Past, present, and future of computer-tailored nutrition education[1–3]

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ABSTRACT Computer-tailored nutrition education is an innovative and promising tool to motivate people to make healthy dietary changes. It provides respondents with individualized feedback about their dietary behaviors, motivations, attitudes, norms, and skills and mimics the process of "person-to-person" dietary counseling. The available evidence indicates that computer-tailored nutrition education is more effective in motivating people to make dietary changes than general nutrition information, especially for reduction of dietary fat. The effectiveness of computer tailoring has been attributed to the fact that individualized feedback commands greater attention, is processed more intensively, contains less redundant information, and is appreciated better than more general intervention materials. Interactive technology (eg, the Internet, the World Wide Web) offers good opportunities for the application of computer-tailored nutrition education, and a first controlled study of Web-based computer tailoring shows promising results. However, using the Web for interactive personalized nutrition education also presents new challenges. *Am J Clin Nutr* 2003;77(suppl):1028S–34S.

KEY WORDS Nutrition education, computer tailoring, feedback, review

INTRODUCTION

Computer tailoring is a health education technique that has become popular in dietary change research in the past decade and is now being adopted by nutrition educators (1, 2). This is not surprising, because computer-tailored interventions have been applied and studied in relation to several health behaviors and have generally been found to be more effective than their nontailored equivalents (2), especially in promoting healthy dietary habits (3). Computer-tailored interventions mimic, to a certain extent, a classic tailoring technique, that of "person-to-person" counseling. As in counseling, computer-tailored interventions provide people with information that is based on their individual characteristics (eg, their behavior, attitudes, and perceived barriers), which makes the information personally relevant. In computer-tailored interventions, the diagnostic and educational expertise and techniques of the counselor are documented in a computerized expert system. The present article first describes the rationale for the application of computer tailoring in nutrition education by reviewing how the steps of carefully planned health education can be applied to computer tailoring. The article then proceeds with a short outline of what is necessary for computer-tailored nutrition education and how computer-tailored interventions are developed and implemented. It further presents the available evidence for the effectiveness of computer-tailored nutrition education and describes the results of the few studies that have to date investigated why and for whom computer-tailored interventions may be effective. The final sections of the article discuss the future of computer tailoring in the era of the Internet and the World Wide Web and present some preliminary results from a study evaluating a Web-based computer-tailored nutrition intervention.

WHY SHOULD WE USE COMPUTER TAILORING?

It is especially since the publication of Green and Kreuter's Precede model and its successor Precede-Proceed (4), as well as similar planning models (5), that health educators have recognized the importance of careful theory-based intervention planning. A schematic representation of such planning models is depicted in **Figure 1.** According to these planning models, the first step in health promotion planning is the identification of a health problem that is serious and prevalent enough to justify spending time, money, and other resources on developing and implementing an intervention. In the second step, the specific behavioral and environmental risk factors for the health problem of interest should be identified, as should the groups who are exposed to these risk factors.

The third step in planned health promotion is to investigate the psychosocial and environmental determinants of exposure to risk factors. This planning phase should identify as precisely as possible why people in the target population engage in risk behavior. In relation to a nutrition behavior, the determinant analysis should, for example, point out why people eat too much saturated fat and whether these determinants differ in relation to such factors as sex, age, and education. This phase in the identification of the determinants of engaging in risk behaviors has long been disregarded. For a long time, nutrition educators assumed that it was enough to know what the problem was and that diet contributed to the problem. Merely telling people that their diet is putting them at risk was supposed to make people change their food habits. Nowadays, however, a large body of empirical evidence shows that health beliefs are only one possible determinant of nutritional habits (6)—and often not the most important determinant. It is therefore necessary to conduct a more thorough inventory of behavioral determinants as part of

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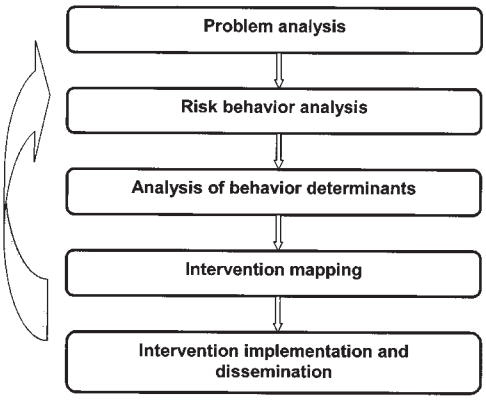

FIGURE 1. A model for planned health promotion.

the development of planned nutrition education. Five categories of important as well as changeable proximal determinants have been identified (7): intentions or motivations, a weighing of pros and cons (attitudes), social influences, perceived behavior control, and personal norms (**Figure 2**).

These categories of determinants explain up to 50% of the variance in fat intake (8, 9). Factors such as sex, age, or socioeconomic status are regarded as more distal correlates of dietary habits. Differences in eating habits between, for example, men and women are supposed to be a result of sex differences in the more proximal determinants (10). The insight that a limited number of determinant categories predict dietary habits relatively well does not mean that determinant research is no longer necessary (11). The determinants should be investigated separately for each specific dietary behavior, and for each population (or population segment), to detect which determinants are most important in a specific context as well as to identify the specific beliefs that underlie the determinants. For example, if a weighing of pros and cons (resulting in a positive or negative attitude) has been identified as the major determinant of motivation to eat a low-fat diet among younger women, this does not mean that the same applies to older men. Social influences may be more important in this group. And if attitudes *are* identified as the main determinant, it is still necessary to find out which positive or negative beliefs should be addressed to change these attitudes. It may be that beliefs about health consequences are important for attitude formation among relatively wealthy people but that beliefs about costs are more important for attitudes toward eating less fat among people who are less well off.

Intervention development: one size fits all?

In the next planning phase, health education methodologies and intervention techniques should be selected and translated into specific intervention activities to address the relevant determinants that can mediate the targeted behavior changes. Because diet-related health risks, such as risk for cardiovascular disease and diabetes, are prevalent among many population segments, many people need to be addressed with interventions aimed at prevention. Therefore, mass media campaigns aimed at whole populations have often been applied to encourage people to adopt healthier diets. Traditionally, mass media campaigns have made use of generic health education materials and messages to address the target population. If the campaign is carefully planned, these generic materials are fitted as closely as possible to the behavioral and environmental determinants of the risk factors targeted by the campaign. However, as we have argued, these determinants differ between people. Because generic materials are supposed to appeal to large groups of people, generic health education can, generally speaking, follow 2 paths. The first is to address just one or a very few determinants (beliefs or barriers) that are generally important for the population at large. This path leads to what may be called "slogan interventions." A good example of such a slogan approach is one of the national campaigns to encourage fat reduction, called "Let Op Vet" (Watch the Fat), that was mounted in the Netherlands in the 1990s (12). A determinants study revealed that many people thought that cutting back on fat would mean cutting back on taste and that this belief was an important reason why Dutch people, on average, were not motivated to reduce their fat intake. A campaign was therefore specifically designed to tackle this belief. Posters, brochures, television ads, and recipe booklets were produced to communicate the message that a diet low in fat can be at least as tasty as a high-fat diet. The second approach to the development of generic health education materials is to provide as much information, related to as many potentially important determinants, as possible. In this "search for yourself" approach, it is not assumed that all people have the same information needs. Rather, it is assumed that people will read and sift through often extensive collections of potentially relevant information. They are supposed to select the information that is relevant to their personal situation, in relation to their specific risk behavior, motivations, and beliefs. It has been found, however, that only people who are already motivated to cut back on fat are willing to search through lengthy brochures on dietary fat reduction for information that applies to their situation.

Both approaches have obvious limitations in their ability to significantly motivate risk behavior change. The "slogan approach" may lead to significant changes in the specific belief that is addressed among a proportion of the people who have that belief, but there is little chance that changing this belief will be more than a first step toward behavior change. The "search for yourself" approach will at best have an impact on motivated people; many people are not motivated to (further) reduce their intake of saturated fat (13, 14).

"Ready-to-wear" health education

Various attempts have been made in the past to match the content of health education more closely with the needs of the target populations. Most of these attempts can be characterized

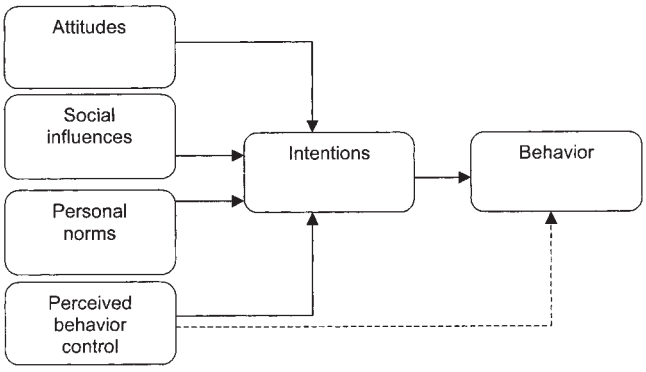

FIGURE 2. Psychosocial determinants of health behavior. From Armitage and Conner (7).

as target group segmentation, based on principles of social marketing. In target group segmentation, different subpopulations are distinguished that are more homogeneous in their information needs than the population at large. Target group segmentation is most often based on sociodemographic characteristics. For example, men may generally have different beliefs about fat reduction than women do. Therefore, it may be worthwhile to produce sex-specific fat reduction brochures. Similarly, preferences for the specific languages, examples, or illustrations used in health education material may differ according to different factors; taking age as one example, there could be different materials for different age groups. Within each target group segment, it is still possible to use the "slogan" or the "search for yourself" approach, but because the intervention is targeted in terms of sex or age, it may appeal to a larger proportion of the specific segment, or the searching may be less extensive.

However, as we have argued, sociodemographic variables are not direct or proximal determinants of health behavior. Useful target group segmentation is possible only if specific target segments are indeed homogeneous enough in their psychosocial beliefs (ie, the proximal determinants of eating behavior and motivation to change). Furthermore, especially since stages-of-change models came into fashion in the 1980s, health behavior change is no longer regarded as a single step from unhealthy (eg, eating a diet high in saturated fat) to healthy (eg, eating a diet low in saturated fat) behavior. The stages-of-change concept from Prochaska and DiClemente's transtheoretical model (13, 15) and Weinstein's precaution adoption process model (16) postulate that behavior change is a phased process. These models state that interventions should be stage specific because different determinants are important for each stage transition. As a consequence, people in different phases in the behavioral change process need different information, skills training, environmental changes, and so on to proceed to the next stage. In fact, the stages of change may serve as segmenting variables for clusters of psychosocial characteristics (17). It may therefore be both possible and more effective to segment health education audiences based on these proximal determinants and on motivational stage of change instead of, or in addition to, sociodemographic characteristics.

Tailored nutrition education

Tailored health education can be regarded as the ultimate aim of target group segmentation: it brings in individualization and personalization of health education based on sociodemographic, behavioral, motivational, and psychosocial as well as physical characteristics (1, 18). This concept, which is also being used in the field of product marketing, has been called "mass customization" and "relational marketing." It has been made possible in recent years by the ability of companies to produce and tailor advertising based on vast amounts of data regarding customer demographics, preferences, and buying habits.

In health education, tailoring has been defined as "any combination of information or change strategies intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest, and have been derived from an individual assessment" (18, page 5; 19). If we translate this general definition into nutrition education practice, a tailored nutrition education intervention would be:

- a combination of nutrition information or dietary change strategies;
- aimed at a specific person;
- based on this person's dietary habits and/or stage of change and the determinants of these habits; and
- assessed for this person in particular.

This is, of course, what many nutrition counselors do every day. However, personal counseling is too time-consuming and therefore too expensive to apply for every individual who, for example, has a diet high in saturated fat or low in fruits and vegetables. Today it is possible to apply tailoring by using interactive technology, which makes personalization of nutrition education applicable to large groups of people at relatively low costs. This is what is referred to as computer tailoring. In computer tailoring, the nutritional and educational expertise of a nutrition counselor, or even better, the combined expertise of many counselors, is translated to a series of "if then" statements and as such documented in an expert system. After a computer-tailored nutrition education system has been developed, it can be applied and distributed relatively independently of nutrition education expertise. In other words, computer-tailored systems make distribution of expert advice possible for nonexpert intermediaries, or without any intermediaries.

HOW IS COMPUTER TAILORING DONE?

The process of computer tailoring attempts to mimic the process of personal counseling: people are surveyed or interviewed, and the results are used to develop individualized feedback and advice. In the computer-tailored interventions developed to date, the survey is generally self-administered or administered by telephone, and the survey results are keyed or automatically scanned into a data file. The tailoring expert system analyses these data and links them with a feedback and advice source. This feedback source is a message library or archive that contains appropriate feedback and advice for each survey response.

The survey is to provide the "diagnosis" for the individual feedback and advice, and should therefore be aimed at assessment of the variables that are important for inducing dietary change, an assessment for which only valid and reliable measurement tools should be used (references 18 and 20 contain excellent descriptions of the process of generating tailored health education materials).

DOES COMPUTER-TAILORED NUTRITION EDUCATION WORK?

Just as it is not possible to conclude in general whether health education leaflets, brochures, or videos are effective, it may be difficult to state conclusively that computer tailoring is effective. However, several recent reviews have demonstrated that tailored printed materials generally outperform standard health education messages (2, 3). Brug et al (3) reviewed the literature on the impact of computer-tailored nutrition education specifically for dietary change and concluded that tailored nutrition education is more effective than general nutrition education, especially for fat reduction. An additional analysis of the pooled results of 3 trials of computer-tailored feedback in the Netherlands showed that computer-tailored interventions resulted in a 5.4% lower fat intake, compared with a 1.4% drop

in a general nutrition information control group ≈4 wk after the intervention (21).

WHY SHOULD COMPUTER-TAILORED NUTRITION EDUCATION BE MORE EFFECTIVE?

The reason why computer tailoring should offer better prospects for effective intervention than general nutrition information has not been fully explored yet. However, the available studies as well as more general behavior change models and theories allow possible working mechanisms to be identified: personalization of the nutrition education, better exposure to and more intensive cognitive processing of the educational information, greater personal relevance of the messages, and the self-evaluation properties of tailored feedback (3, 18, 20).

It has been argued that the personalization of the feedback itself—that is, putting the recipient's name on the feedback (similar to direct mail)—determines the effect of tailoring. Although this may indeed be partly true, various studies have shown that individually tailored interventions have greater effect than merely personalized messages (18, 22, 23), indicating that tailoring is more than just personalization.

Two factors improve the chances that an intervention will succeed. First, for an intervention to have any impact, the target population must be exposed to it (24). There is ample proof that computer-tailored information leads to better exposure. Computer-tailored feedback is more often read in its entirety, is read more thoroughly, and is more often stored as well as discussed with others than general nutrition information (2, 18, 22, 23). Second, the information must be understood and cognitively processed. The fact that computer-tailored feedback is more often discussed with others may be a first indication that computer tailoring leads to more intensive cognitive processing of the information (3). Furthermore, because only personally relevant information is included in the tailored messages, computer-tailored nutrition education will contain less extraneous information. People may therefore restrict their information-processing capacity to information that is relevant to them. Kreuter et al (25) have found evidence that computer-tailored information is indeed processed more intensively. In a randomized trial they studied differences in the quantity and quality of people's cognitive responses to tailored and nontailored weight-loss information. The results showed that computer tailoring led to more positive thoughts, more personally relevant thoughts, stronger motivational thoughts, and more self-assessment thoughts related to weight and weight-loss behaviors. Petty and Cacioppo's Elaboration Likelihood Model (26) asserts that health information may be processed via 2 alternative routes: central or peripheral. The central route, requiring more cognitive processing and leading to more elaborations, is supposed to be stronger when the information is regarded as personally relevant. Furthermore, central route processing will lead more readily to lasting attitude changes. The study by Kreuter et al (25) suggests that computer-tailored information is more likely to be processed centrally.

In a comprehensive review of the effectiveness of nutrition education, Contento et al (27) concluded that nutrition education was more likely to lead to healthier diets if more of the following prerequisites were met:

- Nutrition education should be tailored to motivators and reinforcers that are personally relevant to the people in the target group.
- Nutrition education should apply personalized self-evaluation and self-assessment techniques.
- People in the target group should be able to participate actively in the nutrition education intervention.

As stated above, computer tailoring enables the application of these important health education methodologies and techniques to dietary behavior change. It has indeed been established that computer-tailored nutrition education is perceived to be more personally relevant and that perceptions of personal relevance are positively associated with the impact of computer tailoring (3, 18). Self-evaluation may be especially important in nutrition education. Many people are not aware of how inadequate (from a health promotion point of view) their personal dietary habits are (13, 28). For example, it has been repeatedly found that many people with diets that are higher in fat than is recommended by health authorities believe that their diets are low in fat (6, 14, 29). This lack of awareness results in a lack of "need to change" and, subsequently, in a lack of motivation to reduce fat consumption ("Why change if nothing is wrong?"). The fact that people have no clear idea of how much fat they eat is not surprising given that fat intake is a very complex behavior, involving consumption of various food items in different combinations that may be prepared in different ways. Expert nutritional knowledge and advanced cognitive skills are needed to assess and evaluate fat intake, much less the intake of different types of fat (eg, saturated, monounsaturated). Computer-tailored systems can provide such objective feedback by incorporating the relevant expert knowledge and performing the calculations necessary to determine fat intake and compare it with recommendations.

People have a tendency to evaluate their own behavior by comparing themselves with others (30). Most often, they do this in a "self-serving manner"; that is, they tend to compare themselves with people who perform worse, in their opinion. This often results in a so-called optimistic bias, in that most people think that they perform better than most others (31). This is also true with regard to fat intake: many people seem to evaluate their fat intake not in comparison to dietary recommendations but by comparing their diet with what they think other people eat. In most cases, these "others" are not a realistic representation of their peer group but a "prototypical" group of people with high-fat diets. Most people, therefore, believe that their diet contains less fat than other people's diets. Even though people may think that their fat intake does not meet the nutritional standards, as long as they believe that they eat less fat than most others, they may still not perceive a need to change. Computer-tailored feedback, however, provides the opportunity to give people feedback about their consumption levels compared with nutritional standards *and* peer group average intake levels and thus make people aware of the adequacy of their personal intake levels (3, 32).

FOR WHOM DOES COMPUTER TAILORING WORK?

Because most computer-tailored nutrition interventions to date have used (rather extensive) questionnaires for the personal survey and have provided respondents with written feedback, it has been argued that computer-tailored nutrition education may work only among more highly educated people and people who are already motivated to change their diet (33). Indeed, health communications in general have been found to be more effective among more highly educated people (34), and this may be even more true for written health communications. Nonmotivated people (precontemplators) may not

be willing to complete the survey or may not (seriously) read and process the tailored feedback, because they experience no "need to change" and therefore no reason to participate in the intervention.

Most studies on the impact of computer-tailored nutrition education have indeed been conducted among self-selected samples, which typically results in overrepresentation of female, motivated, and more highly educated respondents, indicating that, like health communications in general, computer-tailored nutrition education appeals more to highly educated, motivated women. However, one of our own studies was conducted in a workplace setting among a largely male employee population and resulted in a 74% participation rate and significant reductions in fat intake in the tailored group (23), indicating that men can be interested in personalized feedback about their diet. Furthermore, a few larger studies have at least included sufficient numbers of men and less highly educated or nonmotivated respondents. These studies provide the opportunity to test possible effect modifications of sex, stage of change, and education. No sex-intervention interactions have been reported for the impact of computer-tailored nutrition education. One study reported specifically on the impact of computer-tailored nutrition education among precontemplators and people with a relatively low educational level (33). Computer tailoring proved to be more effective among precontemplators than general nutrition information did. Furthermore, precontemplators made up 34% of the participants, indicating that many precontemplators do take an interest in personalized dietary feedback if and when it is offered to them. This finding suggests that, at least for dietary fat reduction, precontemplators may lack awareness rather than being uninterested in or resistant to change. Computer tailoring was found to be as successful among people with lower education as it was among more highly educated people, and appreciation and exposure were even better among less highly educated respondents. Furthermore, the Health Works for Women and FoodSmart studies were conducted successfully among lower-income and minority women (35, 36). For poorly educated participants, literacy issues may interfere with the ability to use and understand tailored print material. However, for those with at least some reading ability, tailoring may help because there is less information to read and sift through, because information that is not personally relevant is eliminated.

We have argued that the power of tailoring lies in its ability to make nutrition education more personally relevant. However, individualization of nutrition education may not always be necessary to achieve personal relevance. If the determinants of a specific dietary behavior differ very little between people in a certain population, there should be no need to use computer tailoring. In such a population, well-designed generic materials that address these general determinants will be personally relevant for most of the target audience. Kreuter et al (37) found proof that when generic materials (by chance) fitted in well with the determinants and information needs of the respondents, their impact was as good as or better than that of tailored information. This indicates that in populations or for dietary behaviors with only minor variations in behavioral determinants, there is no need to use individual tailoring techniques.

THE FUTURE OF COMPUTER TAILORING

Tailored print materials or interactive technology

Most investigations into the impact of computer-tailored nutrition education to date have tested computer-tailored print materials (18, 33). Several limitations of printed tailored feedback, however, should be noted. Computer-tailored print materials use only part of the potential of computer tailoring, because interactivity and immediate feedback are not possible. Printed computer tailoring typically uses written surveys that are scanned into a computer, which then creates written feedback based on the individual survey results. The printed feedback, most often in the form of personal letters or individualized newsletters, is then sent by mail to the respondents. This procedure typically takes considerable effort and requires at least a few days, but more often a couple of weeks, between completion of the survey and delivery of the feedback. The longer the period between survey and feedback, the greater the risk that the personal relevance of the feedback is diminished, because people may change their beliefs, motivations, or even dietary behavior in the timespan between survey and feedback. Traditional printed computer-tailored feedback is also more expensive than generic nutrition education, because it requires at least some handling of the survey questionnaires and the feedback letters (18). On the other hand, it is possible that a strong point of printed feedback is its ability to be mailed or given directly to an individual from a trusted source. This may enhance its credibility and allows users to read it as many times as they wish and to share it with others.

A major limitation of computer tailoring is that it is difficult to mimic the positive characteristics of personal counseling beyond a certain point. Most computer-tailored interventions have not allowed for inclusion of direct interaction between the respondent and the nutrition education expert. Whereas computerized feedback has sometimes included tailored advice regarding social interaction with or social support from peers, this interaction is difficult to achieve without more intervention components directly aimed at involving social networks (3). As we have argued, the individualization of messages may be one reason why computer-tailored nutrition education is effective. However, computer tailoring can also be criticized for its individual approach, because it lacks the social component that is present in interpersonal counseling (3). It has also been argued that personalized advice may not be effective because dietary habits are often not volitional or personally determined, because food is often bought or prepared by others. Attempts have therefore been made to conduct family-based tailored nutrition education, in which different family members received tailored feedback and were encouraged to discuss their feedback, especially with the person responsible for cooking and shopping. Although family-based tailored nutrition education has been found to be more effective then generic nutrition education (32), a further study failed to prove the superiority of family-based tailoring over an individual tailored intervention (38).

Using interactive technology in computer tailoring may offer solutions to some of these issues: lower costs, better interaction, less time between screening and feedback, and opportunities for combining computer-tailored feedback with a socially supportive environment (eg, by offering opportunities to e-mail the "expert" or participate in online discussion forums or chat sessions). Interactive technology allows participants to enter the answers to the survey questions directly into the interactive system by means of, for example, mouse clicks, keyboard, voice recording, or touch-screen video. Feedback is then given almost immediately on the (computer) screen (39). An early study using a Web-based computer-tailored system showed that respondents who received interactive computer-tailored feedback appreciated

their information more, were more aware of their fat intake levels, and were more motivated to reduce their fat intake than respondents who received nontailored information (39). This study, however, did not attempt to compare the impact of the Web-based feedback with that of tailored printed feedback.

The Internet, and especially the World Wide Web, is regarded as a very promising medium for health promotion interventions in general and may have great potential for the distribution of computer-tailored nutrition education in particular. In addition to individualized health promotion messages, Internet-based tailoring can incorporate access to vast information sources; communication with experts, peers, or early adopters of health-promoting interventions; and links to providers and distributors of additional health promotion material (40). On the other hand, we are faced with several challenges when using the Web for health promotion. The enormity of the Web, with its virtually unlimited amount of information, the limited possibilities to check the validity of the information, the sometimes-doubtful sources of information, as well as the limitless opportunities to click through to other websites on completely different topics, may all be barriers to bringing across credible and effective nutrition education messages (39). Other potential pitfalls include people's tendency to surf the Internet rather than to spend concentrated time on one site, and the question of whether people read differently and/or are less easily persuaded by electronic text than by traditional text on paper. The real-life opportunities of Internet-based interactive tailored nutrition education therefore remain to be investigated.

Future research

The combination of greater effectiveness than general health education and the possibility of reaching larger numbers of people than interpersonal counseling makes computer tailoring a promising technique worthy of much further research. Several research gaps must be addressed to advance the field of computer tailoring, however. First, research is needed to test the impact of computer-tailored nutrition education by more objective outcome measures. To date, the available evidence is based on food consumption assessments with food frequency questionnaires and other self-reports. Studies are needed, and are currently being conducted, in which biomarkers, such as blood lipids and carotenoids, are used as effect indicators (41). Second, more research is needed to further reveal the processes responsible for the working mechanisms of tailored interventions, as it is not yet fully clear why tailored materials are more successful in influencing behavior than nontailored materials (1, 2). In this line of research, several so-called dismantling studies are under way or in the final planning phase. These studies compare the effects of tailored interventions that differ in the amount or content of the feedback provided. These studies should reveal which characteristics of tailored interventions increase its effectiveness, how far we should go with individualizing feedback, and when and where further differentiation no longer leads to a greater effectiveness or cost-effectiveness. A study recently started in Rotterdam will test 3 tailored nutrition interventions. The first provides respondents with feedback about their intake levels of saturated fat. The second intervention gives additional normative information—that is, the respondents' intake levels are compared with recommendations as well as with the average intake levels of comparable others. The third intervention also provides respondents with suggestions on how to cut back on fat. This study is intended to show whether personalized feedback about intake levels is sufficient to induce dietary change, or whether advice on how to make the required changes is necessary. In addition, studies are needed that test computer-tailored nutrition education against other state-of-the-art intervention approaches, such as telephone counseling, social support interventions, and environmental interventions (eg, at the point of purchase).

Further research is also needed to explore the opportunities for tailoring to multiple health-related behaviors, based on different sources and/or communicated through different channels. Most studies on computer tailoring to date have investigated the potential of interventions aimed at changing one health-related behavior. Computer-tailored interventions have been tested, for example, to encourage people to eat less fat, to stop smoking, to be more physically active, to participate in breast cancer screening, to encourage organ donor registration, or to seek protection from the sun (2, 42–44).

Some studies have targeted 2 or more health behaviors, such as consumption of fat, fruits, and vegetables (22, 45). Attempts have been and are being made to develop broader computer-tailored interventions that address various lifestyle factors. There are several reasons for the development of lifestyle tailored interventions. Prevention of many contemporary health problems involves different lifestyle factors. Prevention of certain cancers may involve smoking cessation, dietary change, and awareness of possible early cancer signs. Prevention of obesity and cardiovascular disease, and probably also diabetes and certain cancers, involves dietary as well as physical activity changes. The so-called WATCH project provided tailored information on multiple behaviors—that is, diet, physical activity, and colorectal screening. The tailored education resulted in improvements in all 3 cancer-preventive behaviors (45). A possible problem with tailored lifestyle interventions is that inclusion of more lifestyle factors necessitates more extensive surveys. People may be less willing to complete such surveys seriously or may be overwhelmed by too many recommendations for change. "Phased" lifestyle tailoring systems are now being considered, in which participants first complete a brief screening instrument to detect the lifestyle factors that are most relevant to or of greatest interest to them personally. These factors are then surveyed more intensively, leading to the generation of computer-tailored feedback. Tailoring on the participants' choice of behavioral priority for change indeed appears to be a promising approach for tailored interventions (46).

CONCLUSION

In conclusion, computer tailoring is currently one of the most promising and innovative approaches in nutrition education. Better exposure and more intensive cognitive processing as a result of individualization and the self-evaluation properties of computer tailoring have been proposed as important causes of the effectiveness of computer-tailored nutrition education. However, little is known to date, and more research is needed about when, why, where, and for whom computer-tailored nutrition education is effective.

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