swiss Society for Nutrition, WHO) guided by theories of behavior change, and participant input, and new content was added each week (see Table 2). Once new content was available, parents received an e-mail or a SMS with a brief summary of the content and a prompt to visit the website, and children received a printed, tailored letter in the mail.

The content was organized according to the FAN weekly themes, and it was adapted to the local community. Parents reported wanting easy access to information about the behavior they were having the most difficulty with. Thus, the content of the website was divided into two behavior sections: "Attività fisica" (physical activity), and "Nutrizione" (nutrition). Parents wanted to know about ways to improve their own behaviors, but also those of their family, so practical examples relating to both adult and child behavior were included in the weekly content of the nutrition and physical activity sections. Parents who were already eating in a healthy way and/or were practicing an adequate amount of physical activity, asked for more support and encouragement to maintain their behavior. They requested more examples and practical tips (eg, recipes, concrete physical activities, and events) to be able to maintain their healthy behaviors, but also to encourage their children to do the same. A third section was added and called "Famiglia" (family). This section gave advice on how to introduce and maintain behaviors in the family environment, thus promoting collective family engagement in healthy lifestyle activities. It also reinforced parents' role modeling, and promoted the activities that were proposed in the forum both from FAN, and from the parents directly, hence including participants ongoing co-creation activities.

Parents also wanted to be able to speak with a dietary consultant about problems in getting their children to eat healthier; hence, a forum with a weekly appointment with a local dietician was implemented on the FAN website. To address privacy concerns, each parent was assigned a pseudonym and given a unique login ID and password. Parents were also able to contact the dietician via a private message by e-mail. Parents also told us they needed recipes for healthy meals that were quick, inexpensive, and appealing to children. So, we created an online recipe library and suggested specific recipes each week on the website, as well as in the letters to children.

Table 2. Weekly Themes for FAN Content.

Week	Themes for Nutrition	Themes for Physical Activity
1	Chi ben comincia… è a metà dell'opera! *[You are off to a good start and that is half the battle!]*	Chi ben comincia… è a metà dell'opera! *[You are off to a good start and that is half the battle!]*
2	Il ruolo dei genitori *[Modeling behavior]*	Il ruolo dei genitori *[Modeling behavior]*
3	La colazione *[Breakfast]*	Al chiuso o all'aperto, basta fare movimento *[Indoor or outdoor, what is important is to practice PA]*
4	Piccoli passi per grandi risultati *[Small steps for big results]*	Da soli o in compagnia, tante occasioni per muoversi *[Alone or together, lots of opportunities to do PA]*
5	Pranzo e merenda con fantasia *[Lunch and snacks with imagination]*	Sani in tutta flessibilità *[Flexibly healthy]*
6	È tutta una questione di strategia *[It is all about strategy]*	È tutta una questione di strategia *[It is all about strategy]*
7	Ogni stagione offre nuove opportunità *[Every season offers new opportunities]*	Piove, piove, la gatta non si muove… ma io sì *[It rains, the cat does not move, but I do]*
8	Non c'è vita senza acqua *[There is no life without water]*	Non c'è vita senza acqua *[There is no life without water]*

Behavior. The behavioral goal of FAN was to encourage initiation, improvements, and/or maintenance of healthy nutrition and adequate amounts of physical activity. In particular, the focus of FAN was to promote the recommended amount of physical activity each day and to encourage adherence to nutrition guidelines, in particular regarding fruit and vegetable consumption, sugar and fat consumption, as well as water consumption.

Theory. FAN content was informed by the Theory of Planned Behavior (TPB).[51] TPB suggests that perceived behavioral control, attitudes, and subjective norms predict intentions to engage in a specific behavior, and intentions, in turn, predict behavior. These concepts were considered for the framing of the communication content delivered weekly to parents and children. To address and increase perceived behavioral control, the content included suggestions on how to cope with barriers (such as time, weather, prices, and difficulty). The content also reinforced positive behaviors.

In order to positively influence attitudes, ideas about ways to eat healthy and practice regular physical activity were suggested, highlighting the benefits and positive aspects (such as having fun, being with the family, improve health, and many others). To promote positive subjective norms towards healthy eating and regular physical activity, parents were encouraged to model healthy behaviors and to explicitly encourage their child to engage in these behaviors. Communications reinforced healthy behaviors as being the norm, and thus expected behavior. Finally, to improve behavioral intentions, strategies were suggested for planning behaviors, such as scheduling physical activity, preparing shopping lists, and preparing for difficult and/or unexpected situations (ie, seasonal variability of fruits and vegetables, rainy and snowy weather).

Insight. During the focus groups and interviews, barriers such as time, costs, or efforts, and motivators such as the health of their children, physical and mental fitness, were also gathered.

Program content was developed to address perceived barriers. The information on the website, the e-mails, the SMS, and the letters provided suggestions of ways to better cope with barriers, but also to reduce perceptions that these factors were hindering healthy behaviors. In the weekly communications, FAN underlined the motives that parents expressed as being important, such as the health of their children, their own health, weight control, wellness post-workout, feelings of wellbeing after a healthy meal, being a role model for their children, dedicating time to the family, and many others.

Exchange value. According to Sutton and colleagues "Creating & maintaining 'fair exchanges' is the heart of marketing."[52] To convey the message that following a healthy diet and practicing regular physical activity are fair exchanges for competing time demands and behaviors, the program positioned healthy diet and regular physical activity as achievable behaviors for all, and as more beneficial than competing behaviors. Ideas were also provided about ways to introduce behavior change in a feasible manner by taking small steps, selecting affordable options, and using time management techniques.

Competition. A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was conducted, to identify competitive behaviors and barriers to adopting or maintaining a healthy diet and regular physical activity. Competitors to regular physical activity included sedentary occupations, computer use, television watching, time spent sitting at work or school, lack of sport facilities, public transportation fees, and time. Competition to eating a healthy diet included the temptation of unhealthy food promoted in grocery shops, on TV, billboards, or packages for children, the high price of healthy food options, and lack of time to prepare healthy dishes that appealed to the whole family.

Segmentation. The content of FAN was designed for several target audience segments, including mothers, fathers, and children in elementary school and the first two grades of middle school. Within the child segment, further segmentation included the child's gender and grade level. With assistance from a schoolteacher, content was targeted for cognitive skills and reading level (such as vocabulary, number of words, font type and size, graphics, and videos). Furthermore, communication was gender-specific because of Italian grammar rules for addressing the gender of the child by using appropriate endings as shown in the following example (eg, "Ciao Maria, sei andata al parco?" vs. "Ciao Mario, sei andato al parco?"; "Hello Maria/Mario, did you go to the park?"). Parents were segmented according to their gender, which behaviors were most difficult for them to perform (ie, physical activity, diet or both), the number of children, gender of children, and their child's behavioral difficulty.[13,14] Examples of messages for the different segments are shown in Table 3.

Methods' mix. FAN addressed all six P's of the social marketing mix: product, place, price, promotion, partnership, and policy.

Product. FAN used the full product platform with three levels of product: core, actual, and augmented. The core product of FAN was better health. The actual product was practicing physical activity for at least 30 minutes per day for adults and for at least 60 minutes per day for children, and to consume a healthy diet, which included eating five portions of fruit and vegetable per day. FAN also promoted having breakfast every day, drinking the recommended amount of water, getting some warm up before physical activities and stretching at the end of it. FAN provided several augmented products, including a website, short messaging service (SMS), e-mails, and letters, each designed to support the actual product.

Table 3. Examples of Tailored Messages.

Segmentation and tailoring variables	Message	Message translated into English
Mother (difficulty = physical activity), with 1 boy (difficulty = diet)	"*Gentile Signora Rossi*, andare al lavoro a piedi è un ottimo modo per aggiungere un po' di attività nella sua quotidianità! Quando prepara la merenda per *suo figlio*, pensi ai diversi tipi di frutta che *gli* può proporre."	"*Dear Mrs. Rossi*, walking to work is a great way to add some physical activity in your everyday life! When you prepare the afternoon snack for *your son*, think about the different fruits you can propose to *him*"
Mother (difficulty = physical activity), with 1 girl (difficulty = diet)	"*Gentile Signora Rossi*, andare al lavoro a piedi è un ottimo modo per aggiungere un po' di attività nella sua quotidianità! Quando prepara la merenda per *sua figlia*, pensi ai diversi tipi di frutta che *le* può proporre."	"*Dear Mrs. Rossi*, walking to work is a great way to add some physical activity in your everyday life! When you prepare the afternoon snack for *your daughter*, think about the different fruits you can propose to *her*"
Mother (difficulty = diet), with 2 girls (difficulty = physical activity)	"*Gentile Signora Bianchi*, non si dimentichi di consumare frutta e verdure in abbondanza! Se le *sue figlie* non hanno voglia di fare attività fisica, *le* stimoli accompagnando*le* a fare un percorso vitae."	"*Dear Mrs. Bianchi*, do not forget to eat enough fruits and vegetables! If *your daughters* do not want to practice physical activity, encourage *them* by going with *them* to do a trail run"

The website supported behavior improvement and maintenance within the whole family. Every week, a new theme for nutrition and for physical activity were introduced. A forum feature was available for parents, where they could discuss concerns or strategies that worked well for them. Recipes and practical examples for healthy menus, and physical activity were also provided. A dietary consultant was available for parents, and reachable through the forum or via private message. Videos were included, that promoted healthy behaviors and provided suggestions for implementation. Further, to remind the participants about the new, weekly updated content, tailored prompts were sent via SMS and e-mail, directing families to the website. Tailored letters were sent directly to children each week, to support the core product.

Place. FAN was a community-based intervention that complemented and reinforced other interventions of the "Healthy Body Weight" cantonal program that took place at schools, in canteens and restaurants, and households. FAN specifically targeted the home environment.

Price. The costs to participants were primarily of a non-monetary nature. No participation fee was charged. An investment in time and effort was needed to read the provided content, complete the assessments, as well as to practice physical activity and prepare healthy meals. FAN tried to minimize the non-monetary costs of adopting the actual product, for example by providing short communication, and suggestions on better time management.

Promotion. To maximize reach, FAN was promoted through the schools, and the media. Teachers sent fliers home to every child in the school, and several articles and radio interviews were published in local media outlets.

Policy. FAN was funded as part of a strategic policy decision of the Canton Ticino. The "Healthy Body Weight" cantonal program included 11 healthy diet and physical activity promotion projects, including FAN.[15]

Partnership. FAN was developed in a collaborative partnership between the Canton Ticino, the

University, the national health promotion office, teachers, dieticians, and the target audience. The co-creation activities previously described, reinforced and strengthened partnerships among parties.

FAN Program Participant Characteristics & Satisfaction

Participant characteristics. The majority of adult participants were women (86.2%) and of Swiss nationality (84.9%). The mean age was 41 years (range = 27 to 61, SD = 5.09). The weight distribution of adult participants included 6.3% obese, 21.5% overweight, 65.0% healthy weight, and 5.3 % underweight, with a mean BMI of 23.4 (SD = 4.13). Male and female children were equally represented in the sample. The majority of children (83.5%) were attending elementary school, while the rest attended secondary school. The mean age was 8.5 years of age. Almost all participants (95.8%) heard about FAN through the brochures distributed in schools. Some participants heard about FAN through an online newspaper (1.5%), through the University website (0.7%), through a search engine (0.4%), or through a local newspaper (0.4%). The rest heard about FAN through word-of-mouth, parents meetings and other sources.

Participant satisfaction. Tables 4 and 5 summarize participants' satisfaction with the program. The majority of parents who completed the immediate post-intervention questionnaire were "positive" or "very positive" about the FAN program (83.7%).[13] Sixty-five percent agreed that the project met their family's expectations and 74.4% said that it was easy to find the information they needed on the FAN website. Some 42.3% of parents stated that FAN motivated them to practice more physical activity, and 60.1% of parents said FAN motivated them to eat in a healthier way. Parents also reported that FAN motivated their children to eat healthier foods (58.0%) and engage in physical activity (42.8%). Many parents (86.7%) also expressed interest in nutrition, physical activity, and other health-related programs delivered using similar Information and Communication Technologies (ICTs) in the future.

With regard to specific FAN components, most parents (81.0%) were satisfied with the letters sent to the children and most children (83.1%) liked them as well; 98.4% of parents stated that the language used in the letters was "adequate" for their children. The majority of the parents stated that the website (78.8%) and the forum (65.9%) were "very" or "quite" useful. Ninety-four percent of parents liked the videos, and nearly as many (91.6%) stated that the videos were useful. The majority of parents liked receiving the FAN e-mails (85.2%) and the SMS messages (84.8%). Most parents (87.3%) also found the e-mail reminders to visit the website useful, but slightly fewer (71.2%) thought the SMS reminders were useful.

Sixty-eight percent of children stated that they liked the FAN program, while 26.8% said that they liked it "so-so." Most children (64.5%) liked the videos shown on the website (15.7% answered "so-so" and 19.8% said "no"). More children (68.0%) than parents (41.1%) expressed interest in participating again in FAN (Tables 4 and 5).

Among the different reasons for satisfaction, promoting health, and in particular physical activity and nutrition, was of major importance for parents. Moreover, the innovative use of ICTs in Canton Ticino was perceived as fundamental in meeting busy parents' needs. Participants also appreciated the structure, regularity, and punctuality of FAN. Some parents stated that they felt cared about, and liked this feeling. Furthermore, they liked the topics and the content both online and in print. Parents particularly appreciated the direct contact of FAN

Table 4. Parents' Satisfaction with FAN (n = 389).

	%
Overall perceptions of the FAN program	
Very Positive	17.7%
Positive	66.0%
Not positive nor negative	16.1%
Negative	0.3%
Specific perceptions of the FAN program	
Met family expectations	64.9%
Easy to find information website	74.4%
Motivated adult to PA	42.3%
Motivated adult to eat healthy	60.1%
Motivated child to PA	42.8%
Motivated child to eat healthy	58.0%
Satisfaction with the letters to children	
Very satisfied	40.9%
Quite satisfied	40.1%
Neither satisfied nor unsatisfied	13.6%
Quite unsatisfied	4.1%
Very unsatisfied	1.4%
Language in letters to child was adequate	
Yes	98.4%
No	1.6%
Usefulness of the website	
Yes, it was very useful	18.4%
Yes, it was useful	60.4%
No, it was not useful	21.2%
Usefulness of the forum	
Yes, it was very useful	15.3%
Yes, it was useful	50.6%
No, it was not useful	34.1%
Liked the videos	
Yes	94.0%
No	6.0%
Usefulness of the videos	
Yes	91.6%
No	8.4%
Liked the e-mails	
Yes	85.2%
No	3.7%
I never received the e-mails	11.1%
Usefulness of the e-mails	
Yes, I visited the website immediately	32.0%
Yes, I visited the website later	55.3%
No	12.6%
Liked the SMS	
Yes	84.8%
No	12.8%
I never received the SMS	2.4%
Usefulness of the SMS	
Yes, I visited the website immediately	12.8%
Yes, I visited the website later	58.4%
No	28.8%
Interest in participating in FAN again [a]	
Yes, for sure	41.1%
I do not know	41.3%
It depends…	9.1%
No, I am not interested	6.5%
Interest in another similar project	
Yes, about nutrition and physical activity	39.8%
Yes, about nutrition only	6.6%
Yes, about physical activity only	1.7%
Yes, about other themes	38.6%
No	13.3%

[a] Those saying "it depends" provided reasons why they would participate in FAN; 2% (not shown) said "Other."

with their children, through the weekly letters. They stated that FAN provided an external source of education and encouragement that was consistent with what they wanted their children to learn and do.

The main reason for dissatisfaction was the burden of the questionnaires, in particular the children's surveys that, despite being tested with the audience, were still perceived as being too long to complete. Some parents also stated that they were unable to exactly express their opinion in the questionnaires, as many were close-ended questions. Another reason for dissatisfaction among some parents and children was the use of a cursive font style for children in forth and fifth grade.[13] While using the cursive font style was common in school, children had some difficulties in reading the font typeface chosen for FAN. Some families found FAN too theoretical, and wished for even more practical examples. Finally, parents stated that often the problem was not the program materials, content, or requested activities specifically, but their lack of time to read all FAN content, and put into practice the advice that was given.

Table 5. Children's Satisfaction with FAN (n = 370).

	%
Liked the FAN program?	
Yes	67.6%
So-so	26.8%
No	5.6%
Liked the letters?	
Yes	83.1%
So-so	10.7%
No	6.2%
Liked the videos?	
Yes	64.5%
So-so	15.7%
No	19.8%
Interested in participating in FAN again?	
Yes	68.0%
No	32.0%

Discussion

Key Findings

The Ticino community was involved in most of the aspects of the development of FAN. Following the recommended social marketing framework and co-creation activities facilitated community involvement, high participation and retention rates, and high levels of satisfaction with the program.[30,42] By being customer-oriented and examining insights, the research team was better able to understand the target audience. During the formative research, families from the target audience contributed by emphasizing what their needs, expectations, and actual behaviors were, complementing the desk literature research previously conducted. This allowed for a deeper understanding of the target audience and the creation of a program that was best adapted to the participants. Not only did families participate in the development of FAN, but teachers and other stakeholders provided feedback, which further contributed to our understanding of the target audience and their needs. This resulted in a program that was adapted to the real and perceived needs of participants. Focusing on the behavioral difficulty perceptions of participants allowed for the development of a communication strategy that was relevant to them. Adhering to the whole marketing mix increased the opportunities of creating a successful program. For instance, the decision to deliver the content of FAN through ICTs and not through face-to-face meetings was a key finding of the formative research. Parents stated they wanted to know more about healthy nutrition and physical activity, but did not have the time to participate in meetings. Hence, we provided them with an online intervention that reached them when and where it was most convenient for them.

This was possible in Switzerland, where the use of ICTs was high. Indeed, Switzerland ranked 7th in international comparisons of home Internet access, with 85% of households having Internet access in 2010.[53] In 2010, the Internet was used regularly by 40% of people with an income of less than 4'000 CHF per month,[54] the medium salary being 4'983 CHF per month. Regarding mobile phones, the penetration rate was 120 subscriptions per 100 inhabitants.[55] Although using ICTs for promoting health was quite new, looking for health information ranked 4th among the different reasons for using the Internet (eg, communication through e-mail, news reading, interaction with public administration, shopping, movies, etc.).[56] That said, it is possible that these data were slightly overinflated, as they measured subscriptions, and not the number of cellphones used or unique users. Indeed it could be that people have more than one subscription, but do not use more than one at a time, or on the contrary that they use more than one phone at a time, as well as they could share their phone with another family member, for example.

Most parents and children expressed satisfaction with the FAN program and the various program components, and found them to be useful. Many parents said that FAN served as motivator for them and for their children to eat healthier. Some parents stated that FAN motivated them and their children to be physically active. Reasons for satisfaction varied, but all comments highlighted the importance of creating a program that suited both the needs and the wants of the target audience. Listening to the families allowed us to create such a program, one that was thus appealing to them. Even when

expressing their dissatisfaction, parents and children were providing insightful and constructive feedback and suggestions on how to improve FAN (ie, use the e-mail and SMS as content-delivery channels, rather than just as a reminder, or decreasing the amount of information delivered per week, so that they would have more time to process it). The uniqueness of FAN, coupled with an in-depth analysis of the target audience, involving parents and children in the process of developing the program, contributed to its success.

The recruitment goal of 250 families was far exceeded, with more than 500 parents and more than 700 children taking part.[13,14] Furthermore, retention rates in the program and assessment completion immediately post-intervention (over 70% for parents and 50% for children)[13,14] were comparable with or higher than other similar studies.[14,38,48,57] This can be attributed, at least partially, to the formative research and the co-creation activities conducted in the development phase of FAN.

Lessons Learned

Developing successful social marketing campaigns requires ample preparation time, and this was time well spent. Program developers need to be flexible, and able to consolidate scientific evidence with the real and perceived needs of the target population, and other stakeholders.[58,59] In the case of FAN, a two-month intervention, roughly ten months were dedicated to program planning and development. Furthermore, based on existing scientific evidence, programs with similar objectives have typically been implemented for at least three months in duration.[32,48-50] However, two months were selected as a compromise between establishing a program based upon a customer orientation and best practice.[60]

Another lesson learned from FAN was that social marketers and program planners need to keep their eyes and their ears always open. While formative research was conducted with the target population and other stakeholders, valuable input was also provided to the research team in an ongoing manner throughout the program implementation phase. Such feedback was incorporated into the program when possible and appropriate. For example, families requested that FAN include recipes that children could prepare in the weekly letters addressed to children, which was a recommendation that was adopted mid-program implementation.

Immediate post-study results also provide insights that can be incorporated into future program revisions. As the results showed, overall, FAN met participants' expectations. For example, looking at the usefulness of both e-mail and SMS reminders, it can be noted that they did function as reminders to visit the FAN website. From the results, it appears that most parents visited the website later, when they had time. Hence, this appeared to be in sync with the objectives of FAN, as being accessible whenever and wherever parents preferred.

Nonetheless, improvements to program components and the promotion of the program should be made based upon posttest debriefing assessments to better understand participant experiences, as reported in survey findings. Increasing the participation in co-creation activities, both initially, during, and in post-program debriefings, would likely result in a program that is liked even more by the population and may be more effective in the long term.

Limitations

The development of FAN was not without challenges. FAN was developed in a State where several other programs with similar aims, but separately targeting adults or children existed. Resources were scarce, which resulted in limited human resources working on the development

of FAN, with high workloads and long working hours for relatively few people. This necessitated the scaling back of some of the initial plans for FAN (eg, website features, for which a higher-level programmer was needed).[13] Recruiting a larger sample for the pre-testing phase would have provided further insight on the development of FAN and the materials used, which could have limited some of the dissatisfaction expressed by some parents and children.[13] Furthermore, it is plausible that some participants were involved in one or more of the other cantonal programs, which could have influenced their satisfaction with or expectations from FAN. Finally, while we would expect little variation in the interpretation of our measures of program satisfaction, we did not test the validity of these items in this study. And, although we did measure changes in behavior over time as part of the larger trial, the findings included in this paper were limited to participant perceptions of the program, satisfaction with various components, and motivation to make behavioral changes. Having included behavioral measures certainly might have helped to verify the self-reported changes in motivation for engaging in physical activity and healthier eating, however that was not the intent of this paper.

Implications for Research & Practice

Previous studies suggested that using a social marketing approach to develop programs promoting healthy diet and physical activity behavior can be effective.[22,23-26] Our study highlighted the importance of the formative research and the co-creation activities. By listening to and understanding the needs of the target audience, the research team developed a program that reached high participation, retention, and satisfaction rates. The FAN case study also showed the importance of establishing good partnerships with stakeholders, seen for example through the promotion activity that took place through the schools.

Future projects aimed to promote dietary and physical activity behaviors for families, should use the social marketing framework. The development of such programs should be described in detail and shared among practitioners and researchers, in order to clarify exactly what was done and create further evidence of best practice. Program developers should also devote enough time and effort during the formative research phase, in order to create programs that are customer oriented, and are better able to incorporate or adapt scientific evidence to the needs of the target audience, in order to increase likelihood of success.

Conclusions

Social marketing was a useful framework that provided guidance for designing a community-based healthy diet and physical activity promotion program for families. Addressing each of the eight consistency criteria allowed us to fully consider factors that helped us reach the population with a program that parents and children were willing to participate in and were ultimately very satisfied with. Elements of FAN success were the co-creation activities conducted with the population and the decision to address the family environment, by delivering the product to each member (parents and children). Hence, we recommend that community health promotion programs adopt the aforementioned social marketing framework.

Acknowledgements

Funding/Support: FAN was funded by the Health Promotion and Evaluation Service, of the Cantonal Doctor's Office, in the Department of Health and Social Affairs of Canton Ticino (Servizio di promozione e di valutazione sanitaria, Ufficio del medico cantonale, Dipartimento della sanità e della socialità, Repubblica e Cantone Ticino) and Health Promotion Switzerland (Promotion Sante Suisse) as part of the Canton Ticino "Healthy Body Weight" ("Peso Corporeo Sano") program. The materials and content expressed herein are those of the authors and do not necessarily reflect the official views of the funding agencies.

Additional Contributions: The authors thank the following individuals and agencies for their invaluable contributions to the FAN project: Health Promotion Switzerland; Antonella Branchi, Alessia Antonietti, and Rubina Bianchetti at the Health Promotion and Evaluation Service, Cantonal Doctor's Office, in the Department of Health and Social Affairs of Canton Ticino (Servizio di promozione e di valutazione sanitaria, Ufficio del medico cantonale, Dipartimento della sanità e della socialità, Repubblica e Cantone Ticino); the Offices of Primary and Middle School Education, in the Department of Education, Culture and Sports of Canton Ticino (Ufficio delle scuole comunali e Ufficio dell'insegnamento medio, Dipartimento dell'educazione, della cultura e dello sport, Repubblica e Cantone Ticino); the dieticians, teachers, and school directors who contributed to the program development and recruitment; and all the parents and children who participated in the formative research and in the FAN program intervention.

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Author Information

Natalie Rangelov is a Doctoral Student and Research Assistant in the Institute for Public Communication (ICP) at Università della Svizzera italiana (USI). She has been a member of the BeCHANGE Research Group since 2010. Natalie holds a MA in Public Management and Policy. Her research focuses on public communication and innovative approaches in the field of health behavior change and support.

L. Suzanne Suggs, PhD, MS, CHES, is an Associate Professor of Social Marketing and Head of the BeCHANGE Research Group in the Institute for Public Communication (ICP), Università della Svizzera italiana, CH. She is also a Visiting Reader in the Institute of Global Health Innovation, Faculty of Medicine, at Imperial College London, UK. Her research focuses on health behavior change communication and social change through Information and Communication Technologies (ICTs). Suzanne is a co-founder and a Board Member of the European Social Marketing Association. She is an Associate Editor of Global Health Communication and on the Editorial Review Board of the Journal of Health Communication.

All authors have equally contributed to the development and implementation of the program, as well as to the data analysis and write up of the manuscript. All authors declare that each of us has approved the manuscript.

Appendix 2. Published Paper Presented in Chapter III

Rangelov, N., Suggs, L. S., & Marques-Vidal, P. (2016). I did eat my vegetables. Agreement between parent and child food intake diaries. Public Health Nutrition, 19(17), 3106–3113. https://doi.org/10.1017/S1368980016001488

Public Health Nutrition: page 1 of 8 doi:10.1017/S1368980016001488

I did eat my vegetables. Agreement between parent and child food intake diaries

Natalie Rangelov[1,*], L Suzanne Suggs[1,2] and Pedro Marques-Vidal[3]
[1]BeCHANGE Research Group, Institute for Public Communication (ICP), Faculty of Communication Sciences, Università della Svizzera italiana, Via G. Buffi 13, 6900 Lugano, Switzerland: [2]Institute of Global Health Innovation, Faculty of Medicine, imperial College London, London, UK: [3]Internal Medicine, Faculty of Biology and Medicine, University of Lausanne, Lausanne University Hospital (CHUV), Lausanne, Switzerland

Submitted 8 January 2016: Final revision received 15 April 2016: Accepted 4 May 2016

Abstract
Objective: To assess the level of agreement between children and their parents when reporting a child's food consumption.
Design: Cross-sectional study in which children and parents independently completed 7 d food diaries describing the foods and drinks the child consumed at every meal and snack. The association between child and parent reporting was assessed for nineteen food groups using Kendall's tau-b non-parametric correlations, Spearman's rank correlations, kappa coefficients and Lin's concordance measure of agreement. Results were also stratified by gender of the child and his/her grade at school.
Setting: Households in Ticino, Switzerland, April–June 2014.
Subjects: Two hundred and ninety-nine children aged 6–12 years and one of their parents participated, with 264 providing complete data (35 % completion rate).
Results: Results showed a high level of agreement between child and parent reporting. Spearman correlations ranged from 0·55 (sauces) and 0·57 (fatty meat) to 0·80 (fruit), 0·83 (starchy foods) and 0·84 (pastries). All nineteen Spearman correlations were significant at the 0·001 level. Kendall's tau-b correlations ranged from 0·44 (fat meat) to 0·81 (puff pastry). Kappa values showed low to high levels of agreement, ranging from 0·15 (sweets) to 0·77 (puff pastry). Lin's concordance correlation coefficients ranged from 0·39 (whole grains) to 0·86 (puff pastry).
Conclusions: When assessing the eating behaviour of children using a 7 d food diary, children's reports might be as reliable as their parents'.

Keywords
Dietary assessment
Food record
Food consumption
Children
Switzerland

Childhood eating behaviours establish lifelong eating habits. Poor eating behaviour in childhood is a risk factor for overweight and obesity, cancer, type 2 diabetes and many other non-communicable conditions in adulthood[1]. Yet, measuring children's eating behaviour is riddled with challenges stemming from accuracy in recall, correct portion sizes, observation effects and participant burden[2–6].

Eating habits of children and adults are most commonly measured using FFQ, food diaries and 24 h recall methods[5]. While there are many variations, adults are often asked to indicate, from a list of items, the frequency of those foods consumed over the past 6 or 12 months. FFQ are most appropriate for epidemiological studies with large samples as they can help identify risk factors for disease and dietary patterns. Still, FFQ are limited by the variety of food items listed, accuracy in food consumption recall and the ability to accurately capture mixed foods (i.e. lasagne)[7,8].

Food diaries are thought to increase accuracy of reporting as they are completed daily. They are typically recommended for a motivated population, due to the burden of completing them[5,9]. However, some literature reports inaccuracies when comparing food records with biomarkers and suggest using a mix of assessment methods to collect more precise food intake data[4,5,10]. Twenty-four hour recall methods are brief and easy to administer, but do not allow for a description of a 'typical diet' as they represent a single day[7,8]. A study conducted in a sample of university students found that food diaries and 24 h recalls captured different information[11]. Another study found overall weaker associations of parent–child diet similarity when using FFQ than with food diaries[12].

Children can face difficulty in recalling the foods that they consumed when the time gap between reporting and food consumption is long[5,9,13,14]. Additionally, in the age range from 6 to 10 years, their reading abilities can differ extensively and portion size estimation represents

*Corresponding author: Email natalie.rangelov@usi.ch; natalie.rangelov@gmail.com

a common challenge[5,9,13,15]. While direct observation and clinical measures can serve as indicators of food consumption, they are not always feasible for public health practice and research. Hence, we are left with a conundrum on effective and efficient ways to measure children's food consumption outside controlled settings. One possible solution could be to ask children to report it directly, but little is known regarding their ability to accurately complete a food diary. There is also some disagreement on whether children or their parents should provide the information[5,9]. A review of studies assessing the validity of child/adolescent FFQ compared with biomarkers and/or other assessment method (i.e. 24 h recall) showed that studies where the FFQ were completed by the parents instead of children, and studies where FFQ were completed by children assisted by their parents or teacher, had weak to moderate validity[5].

Studies measuring agreement between children and parents outside the food consumption domain show that children and parents often differ in their reporting of food insecurity[16], health-related quality of life[17] and engagement in physical activity by children with disabilities[18]. These studies suggest that parents are not always aware of children's precise attitudes and perceptions about their own health and health behaviours. As food consumption reporting may be less susceptible to perceptions, assuming portion sizes are not the object of measurement, we hypothesize that children and parents may both be able to report in an accurate way what a child eats, especially when the child eats in the presence of the parent. Hence, the purpose of the present paper was to assess the level of agreement between children and their parents when reporting a child's food consumption over a 7 d period using a food diary. A second aim was to assess the level of agreement between children and their parents according to children's gender and grade in school. As there is currently no validated measure for eating behaviour of children in Switzerland, a new instrument was developed.

Methods

Study setting and sampling

A cross-sectional study with children attending elementary and middle schools (aged 6–12 years) and one of their parents was conducted between April and June 2014. To be included, families (parent–child dyads) had to live in Ticino, Switzerland, and be able to complete the study in Italian. The Cantonal Department of Education, Culture and Sport (DECS) agreed to the study and identified four elementary schools and four middle schools that were representative of schools in Ticino. Directors of these schools were contacted and they agreed to include their school in the project. The directors recruited teachers and asked them to invite every child in their class, along with their parents, to participate in the study. They sent a package to each child–parent dyad that contained a letter describing the study, a consent form to be signed by the child's parent, two copies of the weekly food diary, a short questionnaire, and instructions with an example of how to complete the diary. Teachers also provided oral instructions to children on how to complete the diary and collected them at the end of the week of completion. The diaries were then sent back to the research team at the university.

The Ethics Committee of Canton Ticino reviewed the study and judged it exempt from full review. In accordance with the Helsinki Declaration, participants were fully informed of the study purpose and all parents provided their written informed consent before participating.

Questionnaires and data collected

The questionnaire collected the age and gender of the parent and the child, height and weight of the child, and the child's class at school. Children and parents separately completed a daily diary of foods and beverages the child consumed at breakfast, lunch and dinner, and during snack breaks (morning, afternoon and after dinner), every day for seven consecutive days. In Ticino, school lunches are not provided in most schools and the majority of children go home for lunch. As such, most meals were consumed primarily at home, excluding the morning snack, and parents were present during most of their child's meals. For each meal and snack time, the participant wrote exactly what the child ate in an open form text box on paper. No portion size was asked for given the known challenges of accurate reporting and that assessing portion size does not necessarily increase validity[5]. Consistent with studies which suggest that children younger than 8 years of age face difficulties in estimating portions, and studies that found weak to moderate correlations when portions were assessed with children younger than 12 years of age[5,13,19,20], our study did not measure portion sizes.

Two versions of the food diary were used: one for elementary-school children and one for middle-school children. The versions differed only in the size of font and the space allowed for data entry. Middle-school children used a one-page diary for the full week, whereas children in elementary school reported each day on a separate page (see online supplementary material, Supplemental Figs 1 and 2). Parents were asked to not help the children recall what they ate and to help their children only if they needed assistance in understanding what the diary asked them to do and where to write their answers. Parents and children were asked to write 'I do not know' when they did not know or did not remember what was consumed. The importance of honest information and completing the diary after each meal and snack was stressed.

Public Health Nutrition

Once the data were collected, three researchers independently coded the diaries. First, the food items were divided in groups according to the Swiss food pyramid[21]. A dietitian helped to develop subgroups of food items and mixed foods. A second coder then double-checked a random sample of food diaries. Food groups are shown in the online supplementary material, Supplemental Table 1. Food items were coded as dichotomous variables for each day and each meal (0 = did not eat a food from that (sub) group; 1 = did eat a food from that (sub)group).

Statistical analysis

Statistical analyses were conducted using the statistical software package IBM SPSS Statistics Version 21.0. Descriptive results were expressed as number and frequency of participants for categorical variables and as range or mean and standard deviation for continuous variables. The weekly proportion of eating a certain food was computed for nineteen food groups consumed, using the total count (range 0–42 times per week) of each group consumed in a week and dividing it by the number of completed entries in a week (range 0–7 d completed). Given that the number of meal occasions in which parents or children wrote 'I do not know' was very low, these data were coded and treated as missing data. The analyses in the present study were performed only among children–parents pairs that completed the diary for all seven days.

Associations between children's and parents' results were assessed using Spearman's non-parametric correlations (ρ), Lin's level of agreement statistics and Kendall's tau-b (τ_B) non-parametric correlations. Spearman's rank correlations were used to test order and to compare with the results of the literature; ρ values between 0·10 and 0·29 indicate a small correlation, between 0·30 and 0·49 a medium correlation, and between 0·50 and 1·00 a large correlation[22]. Lin's statistics were used to test how well the two sets fit a 45° line. As the algorithm assessing Spearman's correlation in IBM SPSS Statistics did not take into account tied values, Kendall's τ_B correlations were computed, using the same methodology as Spearman's correlations, as they are appropriate to use with tied data[23].

Consistent with Thiagarajah *et al.*'s validation study of a food intake questionnaire[13], Cohen's kappa (κ) was used to test the agreement between children's and parents' reporting of weekly consumption occasions. The lower bound of the 95 % CI of the κ estimate was used to categorize agreement and the same categorization of κ values as performed by Thiagarajah *et al.*[13] was applied[24] to allow comparison. Thus, κ values between 0·20 and 0·45 indicate moderate agreement, κ values higher than 0·45 and lower than 0·75 indicate substantial agreement, and κ values equal to or higher than 0·75 indicate very good agreement[13,24]. Finally, the level of agreement between children and their parents was analysed stratifying by gender and grade in school. Although no test was conducted to compare ρ values by gender or school grade, the 95 % CI of the κ estimates are provided to allow for a 'side by side' comparison.

Results

Sample characteristics

Of the 745 children invited to participate by the teachers in eight classrooms, 299 consent forms, food diary pairs and questionnaires were returned to the research team (40 % participation rate). After excluding children–parent pairs that did not complete the diaries for all seven days, a total of 264 children and parent pairs were included in the analysis (35 % of the families invited, 88 % of the consenting parents). Fifty-two per cent of children were female and their age ranged between 7 and 14 years (mean 10·0 (SD 1·7) years). The percentage of children attending 1st, 2nd, 3rd, 4th and 5th grade of elementary school was 10, 11, 19, 23 and 15 %, respectively; 15 % attended 1st grade of middle school and 6 % attended 2nd grade. Participating parents were mostly female (95 %) and aged between 28 and 62 years (mean 41·2 (SD 5·3) years).

Association between children's and parents' reporting

Food consumption reported by children and their parents, and the proportion of consumption at meals, are summarized in the online supplementary material, Supplemental Table 2. The total count and percentage of 'I do not know' answers are shown in Supplemental Table 3. The associations between children's and parents' reporting are summarized in Table 1. Kendall's τ_B correlation between parents' and children's answers ranged from 0·44 for fat meat to 0·81 for puff pastry, indicating medium to large correlations for all foods analysed. Spearman's ρ between parents' and children's answers ranged from 0·55 for sauces and dressings to 0·84 for puff pastry, indicating large correlations for all foods analysed (see Supplemental Table 4). Values of κ showed low to high levels of agreement, ranging from 0·15 for sweets to 0·77 for puff pastry. Considering the lower bound of the CI, fair agreement ($\kappa < 0{\cdot}20$) was found for water, fruit, vegetables, starchy foods, meat, dairy products, fats and oils, and sweets. Moderate agreement ($\kappa = 0{\cdot}20$–$0{\cdot}45$) was found for whole grains, fish, fat meat, sauces and dressings, junk food, sugar drinks and coffee. Strong agreement ($\kappa > 0{\cdot}45$) was found for eggs, legumes, tofu and quorn, fast food and puff pastry. Finally, Lin's correlation coefficients ranged from 0·39 for whole grains to 0·86 for puff pastry (see Table 1).

Kendall's τ_B correlations between children's and parents' reporting of food by meal are summarized in Table 2. Kendall's τ_B values ranged from 0·20 for sugar drinks after dinner to 1·00 for coffee at lunch and dinner, and for eggs after dinner. Vegetables at breakfast, meat at morning snack and puff pastry at afternoon snack showed non-significant results. During some meal occasions, some foods were not

Table 1 Associations between food items logged by children aged 6–12 years and food items logged by their parents in a week (*n* 264); Ticino, Switzerland, April–June 2014

Food item	Kendall's τ_B	κ	95 % CI	Lin's coefficient	95 % CI
Water	0·49	0·20	0·15, 0·25	0·65	0·58, 0·71
Fruit	0·64	0·25	0·19, 0·31	0·77	0·72, 0·81
Vegetables	0·54	0·19	0·14, 0·25	0·59	0·53, 0·66
Starchy foods	0·66	0·18	0·13, 0·23	0·78	0·73, 0·82
Whole grains	0·57	0·37	0·20, 0·54	0·39	0·32, 0·46
Meat	0·47	0·23	0·17, 0·30	0·61	0·54, 0·68
Fish	0·58	0·50	0·42, 0·58	0·79	0·74, 0·83
Eggs	0·64	0·58	0·50, 0·66	0·74	0·69, 0·79
Legumes, tofu, quorn	0·64	0·59	0·50, 0·68	0·75	0·69, 0·80
Dairy products	0·61	0·16	0·11, 0·21	0·73	0·67, 0·78
Fats & oils	0·52	0·17	0·11, 0·23	0·66	0·60, 0·73
Sauces & dressings	0·49	0·42	0·33, 0·51	0·56	0·48, 0·64
Fat meat	0·44	0·31	0·24, 0·38	0·53	0·45, 0·61
Fast food	0·58	0·55	0·47, 0·63	0·67	0·60, 0·73
Junk food	0·64	0·50	0·42, 0·58	0·80	0·76, 0·85
Sweets	0·58	0·15	0·10, 0·20	0·71	0·65, 0·76
Sugar drinks	0·59	0·32	0·26, 0·38	0·70	0·64, 0·76
Puff pastry	0·81	0·77	0·68, 0·86	0·86	0·84, 0·89
Coffee	0·62	0·56	0·36, 0·76	0·57	0·49, 0·65

All values are significant at $P<0·01$.

Table 2 Associations between food items logged by children aged 6–12 years and food items logged by their parents in a week (*n* 264), by meal, using Kendall's τ_B coefficient; Ticino, Switzerland, April–June 2014

	Meal					
Food item	Breakfast (*n* 264)	Morning snack (*n* 261)	Lunch (*n* 264)	Afternoon snack (*n* 263)	Dinner (*n* 262)	After dinner (*n* 263)
Water	0·78	0·31	0·45	0·56	0·48	0·60
Fruit	0·74	0·63	0·60	0·67	0·65	0·69
Vegetables	−0·004^{NS}	0·71	0·56	0·44	0·56	0·30
Starchy foods	0·83	0·75	0·60	0·65	0·63	0·64
Whole grains	0·58	0·71	0·31	0·82	0·54	NA
Meat	0·65	−0·009^{NS}	0·60	0·64	0·55	NA
Fish	NA	NA	0·68	NA	0·75	NA
Eggs	0·85	0·81	0·71	0·57	0·75	1·00
Legumes, tofu, quorn	NA	NA	0·64	NA	0·73	NA
Dairy products	0·72	0·58	0·59	0·68	0·53	0·65
Fats & oils	0·78	0·67	0·52	0·38	0·53	0·32
Sauces & dressings	NA	NA	0·49	NA	0·62	NA
Fat meat	0·86	0·70	0·50	0·48	0·53	0·50
Fast food	NA	NA	0·66	0·40	0·64	NA
Junk food	0·69	0·76	0·47	0·74	0·41	0·60
Sweets	0·74	0·67	0·52	0·57	0·54	0·63
Sugar drinks	0·83	0·64	0·6	0·59	0·63	0·20
Puff pastry	NA	NA	0·83	−0·004^{NS}	0·86	NA
Coffee	0·59	NA	1·00	0·32	1·00	NA

NA, food not consumed/sample size too small.
Values are significant at $P<0·01$ except those marked NS.

consumed or the sample size was too small. Hence, the correlation analysis was not performed (e.g. fish and fast food at breakfast and morning snack). Spearman's ρ between children's and parents' reporting of food by meal are summarized in the online supplementary material, Supplemental Table 4.

Association according to gender and grade at school

For boys and girls, agreement between parents' and children's reporting was similar for most foods. Kendall's τ_B correlations between boys and their parents ranged from 0·41 for sauces and dressings to 0·77 for puff pastry, indicating medium to high correlations. Between girls and their parents, Kendall's τ_B ranged from 0·46 for fat meat to 0·84 for puff pastry, indicating medium to high correlations. Kendall's τ_B for fruit was 0·65 for boys and 0·63 for girls; for puff pastry it was 0·77 for boys and 0·84 for girls; and for starchy foods it was 0·62 for boys and 0·72 for girls. Kendall's τ_B correlation coefficients for all food groups according to gender are summarized in Table 3. Spearman's rank correlations are described

Table 3 Kendall's τ_B and κ values for food items logged by children aged 6–12 years and food items logged by their parents in a week (*n* 264), by gender; Ticino, Switzerland, April–June 2014

	Kendall's τ_B		κ			
	Boys	Girls	Boys	95 % CI	Girls	95 % CI
n	127	137	127	–	137	–
Water	0·44	0·53	0·16	0·09, 0·23	0·24	0·17, 0·31
Fruit	0·65	0·63	0·21	0·13, 0·29	0·29	0·20, 0·38
Vegetables	0·45	0·61	0·18	0·10, 0·26	0·19	0·11, 0·27
Starchy foods	0·62	0·72	0·14	0·07, 0·21	0·22	0·14, 0·30
Whole grains	0·74	0·48	0·53	0·24, 0·82	0·28	0·08, 0·48
Meat	0·46	0·47	0·16	0·07, 0·25	0·30	0·21, 0·39
Fish	0·54	0·63	0·44	0·32, 0·56	0·54	0·43, 0·65
Eggs	0·68	0·60	0·53	0·42, 0·64	0·62	0·51, 0·73
Legumes, tofu, quorn	0·67	0·62	0·65	0·51, 0·79	0·55	0·42, 0·68
Dairy products	0·61	0·60	0·13	0·06, 0·20	0·19	0·11, 0·27
Fats & oils	0·48	0·56	0·16	0·08, 0·24	0·18	0·10, 0·26
Sauces & dressings	0·41	0·57	0·39	0·25, 0·53	0·44	0·31, 0·57
Fat meat	0·43	0·46	0·27	0·17, 0·37	0·34	0·24, 0·44
Fast food	0·57	0·60	0·54	0·43, 0·65	0·55	0·44, 0·66
Junk food	0·72	0·61	0·61	0·49, 0·73	0·41	0·30, 0·52
Sweets	0·60	0·57	0·11	0·05, 0·18	0·20	0·12, 0·28
Sugar drinks	0·53	0·65	0·31	0·22, 0·40	0·33	0·24, 0·42
Puff pastry	0·77	0·84	0·73	0·58, 0·88	0·80	0·68, 0·92
Coffee	0·73	0·50	0·67	0·42, 0·92	0·44	0·14, 0·74

All values are significant at $P < 0·01$.

in the online supplementary material, Supplemental Table 5.

For boys κ values ranged from 0·11 for sweets to 0·73 for puff pastry, while for girls κ ranged from 0·18 for fats and oils to 0·80 for puff pastry, showing low to high agreement for both genders. The κ (95 % CI) for sweets was 0·11 (0·05, 0·18) for boys and 0·20 (0·12, 0·28) for girls; for vegetables it was 0·18 (0·10, 0·26) for boys and 0·19 (0·11, 0·27) for girls; for puff pastry it was 0·73 (0·58, 0·88) for boys and 0·80 (0·68, 0·92) for girls; and for fruit it was 0·21 (0·13, 0·29) for boys and 0·29 (0·20, 0·38) for girls. See Table 3 for all food groups according to gender.

Overall, there was higher agreement between children in middle school and their parents, than between children in elementary school and their parents, with few exceptions. Kendall's τ_B correlations ranged from 0·006 (meat) for children in 1st grade of elementary school to 1·00 (coffee) for children in middle school. Kendall's τ_B and κ values are summarized in Tables 4 and 5.

Discussion

To our knowledge, the present study is one of the few comparing 7 d food diaries completed by children and parents. Our results showed a significant agreement between children's and parents' reported food consumption; furthermore, the agreement measures tended to be higher than found in the food consumption reporting literature[13]. For example, the study conducted in 2004 by Thiagarajah *et al.* among 120 children attending 4th grade from five elementary schools in south-central Indiana (USA) validated the food behaviour questions from the School Physical Activity and Nutrition questionnaire[13]. The Spearman correlation coefficients are higher in our study compared with Thiagarajah *et al.* (i.e. 0·80 *v.* 0·40 for fruit, 0·71 *v.* 0·52 for sugar drinks and 0·57 *v.* 0·43 for fat/fried meat, respectively), while the κ values are comparable (i.e. 0·25 *v.* 0·27 for fruit, 0·32 *v.* 0·38 for sugar drinks and 0·31 *v.* 0·38 for fat/fried meat, respectively).

Diaries completed by older children and their parents showed higher Spearman correlation coefficients and κ values, a finding consistent with previous studies[13,25]. While younger children may encounter some difficulties in completing food diaries, several studies have shown that for children older than 8 years of age, validity is higher when the diaries are completed by the child rather than by a proxy[5,9]. Further, a validation study conducted among children aged 9–11 years found that mixed foods had lower agreement scores than well-defined foods and foods consumed less frequently[13]. Because of the coding system adopted for the present study (i.e. coding each of the foods in a mixed dish separately) our study partially solved this issue.

Studies with adults show women tend to report their dietary intake more accurately than men[26,27]; however, in our study, no differences were found between boys and girls and their level of agreement with their parents. Our results are consistent with those reported by Thiagarajah *et al.*, who also found no gender differences in validity, except for a few items (gravy, French fries and chips), where a higher agreement was found in girls[13].

Strengths and limitations

The methodology used in the current study could serve as reference for other studies assessing children's food intake. First, our analysis included basic food groups,

Table 4 Kendall's τ_B values of food items logged by children aged 6–12 years and food items logged by their parents in a week (*n* 264), by class at school; Ticino, Switzerland, April–June 2014

Education	Elementary school					Middle school	
Grade	1st	2nd	3rd	4th	5th	1st	2nd
n	26	30	51	60	40	39	15
Water	0·41**	0·52**	0·38**	0·52**	0·71**	0·48**	0·78**
Fruit	0·48**	0·77**	0·63**	0·61**	0·68**	0·75**	0·93**
Vegetables	0·14	0·43**	0·57**	0·59**	0·54**	0·68**	0·66**
Starchy foods	0·50**	0·62**	0·70**	0·67**	0·61**	0·80**	0·82**
Whole grains	NA	NA	0·83**	0·61**	0·71**	0·39**	NA
Meat	0·006	0·40**	0·51**	0·70**	0·36**	0·65**	0·42**
Fish	0·29	0·40**	0·69**	0·50**	0·65**	0·71**	0·80**
Eggs	0·39*	0·64**	0·60**	0·60**	0·69**	0·81**	0·76**
Legumes, tofu, quorn	0·44*	0·49**	0·63**	0·81**	0·50**	0·76**	0·37
Dairy products	0·51**	0·50**	0·51**	0·59**	0·72**	0·74**	0·86**
Fats & oils	0·35*	0·45**	0·51**	0·60**	0·55**	0·51**	0·53**
Sauces & dressings	0·16	0·29	0·68**	0·49**	0·57**	0·56**	0·53*
Fat meat	0·20	0·39**	0·44**	0·48**	0·61**	0·53**	0·75**
Fast food	0·42**	0·71**	0·56**	0·49**	0·74**	0·66**	0·73**
Junk food	0·75**	0·52**	0·60**	0·68**	0·61**	0·67**	0·87**
Sweets	0·30*	0·52**	0·64**	0·65**	0·65**	0·60**	0·82**
Sugar drinks	0·07	0·49**	0·67**	0·61**	0·65**	0·79**	0·85**
Puff pastry	0·71**	0·76**	0·72**	0·93**	0·86**	0·92**	0·79**
Coffee	0·39*	NA	0·55**	0·69**	0·54**	1·00**	1·00**

NA, not assessable as no child in the class reported having eaten this food.
*$P < 0·05$, **$P < 0·01$.

Table 5 κ values of food items logged by children aged 6–12 years and food items logged by their parents in a week (*n* 264), by class at school; Ticino, Switzerland, April–June 2014

Education	Elementary school					Middle school	
Grade	1st	2nd	3rd	4th	5th	1st	2nd
n	26	30	51	60	40	39	15
Water	0·04	0·13**	0·21**	0·19**	0·21**	0·24**	0·52**
Fruit	0·08	0·17**	0·15**	0·19**	0·40**	0·38**	0·61**
Vegetables	−0·06	0·22**	0·18**	0·18**	0·28**	0·26**	0·13
Starchy foods	0·12**	0·16**	0·11**	0·16**	0·22**	0·26**	0·30**
Whole grains	NA	NA	0·55**	0·42**	0·66**	0·17	NA
Meat	0·02	0·19**	0·12*	0·30**	0·19**	0·52**	0·22*
Fish	0·09	0·32**	0·60**	0·44**	0·52**	0·69**	0·71**
Eggs	0·31*	0·37**	0·68**	0·49**	0·61**	0·79**	0·72**
Legumes, tofu, quorn	0·38**	0·44**	0·58**	0·70**	0·45**	0·75**	0·32
Dairy products	0·08*	0·03	0·00	0·19**	0·26**	0·32**	0·21**
Fats & oils	−0·06	0·01	0·11*	0·25**	0·23**	0·32**	0·15
Sauces & dressings	0·14	0·14	0·56**	0·36**	0·60**	0·52**	0·52**
Fat meat	0·07	0·21	0·28**	0·35**	0·29**	0·44**	0·49**
Fast food	0·57**	0·45**	0·45**	0·50**	0·57**	0·75**	0·71**
Junk food	0·53**	0·44**	0·34**	0·60**	0·39**	0·53**	0·83**
Sweets	0·07	0·04	0·13**	0·14**	0·18**	0·21**	0·50**
Sugar drinks	0·62	0·28**	0·20**	0·33**	0·32**	0·48**	0·74**
Puff pastry	0·57**	0·69**	0·64**	0·85**	0·83**	1·00**	0·83**
Coffee	0·37**	NA	0·49**	0·48**	0·55**	0·74**	1·00**

NA, not assessable as no child in the class reported having eaten this food.
*$P < 0·05$, **$P < 0·01$.

which can be obtained for any study across the world. Second, specific cultural foods (i.e. peanut butter, gravy, noodles, etc.) can be easily included in the food categories identified for the study and processed similarly. Furthermore, observation effects were minimized due to the longevity of the data collection, seven consecutive days. One study showed that people typically revert to their normal behaviour after the 'observation effect' wears off in 2–3 d[28].

The primary limitation in the present study is the lack of a direct observation or biomarkers to compare with self-reporting. This was mostly due to feasibility reasons, as collecting blood or urine samples, or hiring staff to observe families, was far beyond our budget and would have likely

resulted in a lower participation rate. Further, it cannot be excluded that children and parents completed the food diaries together, even though the importance of completing the diaries separately was stressed in the instructions. The relatively low completion rate of 35 % is unfortunate, but is comparable to participation rates reported elsewhere (16–57 % for men and 31–74 % for women)[29]. This is a challenge in food consumption reporting; the 7 d give a better picture of what children eat than a shorter period reporting, but it also increases respondent burden.

Although κ value is commonly used to assess agreement, it might not be appropriate to compare studies, as it depends on the prevalence of the findings and on the number of categories[30–32]. Additionally, as the thresholds to define the strength of agreement vary across the literature, our results might have been over- or underestimated. Using the more stringent thresholds by Landis and Koch[33], the percentage of κ values showing moderate agreement increased from 33 % to 43 %, while the percentage of κ values showing substantial agreement decreased from 38 % to 5 %.

We also had to use a non-validated food diary, due to the lack of validated food diaries in Switzerland. Further, social desirability could play a factor in child or parent reporting. Finally, recall bias could not be completely ruled out, but we believe it was minimized due to the requirement that eating behaviour should be recorded immediately after each meal or snack.

Conclusion

Our study reports significant agreement between children's and parents' reported food consumption, when using 7 d diaries without reported portion sizes. When assessing children's eating behaviour using a food diary completed each day, children may be just as able as their parents to reliably report what they ate.

Acknowledgements

Acknowledgements: The authors thank Ms Maria Lagomarsino for her help with data entry. They also thank the parents and children who participated in this study and the teachers, school directors and DECS administration. *Financial support:* This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. *Conflict of interest:* None. *Authorship:* Each author contributed equally to the design of this paper, including the research questions, study design, analysis plan and conduct, and writing the manuscript. *Ethics of human subject participation:* This study was conducted according to the guidelines laid down in the Declaration of Helsinki and was exempt from full ethics review by the Canton Ticino Ethics Review Committee, in accordance with Swiss Human Subjects Law. Written informed consent was obtained from all participants prior to any data collection.

Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980016001488

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Public Health Nutrition

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Public Health Nutrition

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