
How to foster informed decision making about food supplements: results from an international Delphi study

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Abstract

Food supplement use can have beneficial and detrimental effects, making informed decisions about supplement use important. How these decisions are made and which communication strategies can stimulate informed decision making is unclear. This study identified the important characteristics of (i) informed decision making about food supplement use and (ii) important factors indicating how to communicate about food supplements to foster informed decision making. An online three-round Delphi study was conducted. International experts within the field of (risk) communication about food supplements or related fields were recruited via email. The participants' age ranged from 25 to 69 years, and sample sizes for the three rounds were 38, 89 and 51, respectively. Experts indicated that for making an informed decision about food supplement use one needs to have knowledge of their positive and negative effects, the ability to compare these effects, knowing alternatives besides supplements, feeling informed, and feeling able (self-efficacious) to make the decision and making the decision voluntarily. Important communication strategies mentioned were: provision of information about positive and negative effects and the nature of these effects including scientific evidence, ensuring information is easily accessible, well ordered, tailored and provided by a trustworthy, credible and independent source.

Introduction

Food supplement use is a widespread phenomenon in industrialized countries. Between 1987 and 2003, the overall prevalence of supplement use in the Dutch general population has increased from 17% to 42% [1]. In the adult population, supplement use ranges from 30% to 56% [2] which is comparable to the United States (49%), and Western and Northern European countries, where supplement use ranges from 16% to 52% among men and from 27% to 66% among women [3, 4]. Certain Dutch groups are at increased risk of micronutrient deficiency and thus may profit from using food supplements: infants up to 3 months old (vitamin D and vitamin K), young children up to age 4 (vitamin D), pregnant women and women who would like to get pregnant (folic acid), men above 70 years old (vitamin D), post-menopausal women (vitamin D), people who are insufficiently exposed to natural sunlight (vitamin D), people with dark skin (vitamin D) and vegetarians (vitamin B12). The consensus is that for other subpopulations, food supplements will have no added value to a normal balanced diet [5, 6].

Scientific evidence for the efficacy of supplements in promoting health or preventing diseases for non-at-risk groups is uncertain and sometimes conflicting, and some supplements may have both positive and negative health effects [7, 8]. Consequently, it is important that potential consumers are adequately advised about its use and potential effects in order to facilitate them to make an

informed decision about the choice to use supplements or not. The complexity concerning the effects of food supplements makes it challenging to provide clear messages detailing the rationale for using a particular supplement. Given this complexity, the question is also how to enable consumers to make an informed decision regarding supplement use instead of (simply) advising in favor or against use. In this context, the focus is thus not necessarily the consumer's end behavior and choice for a particular supplement that should be targeted, but the process on how a decision was made and whether this decision was well informed.

The concept of informed decision making (IDM) was first used in the context of clinical treatment and (genetic) screening. Decisions in these contexts often involve situations in which no single best therapeutic action exists and choices depend on how patients value benefits versus harms [9]. However, IDM also relates to health decisions that are made outside of a clinical encounter and without any input of a healthcare provider [10]. In contrast to patient decision making (i.e. discrete health decisions), the field of everyday self-care decision making (e.g. the use of complementary and alternative medicine) remains largely unexplored [11]. IDM is especially useful in case of (among others) uncertainty regarding effectiveness and the balance between benefits and harms (of choice options), when balanced information is unavailable and when controversy exists among health professionals regarding the choice options [12]. These conditions may also apply to IDM regarding supplement use [7, 8], suggesting that IDM may be a more appropriate communication strategy than advising in favor or against supplement use. Frequently mentioned characteristics to describe IDM within the medical decision making literature are; having relevant knowledge regarding the (medical) choice options; actively participating in decision making; making the decision is in line with one's values; being satisfied with the decision or decision making process; and reduction of one's level of decisional conflict or uncertainty (Table I [12–17]).

Concerning food supplement use, it is not clear whether these characteristics are also important for

stimulating informed decisions regarding its use and how this topic needs to be addressed by health communicators as the need for and effects can be unclear, and food supplements may have the potential to be both beneficial and harmful to health [7, 8]. Petróczi *et al.* [18] found that users' decisions on food supplement use may not be (fully) informed and observed that individuals took food supplements for other health reasons than their actual, scientific-proven health effects. Similar conclusions were found by Sirico *et al.* [19] indicating a difference between evidence-based rationales to use food supplements and individuals' actual reasons to use them. Previous research demonstrated that public acceptability of food-related uncertainties and adherence to governmental messages can be low when this uncertainty results from conflicting information or disagreements among experts [20, 21]. Although a wide range of different communication techniques aimed at improving understanding of probabilities and uncertainties is studied within the risk communication literature (e.g. using different numerical formats, using verbal instead of numerical probability expressions, framing information in terms of gains instead of losses and including benefit information), there is no consensus on which technique results in the best informed decisions in case of uncertain or two-sided information [22]. Adequate supplement use requires making well-informed choices. Yet, it is unclear what characterizes such informed choices, and which communication strategies may foster IDM about food supplement use.

This study was aimed to reach consensus among a diverse group of experts regarding: (i) the most important characteristics of an informed decision regarding the use or non-use of supplements with both positive and negative effects and (ii) the most important factors related to communication about food supplements that can enhance or hinder IDM. We defined food supplements as products taken orally that contain one or more 'dietary ingredients', intended to supplement normal diet which are categorized as foods and not as drugs [see e.g. *Dietary Supplement Health and Education Act of 1994* (USA) [23]].

Table I. *Characteristics to describe IDM*

Reference	Definition or elements IDM
Braddock III <i>et al.</i> [15]	<ul style="list-style-type: none"> • Discussion of the patient's role in decision making • Discussion of the clinical issue or nature of the decision • Discussion of the alternatives • Discussion of the pros (potential benefits) and cons (risks) of the alternatives • Discussion of uncertainties associated with the decision • Assessment of patient's understanding • Exploration of patient preference
Marteau <i>et al.</i> [13] and Michie <i>et al.</i> [14]	<ul style="list-style-type: none"> • The decision is based on relevant knowledge • The decision is consistent with the decision maker's values • The decision is translated into behavior
Molenaar <i>et al.</i> [17]	<ul style="list-style-type: none"> • Knowledge or understanding of treatment options (e.g. of the risks and benefits of the options) • Consistency between patients' treatment preferences and provided information • Consistency between patients' treatment preferences and values • Awareness of a choice between treatment options • Willingness to participate in decision making (decision-making autonomy) • Involvement in decision making • Self-efficacy related to participation in health care • (Reduced or reasonable) level of decisional conflict • (Reduced) level of decision uncertainty • Satisfaction with the treatment preference • Satisfaction with the actual decision made • Satisfaction with the decision-making process
O'Connor <i>et al.</i> [16]	<ul style="list-style-type: none"> • Knowledge of treatment options and outcomes • An accurate perception of the probabilities of outcomes • An active role in decision making • (Reduced) level of decisional conflict • Satisfaction with the decision • Satisfaction with the decision-making process
Rimer <i>et al.</i> [12]	<p>Definition/components of IDM:</p> <ul style="list-style-type: none"> • Knowledge about the risk/seriousness of the disease • Understanding of the disease or condition being addressed • Comprehension of the clinical service: its benefits, risks, limitations, alternatives and uncertainties • More realistic expectations of health care outcomes • Consideration of one's preferences and making a decision consistent with them • Making a decision in line with one's values • Participation in decision making at the level desired by the decision maker • Satisfaction with the decision-making process • Satisfaction with the decision • (Reduced) level of decisional conflict • (Reduced) level of uncertainty

(continued)

Table I. *Continued*

Reference	Definition or elements IDM
	<ul style="list-style-type: none"> • Adherence to the decision made by the decision maker • (Reduced) level of anxiety, depression or regrets
	<p>Steps in the process of (informed) decision making:</p> <ul style="list-style-type: none"> • Understanding of the clinical service: its risks, benefits and alternatives • Understanding personal values and preferences • Weighing pros and cons of the clinical service • Clarifying decisional preferences • Finding additional information, if needed • Deciding on an action plan

Materials and methods

Participants

An online three-round international Delphi study was conducted among experts [24, 25]. Procedures of earlier studies were followed using a three-round method as this has been found to be advantageous, because factors for which no clear consensus has been reached in the second round are offered another time to respondents for a critical review concerning their importance [26, 27]. Experts were selected based on two criteria: (i) they have experience in the field of (risk) communication about food supplements or a related field and (ii) the experts come from various fields (e.g. health communication, psychology, etc.) and have diverse backgrounds (e.g. research based, practice based, etc.). They were selected via the following recruitment methods: (i) by approaching contacts of our own network consisting of researchers in the field of health communication, risk communication, health promotion, risk perception and (health) psychology; (ii) selection of (co)authors of scientific papers, books, reviews or reports and speakers on conferences within the field of (risk) communication about food supplements or related fields; (iii) visiting websites of commercial, governmental or independent organizations within the field of (risk) communication about food supplements or related fields (e.g. food safety authorities, dietitians and scientific societies); and (iv) snowball sampling (e.g. suggestions of

invited experts and researchers). Consequently, 91 experts were invited by mail to participate in all three rounds of the Delphi study (Table II). The mail contained a link to the online questionnaire. Respondents had 4 weeks to complete the questionnaire, and non-responders received reminders after 2 weeks and 3 days before the end of the study. A total of 38 experts from a variety of professional fields (e.g. health promotion, psychology, health psychology, risk communication) participated in the first round [42% response rate; 22 females, 15 males and 1 unknown gender; mean age is 41.8 years (SD = 10.7)].

First round

The aim of the first round was to obtain a list of characteristics to describe IDM regarding use of food supplements with both positive and negative effects as well as a list of enhancing and hindering factors for IDM. During the first round, we asked a small number of key experts within the field of (risk) communication about food supplements or related fields to answer multiple questions related to informing people about both positive and negative effects of food supplements. Their responses were summarized into a list of unique (non-overlapping) factors.

Questionnaire

The first-round questionnaire consisted of 10 open-ended questions related to informing people about

Table II. First-, second-, and third-round types of expertise

Type of expertise	Round 1		Round 2		Round 3	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Research-based expertise	20	52.6	42	47.2	22	43.1
Practice-based expertise	1	2.6	4	4.5	4	7.8
Both (research- and practice-based expertise)	15	39.5	39	43.8	24	47.1
Other	2	5.3	4	4.5	1	2.0

the positive and negative effects of food supplements. Six of these questions were related to IDM. In one of these questions, experts were asked to list important characteristics to describe IDM: ‘What are the characteristics of an informed decision in the case of a food supplement with both positive and negative health effects?’. Five questions were related to enhancing and hindering factors for IDM, for example: ‘What factors can influence (improve/hinder) IDM in the case of a food supplement with both positive and negative health effects?’. As the main topic of this study is IDM and its enhancing and hindering factors, the other questions will not be discussed in this study.

Data analysis

Two researchers independently listed all unique factors [26, 28]. Similar responses were combined into one factor. Next, responses were clustered in terms of similarity by three other researchers in order to further reduce the number of factors and to result in a second-round questionnaire that could be completed in maximally 30 min. The final list consisted of 59 factors of which 13 were characteristics describing IDM regarding supplement use and 46 were enhancing or hindering factors for IDM (Tables III and IV).

Second round

The aim of the second-round questionnaire was to rate the IDM characteristics identified during the first round on importance and to determine their enhancing or hindering nature for IDM. During the second round, a larger group of experts rated these

factors on importance in a structured questionnaire. On the basis of their ratings, a group median and consensus score were calculated for each factor. Experts were recruited using the same criteria and recruitment methods as in Round 1. All participants who were invited for the first round were also invited to participate in the second round, unless they explicitly declined participation. This resulted in a list of 303 experts who were invited by mail to participate in the second and third rounds of the Delphi study. The online questionnaire was accessible for completion during 6 weeks. Non-responders received reminders 2 and 4 weeks after the first invitation and 4 days before the deadline for responding to this questionnaire. A total of 89 experts from a variety of professional fields (e.g. health promotion, psychology, risk communication, nutrition) participated in the second round [29% response rate; 55 females, 33 males, 1 unknown gender; mean age is 44.6 years (SD = 11.4)].

Questionnaire

In the first part of this questionnaire, experts were presented with the list of 13 IDM characteristics identified in Round 1 and were asked the following question: ‘Which characteristics are important indicators of an informed decision regarding the use or non-use of a food supplement with two-sided effects for a particular person?’. Experts could indicate the importance of each characteristic using a Likert scale ranging from 1 (very unimportant) to 7 (very important). In the second part of the questionnaire, experts were presented with the list of 46 enhancing or hindering factors for IDM regarding food

Table III. Second- and third-round ratings of characteristics to describe IDM regarding supplement use

Factors ^a	Round 2			Round 3 ^b		
	N	Mdn	IQR	N	Mdn	IQR
The person is aware of his/her needs for the food supplement	89	6.0	1.0			
The person knows the negative effects of the food supplement	89	7.0	1.0			
The person knows the positive effects of the food supplement	89	6.0	1.0			
The decision concerning the use of food supplements is in line with a person's personal values regarding the use of food supplements	89	5.0	2.0	51	5.0	2.0
The decision to use or not to use the food supplement, should be translated into behavior	89	5.0	2.0	51	5.0	2.0
The person should have the feeling of being fully informed	89	6.0	2.0	51	6.0	0.0
The decision should be made voluntarily without social pressures	89	6.0	2.0	51	6.0	1.0
The person understands all relevant information about the food supplement	89	6.0	1.0			
The person can compare the pros and cons of the food supplement	89	6.0	1.0			
The person feels able to make the decision	89	6.0	1.0			
The person feels more confident about the correctness of the decision	89	5.0	2.0	51	5.0	1.0
The person knows alternative options besides the use of the food supplement	89	6.0	2.0	51	6.0	1.0
The person feels more certain about the expected benefits of the food supplement	89	5.0	2.0	51	5.0	1.0

Bold values represent the items for which consensus was reached (IQR ≤ 1).

^aFactors were rated on a seven-point Likert scale ranging from 1 (very unimportant) to 7 (very important).

^bFactors for which consensus was reached during the second round were excluded from the third-round questionnaire. For this reason, third-round data for these factors are missing.

supplements and were asked the following question: 'Please indicate to what extent these factors are hindering or enhancing for IDM in a person'. They could indicate the degree to which the factors were hindering or enhancing using a Likert scale ranging from 1 (very hindering) to 7 (very enhancing). (See Tables III and IV for more details about the specific factors.)

Data analysis

Researchers are recommended to use the median rather than the mean because outliers can distort the mean unrealistically [29]. Consequently, for each factor, a median (Mdn) score was calculated which is common in Delphi studies, as they are less sensible to outliers. The larger the median, the more important or enhancing experts considered the corresponding factor. The lower the median, the less important or the more hindering experts considered the corresponding factor. A factor was considered to be important or enhancing if the median was 6 or

higher and unimportant or hindering if the median was 2 or lower.

The degree of consensus among experts on the importance of the factors was measured by calculating the interquartile range (IQR) for each factor. The IQR is the measure of dispersion for the median and consists of the middle 50% of the observations. An IQR of <1 means that more than 50% of all opinions fall within 1 point on the scale and serves as a method of determining consensus. The smaller the IQR, the higher the degree of consensus. An IQR of 2 or less on a 10-unit scale and an IQR of 1 or less on a 4- or 5-unit scale can be considered a consensus [29]. As we used a seven-point scale, we decided to use an IQR of 1 or less as a cutoff point for consensus [26, 28].

Third round

The aim of the third and final round was to generate consensus among experts on the importance of the factors. Experts were therefore asked to rerate the importance of factors on which no consensus was

Table IV. Second- and third-round ratings of enhancing and hindering factors for IDM regarding supplement use

Factors ^a	Round 2			Round 3 ^b		
	N	Mdn	IQR	N	Mdn	IQR
Information that discusses both the positive and negative effects of a food supplement	88	6.0	2.0	50	6.0	0.0
Discussion of risks and benefits of the food supplement in two separate paragraphs	88	5.0	2.0	50	5.0	2.0
Stressing the pros of the supplement more than the cons	88	2.0	3.0	50	2.0	1.0
Stressing the cons of the supplement more than the pros	88	2.0	1.0			
Making too exaggerated claims about the food supplement (e.g. claiming that it prevents you from getting a heart attack instead of claiming that it reduces the chance of getting a heart attack)	88	2.0	2.0	50	2.0	1.0
Messages framed in terms of the benefits of using a particular food supplement	87	4.0	2.0	50	4.0	2.0
Messages framed in terms of the costs of failing to engage in using a particular food supplement	88	3.0	2.0	50	3.0	2.0
Inconsistencies in the message	88	2.0	1.0			
Absence of sufficient contextual information (e.g. explaining what an absolute magnitude means or explaining whether 1% is a small or big effect, etc.)	88	2.0	1.0			
Absence of information about alternative sources/providers where the food supplement can be obtained	88	3.0	2.0	50	3.0	2.0
Absence of information indicating how negative consequences of the product can be controlled	88	3.0	2.0	50	2.5	1.0
Absence of information about the costs of the food supplement	88	3.0	2.0	50	3.0	1.0
Absence of information about popular misconceptions regarding the food supplement	88	3.0	2.0	50	2.0	1.0
Provision of scientific evidence for the claimed effects	88	6.0	2.0	50	6.0	0.0
Provision of evidence showing how long the supplement is already existing and working	88	5.0	2.0	50	5.0	1.0
Making sure that the communicated information is in line with the legislation	88	5.0	2.0	50	5.0	2.0
Provision of specific information about the nature of the effects of the food supplement	88	6.0	1.0			
Provision of too complex information	88	2.0	2.0	50	2.0	2.0
Too complex discussion of numerical information (e.g. 30% instead of 3 out of 10)	88	3.0	1.0			
Too long messages	88	2.0	1.0			
Too short messages	88	3.0	2.0	50	3.0	2.0
Information is discussed in an abstract way without providing clear examples	88	2.5	1.0			
Making sure that information about the supplement is easily accessible	88	6.0	2.0	50	6.0	0.0
Making sure that the information is well ordered	88	6.0	1.0			
Repetition of the most important information	88	5.0	1.0			
The use of colors in the message	88	5.0	1.0			
A nice design of the message	88	5.0	2.0	50	5.0	1.0
The use of images in the message	88	5.0	2.0	50	5.0	1.0
Provision of information by a trustworthy, credible and independent source	88	6.0	2.0	50	6.0	1.0
Provision of personal stories about the experienced effects of the food supplement	88	4.0	1.0			
Received information or advice about food supplements from significant others	88	4.0	2.0	50	4.5	1.0
Provision of information via patient education channels/groups	88	5.0	2.0	50	5.0	1.0
Information provided by commercial groups (e.g. food companies)	88	3.0	2.0	50	3.0	2.0
Provision of information via TV commercials	88	4.0	2.0	50	4.0	1.0
Provision of information via internet	88	5.0	1.0			
Empathy for concerns of the person about using the food supplement	88	4.0	1.0			
Provision of layered information (e.g. hyperlinks providing additional information when needed)	88	5.0	2.0	50	5.0	1.0

(continued)

Table IV. *Continued*

Factors ^a	Round 2			Round 3 ^b		
	<i>N</i>	Mdn	IQR	<i>N</i>	Mdn	IQR
Tailoring the channel of the information to the person's needs	88	5.0	1.0			
Tailoring the information to relevant demographic characteristics of the person	88	5.0	1.0			
Tailoring the information to a person's level of knowledge regarding food supplements	88	6.0	1.0			
Tailoring the information to specific needs/characteristics of the person (e.g. doing certain sports; being ill)	88	6.0	1.0			
Tailoring the information to a person's prior/current attitude toward the use of food supplements	88	5.0	2.0	50	5.0	1.0
Tailoring the tone of voice of the message to a person's preferences	88	5.0	1.0			
A person's positive attitude toward health in general	88	5.0	2.0	50	5.0	0.0
A person's inclination to want to carefully process all relevant information	88	5.0	2.0	50	5.0	1.0
A person's inclination to scan the information superficially and rely on brief statements	88	4.0	2.0	50	4.0	1.0

Bold values represent the items for which consensus was reached ($IQR \leq 1$).

^aFactors were rated on a seven-point Likert scale ranging from 1 (very hindering) to 7 (very enhancing).

^bFactors for which consensus was reached during the second round, were excluded from the third-round questionnaire. For this reason, third-round data for these factors is missing.

reached during the second round on the basis of the corresponding group median and consensus scores. All experts who participated in the second round were also invited to participate in the third round. This resulted in a list of 89 experts who were invited by mail to participate in the third round of the Delphi study. Respondents had 4 weeks to complete the questionnaire, and non-responders received reminders after 2 weeks and 1 week before the deadline for responding to this questionnaire. A total of 51 experts from a variety of professional fields (e.g. health promotion, psychology, communication, nutrition) participated in the third round [57% response rate; 27 females, 23 males, 1 unknown gender; mean age is 45.3 years ($SD = 11.3$)].

Questionnaire

During the third-round, experts rerated the remaining seven IDM characteristics and 28 enhancing and hindering factors for IDM on which no consensus was reached during the second round (i.e. factors with an $IQR > 1$) on importance and the degree of hinder/enhancement, using the same Likert scales as in Round 2. Below each factor the corresponding

second-round group median and IQR were displayed. This enabled experts to adjust their second-round rating of each factor, based on the group response. (See Tables III and IV for more details about the specific factors.)

Data analysis

Again, the median and the IQR were calculated for each factor. We used the same cutoff points for importance, degree of hinder/enhancement ($Mdn \leq 2$ and ≥ 6) and consensus ($IQR \leq 1$) as in Round 2.

Ethics approval and consent to participate

This study was conducted according to the guidelines laid down in the Declaration of Helsinki. Under Dutch law, approval of a Research Ethics Committee is only required if participants are subject to procedures or are required to follow rules of behavior (see <https://english.ccmo.nl/investigators/legal-framework-for-medical-scientific-research/your-research-is-it-subject-to-the-wmo-or-not>). As participants in this study were not subject to procedures or required to follow rules of behavior, approval

of the Research Ethics Committee was not necessary.

Results

During the first round, the 39 experts identified 13 unique characteristics to describe IDM and 46 enhancing or hindering factors for IDM regarding food supplements. All factors mentioned in the first round were included as items in the second-round questionnaire (see Tables III and IV for more details). In the second round, the 89 participating respondents reached consensus ($IQR \leq 1$) on importance for 6 of the 13 IDM characteristics. In addition, consensus on degree of enhancement or hindrance for IDM was reached for 18 of the 46 enhancing/hindering factors for IDM. In the third round, consensus was reached by the 51 participants on another 5 IDM characteristics and another 20 enhancing/hindering factors.

Characteristics of an informed decision

Important (or very important) indicators ($Mdn \geq 6$) of IDM were decision makers' awareness of their needs for the food supplement, knowledge of the supplement's positive and negative effects, their ability to compare supplements' pros and cons and knowledge about alternative options besides the use of food supplements.

In addition, experts agreed that it was important that the decision maker should have the feeling of being fully informed, feels able to make the decision and that the decision should be made voluntarily (see Table III).

Enhancing and hindering factors for IDM

One category of enhancing factors ($Mdn \geq 6$) on which consensus was reached, pertained to the content of information about food supplements and included: information that discusses both the positive and negative effects of a food supplement, provision of scientific evidence for the claimed effects and provision of specific information about the nature of the effects of the food supplement.

Another category of enhancing factors related to the way information is presented: making sure that information is easily accessible, well ordered and tailored to a person's level of knowledge and characteristics. In addition, one enhancing factor experts agreed upon was related to the source of the message: provision of information by a trustworthy, credible and independent source.

Experts also reached consensus ($Mdn \leq 2$) on a number of hindering factors for IDM: stressing the pros of the supplement more than the cons or vice versa, making too exaggerated claims, absence of contextual information, absence of information about popular misconceptions regarding the food supplement, inconsistencies in the message and too long messages (see Table IV).

Discussion

The aim of this study was to reach consensus within a diverse group of experts regarding the most important characteristics of an informed decision regarding the use or non-use of food supplements with both positive and negative effects and the most important enhancing and hindering factors for IDM. Experts reached consensus on the importance of the greater part of the IDM characteristics as on the influence of most enhancing and hindering factors on IDM.

The results regarding characteristics of IDM regarding supplement use were generally in line with previous research on IDM regarding medical decisions. Important characteristics mentioned by the experts were knowledge (regarding effects or alternatives) and understanding of the provided information [12–17]. In addition, experts agreed that feeling being informed, feeling able to make the decision and to do this voluntarily are important for IDM. As in other studies the importance of (absence of) decisional conflict was also found to be important for IDM [12, 16, 17, 30, 31]. Next, the ability to compare pros and cons was regarded important for IDM, confirming previous earlier findings [12].

Experts did not reach consensus on the fact that (i) the decision should be in line with a person's

personal values and (ii) the decision should be translated into behavior. This finding is in contrast with other literature on IDM describing the importance of consistency between values and decisions and behavioral implementation of the decision [12–14, 17]. Our differences may be explained by the nature of the decisions at stake. We investigated decisions about food supplement use, while most IDM studies concern medical decisions regarding life-threatening diseases [12–14, 17]. The impact of the latter type of decisions is probably higher than the impact of the decision to use food supplements and requiring more impact of values and translation of decisions into consequences.

Experts also rated the degree to which a number of factors was enhancing or hindering for IDM. These ratings revealed that experts preferred balanced information over unbalanced information. For example, experts agreed that information on both positive and negative effects is facilitating for IDM, while stressing the pros more than the cons or vice versa and making too exaggerated claims about food supplements were rated as hindering. In addition, provision of scientific evidence for the claimed effects was considered a facilitating factor. Provision of balanced information and scientific evidence are important quality criteria of so-called ‘decision aids’ [16, 32, 33] and thus also relevant for IDM. Inconsistencies in the message were rated as hindering, which is in line with the studies of Frewer *et al.* [21] and Markon and Lemyre [20] who indicated low public acceptability and low message adherence as consequences. Not describing popular misconceptions about food supplements was also mentioned as an important hindering factor, which is relevant as consumers’ understanding of nutrition information on labels is suboptimal [34] and (false) health claims may lead to inaccurate beliefs about supplements [35]. Providing information on these misconceptions may prevent these false beliefs.

Experts agreed that tailoring information to a person’s level of knowledge and needs/characteristics were facilitating for IDM. Rimer *et al.* [36] also concluded that tailoring to (among other things) one’s readiness to undergo mammography, knowledge of the procedure and age-specific benefits and

limitations (of mammography) led to increased levels of knowledge regarding breast cancer and mammography and more accurate risk perceptions regarding breast cancer compared with usual care. Giuse *et al.* [37] found that tailoring communication about hypertension led to greater gains in knowledge than standard-of-care discharge instructions. Hence, tailoring information to needs of the customer may be a promising strategy for improving IDM concerning food supplement use.

One limitation of this study may be that experts had to provide overall suggestions without being able to take into account the fact that different supplements may need different strategies, also because supplements differ in effectiveness [7, 8]. Hence, IDM promoting strategies for one type of supplement may not work with other supplements. Another limitation is the suboptimal response rate, ranging from 29% to 42%. Although these percentages are not optimal, they are comparable to other Delphi studies [26, 28, 38]. Finally, consulting consumers in addition to experts may expose important differences between these groups. In the current study, personal values were not considered but are relevant to include as well, but were beyond the scope of this study.

Our Delphi study resulted in a list of important IDM characteristics, which provides insight into the end results or outcomes that could be reached with communication about food supplements. To the best of our knowledge, no questionnaires or measurement tools exist that specifically measure IDM regarding food supplements. An important next step could therefore be to develop a questionnaire or measurement tool which makes it possible to measure the level or degree of IDM, based on the characteristics identified in this Delphi study. Existing medical measurement tools frequently measure the degree to which the decision is in line with the decision maker’s values [13, 14], which may be less important for IDM regarding food supplements according to the experts in our study. Another interesting direction for future research is to conduct experimental studies that could shed more light on which identified communication factors actually

lead to increased or decreased levels of IDM (as measured by an IDM questionnaire).

With respect to implications of this study, an important finding of this Delphi study is that experts considered provision of balanced information of both the positive and negative effects together with information about the nature of the effects, scientific evidence for the effects and popular misconceptions important for enhancing IDM regarding supplement use. It is therefore recommended to incorporate this information on the product labels, instruction leaflets, (informative) websites or other communication channels. Furthermore, experts expressed a preference for tailoring communication to a person's level of knowledge or characteristics. A possible way to implement this communication strategy is to design informative websites about food supplements where visitors receive information that is specifically tailored to their personal characteristics by making use of advanced routings. Another advantage of this technique is that irrelevant information is skipped, preventing users from having to read long messages which experts considered an important hindering factor for IDM.

In conclusion, the most important characteristics of an informed decision regarding the use or non-use of food supplements with positive and negative effects are: having knowledge and understanding of the supplements' positive and negative effects, the ability to compare these pros and cons, knowledge of alternatives besides supplement use, feeling fully informed and able (self-efficacious) to make the decision and making the decision voluntarily. In order to enhance IDM regarding food supplements, balanced and contextualized information should be provided about both the positive and negative effects of supplements, the nature of these effects and popular misconceptions. Moreover, scientific evidence for the claimed effects should be included. In addition, this information should be easily accessible, well ordered and tailored to a person's level of knowledge and personal characteristics. Finally, the information is preferably provided by a trustworthy, credible and independent source.

Declarations

Consent for publication

Not applicable.

Availability of data and material

Data from the interviews are available upon request.

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Conflict of interest statement

None declared.

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