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General Introduction
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In this thesis, we evaluated the front-of-pack (FOP) nutrition label “Choices” in the Netherlands (in Dutch ‘Ik Kies Bewust logo’). The aim was to investigate the effects of the logo on consumer behavior, product development, and public health. This General Introduction introduces the research area of FOP labeling, describes the background of the Choices logo, and provides the aim and outline of this thesis.

Nutrient information on food products

Globally, dietary intakes of trans fatty acids (TFA), saturated fatty acids (SAFA), sodium and sugar exceed the recommendations (1). As a result, the prevalence of diet related chronic diseases, such as heart disease, obesity and diabetes, is increasing. Therefore, the World Health Organization’s (WHO) Global Strategy on Diet, Physical Activity and Health recommended the private sector to limit the levels of TFA, SAFA, salt and free sugars in food products in order to reduce this prevalence (2). One way to help consumers reduce the intake of these nutrients is to improve the product composition; another is to motivate consumers to make healthier choices. Displaying information about the nutrient content on food products can both stimulate food manufacturers to develop healthier products and can help consumers make healthier choices at the point-of-purchase. The nutrient content is reflected in the nutrition facts panel on the back of packaged food products, expressed in relative and absolute quantification of nutrients (Figure 1). Nutrition facts panels have been mandatory in the US since 1990, in Canada since 2007, and in Australia and New Zealand since 2002 (3, 4). In Europe, mandatory regulations for nutrition facts panels have been adopted only very recently (July 2011) (5). It depends on the country which nutrients are listed, and whether they are expressed per 100 grams or per portion. A recent review concludes that nutrition facts panels are among the most prominent sources of nutrition information (3). One of the advantages compared with other sources of nutrition information (e.g. promotion folders or nutrition information provided by health professionals) is that the information on nutrition facts panels can be used in the point-of-purchase setting where actual purchasing decisions have to be made (6, 7). A disadvantage of the nutrition facts panel is that it can be difficult for consumers to understand, which may hamper its use (8). It is supposed that older consumers and consumers with lower levels of education and income experience particular difficulties – exactly those people with the greatest need to adopt healthier dietary patterns (3, 4, 8). It has therefore been suggested that interpretational aids may serve a useful function in getting consumers to use the nutrition facts panel more often and more effectively (8).

Figure 1. Nutrition facts panel (example from the Netherlands).
As a result, nutrition and health claims and FOP labeling formats are increasingly displayed on product packages. Nutrition and health claims convey information on food characteristics (e.g. "contains calcium") and on the link between diet and health (e.g. "contributes to prevention of osteoporosis"). Current food packaging has given rise to a considerable number of debatable claims. There are indications that these claims increase consumers’ perception of the healthfulness of food products, whereas others state that these claims are misleading and confusing (9-11). Additionally, FOP labeling formats were developed as interpretational aids to supplement the nutrition facts panel back-of-pack. FOP labels help to distinguish “healthier” food options from less healthy options. They require less detailed nutritional knowledge than that needed for interpreting the traditional nutrients facts panel. In general, FOP labels have two aims. First, they aim to help consumers to make healthier choices. Second, FOP labels aim to stimulate food manufacturers to develop healthier products.

**Categorization of front-of-pack (FOP) labels**

Since the 1990s, many countries, food manufacturers, retailers and consumer organizations have developed their own FOP labels, with different designs and criteria. FOP labels can be categorized in three groups: “non-directive”, “semi-directive” and “directive” FOP labels, a categorization proposed by the European Union funded project “Food Labeling to Advance Better Education for Life” (FLABEL) (12). Table 1 illustrates the three categories and their main characteristics.

<table>
<thead>
<tr>
<th>FOP label category</th>
<th>Main characteristics</th>
<th>FOP label examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-directive</td>
<td>Overall conclusion whether product is healthy is left to consumer.</td>
<td>Guideline Daily Amounts (GDA) NuVal</td>
</tr>
<tr>
<td>Semi-directive</td>
<td>Provide some direction, but leave final healthiness interpretation to consumer.</td>
<td>Traffic lights label Guiding Stars</td>
</tr>
<tr>
<td>Directive</td>
<td>Communicate overall healthiness; no interpretation needed by consumer.</td>
<td>Green Keyhole Pick the Tick Choices logo</td>
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Table 1. Categorization of FOP labels proposed by the European Union funded project ‘FLABEL’.
use of colors), but leave the final healthiness interpretation to the consumer. An example is the traffic light label, which also originates from the United Kingdom and is currently used on many food products in different countries (15). These labels rank total fat, saturated fat, sugar and sodium and code them with a color as high (red, “think before you eat”), medium (amber, “OK”) or low (green, “go”), based on cut-points established by the Food Standards Agency (15). Another example is the American “Guiding Stars” symbol displayed on supermarket shelves, which expresses the relative healthiness of a food product by showing 1, 2 or 3 stars (16).

Finally, there are directive FOP labels, also called “health logos”. They serve as a “health quality mark” and are present only on products with a relatively favorable nutrient composition. They communicate the overall healthiness of the food product and no interpretation by the consumer is needed. These labels provide an integrative assessment of a combination of nutrients, such as saturated fat, total fat, salt, added sugar, fiber and energy, based on pre-set product criteria. Directive FOP labels generally have category-specific criteria. Because the range of the intake of different nutrients is too great for one set of criteria to be created for all food products when foods are labeled with one “health quality mark”, product grouping is needed (17, 18). Thus, the presence of a directive FOP label usually means “healthier product” within a predefined product group. Although there is much debate whether consumers choose within or across product groups, there is some evidence that FOP labels should be category-specific to be helpful in promoting healthier diets, but with a limited number of categories to avoid being confusing (18). Furthermore, it is supposed that systems that rely on one set of criteria for the entire food supply are less aimed at stimulating product reformulation compared with systems which have product group-specific criteria. Examples of directive FOP labels are the Green Keyhole Symbol in Sweden (19), the Heart Symbol in Finland (20), the Pick the Tick logo in Australia and New Zealand (4), the Healthier Choices Symbol in Singapore (21) and the Choices logo in the Netherlands (22).

In 2010, the Institute of Medicine from the United States published an overview of the FOP labeling systems internationally available, which describes the different designs, criteria and system developers (23). Food manufacturers, retailers, health organizations, and others developed their own symbols and systems, not without controversy. Concerns, particularly over nutrient criteria that vary widely and sometimes conflict among the many systems in the marketplace, and lack of conclusive effectiveness research on these labels have fueled current debate on the future use of FOP labels.

Research about front-of-pack (FOP) labeling
In recent years there has been vigorous international debate about the preferred format and potential impact of FOP nutrition labeling. Existing FOP labels use different criteria to categorize products as healthy or otherwise. Furthermore, they vary considerably in appearance (e.g. colors, sizes, placing on the package, expressions by numbers). Regulatory changes are currently being considered by the European Parliament (5) and regulatory bodies in Australia and New Zealand (24, 25). Also, the Institute of Medicine (IOM) and the Food and Drug Administration (FDA) in the
United States are currently conducting research in this area and preparing advice for the US government (23, 26). In this highly political debate, policy-makers, scientists, industry groups and consumer organizations are looking for literature evaluating FOP labels in order to make well-informed decisions (11, 27). As a result, a growing number of studies testing the effectiveness of the FOP labels have been published (science based and non-science based). Researchers study different aspects, such as (self-reported) consumer understanding and use of FOP labels (6, 19, 28-36), actual label use in real life shopping environments (37-45), and effects on reformulation (46-48), sales (16, 49, 50) and health outcomes (51-55). In this way, they aim to evaluate the usefulness, adoption, reach and impact of these labels. Obviously, for industry groups, effects on sales play an important role, as their primary aim is to sell their products. We will discuss the role of the different stakeholders, their conflicting interests and the role of science further in the General Discussion of this thesis.

Currently, the FOP studies published use different methodologies and different FOP labels for comparison (56). Therefore, we cannot draw any conclusions yet as to whether and how these labels influence public health. Do FOP labels actually help consumers to make healthier choices and do they stimulate product development? This thesis focused on answering these questions by evaluating the effectiveness of the directive FOP label “Choices” in the Netherlands.

**Choices Netherlands**

The FOP label “Choices” (in Dutch ‘Ik Kies Bewust logo’; Figure 2) was developed by large food companies in the Netherlands. At the request of the Dutch Minister of Health, the Choices Foundation was created, with representatives from food industry, the Netherlands Nutrition Center, retail and catering organizations. The logo has appeared on a variety of products in the Netherlands since 2006 which are available in many supermarket chains and food service locations including railway stations and worksite cafeterias. The program aims to help consumers to make a favorable choice within each product category and should stimulate product innovation towards healthier products.

The initial product criteria of the Choices logo were based on the Nutrition Enhancement Program of Unilever, and on criteria of the Netherlands Nutrition Center (57). Subsequently, an independent committee of Dutch scientists has developed a new set of product criteria. This scientific committee periodically adjusts the criteria in order to continue encouraging food manufacturers to improve their products. The logo is assigned to products that contain lower levels of sodium, added sugar, SAFA, TFA and caloric content and increased levels of dietary fiber compared with similar products within the same product category. Basic product categories have been de-
fined which provide the essential and beneficial nutrients, and which are based on food-based dietary guidelines: vegetables and fruits, sources of carbohydrates, sources of proteins (meat, fish, eggs and meat substitutes), dairy products, oils and fats, and ready meals. Additionally, categories were identified which provide fewer essential nutrients but are consumed regularly and are consequently of interest for product innovation: soups, sauces, snacks and beverages.

Food companies pay a fee to join the Choices Foundation. These fees are used to cover the costs of communication regarding the logo, especially mass media communications to introduce and explain the meaning of the logo to consumers. Although any food manufacturer can join the Choices Foundation and opt to carry the logo on products that comply with the criteria, not all producers have joined. This means that not all products on the market complying with the Choices criteria carry the logo. In March 2011, 106 participants, including food manufacturers, retailers and caterers, joined the Foundation in the Netherlands, and the logo was assigned to approximately 5100 packaged products and 1500 fresh fruits and vegetables (58).

A year before the launch of the Choices logo, in 2005, another health logo was launched in the Netherlands. This logo was developed by the largest retailer in the country, was present on the retailer’s own brands and was called ‘Gezonde Keuze Klavertje’. Its criteria were comparable with the Choices criteria. It was, however, confusing to have two health logos in one country. As a result, the government strongly advised that the two health logos should be combined (59). After two years of negotiations, the stakeholders agreed on a single national health logo in the Netherlands, and this was presented to the Minister of Health on the 1st of March 2011. The politics around this process and around FOP labeling in general are discussed further in the General Discussion of this thesis.

**Choices International**

Since 2008, the Choices International Foundation has secured the endorsement of local authorities, scientists, non-governmental organizations, and the food industry for the international roll-out of the Choices logo: the logo was launched in several countries in Europe (2008-2011) and in Israel (2011). Since 2010, the International Foundation has been exploring how to create local foundations in South America and Asia. The international Choices criteria are based on the Dutch criteria. However, the international roll-out has necessitated a complete re-evaluation of the criteria for further international applicability. Therefore, an independent scientific committee of experts in nutrition, food science, and consumer behavior from Europe, the United States and South Africa was established (60). They developed international nutrient criteria by redefining product groups as well as the full set of criteria. The final set of criteria is to be re-evaluated every three years in order to continue stimulating product innovations and to achieve population dietary intake aims.

**Aim of this thesis**

At the start of this thesis in September 2007, the Choices logo has been on the Dutch market for more than a year. Scientists, industry groups, the Dutch government and the Dutch Choices Foundation expressed a need to evaluate the logo's
effectiveness. Therefore, the aim of this thesis was to evaluate the effectiveness of the Choices logo on consumer behavior, product development, and public health in the Netherlands. This thesis describes five effectiveness studies, as illustrated by the scheme in Figure 3. “Effectiveness” was defined as effects of FOP labels on consumer behavior, reformulation and health outcomes. Consumer behavior was subdivided in effects on consumers’ self reported understanding and use of FOP labels, effects on consumers’ observational use and effects on sales. This subdivision was based on the designs and main outcomes of current FOP labeling studies. In addition to these five effectiveness studies, this thesis describes two more studies: an implementation evaluation and a review of methodologies used in earlier FOP label evaluation studies.

Research settings and methodologies
In the studies described in this thesis, we have used different methodologies and different research settings to evaluate the logo’s effectiveness. To evaluate its effectiveness on consumer behavior, we collected self-reported questionnaire data, conducted in-store observations, and collected observational sales data. Further, these consumer studies took place in different point-of-purchase settings where the logo is available, such as in supermarkets and worksite cafeterias. To evaluate the logo’s effectiveness on reformulation, we collected nutrient composition data provided by food manufacturers. Finally, to evaluate the effectiveness of the logo on public health, we performed a modeling study in which we used existing national food consumption (61) and food composition databases (62).

Outline of this thesis
Regarding the effectiveness of the Choices logo on consumer behavior, we conducted three studies. This thesis starts in chapter 2 with a self-reported consumer study. We collected quantitative data from large consumer panels (n=2159) in combination with qualitative focus group interviews with 41 consumers a year after the introduction of the logo. The aim of this study was to evaluate the self-reported use and understanding of the logo. Chapter 3 describes an observational consumer study (n=404), in which we used a combination of questionnaires and in-store product observations in nine supermarkets. Consumer characteristics were linked to reported use and actual use of the logo to gain insight in what types of consumers purchase logo products. Chapter 4 describes our third consumer study, in which we measured sales data in 25 worksite cafeterias by conducting a randomized controlled trial. We investigated the effect of labeling vs. no labeling on employee’s food choices during lunch. Chapter 5 does not describe a real effectiveness study, but an implementation evaluation study. A good implementation of an intervention is essential before being able to evaluate its effectiveness. Therefore, the implementation of Choices in worksite cafeterias was evaluated by collecting questionnaire data from 316 catering managers who had implemented the Choices logo in his or her cafeteria. Chapter 6 describes an effectiveness study again, in which the effects of the Choices logo on reformulation and healthier product development were evaluated. We collected the nutrient composition data of 821 products; these data were provided by 47 food manufacturers who joined the Choices Foundation. The final effectiveness study, a modeling study, is described in chapter 7. The potential effect
of consuming a diet complying with the Choices criteria on the cholesterol levels of the Dutch population was investigated. For the data analyses, we combined Dutch food consumption data with Dutch food composition data to calculate shifts in fatty acids intake. Afterwards, we used quotations from meta-analyses to calculate how blood lipids change when the composition of the diet changes. Chapter 8 provides an overview of the methodological quality of current FOP labeling research. We describe the strengths and limitations of current labeling studies, and propose future research challenges. This thesis ends in chapter 9 with a General Discussion, which discusses the studies’ main findings, the studies’ methodological strengths and limitations, and proposes recommendations for further research and practice. Finally, we relate the findings of this thesis research to the current international debate about front-of-pack labeling.

In conclusion, by using different outcome measures, different settings, different methods of data collection, and different research designs we aimed to gain insight into the effectiveness of the Choices logo on consumer behavior, product development, and on public health. I hope this thesis will contribute to the interesting research area and to the international debate about front-of-pack nutrition labeling.
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