E-health4Uth

Integrating
Monitoring and Prevention
in Youth Health Care

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E-health4Uth

Integrating Monitoring and Prevention
in Youth Health Care

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Integratie van Monitoring en Preventie
in de Jeugdgezondheidszorg

Proefschrift

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Voor Sandro,

van wie ik heel veel hou

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1

General Introduction

1.1 Introduction

This thesis reports on a number of studies examining the development, implementation and evaluation of E-health4Uth; an Internet tool developed to support preventive youth health care (YHC). This General Introduction describes the relevance of such an Internet tool and the methods used for the various studies, including the objectives of the studies. The structure and outline of the thesis is presented at the end of this General Introduction.

1.2 Problem analysis / relevance

The Internet tool E-health4Uth was specifically developed for the preventive YHC setting. Therefore the next paragraph describes the current Dutch YHC briefly, followed by the concept of e-health and what it embodies, and finishing with an explanation of how e-health aimed to benefit preventive YHC for the current project.

Current Dutch YHC

Preventive YHC, as a formal system, has a history of over 100 years [1]. It started with specific child health centers for babies, infants (0-4 years old) and mothers, initiated by committed physicians and citizens (this age-group will receive no further attention in this thesis). In the same period school physicians were appointed by municipalities in order to control infectious diseases among school children (4-19 years old), as well as to promote a healthy school environment ('Schoolgezondheidszorg' in Dutch). In 1990, a law concerning collective prevention and public health (WCPV) came into effect in the Netherlands, which made it obligatory for every municipality to participate in a regional or local municipal health service (MHS, 'GGD' in Dutch)[1]. This MHS had to provide preventive health care for school-aged children and adolescents. In subsequent years, an amendment ('Algemene Maatregel van Bestuur' in Dutch) to this law came into effect, which outlined the preventive health tasks to be performed by MHSs. This included giving continuous attention to a healthy physical, mental and social development of youth up to 19 years old [1].

A few years after introduction of the WCPV, the Minister of Health concluded that there were substantial regional variations regarding the provision of

preventive YHC. Accordingly, the Minister initiated the development of a set of preventive YHC products to be provided to all Dutch children, along with a framework for optional additional products related to local circumstances, e.g. youth being at risk for an unhealthy development. The result was published in 2002 as a report outlining the basic functions of YHC ('Basistakenpakket Jeugdgezondheidszorg' in Dutch) [2]. Recently, the evidence for the effectiveness of each of the functions of Dutch YHC has been evaluated; it was concluded that although many of the YHC functions (i.e. interventions) can be labeled as 'effective', others have not yet been evaluated at all, for which a research agenda of effectiveness studies in preventive YHC was proposed [3].

Among the parties involved in the provision of preventive YHC, there is consensus on the set of preventive YHC interventions that should be provided to all Dutch children, which comprises the following six groups [1, 4]:

1. Monitoring and detection of health risks,
2. Estimation of the need for specific care,
3. Screening for diseases and providing vaccinations,
4. Education, advice, instruction, and guidance regarding health behaviors and parenting,
5. Elimination of specific health hazards, including environmental hazards,
6. Coordination of care systems and networks, and initiation of cooperation between care systems.

Each of these six groups may consist of YHC functions/interventions that aim at the individual as well as activities that aim at populations (so-called 'collective prevention'). Alongside the set of preventive YHC interventions that should be provided to all Dutch children, guidelines for the 'contact moments' have been developed, i.e. the specific ages of children at which specific interventions should be provided, to make sure that all municipalities apply the same scheme of prevention [1, 5].

In the Netherlands, children go to elementary school at the age of 4 years. Preventive YHC for school-aged children and adolescents includes elements of all of the six above-mentioned product groups. These interventions are partly provided in the context of a so-called 'periodic health examination' ('Preventief Gezondheids Onderzoek' or 'PGO' in Dutch), a face-to-face contact between a physician/nurse (i.e. school physician/nurse) with the child/adolescent (including one parent, in the case of elementary schoolchildren). According to the guidelines

for the 'contact moments', all school-aged children and adolescents are invited approximately five times:

- One or two examinations at 5 years of age, of which one involves screening for speech/language disorders,
- Two examinations between age 6 and 12 years, of which one involves a vaccination without further counseling,
- One examination during secondary school from the age of 12.

During the examinations (PGOs) attention is given to growth, development, general functioning, and general behavior of the children/adolescents. During such a contact moment, the physicians/nurses interview the children/adolescents and parents and provide counseling, perform specific tests (e.g. screening tests), provide vaccination (if required), and sometimes may perform a physical examination. If abnormalities or specific problems are encountered, the physician/nurse may invite the child/adolescent and parent for a follow-up visit or may refer them to a general practitioner. As such, preventive YHC is an entry point into the curative health care system. Physicians and nurses have extensive contact with schools. They encourage and support health-promoting schools' initiatives that aim at developing policies to sustain healthy schools (Dutch term for this is Schoolgezondheidsbeleid, 'SGB') [6, 7].

E-health

In a very broad definition, Eng describes e-health as 'the use of emerging information and communications technology, especially the Internet, to improve or enable health and healthcare' [8]. Other researchers have attempted to refine that definition. Pagliari et al. [9]., for example, defined e-health as 'an emerging field of medical informatics, referring to the organization and delivery of health services and information using the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a new way of working, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.' In this definition, Pagliari et al. emphasize that e-health should not be solely viewed as a technology but that it must be considered in the context of the whole organization and delivery of care.

In a recent report, Van Rijen et al. distinguished three major application domains [10]. *First*, in the domain of diagnosis and therapy, communication technology is used to bridge the physical distance between patient and care provider. Consequently, the patient can be in a different location than the care provider. Additionally, care providers physically located in different places can communicate when treating the same patient. This domain is often referred to as telemedicine when it focuses on diagnosis and therapy with sub-divisions that reflect the nature of the activity involved (e.g., e-consulting when the patient uses the technology to contact the care provider, or e-therapy when the technology is used to deliver treatment). When topics such as patient education are also included, the term telehealth is often used.

The *second* domain is that of the infrastructures that support the delivery of care. This domain ranges from patients using the Internet to schedule appointments with their care providers to care providers that use Interactive Computer Technology (ICT) for their financial reimbursements. A wide range of terms is used to denote the subdivisions in this domain: e-procurement, e-finance, e-logistics, and so on.

The *third* domain is that of public health: e-public health. This domain involves the use of ICT in the area of public health, and again the terms used to further describe these applications reflect the activities in that field: e-prevention, e-health-education, and so on.

Not only do the application domains vary, also the applications themselves present a wide range of tools that are used. The tools range form computer-assisted telephone interviews to chat rooms, from web-driven databases to computer games, or from educational websites to self-testing. Although all of these applications will involve the use of ICT, not all require Internet access. However, a wide diversity is available when one only considers those applications that are Internet-based, such as password-protected websites for medical records and publicly accessible information sites.

Given the range of tools applied to the various application domains, it should be no surprise that the potential advantages of E-health can also span a wide spectrum. For some applications, the increased efficiency is the dominant advantage. For example, computerized health and health behavior questionnaires via the Internet are an efficient approach to sample data by eliminating manual data entry by researchers [11, 12]. For other applications, the reliability of the data obtained is the major advantage. For instance, E-health allows openness of

communication because participants may feel more comfortable exploring sensitive issues when interacting with the computer as opposed to a health care provider [11, 13]. Other advantages of interactive health communication include the enhanced convenience, novelty, and appeal of computer-mediated communication; its flexibility, and its interactivity [11]. E-health also provides long-term positive effects [10]: E-health can improve the quality of care, the patient-physician relationship (better connection between needs of patient and abilities of caregiver), and the accessibility of care (it is anonymous, distances do not matter). Finally, e-health induces renewal of organization structures, possibilities for education (of caregivers), and new forms of care (telemedicine, e-therapy).
E-health applications also have some disadvantages and barriers, such as security, privacy issues and the pre-requisite of computer literacy. Research that addresses these limitations has resulted in a variety of applications that range from secure communication channels to virus scanners. Some researchers argue that if the available technology is applied, electronic files are regarded as safer than the current paper files [10]. Although preventive actions are performed, potential long-term negative effects should also be taken into consideration [10]. These include: insufficient quality and fraudulence activities, infringement of privacy and confidentiality, flaws/mistakes in programming and/or equipment (software, hardware), abuse, social isolation, and widening of socioeconomic disparities. Although the potential of e-health is widely recognized, we should be careful not to expect too much of e-health, it is not a 'silver bullet' that solves everything.

Innovating YHC by e-health: this thesis

As has been outlined, e-health covers a broad spectrum. For this thesis, we focus on e-health in the context of preventive YHC, which we call E-health4Uth (see Fig. 1.1). We applied the Internet as a tool for YHC – and we limited the use of this tool to an environment that protects privacy using username and password protection. First we will describe the role and function of our project within the broader YHC context. Subsequently, we describe the aspects of e-health that were applied within this project.

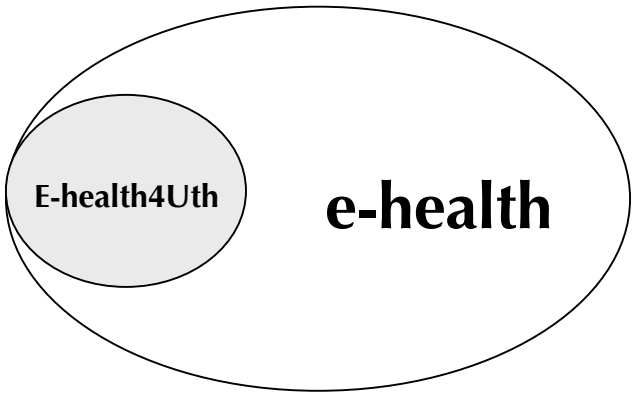

Fig. 1.1 E-health4Uth covers only elements of the broad spectrum of e-health

Monitoring and prevention

E-health4Uth focused on three of the function/intervention groups mentioned earlier, namely 1, 2 and 4: monitoring, estimating the need for care, and education and advice. From now on this will be referred to as 'monitoring and prevention', with a division between targeting the individual and the group. This is illustrated in a so-called preventive YHC-quadrant (see Fig. 1.2). The YHC-quadrant explains where in the YHC-field our project was carried out. However, the prevention at the group level (see square 4, Fig1.2) was not evaluated in the studies that comprise this thesis. Our project targeted school-aged youth and was applied during two of the scheduled contact moments:

- 10 years old (group 7) at elementary schools; referred to as school children,
- 15 years old (3rd grade) at secondary schools; referred to as adolescents.

When referring to both ages, we use the term 'students'.

Monitoring involves the assessment of health topics and health-related behavior topics. Questionnaires are used most frequently for this purpose. For adolescents this involves completing health/health behavior questionnaires at school (see square 1 of Fig. 1.2). Parents complete such questionnaires at home in the case of elementary school children. Instead, for the current project, we complemented the standard practice by having children complete health behavior questionnaires at school in order to involve children in the process.

	MONITORING	PREVENTION
INDIVIDUAL	*Assessment of health/health behavior *(e.g. via questionnaires, consultation with physician/nurse)* *Detection of individuals at risk *(e.g. for referral to physician/nurse)* **1**	*Individual education *(e.g. via preprinted leaflets)* *Individual counseling *(e.g. via interviewing techniques/protocols)* **3**
GROUP / POPULATION	**2** *Group profiles *(e.g. at school- or regional level)*	**4** *Group education *(e.g. parental education at schools)* * Health-promoting schools *(e.g. integral approach for school interventions)*

Fig. 1.2 YHC-quadrant

In addition to completing questionnaires, consultation (including a physical examination, e.g. visual test) with the physician/nurse takes place to monitor children's health status (during a 'PGO' as described earlier) (see square 1, Fig.1.2). For elementary school children a parent/caregiver must be present. Concerning the adolescents, we complied with the common practice of one of the participating regions (MHS in Vlaardingen). This practice focuses on risk selection: only referring adolescents at risk for consultation with the physician/nurse. Being at risk was indicated by a higher number of self-reported problems related to physical, mental or psychosocial development.

Monitoring data can be informative at the individual level, but also at the group level (see square 2, Fig.1.2). The data allows the analysis of the prevalence of health issues in certain areas, schools, or classes, referred to as school profiles.

Monitoring data can be collected with the aim to prevent the health issues that may arise. Prevention at the individual level entails health education through preprinted leaflets or brochures, and/or counseling by a physician/nurse (e.g. during a 'contact-moment') (see square 3, Fig.1.2).

For example, parental education at schools and health-promoting schools can be considered as prevention at the group level (see square 4, Fig.1.2) [7]. Another example would be that, based on monitoring, preventive YHC provides data on physical, mental and social health of youth at population level to the municipality, to support the development of policies aimed at specific groups of youth.

E-health applications within the YHC-quadrant

We developed an Internet tool with the aim to support this current procedure and to integrate monitoring and prevention. Currently, monitoring is mainly done via paper and pencil (P&P) questionnaires, completed questionnaires are manually entered/scanned, and if referral is indicated then individuals are invited by mail. The currently provided health education mainly includes counseling (the completed P&P questionnaire is used to direct the counseling) and preprinted leaflets may be provided.

The tool E-health4Uth can increase efficiency of the monitoring and overcome some of the limitations of P&P assessment. It has the advantages of eliminating manual data entry by researchers and thus reducing transcription errors as well as workload, dynamic question selection processes that improve ease of use (i.e. automatically skipping questions), and forced data entry resulting in complete data collection. Having the data stored in an electronic database allows electronic composition of group profiles.

E-health4Uth could make integration of monitoring and prevention at the individual level possible by giving immediate online feedback to the student based on the responses they provide and also by informing the physician/nurse via Internet of the students' answers so these can be used to support the counseling with the student. The latter falls under the previously mentioned second domain of e-health: supporting the delivery of care [10]. Internet offers the opportunity of quick and cost-efficient online selection and referral of participants identified to be at risk for certain illnesses to medical services [14]. Additionally, Internet provides the chance to give computer-tailored feedback on health and health behavior instead of generic health information. This aspect refers to e-health education, which falls under the e-public health domain (see paragraph on e-health). Interactive program delivery preferably involves individualization and tailoring to the responses and characteristics of each respondent as computer-tailored feedback on health and health behavior has been shown to be more effective than generic (preprinted) health advice in various studies [11, 15-18]. However, this has not received much investigation among youth to date. Little research on interventions on health promotion for healthy behaviors using specifically the Internet has been conducted so far. De Nooijer et al. reported in a review that there is no convincing evidence that web-administered interventions show a superior effect above other interventions; however, they have the

potential to be effective in promoting healthy behavior [19]. A major issue for effectiveness of web-based health promotion is the lack of reach and exposure to the intervention, as in most included interventions response relied on participants accessing the web site on their own initiative. This can be overcome when applying Internet-administered interventions within a closed (i.e. more controlled) setting, such as the YHC-setting; preventive YHC has a large reach of the target group and relies less on student's individual motivation when done in the school context.

At the group level, E-health4Uth may integrate monitoring and prevention as well; having electronic group profiles allows providing feedback via Internet to e.g. schools on the schools' health/health behavior status, including comparisons between gender and regions. As currently many interventions or school programs are available, in future the Internet provides the opportunity to make the automatic connection between the group profiles and these interventions through existing databases [7]. However, this has not been developed for E-health4Uth at this stage.

1.3 Methods

Internet tool for E-health4Uth

In summary, the Internet tool for E-health4Uth had the following features:

1. Questionnaire assessment for student,
2. Feedback to student,
3. Information to physician/nurse to support the counseling,
4. Generator of SPSS datafile with group results,
5. Feedback to schools about group results (in comparison to region) using graphs and tables (not evaluated in this thesis).

The feedback to the student (feature 2) had several optional aspects throughout the different studies:

a. Information on a referral based on an increased health risk (only applied at secondary schools),

b. Personal feedback regarding general health issues, based on Health Risk Appraisal* (only applied at secondary schools) [20],
c. Tailored advice on health-related behavioral topics (in our case nutrition) including print option, based on the computer-tailoring approach† [17, 21].

The information to the physician/nurse (feature 3) included an overview of which students were at health/health behavioral risk or not and printable information for each student. This information for each student involved the following aspects:

a. A summary of the health and/or health-behavioral status,
b. All individual items including answers in an overview,
c. The complete electronic feedback of the student.

A more detailed description of the Internet tool E-health4Uth is enclosed in Appendix 1.

Interventions and procedure

For this thesis two types of Internet-based interventions were evaluated: monitoring tools and prevention tools. The monitoring tools involved assessment by means of Internet-administered questionnaires among students (Chapters 1-4). The prevention tools involved the total practice of E-health4Uth: assessment among students (which is also the monitoring tool), information on a referral (if applicable), feedback/information to student and physician/nurse, and counseling by a physician/nurse (Chapters 5-6).

In total four field studies were performed, listed in the order that these studies were conducted:

1. Monitoring tool at secondary schools (Chapter 1),
2. Monitoring tool at elementary schools (Chapter 4),
3. Prevention tool at secondary schools (Chapters 2, 3, 5),
4. Prevention tool at elementary schools (Chapter 6).

* Health Risk Appraisal involves feedback regarding the individual health/ health behavior status for the topics that were assessed by the questionnaire. For instance, students with a score indicating a risk (e.g. below a certain cutoff point, based on norms) received feedback making them aware of the reported complaints.

† Computer-tailoring is 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."

Field study number 3 resulted in the evaluation of the prevention tool (Chapter 5), but also of two monitoring tools (Chapters 2-3).
Although each intervention addressed different aspects, all were relevant examples of health and/or health behavior and fitted within the priorities of preventive YHC. The feedback component of the Internet tool was developed according to an expert system as applied with computer-tailoring described by Kreuter et al. [21] Concerning the contents of the tailored advice on health behavior to the students, we applied existing theory-based Dutch tailored advice.
The studies were conducted with the participation and cooperation of two MHS, in Vlaardingen (urban area) and Harderwijk (rural area). Schools providing special education (i.e. education for children with learning- or behavioral problems, due to a handicap or chronic disease, and not able to follow regular education) were excluded for these studies. Through pretests, we determined that adequate Internet facilities were present in schools of the participating regions. By means of prototype testing (firstly the monitoring tool and secondly the prevention tool) the Internet tool was tested within elementary and secondary schools separately.
The interventions were aimed to support preventive YHC, therefore also to support the intermediates (physician/nurse, epidemiologist, school health educator) in providing health care. Since these intermediates have been involved from the start in the development of the interventions, the chance of large-scale implementation at a later stage is increased.

Objectives and evaluations of interventions

The objective of the interventions was to support YHC by means of E-health4Uth. In order to evaluate whether our objective was reached, we investigated the following research questions:

Q1. Are the Internet-based monitoring and prevention tools feasible? (All Chapters, specifically 2, 5, and 6),
Q2. How do users evaluate the Internet-based monitoring and prevention tools? (Chapters 2, 5, and 6),
Q3. Do Internet-administered monitoring tools yield equivalent scores with the P&P versions of the same tools? (Chapters 2 – 5),
Q4. What are the effects of the Internet-based prevention tool on students' health behavior and determinants? (Chapter 7).

To determine the feasibility, we assessed several indicators, such as the duration and the use of the administration mode 'Internet'. The users' evaluations were based on several aspects such as acceptability (e.g. satisfaction rates) and quality of the tools (e.g. credibility of advice).
An important topic addressed in this thesis focuses on the Internet-administered monitoring tools being score equivalent with the P&P versions (this may be regarded as an aspect of relative validity). Some is known among adults, and for this thesis we continued this field of research among adolescents and children. Several health and health behavior questionnaires in two settings (elementary and secondary schools) were compared using both Internet and P&P modes.
To evaluate the monitoring and prevention tools, we compared the E-health4Uth procedure with the current procedure (where possible). Concerning the feasibility and users' evaluations, we expected the E-health4Uth monitoring and prevention tools to receive an equally or better evaluation than the current procedure. Concerning the score equivalence, we expected to establish similar scores between Internet and P&P modes of administration; this would support conversion to Internet mode of administration and allow longitudinal data comparison. Regarding the effect evaluation, we hypothesized that E-health4Uth would establish healthier behavior in comparison with the current procedure.
As a method to evaluate this, we applied randomized study designs [22]. This involved randomizing students at the individual level (within classes), except for the study on the prevention tool at elementary schools in which we randomized at the class level (Chapter 7). Further we applied comparative/parallel group designs where students were randomized to E-health4Uth or the current procedure, except for the study on the monitoring tool at elementary schools (Chapter 2). For that study we used a cross-over design, where students were randomized to complete one or other of the instruments first and then, after a diversionary activity (to forget their responses), they complete the other instrument [23]. This made comparisons within children possible.

1.4 Structure of the thesis

Table 1.1 gives an overview of the studies. Part I (Chapters 2-5) focuses on monitoring tools. The first three Chapters report data from adolescents from secondary schools, applying a parallel design. Chapter 2 describes score

equivalence and students' evaluations of a health and health behavior questionnaire. Chapter 3 deals with the score equivalence of a health-related quality of life questionnaire, while information about feasibility and the score equivalence of respiratory questionnaires is presented in Chapter 4. Chapter 5 describes feasibility, score equivalence, and students' evaluations of a health and health behavior questionnaire among elementary school children, by applying a cross-over design.

Part II (Chapters 6-7) focuses on prevention tools. The process evaluation of E-health4Uth at secondary schools, including the referral of students at risk is reported in Chapter 6. The 7th Chapter deals with the evaluation of E-health4Uth at elementary schools. This study concerned the effectiveness of a two-component intervention: Internet-tailored nutrition advice combined with nutrition counseling.

Finally, the last part of this thesis (General Discussion) summarizes and integrates the results of the studies, discusses possible explanations for the findings, provides some implications for further implementation of E-health4Uth and suggestions for further research, and presents overall conclusions.

Table 1.1 Overview of the different studies presented in the thesis

Chapter	Sample	n [a]	Study design	Data collection
2	Secondary school children 3rd grade of two MHSs (mean 15 yrs old)	565	Parallel, randomization at individual level	Internet-administered (two interfaces) and P&P questionnaires
3 [b]	Secondary school children 3rd grade of two MHSs (mean 15 yrs old)	933	Parallel, randomization at individual level	Internet-administered and P&P questionnaires
4 [b]	Secondary school children 3rd grade of two MHSs (mean 15 yrs old)	933	Parallel, randomization at individual level	Internet-administered and P&P questionnaires
5	Elementary school children 7th grade of two MHSs (mean 11 yrs old)	249	Cross-over, randomization at individual level	Internet-administered and P&P questionnaires
6 [b]	Secondary school children 3rd grade of two MHSs (mean 15 yrs old)	933	Parallel, randomization at individual level	Internet-based registrations, P&P questionnaires
7	Elementary school children 7th grade of two MHSs (mean 10 yrs old)	486	Experiment, randomization at class level	Internet-based and written registrations, Internet-administered questionnaires

[a] *Participating number of students;*
[b] *Chapters 3, 4, and 6 report data from the same field study.*

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2

Internet-administered Adolescent Health Questionnaires Compared with a Paper Version in a Randomized Study

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Abstract

Purpose To assess whether the scores of an Internet-administered adolescent health questionnaire (using two different interfaces) are equivalent to those obtained via paper and pencil (P&P). Furthermore, it compares adolescents' evaluations of modes of administration.

Methods We randomly assigned 591 adolescents (13-17 years) from five secondary schools within their classes to one of the two Internet interfaces (multiple items versus one item per screen), or P&P. Adolescents completed questionnaires on psychosocial well-being (KIVPA), self-reported problems, health care utilization, and health-related behavior and supplementary evaluation surveys (on the given health questionnaire mode) in the computer classrooms. Differences among questionnaire scores between administration modes were analysed by the Student's t test and Wald test.

Results Response rate was 96% (N=565). Adolescents in the Internet one-item mode more frequently reported satisfaction with appearance compared to the Internet multiple-items mode ($p<0.01$). The Internet group had more adolescents rating they have a sufficient number of friends than those in the P&P mode ($p<0.01$). The Internet mode received more favorable evaluations than P&P. The multiple items per screen format was favored over the one item per screen format on perceived speed of the administration mode.

Conclusions Health questionnaires via Internet were positively evaluated and generally resulted in equal scores of health status/health behavior compared to the P&P mode. We recommend further research with other questionnaires, and in other settings as well with regard to score equivalence between web-based and P&P-administered questionnaires.

2.1 Introduction

Health questionnaires are frequently used in secondary schools for monitoring the health and social problems of adolescents. Municipal health services in the Netherlands traditionally collect such data to create school health profiles by administering paper and pencil (P&P) health questionnaires at secondary schools. In some cases these questionnaires are used for individual risk assessment; adolescents 'at risk' are referred to the school physicians/nurses and educated on their health. Logistic issues make this procedure cumbersome and time-consuming. The process of completing questionnaires, referral and delivering health advice [1, 2] may benefit from being computerized.

Computerizing health questionnaires has a number of practical advantages [3-19]. Traditional P&P data-collection includes administrative tasks/resources such as data-transcription, the risk of missing values and unclear answers or having to read through a skip-pattern of questions. Computer- and Internet-based surveys can overcome this. It should be noted that differences exist between computer and Internet surveys. For instance Internet questionnaires are dependent on Internet connection, while computerized methods (e.g. CASI, Computer-Assisted Self-Interview) can be audio-assisted.

Whether computerization of surveys alters the responses of adolescent health questionnaires is still a topic of active research [4, 7, 9]. No known study has compared responses of electronic health questionnaires to P&P versions in the secondary school setting.

Research has shown that youngsters generally rate the computerized interface highly acceptable [4, 10, 20]. Fleming [5] and Pealer et al. [10] investigated electronic health questionnaires in the school itself, and concluded that adolescents felt comfortable answering sensitive questions.

The aim of the current study is to compare results from an adolescent health questionnaire (i.e. score equivalence) between an electronic version and a standard P&P version in secondary schools using a randomized study design. Furthermore adolescents' evaluations of the different modes of administration are examined.

2.2 Methods

Sample and procedure

The municipal health service (Vlaardingen, The Netherlands) selected 24 third grade classes from five secondary schools with various educational levels. The 24 classes contained 591 adolescents. Within classes, each adolescent was randomly assigned to completing the health questionnaire via one of the three modes: P&P, Internet one-item per screen, and Internet multiple-items per screen (see "Internet-tool" section below), resulting in 33% of adolescents being assigned to each mode. After completing the questionnaire, adolescents filled out an evaluation form of the given administration mode.

Privacy issues and informed consent

The medical ethical committee of the Erasmus MC, Rotterdam, approved the study. The procedure was performed according to the standard practice of the participating municipal health services. Parents and children were notified through an information letter and were given the opportunity to refuse participation. It was emphasised that only the school physician/nurse and the researcher would be informed about the questionnaire responses, and that they may receive a recommendation to attend a consultation with the school physician/nurse. Parents and school teachers could only obtain the survey results of an individual student by obtaining the student's approval. No parents and adolescents refused participation.

Internet-tool

The Internet version of the health questionnaire was developed through a generic (adaptable) Internet-tool, using PHP (version 4.0.1 and higher), MySQL (version 3.22 and higher), and JavaScript (version 1.3) providing adequate privacy protection. The electronic version involved two different types of interfaces: one-item per screen and multiple-items per screen. The "Internet one-item" version displayed one item per screen in a fixed order. The other Internet version showed the respondent multiple items of the same topic per screen with a list of the health topics to choose from in the left frame, and is referred to as "Internet multiple-items". Both versions automatically skipped questions and checked for missing responses.

Health questionnaire

The health questionnaire consisted of 4 topics: the short indicative questionnaire for psychosocial problems among adolescents (called "KIVPA") [21], self-reported problems, health care utilization, and health-related behavior. The "KIVPA" contained three multi-item scales [21]: psychosomatic scale (9 items, Cronbach α = .70 [22]), self-analysis scale (14 items, Cronbach α = .77), and indicative scale for mental health (8 items, Cronbach α = .57). The following items comprised the *psychosomatic scale*: feeling listless, feeling weary without knowing why, having a headache because of stress, having lack of appetite, finding it difficult to fall asleep, having a sensitive skin so that you easily get rash, spots or itch, having stomach-ache around your navel, feeling that you cannot relax your muscles properly, and bursting out crying without apparent reason. Response options for the psychosomatic items were "often", "sometimes", and "never". The *self-analysis scale* consisted of the items: feeling good about yourself, being disobedient, feeling unsure of yourself, worrying a lot, being independent, being short-tempered, being nervous, being a happy person, being withdrawn, feeling lonely, being very shy, being spontaneous, feeling depressed, and enjoy undertaking a lot of things. Response options ranged from "totally agree" to "totally disagree" in a 4-point Likert scale and were recoded into "agree" or "disagree" [21]. The indicative scale for mental health included items on self-perceived health, worrying about the future, liking it at home, ease of talking with parents or guardians, having sufficient number of friends, being satisfied with your appearance, having a sexual experience with someone against your will, and having felt restless or agitated resulting in taking a sedative or hypnotic. Response options were "yes"/"no". Owing to the low reliability of this scale, the mental health items were analyzed separately instead of as a scale. Lower KIVPA-scales scores indicate having more health problems.

"Self-reported problems" were composed of chronic conditions, problems at school, and problems at home. *Chronic conditions* included 16 items: reduced visual acuity (even with glasses/lenses), other ocular symptoms, hearing impairment, other ear symptoms, chronic rhinitis, chronic sinusitis, speech/voice dysfunction, back pain/complaints, arms/legs/feet dysfunction/pain, chronic skin problems, being inflexible (not athletic), exhaustion from labor, recurrent coughing, urinary symptoms, allergies, and other disabilities/ chronic conditions. *Problems at school* addressed having trouble with certain courses, relationship with teachers, quantity of homework, amount of free time, grades, being bullied,

and desire to leave school. *Problems at home* addressed arguments at home, being beaten or abused, thinking of running away, and having the feeling of not being understood. Responses were in "yes"/"no"-format and analyzed as the percentage of adolescents with 1 or more self-reported problems in a given area.
"Health care utilization" was operationalized as visits to the general practitioner, medical specialist and hospital admissions during the past year. "Health-related behavior" involved healthy diet, current smoking, regular alcohol consumption, having sexual intercourse, and doing sports regularly. Response options were "yes"/"no".

Evaluation form on adolescents' appraisal

The evaluation form assessed the respondents' opinions about "pleasantness" (4 items), "difficulty" (4 items), and "perceived speed" (1 item) of the questionnaire mode to which they were assigned. The scale of "pleasantness" (Cronbach α = 0.79) consisted of the items willingness to complete this questionnaire mode repeatedly, fun, a pleasant experience, and annoying to fill out. The level of "difficulty" consisted of the items being hard to complete, a complicated mode to complete, clear on what to do, and understandable questionnaire mode (Cronbach α = 0.68). The response format was a 5-point Likert-scale from totally disagreeing to totally agreeing. Answers were recoded into the same direction with 1 indicating the worst possible evaluation and 5 the best possible evaluation.

Statistical analyses

The equivalence of the scores was determined through the Student's t-test for the two KIVPA-scales and logistic regression (Wald test) for dichotomous variables. As a measure of effect size, mean differences were calculated for the two KIVPA-scales and odds ratios for dichotomous variables. Odds ratios estimated the likelihood of a health outcome between the compared administration modes. When comparing the two Internet interfaces, the multiple-items per screen interface was used as the reference category. When comparisons where made between the Internet and P&P modes, the latter was used as the reference category for the analyses.
To assess the adolescents' evaluation, comparisons between modes were performed using the Student's t-test.
SPSS version 10.0.7 was used for all statistical analyses.

2.3 Results

Response and socio-demographic background

The response rate was 96%. The total number of adolescents actually completing the questionnaire was 565, of which 185 adolescents via P&P, 193 via Internet one-item and 187 via Internet multiple-items. Twenty-two adolescents did not attend the sessions. Three students did not complete the questionnaire. The answers of one respondent were lost owing to a technical error.

Table 2.1 shows the self-reported socio-demographic characteristics of adolescents for the total group and each administration mode. The expected percentages of the socio-demographic aspects (see total sample) did not differ significantly ($p \geq 0.05$) compared to the different administration modes.

Table 2.1 Socio-demographic characteristics of all participants and by administration mode

	Total group	**Paper&pencil**	**Internet one-item**	**Internet multiple-items**
	(N=565)	(N=185)	(N=193)	(N=187)
	mean (range)	mean (range)	mean (range)	mean (range)
Age (years)	14 (13-17)	14 (13-16)	14 (13-17)	14 (13-16)
	% of N	% of N	% of N	% of N
Gender				
Boys	46	48	50	39
Secondary school type				
Lower secondary / vocational education	60	60	60	60
Intermediate secondary / vocational education	17	19	17	17
Upper secondary education	23	21	23	24
Ethnic background				
Dutch	73	77	70	73
Turkish	9	7	11	8
Moroccan	2	2	4	1
Surinamese	3	2	3	5
Antillean / Arubean	2	1	2	1
Other	11	11	11	10

Score equivalence between administration modes

The scores regarding health issues did not differ significantly between the two Internet versions, except for 'satisfaction with appearance' ($p \leq 0.01$) with an odds ratio of 2.08 (95% CI 1.19 – 3.62) for the unfavorable outcome among adolescents in the Internet multiple-item group. Eighty-eight percent of the adolescents Internet one-item group reported being satisfied with their appearance, compared to 78% of the Internet multiple-items group.

Table 2.2 Comparison of health scores between paper&pencil and Internet modes of administration

	No. of items	**Paper&pencil** (N=185)		**Internet** (N=380)		**P-value**[#]	**Effect size**[*]
KIVPA questionnaire (range)		Median	Mean (SD)	Median	Mean (SD)		
Psychosomatic scale (0-18)[Ψ]	9	14	13.7 (2.7)	14	13.2 (2.9)	0.10	0.42
Self-analysis scale (0-14)[Ψ]	14	12	11.6 (2.2)	12	11.3 (2.3)	0.14	0.33
Indicative items for mental health		% of adolescents reporting the presence of					
Good self-perceived health	1	91		88		0.33	0.74
Worrying about the future	1	11		15		0.17	1.48
Liking it at home	1	94		94		0.92	1.04
Ease of talking with your parents/guardians	1	90		89		0.65	0.87
Having a sufficient number of friends	1	91		97		<0.01	2.75
Being satisfied with your appearance	1	85		83		0.55	0.86
Having a coercive sexual experience	1	5		7		0.52	1.28
Having felt so restless or agitated resulting in taking sedative or hypnotic	1	2		4		0.34	1.73
Self-reported problems		% of adolescents with ≥1 self-reported problems					
Chronic conditions	16	75		72		0.44	0.85
Problems at school	8	87		88		0.64	1.14
Problems at home	4	29		25		0.27	0.80
Self-reported health care utilization		% of adolescents with self-reported visits in the past year to					
General practitioner	1	59		63		0.36	1.19
Specialist	1	37		29		0.06	0.69
Hospital admissions	1	6		5		0.58	0.80
Self-reported health-related behavior		% of adolescents reporting the presence of					
Healthy diet	1	80		76		0.30	0.80
Smoking	1	22		16		0.11	0.69
Alcohol consumption	1	35		28		0.12	0.74
Having sex	1	15		10		0.08	0.62
Regular sports	1	72		76		0.29	1.24

[Ψ] KIVPA scales: lower scores indicate more health problems

[#] Statistical test used: Student's t Test for KIVPA-scales, Wald Test (logistic regression) for remaining variables

[*] Effect size: mean difference for KIVPA-scales, odds ratio for remaining variables

Comparison of scores regarding health issues between P&P and Internet (i.e. combined one-item and multiple-items) is shown in Table 2.2. No significant differences among scores were found except for the item 'having sufficient number of friends' ($p<0.01$) with a more favorable outcome among adolescents in the Internet group (odds ratio 2.75, 95% CI 1.30 – 5.90).

Power analysis for score equivalence

We used observed percentages of adolescents reporting good self-perceived health to illustrate the power of the study. With the current data set we could have found a significant difference for good self-perceived health between 90% healthy for the P&P group and 82% healthy for the Internet group with a power of 80%. Looking at the KIVPA scale scores, a difference between means of P&P and Internet of 0.75 reached a power of 80%. We consider differences of this size (or smaller) between modes as irrelevant.

Adolescents' evaluation between administration modes

When comparing the mean scores of the adolescents' evaluation between P&P and Internet-mode, the Internet-mode received more favorable evaluations than the P&P method on all aspects. These differences were statistically significant for the scales "pleasantness" ($p<0.01$) and "difficulty" ($p<0.01$), but not for the single-item perceived speed. The mean evaluation scores for "pleasantness" were 2.7 (sd 0.9) for P&P and 3.0 (0.8) for Internet mode. The level of "difficulty" showed a mean score of 3.6 (sd 0.7) for P&P and 3.9 (sd 0.6) for Internet.

The comparison between both Internet-modes on these aspects showed that the Internet multiple-item mode, mean 2.8 (1.1), was significantly favored on "perceived speed" of the mode compared to the Internet one-item mode, mean 2.4 (sd 1.1) ($p<0.01$).

2.4 Discussion

In this study we compared two modes of Internet-administered adolescent health questionnaire and a traditional P&P version in secondary schools. Score equivalence between modes and adolescents' evaluations of the different modes of administration were assessed.

The reporting of satisfaction with appearance differed between the two different Internet modes. Having sufficient number of friends was more often reported in the Internet group compared to the P&P group. This is in accordance with previous research showing few differences of health questionnaire scores between different modes of administration [4, 7, 9]. The power of the current study supports that the non-effects are true non-effects.

Some researchers [15, 16, 23] suggest that the type of computer interface influences the respondents' answers to health questionnaire items (e.g. that the type of interface of Internet multiple-items resembles the paper-format better than the one item interface). Some studies showed that sensitive health problems or risk behaviors such as marijuana use or male-male sex may be reported more frequently via computer (independent from the type of interface) than via P&P [4, 7, 9]. In the current study adolescents evaluated Internet as more pleasant compared to P&P, which may indicate that adolescents feel more comfortable answering sensitive issues via Internet. However, when we compare the topics that might be regarded as sensitive in our study (such as psychosocial well-being, problems at home, smoking, alcohol consumption and sexual intercourse), most topics were (not statistically significant) more frequently reported via P&P than Internet. We have no explanation for the few differences that were found and note that the reporting of health and health-related behavior via Internet requires further investigation. This may preferably involve studies with other questionnaires, in different settings and complemented by qualitative research investigating reasons of different reporting.

Adolescents rated the administration of the health questionnaire via Internet more favorably than the P&P method. Multiple-items per screen demonstrated better evaluations with regard to perceived speed of the administration mode than the interface one-item per screen. However, the difference regarding speed-evaluation should be interpreted carefully, because in our study incidental errors owing to slow Internet connection could be solved more easily in the Internet multiple-items mode (by clicking on the list of categories in the left frame).

Limitations

One should keep in mind that our study was performed in co-operation with the municipal health service and its normal practice in schools of collecting health questionnaires. In situations other than collecting data during school time in the school under supervision of the school nurse, a comparison between the modes

of administration may show different results on score equivalence. The setting may also have encouraged the high response rate. Radon et al. [24] invited young adults to complete electronic surveys at home or in the Internet café and Pealer et al. [10] invited undergraduates to complete them at the University. Both studies resulted in lower response rates in comparison to the current study.

The adolescents evaluated the Internet-based questionnaire to be better than the identical printed version. Internet offers the advantages of no data entry, automatically skipping questions, and identifying missing values. Additionally, Internet provides the chance to give computerized tailored feedback on health and health behavior, which can be more effective than generic health information [1, 2]. The Internet questionnaire also offers the opportunity for on-line selection and referral of adolescents to the school physician/nurse. Given the growing evidence that web-based questionnaires provide identical results as the current printed questionnaires, these are rationales to implement electronic health questionnaires in secondary schools and to further explore the implementation of tailored feedback and referral via Internet in the school setting.

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3

Internet-administration of the Child Health Questionnaire Child Form (CHQ-CF) compared to the standard paper version in a large randomized study

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Submitted for publication

Abstract

Background Paper formats of validated health questionnaires used in evaluations of medical care will increasingly be replaced by Internet versions. Comparison of results between studies that use Internet and paper and pencil (P&P) questionnaires requires equivalence between these modes of administration.

Objective This study compares the number of missing answers, score distributions, internal consistency of multi-item scales, and discriminative validity of the Child Health Questionnaire-Child Form (CHQ-CF), when administered on P&P or by Internet.

Methods 1,071 adolescents were invited to complete the CHQ-CF and items on chronic conditions, using either a P&P or Internet questionnaire, under supervision at school. Participants were randomized to either mode.

Results The participation rate was 87.1%. The age range was 13-17 years. Demographic and disease characteristics were equally distributed in groups allocated to P&P and Internet formats. Internet resulted in fewer missing answers compared with P&P ($p<0.01$). The score distributions, internal consistency of scales, and discriminative validity were all similar between P&P and Internet-administration. However, the P&P version resulted in somewhat higher (healthier) scores on 4 of 10 CHQ-CF scales compared to the Internet version ($p<0.05$). Regarding scores of 4 CHQ-CF scales, mode of questionnaire administration interacted significantly with age ($p<0.05$).

Conclusions Although, overall, the P&P and Internet versions yielded comparable results, some small but statistically significant differences in scores were present, for which we have no explanation. We recommend repeated studies with the CHQ-CF and other measurement instruments. Meanwhile, P&P and Internet modes of questionnaire administration should not be combined in a single study.

3.1 Introduction

Patient-reported (self-reported) health measures are essential in many evaluations of medical care [1]. Validated questionnaires are available to describe health in adults and children/adolescents [2-8]. We expect the commonly used P&P formats of such questionnaires to be increasingly replaced by Internet versions [9]. The advantages of using the Internet include on-line data-entry and procedures designed to reduce the number of missing answers and the length of questionnaires [10, 11].

The mode of questionnaire administration (e.g. written questionnaire, face to face interview, telephone interview, computer questionnaire) may affect the participation rate, number of missing answers, and actual scores [12-15]. Few and only small score differences have been reported in comparisons with P&P versions [16-18]. However, in studies comparing P&P and computer questionnaires on sensitive topics such as drug use or unsafe sexual behaviors, increased reporting by computer was found as this medium, apparently, is perceived as providing more privacy than P&P procedures [19-21]. Studies have demonstrated that distribution of electronic questionnaires on the Internet is feasible in various settings [22, 23]. Few studies have evaluated the score equivalence of P&P and Internet-administration of the same health questionnaire in a randomized design (see Discussion) [24-26].

In the current randomized study, in a large adolescent population (13-17 years old), we compared the respective responses elicited by P&P and Internet-administration of a widely used, validated generic health questionnaire, the Child Health Questionnaire-Child Form (CHQ-CF) (27-31). The CHQ-CF can be used to describe the health and health-related quality of life of children in evaluation studies of community health and clinical interventions [6], burden-of-disease studies [32], and in community health and clinical practice [33]. The study compared the two modes of administration with regard to the equivalence of (a) the number of missing answers, (b) the score distributions including mean scale scores in the whole sample and in gender and age specific subgroups, (c) the internal consistency of multi-item scales, and (d) the ability of the CHQ-CF87 to discriminate between groups with and without self-reported chronic conditions.

3.2 Methods

Study population

In 2003, 1,071 students belonging to 55 classes of various educational levels in the 3rd year (average age 15 years) of 7 secondary schools in the area of Vlaardingen and Harderwijk, The Netherlands were invited to complete the Child Health Questionnaire Child Form (CHQ-CF). The parents and students each received written information about the study and were allowed several weeks to refuse participation (passive consent).

Data collection

The CHQ-CF consists of 87 items with 4, 5, or 6 response options, divided over 10 multi-item scales and 2 single-item scales (Table 3.1) [27]. "Role functioning-emotional" and "role functioning-behavioral" were combined into a single scale; "change-in-health" was not fielded. For each scale, items were summed up (some recoded/recalibrated) and transformed into a 0 (worst possible score) to 100 (best possible score) scale [27]. Items on standard socio-demographic variables and the prevalence of 7 chronic conditions were included in the questionnaire.

From the conventional P&P format, an Internet version of the questionnaire was developed through a generic Internet tool, using PHP (4.0.1), MySQL (3.22), and JavaScript (1.3). The Internet version checked for missing answers, but if the user failed to "logout" properly, missing answers could remain.

Randomization

Within each school class, each student was assigned at random to either the P&P or the Internet mode of administration. Students completed the questionnaires in a classroom with computers linked to the Internet, under the supervision of a research assistant.

Analysis

Differences between the characteristics of the participants allocated to P&P and Internet questionnaires were tested by Student's *t*-test and the chi-square test. The difference in the number of missing answers to CHQ-CF items between the two formats was assessed by the Mann-Whitney U test. Differences between CHQ-CF

Table 3.1 CHQ-CF scales, items per scale, and interpretation of low and high scores [1]

CHQ-CF Scales	Number of items	Description low score	Description high score
Physical functioning (PF)	9	Child is limited a lot in performing all physical activities, including self-care, due to health	Child performs all types of physical activities, including the most vigorous, without limitations due to health
Role functioning: Emotional (RE) [2]	3	Child is limited a lot in school work or activities with friends as a result of emotional problems	Child has no limitations in schoolwork or activities with friends as a result of emotional problems
Role functioning: Behavioral (RB) [2]	3	Child is limited a lot in school work or activities with friends as a result of behavior problems	Child has no limitations in schoolwork or activities with friends as a result of behavior problems
Role functioning: Physical (RP)	3	Child is limited a lot in school work or activities with friends as a result of physical health	Child has no limitations in schoolwork or activities with friends as a result of physical health
Bodily pain (BP)	2	Child has extremely severe, frequent and limiting bodily pain	Child has no pain or limitations due to pain
General behavior (BE)	17	Child very often exhibits aggressive, immature, delinquent behavior	Child never exhibits aggressive, immature, delinquent behavior
Mental health (MH)	16	Child has feelings of anxiety and depression all of the time	Child feels peaceful, happy and calm all of the time
Self esteem (SE)	14	Child is very dissatisfied with abilities, looks, family/peer relationships and life overall	Child is very satisfied with abilities, looks, family/peer relationships and life overall
General health perceptions (GH)	12	Child believes it's health is poor and likely to get worse	Child believes it's health is excellent and will continue to be so
Change in health [3] (CH)	1	Child's health is much worse now than 1 year ago	Child's health is much better now than 1 year ago
Family activities (FA)	6	The child's health very often limits and interrupts family activities or is a source of family tension.	The child's health never limits or interrupts family activities nor is family a source of tension
Family cohesion (FC)	1	Family's ability to get along is rated "poor"	Family's ability to get along is rated "excellent"

[1] Reproduced with permission (27).
[2] The CHQ-CF scales "Role functioning-emotional" and "Role functioning-behavioral" were merged into a single scale "Role functioning-emotional/behavioral" (REB) in this study.
[3] This single-item scale was not fielded in this study.

scale scores by format in the total sample were assessed by Mann-Whitney U tests; additionally, ANOVA was applied to test whether the mode of questionnaire administration interacted with the variables gender (male n=432; female n=501) and age (13-14 year olds, n=399; 15-17 year olds, n=534). Cohen's effect sizes, defined as d = [Mean(a) – Mean(b)]/SD, where the denominator was the square root of $[(n_a\text{-}1)SD_a^2 + (n_b\text{-}1)SD_b^2] / [(n_a\text{-}1) + (n_b\text{-}1)]$, were applied to indicate the relative magnitude of score differences [34]. Following Cohen's suggested guidelines, $0.20 \leq d < 0.50$ indicated a "small effect", $0.50 \leq d < 0.80$ a "medium effect", and $d \leq 0.80$ a "large effect"; we consider effect sizes < 0.20 as

negligible [34]. Cronbach's alpha was applied to evaluate the internal consistency of CHQ-CF multi-item scales by format [35]. We assessed the CHQ-CF's ability to discriminate between subgroups with 1 or 2, or 3 or more, and 0 chronic conditions in the two formats by Mann-Whitney U tests, and by Cohen's effect sizes, defined as d = [Mean(a) – Mean(b)]/SD in the condition subgroup [34]. All analyses were done using SPSS, Version 11.0.1. The medical ethical committee of the Erasmus MC-University Medical Center Rotterdam approved the study.

3.3 Results

Participants and randomization

The participation rate was 87.1%. The age range of participants was 13-17 years (mean 14.7; SD 0.68); 53.8% were female; 92.8% were born in the Netherlands; the majority attended lower secondary education (Table 3.2). The prevalences of self-reported chronic conditions were as follows: asthma, 8.1%; allergies, 24.5%; problems with hearing, 6.6%; problems with seeing, 8.4%; headaches or migraine, 17.0%; chronic low back pain, 17.0%; and depression or anxiety attacks, 7.9% (Table 3.2). These characteristics were equally distributed in the groups respectively assigned to P&P and Internet questionnaires ($p \geq 0.05$; Table 3.2). The demographic characteristics of the participants (age, gender, country of birth, and educational level) reflected those of the general Dutch adolescent population [36].

Difference in number of missing answers between modes of CHQ-CF administration

At the item level, use of the P&P version of the CHQ-CF resulted in more missing answers (0-1.89% per item; mean 0.54%) compared with the Internet version (0-0.22% per item; mean 0.04%; $p<0.01$).

Table 3.2 Characteristics of study participants
(total sample n=933, participants assigned to the paper questionnaire n=475, participants assigned to the Internet questionnaire n=458)

	Total study group (*n*=933)			**Group with paper mode of administration (*n*=475)**			**Group with Internet administration (*n*=458)**			***p*-value**
	Mean (SD) or Range	*n*	% of Participants	Mean (SD) or Range	*n*	% of Participants	Mean (SD) or Range	*n*	% of Participants	Internet versus paper mode
Demographic characteristics:										
Age (years)										
Mean (SD)	14.7 (0.68)			14.7 (0.68)			14.7 (0.68)			0.61 [1]
Range	13-17			13-17			13-17			
Gender										
Women		501	53.7%		244	51.4%		257	56.1%	0.17 [2]
Born in the Netherlands										
Yes		866	92.8%		441	92.8%		425	92.8%	0.90 [2]
Educational level of the school										
Lower secondary education		545	58.4%		274	57.7%		271	59.1%	
Intermediate secondary education		179	19.2%		94	19.8%		85	18.6%	0.88 [3]
Higher secondary education		209	22.4%		107	22.5%		102	22.3%	
Chronic conditions:										
Asthma										
Yes		76	8.1%		40	8.4%		36	7.9%	0.81 [2]
Allergies										
Yes		229	24.5%		118	24.8%		111	24.2%	0.88 [2]
Problems with hearing										
Yes		62	6.6%		30	6.3%		32	7.0%	0.70 [2]
Problems with seeing										
Yes		78	8.4%		39	8.2%		39	8.5%	0.91 [2]
Headaches or migraine										
Yes		159	17.0%		81	17.1%		78	17.0%	1.00 [2]
Chronic low back pain										
Yes		159	17.0%		88	18.5%		71	15.5%	0.22 [2]
Depression and/or anxiety attacks										
Yes		74	7.9%		36	7.6%		38	8.3%	0.72 [2]

[1] Student's *t*-test
[2] Chi square test *df* = 1
[3] Chi square test *df* = 2

Table 3.3 Comparison of mean scores, score-distributions, and other psychometric properties of CHQ-CF scales in subgroups with paper (*n* = 475) and Internet modes (*n* = 458) of questionnaire administration

CHQ-CF scales [1] (range 0-100)	*Mode of administration*	Mean (SD)	Paper versus Internet mode of administration: *p*-value (MWU) [2]	Paper versus Internet mode of administration: Effect size *d* [3]	Range of scores	% max [4]	% min [5]	25th %tile	50th %tile	75th %tile	Cronbach's alpha	Average item-own scale correlation [6]	Average item-other scale correlation
Physical Functioning	*Paper*	96.0 (6.9)	0.37	0.01	44-100	56	0	96	100	100	0.69	0.39	0.19
	Internet	95.8 (7.2)			37-100	53	0	93	100	100	0.72	0.44	0.18
Role funct.-Emo/beh	*Paper*	89.4 (17.2)	0.14	0.00	0-100	60	0	78	100	100	0.81	0.65	0.34
	Internet	89.5 (15.1)			0-100	54	0	86	100	100	0.70	0.51	0.28
Role funct.-Physical	*Paper*	95.0 (12.9)	0.02	0.05	22-100	81	0	100	100	100	0.86	0.74	0.29
	Internet	94.4 (11.7)			22-100	75	0	89	100	100	0.76	0.59	0.24
Bodily Pain	*Paper*	73.5 (22.7)	0.56	- 0.05	0-100	25	0	60	80	100	0.88	0.80	0.35
	Internet	74.7 (21.4)			0-100	24	1	60	80	90	0.89	0.81	0.29
General Behavior	*Paper*	80.9 (10.6)	0.00	0.21 *	25-100	1	0	75	82	88	0.83	0.43	0.25
	Internet	78.6 (11.4)			35-100	0	0	72	79	87	0.85	0.45	0.25
Mental Health	*Paper*	76.5 (15.4)	0.01	0.12	14-100	2	0	69	80	86	0.92	0.62	0.34
	Internet	74.6 (14.8)			14-100	0	0	67	77	84	0.90	0.58	0.31
Self Esteem	*Paper*	74.7 (12.2)	0.99	0.02	20-100	1	0	68	75	82	0.88	0.55	0.29
	Internet	74.4 (11.6)			25-100	0	0	70	76	82	0.87	0.54	0.28
General Health	*Paper*	73.5 (16.5)	0.59	0.05	19-100	3	0	63	76	86	0.82	0.49	0.27
	Internet	72.6 (16.7)			20-100	1	0	63	75	86	0.81	0.47	0.27
Family Activities	*Paper*	80.0 (17.7)	0.03	0.11	8-100	17	0	67	83	96	0.81	0.58	0.24
	Internet	78.1 (16.9)			25-100	13	0	67	79	92	0.78	0.54	0.26
Family Cohesion	*Paper*	70.6 (23.5)	0.91	0.00	0-100	18	2	60	85	85	na	na	0.35
	Internet	70.7 (23.0)			0-100	16	2	60	85	85	na	na	0.32

[1] The CHQ-CF scales 'Role functioning-emotional' and 'Role functioning-behavioral' were merged into a single scale in this study.

[2] Two-sided Mann-Whitney U test of scale scores of group using paper and group using the Internet questionnaire.

[3] Difference of mean scores divided by weighted average of SDs in groups with paper and Internet questionnaires; * indicates a small effect size ($0.20 \leq d < 0.50$), (34).

[4] / [5] % of respondents with best/worst possible score (ceiling/floor).

[6] Each item was correlated with the applicable ad-hoc scale without the item under consideration.

na Not applicable.

Table 3.4 Discriminative ability of the CHQ-CF scales between subgroups differing in the participants' number of chronic conditions, for the group that was assigned to the paper questionnaire (*n* = 475) and for the group that was assigned to the Internet questionnaire (*n* = 458)

		Number of chronic conditions per participant						
		0 conditions	**1 or 2 conditions**	**≥ 3 conditions**	**1 or 2 versus 0 conditions**		**≥ 3 versus 0 conditions**	
CHQ-CF scales[1] (range 0-100):	***Mode of administration***	*n*=224 (Paper) *n*=206 (Internet) Mean (SD)	*n*=210 (Paper) *n*=217 (Internet) Mean (SD)	*n*=41 (Paper) *n*=35 (Internet) Mean (SD)	*p*-value (MWU)[2]	Effect size *d*[3]	*p*-value (MWU)[2]	Effect size *d*[3]
Physical functioning	*Paper*	97 (5)	96 (7)	90 (10)	0.00	0.24*	0.00	0.80***
	Internet	97 (5)	95 (7)	89 (12)	0.00	0.28*	0.00	0.64**
Role funct.-emo/behav	*Paper*	93 (13)	88 (18)	77 (24)	0.01	0.25*	0.00	0.64**
	Internet	91 (14)	89 (15)	79 (18)	0.12	0.15	0.00	0.66**
Role funct.-physical	*Paper*	97 (11)	94 (13)	91 (17)	0.01	0.19	0.00	0.34*
	Internet	96 (10)	94 (13)	91 (13)	0.21	0.14	0.01	0.34*
Bodily pain	*Paper*	82 (18)	70 (22)	47 (24)	0.00	0.52**	0.00	1.45***
	Internet	80 (18)	72 (21)	55 (24)	0.00	0.39*	0.00	1.03***
General behavior	*Paper*	84 (9)	80 (10)	71 (13)	0.00	0.40*	0.00	0.98***
	Internet	81 (10)	78 (11)	69 (14)	0.01	0.26*	0.00	0.90***
Mental health	*Paper*	83 (10)	74 (16)	57 (16)	0.00	0.56**	0.00	1.58***
	Internet	80 (11)	72 (15)	59 (18)	0.00	0.50	0.00	1.20***
Self esteem	*Paper*	79 (10)	73 (12)	61 (12)	0.00	0.52**	0.00	1.44***
	Internet	77 (9)	73 (12)	66 (14)	0.00	0.33*	0.00	0.80***
General health	*Paper*	80 (14)	71 (15)	54 (14)	0.00	0.57**	0.00	1.82***
	Internet	79 (13)	70 (17)	55 (18)	0.00	0.54**	0.00	1.29***
Family activities	*Paper*	83 (16)	79 (18)	70 (20)	0.00	0.26*	0.00	0.67**
	Internet	81 (16)	78 (17)	66 (15)	0.09	0.17	0.00	0.97***
Family cohesion	*Paper*	77 (21)	68 (23)	53 (26)	0.00	0.38*	0.00	0.89***
	Internet	74 (20)	68 (24)	64 (28)	0.02	0.24*	0.03	0.38*

[1] The CHQ-CF scales 'Role functioning-emotional' and 'Role functioning-behavioral' were merged into a single scale in this study.
[2] Two-sided Mann-Whitney U test.
[3] Difference of the means divided by SD in the subgroup with chronic condition(s), where * indicates a small effect ($0.20 \leq d < 0.50$), ** indicates a medium effect ($0.50 \leq d < 0.80$), and *** indicates a large effect ($d \geq 0.80$) (34).

CHQ-CF scores by mode of administration

In the whole sample, 4 CHQ-CF scales resulted in statistically significant higher scores for P&P compared to Internet administration ($p<0.05$): the scale "general behavior" showed a "small" effect-size ($d=0.21$), while the scales "role functioning-physical", "mental health" and "family activities" showed only negligible effect sizes ($d<0.20$) (Table 3.3). The mode of questionnaire administration did not interact significantly with gender ($p\leq0.05$ regarding all scales), and neither with age ($p\leq0.05$ regarding 6 scales), except for the CHQ-CF scales "role functioning-emotional/behavioral" ($p<0.05$), "mental health" ($p<0.05$), "self esteem" ($p<0.05$), and "general health" ($p<0.01$). Regarding these 4 CHQ-CF scales, in the subgroup of 13-14 year olds, P&P administration resulted in relatively low scores compared to Internet (or nearly equal scores in the case of "mental health"), while in the subgroup 15-17 year olds P&P administration resulted in relatively high scores compared to Internet (data not shown).

Internal consistency of scales by mode of administration

Cronbach's alphas for the two formats were similar (Table 3.3).

Discriminative validity by mode of administration

CHQ-CF scales applied by either mode of administration were able to differentiate well between subgroups with few or many chronic conditions and the subgroup with no conditions (Table 3.4). Additional ANOVA analyses showed that regarding the scores of all CHQ-CF scales, the mode of questionnaire administration did not interact significantly with the variable "number of chronic conditions" ($p\geq0.05$ for all scales).

3.4 Discussion

In this first randomized study of score equivalence between Internet and P&P versions of the CHQ-CF, we found that score distributions, internal consistency of scales, and discriminative validity were similar. However, we did find some small but statistically significant score differences that require attention.

Recently, Ritter et al. found no score differences between Internet and P&P modes of administration for 16 health-related measures, but this study was conducted in an opportunity sample retrieved from the Internet, which limits its

generalizability [24]. In a randomized Internet-P&P comparison among adolescents concerning various health measures, one statistically significant score difference was reported among 21 topics [25]. In another randomized adolescent study, an Internet and P&P administered asthma symptoms index and a medical consumption index yielded equivalent scores, while the same study showed that of 11 indicators of fruit consumption and determinants of fruit consumption, one measure showed significant score differences between Internet and P&P administration [26].

Strengths of the current study: The participation rate was high. Internet and P&P questionnaires were completed in a controlled environment with adequate privacy and supervision. Study group characteristics (age, gender, country of birth, and educational levels) were representative of those of the general Dutch adolescent population [36]. Randomization was successful with respect to the evaluated characteristics. A widely used, validated health measure was applied [27-31].

Limitations: Other age groups, countries, and settings, e.g. clinical settings, as well as other measurement instruments, may give different results. Therefore we recommend additional studies of other measures, and in other populations, including clinical samples.

Missing values: Compared to the P&P version, the Internet version was successful in reducing the quantity of missing data. Theoretically, differences in selective partial non-response between formats might have contributed to differences in scores. In this study, in the subgroup (n = 86) that had at least one missing answer to a P&P CHQ-CF item, all scale means were somewhat lower than in the subgroup (n = 389) with no missing answers, but these differences were not significant ($p \geq 0.05$). Thus, missing answers cannot be considered a source of the observed score differences.

Scores by mode of administration: In the whole sample, the P&P version resulted in significantly higher (healthier) scores for 4 out of 10 scales compared to the Internet version. However, it should be considered that given multiple comparisons, there is a 1-in-20 chance of a false association (Type I error at $\alpha=0.05$) [37]. A commonly used Bonferroni correction for 10 comparisons would imply an adjusted $\alpha=0.05/10=0.005$ [37]; at $\alpha=0.005$, one score difference, i.e. regarding the scale "general behavior" was significant. Furthermore, it should be noted that only the score difference between P&P and Internet administration regarding "general behavior" had a relative size just above the threshold that

applies to a "small" Cohen's effect size; the other 3 score differences, i.e. regarding "role functioning-physical", "mental health" and "family activities" can be considered negligible. Within the relatively narrow age range of this sample that was taken from one school class (3rd year of secondary schools), the study showed significant interaction of administration mode and age with regard to 4 of the 10 CHQ-CF scales ("role functioning-emotional/behavioral", "mental health", "self esteem", and "general health"), 3 of which did not show significant score differences in the whole sample. This study provides no explanations for the established (very) small but significant score differences, and the established interaction of administration mode with age for some scales.

Conclusions: Comparison of results between studies that use Internet and P&P questionnaires, or both, requires equivalence between these modes of administration. This study comparing P&P and Internet administrated versions of the CHQ-CF showed that computer administration through the Internet resulted in fewer missing values and that, overall, P&P and Internet versions of the CHQ-CF indeed yielded comparable results. Medium and large CHQ-CF score differences between modes of administration were absent. However, some small but statistically significant score differences were present in this first CHQ-CF study, for which we have no explanation. Therefore, we recommend repeated studies in other populations and with the CHQ-CF as well as other measurement instruments to confirm or reject these results. Meanwhile, we recommend that P&P and Internet modes of CHQ-CF administration not be combined in a single study.

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4

Internet and Paper Respiratory Questionnaires Yield Equivalent Results for Adolescents

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Abstract

Background This study compared results from Internet and paper and pencil (P&P) questionnaires about respiratory symptoms in order to find out if both forms of the survey yielded the same answers.

Methods 1,071 students, ages 13 to 17, were asked to complete either an Internet or a P&P questionnaire. The demographic characteristics of the participants equalled those of the general Dutch adolescent population. Participants were randomly assigned to fill out an electronic or P&P questionnaire. In addition to eight items from the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, two items on doctor visits (medical attention) regarding asthma respectively allergic disease during the past 12 months were included.

Results The participation rate was 87%. The Internet version of the questionnaire showed fewer missing answers than the P&P version, but this was not statistically significant. The respiratory items did not show statistically significant score differences between the Internet and P&P modes of administration ($p \geq 0.05$).

Conclusion From these results we conclude that respiratory questionnaires may be provided to adolescents electronically as well as via P&P, since both approaches yield equal results. To generalize these findings, we recommend repeated studies in other settings.

4.1 Introduction

In addition to tests and clinical measures, validated respiratory self-report questionnaires constitute essential tools in respiratory disease epidemiology, screening procedures, monitoring patients' symptoms, and in clinical evaluation studies [1-4]. The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire with 8 items on wheezing and asthma is a widely used, validated respiratory symptoms questionnaire [5, 6].

Self-reported measures, also referred to as patient-reported outcome measures, are often gathered by means of paper and pencil (P&P) questionnaires. This common P&P version may be replaced by an Internet version of the same questionnaire. The electronic version can be administered on the computer by way of the Internet in a password-protected and secure environment, either at the clinic, at home, or even at the school in the case of adolescents. Internet questionnaires provide practical, logistical advantages such as reducing paper work and eliminating manual data entry (thus reducing transcription errors as well as workload). In addition, Internet questionnaires allow dynamic question selection processes that improve ease of use and can also be used to require data entry, which can result in less missing data. Internet questionnaires may enhance research applications as well as applications in day-to-day practice [7-9]. Before switching from P&P to Internet forms of a questionnaire, the score equivalence (i.e. comparative validity) of identical questionnaires delivered via P&P and electronically needs to be studied.

In this randomized study, we assessed results from identical Internet and P&P versions of a respiratory questionnaire administered to a large adolescent population. This questionnaire included 8 ISAAC items on wheezing and asthma and two additional items on the presence of doctor visits (medical attention) with regard to asthma respectively allergic disease during the past 12 months. We also evaluated whether the number of missing answers was the same in both modes of administration.

4.2 Methods

Study subjects

In 2003, 1,071 students were invited to complete a respiratory questionnaire. The students, from seven secondary schools in the area of Vlaardingen and Harderwijk, the Netherlands, were from 55 third-year classes with varied educational levels. In addition to the respiratory items, items on standard socio-demographic variables were included.

Based on the conventional P&P questionnaire, an Internet version was developed based on PHP 4.0.1, MySQL 3.22, and JavaScript 1.3. At the end of the questionnaire, the Internet version checked for missing answers and invited the respondent to complete the remaining unanswered items, if present; however, without proper 'logout' the respondent could leave items unanswered.

Randomization

Within each school class, each student was assigned at random to either the Internet or the P&P mode of administration. Students completed the questionnaires at school in a classroom under supervision of a research assistant.

Analysis

We used Chi-square tests to determine whether the socio-demographic characteristics of the participants were equally distributed in the subgroup that completed the Internet questionnaire and the subgroup that completed the P&P version. The difference between the average numbers of missing answers per item of the respiratory questionnaire for each mode was assessed by the Mann-Whitney U-test. The differences between responses in both subgroups to the dichotomous items of the respiratory questionnaire were assessed by Chi-square tests. Differences between responses to the two ISAAC items concerning frequency of symptoms (3, respectively 4 ordered response options) were assessed by Mann-Whitney U-tests. The analyses were also performed in subgroups of the study population, i.e. boys (n=432), girls (n=501), 13-14 year olds (n=399) and 15-17 year olds (n=534). Additionally, in the whole study population, we tested whether scores between the Internet and P&P modes of administration were significantly different from each other by multivariate models that included interactions with gender and age. All analyses were done using

SPSS, Version 11.0.1. The medical ethical committee of the Erasmus MC-University Medical Centre Rotterdam approved the study.

4.3 Results

Participants and randomization

Participation rate was 87.1%. The age range of participants was 13-17 years (mean 14.7; SD 0.68); 53.8% were female; 92.8% of the participants were born in the Netherlands; the majority attended lower secondary education. These characteristics were equally distributed in the groups allocated to Internet and P&P modes (p≥0.05) (Table 4.1). The demographic characteristics of the participants (age, gender, country of birth, and educational level) reflected those of the general Dutch adolescent population [9].

Table 4.1 Characteristics of participants in the study stratified for Internet and P&P mode of questionnaire administration (*n*=933)

	Internet mode of administration (*n*=458)		**P&P mode of administration** (*n*=475)		***P*-value**
	n	% of participants	*n*	% of participants	Internet versus P&P mode
Age					0.36 [1]
13-14 years	189	41.3%	210	44.2%	
15-17 years	269	58.7%	265	55.8%	
Gender, Female	257	56.1%	244	51.4%	0.17 [1]
Born in the Netherlands, Yes	425	92.8%	441	92.8%	0.90 [1]
Educational level of the school					0.88 [2]
Lower secondary	271	59.1%	274	57.7%	
Intermediate secondary	85	18.6%	94	19.8%	
Higher secondary	102	22.3%	107	22.5%	

[1] Chi squared test *df*=1
[2] Chi squared test *df*=2

Missing answers by mode of administration

On average, the number of missing answers per item of the respiratory questionnaire did not differ significantly between modes of administration (p≥0.05); the Internet mode showed on average 0.25% missing answers per item (range 0-0.66%) and the P&P mode on average 0.72% per item (range 0-1.68%).

Score differences by mode of administration

The 10 respiratory items did not show score differences that were statistically significant between the Internet and P&P modes of administration in the whole sample (Table 4.2) as well as in 4 subgroups (boys, girls, 13-14 year olds and 15-17 year olds) ($p \geq 0.05$ for all comparisons); the mode of questionnaire administration did not interact significantly with gender and age ($p \geq 0.05$).

Table 4.2 Respiratory disease and symptoms scores by mode of administration (*n*=933)

	Internet mode of administration (*n*=458)	**P&P mode of administration** (*n*=475)	***P*-value**
	% of participants	% of participants	Internet versus P&P mode
Ever had wheezing or whistling, Yes	16.9%	16.7%	0.94 [1]
Ever had asthma, Yes	10.7%	9.9%	0.69 [1]
Last 12 months doctor visits regarding asthma, Yes	4.8%	5.7%	0.55 [1]
Last 12 months doctor visits regarding allergy, Yes	13.8%	14.3%	0.81 [1]
Last 12 months wheezing/whistling, Yes	10.0%	10.5%	0.81 [1]
Last 12 months number of attacks of wheezing			0.35 [2]
1 to 3	6.8%	7.8%	
4 to 12	1.8%	1.3%	
4 or more	0.9%	1.3%	
Last 12 m. how often sleep disturbed by wheezing			0.74 [2]
Sometimes but less than one night per week	2.0%	1.7%	
One or more nights per week	0.2%	1.1%	
Last 12 months wheezing limited speech, Yes	1.7%	1.5%	0.74 [1]
Last 12 m. sounded wheezy during/after exercise, Yes	9.8%	12.0%	0.29 [1]
Last 12 months dry cough at night (without a cold), Yes	16.6	14.5%	0.38 [1]

[1] Chi squared test *df*=1;
[2] Mann-Whitney *U* test.

4.4 Discussion

In this first randomized adolescent study that compared Internet and P&P administration of the ISAAC asthma and wheezing questionnaire, the Internet version of the questionnaire was shown to be feasible. We established score equivalence, in other words comparative validity, between the Internet and P&P

versions. Both the Internet mode of administration and the P&P version showed relatively few missing answers. Although the Internet mode of administration showed somewhat fewer missing answers than the P&P version, this difference was not statistically significant.

The study had a high participation rate. The reported prevalence of wheezing and asthma in this study was comparable to published rates in other childhood studies in the Netherlands and Western Europe [11, 12]. In this study, randomization to P&P and Internet administration was successful with respect to the evaluated characteristics.

Turner et al. have shown that computer questionnaires compared to P&P questionnaires might result in a higher reported prevalence of sensitive behaviors such as adolescent sexual behavior, drug use, and violence [13]. However, the topics in the respiratory questionnaire of this study cannot be considered to be of a sensitive nature, and score differences such as reported by Turner et al. did not occur in our study. The results of our study support the preliminary findings of Internet studies that used other health questionnaires [14, 15].

There were some limitations to this study. This study was performed in a school setting with relatively healthy adolescents. The use of Internet vs. P&P questionnaires in clinical settings and in other age groups was not studied. We only studied the P&P version of the ISAAC and the Internet version of that questionnaire and did not evaluate the video-supported version of the ISAAC questionnaire [5]. In this study, a randomized parallel group design was applied by which we were able to show that on the group level, the Internet and P&P modes of administration of the questionnaire yielded equal scores. This design, however, did not allow us to evaluate whether changes in reported symptom status over time by a single person may be influenced by the mode of administration. For that purpose we recommend repeated studies with a randomized cross-over design [16].

We conclude that respiratory questionnaires may be provided to adolescents electronically as well as via P&P, since both approaches yield equal results. To generalize these findings, we recommend repeated studies in other settings.

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5

Internet versus paper mode of health and health behavior questionnaires in elementary schools: asthma and fruit as examples

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Abstract

Background Internet has become an inevitable tool for collecting health and health behavior questionnaires. This study compared the feasibility, presence of score differences and subjective evaluations by children between Internet and identical paper (asthma/fruit) questionnaires in elementary schools.

Methods A randomized cross-over design was applied, with children starting with one administration mode before completing (five minutes later) the other mode. Ten Dutch elementary schools with 270 school children (5^{th} grade, 10-12 years) were approached to participate.

Results Response was 92%. The Internet mode had significantly less missing/non-unique answers than the paper mode ($p<0.01$). The completion times did not differ significantly between the Internet and the paper mode. Except for perceived self-efficacy to eat sufficient fruit ($p<0.05$), no differences in the asthma and fruit scores were found when comparing between the two modes. All variables showed strong intraclass correlation coefficients ($ICC \geq 0.64$) between modes. Most items had good to very good agreement (kappa 0.61-0.95). The percentages for global and exact agreement ranged per item from 61.3 to 100. Most children preferred the Internet mode on "general preference" and "ease of use" aspects, but rated no preference on "understandability". The majority rated the evaluation aspects of the Internet mode positively.

Conclusion Thus, Internet administration of a health and health behavior questionnaire is feasible at elementary schools, gives comparable responses, and is well accepted and preferred by children compared to the paper version. Therefore it is recommended to use Internet as a tool in health and health behavior research among children.

5.1 Introduction

Health and health behavior questionnaires of youngsters allow to determine community and school health profiles on which recommendations for interventions can be made. Such questionnaires may also provide a starting point for individual consultation with the school physician or nurse. Currently this is mainly done via paper questionnaires, which have known limitations. Although computer- and Internet-based questionnaires can overcome many of these issues [1, 2], they also have their own characteristics, for example Internet questionnaires are dependent on Internet connections.

Internet has become an inevitable tool for collecting health and health behavior questionnaires. To computerize health and health behavior questionnaires via the Internet is a highly efficient approach to sample data, with the advantages of eliminating manual data entry by researchers and thus reducing transcription errors as well as workload, dynamic question selection processes that improve ease of use, and forced data entry resulting in complete data collection. Internet offers the opportunity for quick and cost-efficient online selection and referral of participants identified to be at risk for certain illnesses (for example asthma) to medical services [3]. Additionally, Internet provides the chance to give computerized tailored feedback on health and health behavior, which is shown to be more effective than generic (paper) health advices in various studies [1, 4-7].

Before researchers and practitioners convert from the current paper questionnaires to Internet-administered questionnaires, it is of relevance to assess score equivalence between both methods. So far, studies on score equivalence have been conducted among adults and adolescents, except for two studies in elementary schools investigating self-reported tobacco/alcohol use and bullying [8, 9]. Overall, studies showed similar responses to identical computer and paper questionnaires, but some studies suggested that sensitive topics generally may yield more honest (socially undesirable) reporting via computer [8, 10-12]. Feasibility studies showed a similar or smaller number of missing responses for computer compared to paper questionnaires and positive evaluations of the computerized mode [8-10, 13-15]. Studies do not agree, however, with regard to completion times between modes [14, 15]. Together with the present technical developments [1, 2], this led us to investigate the possibilities of Internet-administered health and health behavior questionnaires in the elementary school setting. This is the first study to

compare the feasibility, the presence of score differences and subjective evaluations by respondents between Internet and identical paper health and health behavior questionnaires among children.
This study compared two modes of administration of a health and health behavior questionnaire. Asthma symptoms were chosen as topic of health and fruit consumption as the focus of health behavior. Asthma is a chronic illness in youth with a high prevalence [16]. Early detection, treatment and education of asthmatic children may have positive effects [3, 7]. High fruit consumption is associated with a lower risk of cancer and coronary heart diseases [17, 18]. Fruit consumption is lower than recommendations among young adolescents [19]. Currently, computer-tailored health education on fruit consumption and on asthma is used among adults and adolescents [4, 20].
Therefore the current study assessed: 1) the feasibility of the Internet mode by comparing completion times and the number of missing/non-unique (that is double) responses with the paper mode, 2) differences in responses to the asthma and fruit questionnaire between modes, and 3) the children' evaluations of the two modes.

5.2 Methods

Sample and setting
Two municipal health services situated in a rural (Harderwijk) as well as an urban (Vlaardingen) area, in The Netherlands participated in the study. The municipal health services invited 270 5th graders (10-12 years old) of 10 elementary schools. These schools varied with respect to socio-economic and cultural background and had adequate computer and Internet facilities (Internet explorer 5.0 or higher). Parents received written information about the project and were given several weeks time to refuse their child's participation. The medical ethical committee of the Erasmus MC University Medical Center Rotterdam approved the study.

Study design and procedure
A randomized cross-over design was applied, in which all children completed the asthma and fruit questionnaire via both Internet and paper modes. Beforehand, each child was randomly assigned within classes to start with one or the other of

the administration modes. Before starting on the second mode, children played a concentration-reaction computer game for five minutes to diminish remembrance of the first assessment. Children finished the session by completing a form on socio-demographic characteristics, computer experience, and evaluation of the modes. A research assistant was present to explain the procedure to the children and help out when necessary. Data collection took place during November and December 2002.

Questionnaires

Variables that consist of counting several ordinal items divided by the number of items are referred to as "scales". A variable composed of counting the number of answers "yes" of several (bi)nominal items is referred to as "index".

Asthma and fruit questionnaire

The eight-item validated and widely used International Study of Asthma and Allergies in Childhood (ISAAC) asthma questionnaire was applied [16, 21], which is referred to as the "asthma symptoms index". Additionally, three items assessed visits to the physician and medication used for respiratory symptoms, referred to as "medical consumption index".

The fruit questionnaire was based on a validated food frequency questionnaire [22] and on pretested questions regarding determinants of fruit consumption designed by Martens, Van Assema, & Brug [23]. Fruit and fruit juice consumption were measured by three items regarding days per week eating/drinking, number of pieces/glasses per day, and number of pieces/glasses in the past day; multiplying the number of days per week by the number of pieces/glasses a day, and dividing this by 7 assessed the "mean daily consumption". Further the fruit questionnaire consisted of the following five multi-item scales: awareness (2 items, for the Internet and paper modes Cronbach's alphas [24] were 0.71 and 0.74 respectively), attitude (8 items, Cronbach's alphas were 0.64), social influence (4 items, Cronbach's alphas were 0.69 and 0.66), intention to change (2 items, Cronbach's alphas were 0.58 and 0.63), and availability/accessibility (6 items, Cronbach's alphas were 0.68 and 0.69). These scales, including one single-item scale (self-efficacy) and one index (family food rules), assessed the determinants of fruit consumption. A higher score indicated more (=better) fruit consumption or more positive fruit consumption determinants.

Other data

Items on age, gender, countries of birth of respondent and parents to determine ethnic background [25], and living situation assessed socio-demographic characteristics. In addition, computer experience, and the starting/finishing time of completing the asthma and fruit questionnaire were registered. Completion times of the Internet version were automatically registered.

Evaluation of administration mode

The children's preferences for one of both administration modes with regard to "general preference", "understandability" and "ease of use" were measured. For the evaluation of the Internet mode, nine items were assessed.

Internet tool

The Internet version of the asthma and fruit questionnaire was developed through a generic Internet tool, using PHP (4.0.1 and higher), MySQL (3.22 and higher), and JavaScript (1.3). Access to the questionnaires was password protected, with the child's name not being recorded. Data was sent to the server in a scrambled format. The screen of the questionnaire was split into two frames, the left one displaying a list of topics, the right one displaying the questions per topic. Questions not being relevant to the child were not displayed. Logging out after completing the questionnaire was only allowed after answering all items.

Analysis

Feasibility

The total number of missing/non-unique (that is double) answers in the asthma and fruit dataset was determined per mode. Differences between these numbers on both modes were analyzed using the Sign rank test. The mean duration (in minutes) for completing the questionnaire with the Internet or paper mode was compared by means of the paired t-test.

Score equivalence

Score equivalence implies the similarity of responses to the asthma and fruit questionnaire between modes. The equivalence of the scores at the group level was assessed by performing the Wilcoxon test (non-parametric distribution) for continuous variables or the Sign rank test for categorical variables. In addition, at the individual level Intraclass Correlation Coefficients (ICCs) evaluated the

concordance between the asthma and fruit variables answered via Internet and paper. ICCs were interpreted as 0.00-0.19 negligible correlation; 0.20-0.34 weak correlation; 0.35-0.49 moderate correlation; and 0.50-1.00 strong correlation [26]. The agreement between Internet and paper modes at the item level was determined by Cohen's kappa coefficients, according to guidelines of Landis and Koch [27]: 0.00-0.19 poor agreement; 0.20-0.40 fair agreement; 0.41-0.60 moderate agreement; 0.61-0.80 good agreement/substantial; and 0.81-1.00 very good agreement/almost perfect. Finally, percentages of agreement were determined, where exact agreement is defined as the percentage of children giving exactly the same response via both modes; global agreement refers to the percentage of children giving responses that differ not more than one category on either side of exact agreement.

Evaluation of administration mode

The percentage of children reporting preferences for either Internet, paper or no preference was determined. The same was done for the responses to the evaluation aspects of the Internet mode. Differences between groups starting with Internet or paper mode were tested by the χ^2-test.

5.3 Results

Sample

Of the 270 invited children, 249 (92%) children participated in the study, of which 123 children started with the Internet version. Reasons of absence were mainly illness and three children's parents had refused participation. Four children did not complete the form with self-reported characteristics and evaluation. Table 5.1 lists the characteristics of the participating children.

Feasibility

The Internet version of the asthma and fruit questionnaire had no non-unique (that is double) answers. The Internet version resulted in 31 missing answers, owing to a few cases that did not logout. The paper version had 93 missing and 13 non-unique answers. The difference in total missing/non-unique answers between the two modes was significant ($p<0.01$).

The Internet mode took the children on average 14.2 minutes (4.3 sd) to complete, while the paper mode resulted in a mean completion time of 14.4 minutes (5.7 sd). This was no significant difference (p≥0.05).

Table 5.1 Characteristics of the study participants by total group and order of administration mode

	Total group (n=245) % of n	**Internet first** (n=122) % of n	**Paper first** (n=123) % of n
Age (years) *			
10	57.8	60.7	54.9
11	38.1	37.7	37.3
12	4.1	1.6	6.3
Gender *			
Boys	53.9	55.3	50.8
Ethnic background *			
Dutch	77.5	78.7	76.2
Turkish	6.6	4.9	8.2
Moroccan	0.8	0.8	0.8
Surinamese	1.2	0.8	1.6
Antillean / Arubean	1.2	0.8	1.6
Other	12.7	13.9	11.5
Living with *			
Both parents	82.0	85.4	78.7
Siblings	35.5	40.7	30.3
Computer experience *			
No experience	14.5	14.0	15.0
Little experience	39.4	43.8	35.0
Much experience	46.1	42.1	50.0

* No significant differences between group starting with Internet and group starting with paper (χ^2-test, p≥ 0.05)

Score equivalence

Table 5.2 shows similar mean scores between the Internet and paper modes. The only significant difference between administration modes was found for perceived "self-efficacy" of eating sufficient fruit (p=0.04). All variables showed strong ICCs (0.64-0.90).

One third of the items showed moderate agreement between Internet and paper modes (kappa 0.43-0.60) (Table 5.3); the remaining items had good to very good agreement (kappa 0.61-0.95). The percentages exact agreement of the items ranged from 61.3-98.8, percent global from 80.6-100

Table 5.2 Concordance of scores for asthma and fruit variables between the Internet and paper modes at the group level (n=249)

VARIABLES (number of items)	**Range** [A]	**Internet mode** Median (15-85th %)	**Paper mode** Median (15-85th %)	**P-value**	**ICC** [B]
ASTHMA SURVEY					
Asthma symptoms index (8)	0 – 8	1.0 (0.0-2.0)	1.0 (0.0-3.0)	0.14 [C]	0.91
Medical consumption index (3)	0 – 3	0.0 (0.0-1.0)	0.0 (0.0-1.0)	0.27 [C]	0.84
FRUIT SURVEY					
Fruit consumption					
Mean daily pieces of fruit (1*1)	0 – 4	1.0 (0.3-2.7)	1.0 (0.3-2.8)	0.86 [D]	0.85
Pieces of fruit past day (1)	0 – 4	1.0 (0.0-3.0)	1.0 (0.0-2.0)	0.33 [C]	0.84
Mean daily glasses of fruit juice (1*1)	0 – 2	0.9 (0.3-2.0)	0.9 (0.3-2.0)	0.67 [D]	0.79
Glasses of fruit juice past day (1)	0 – 2	1.0 (0.0-2.0)	1.0 (0.0-2.0)	0.80 [C]	0.78
Determinants of fruit consumption					
Awareness scale (2)	0 – 4	2.0 (1.0-2.5)	2.0 (1.0-2.5)	1.00 [C]	0.84
Attitude scale (8)	0 – 4	3.0 (2.5-3.6)	3.0 (2.5-3.5)	0.38 [D]	0.84
Social influence scale (4)	0 – 4	2.5 (1.8-3.3)	2.5 (1.8-3.3)	0.17 [C]	0.85
Self-efficacy scale (1)	0 – 4	4.0 (2.0-4.0)	4.0 (2.4-4.0)	0.04[C*]	0.64
Intention to change scale (2)	0 – 1	0.5 (0.0-1.0)	0.5 (0.0-1.0)	0.70 [C]	0.77
Family food rules index (3)	0 – 3	0.0 (0.0-1.0)	0.0 (0.0-1.0)	0.76 [C]	0.75
Availability/accessibility scale (6)	0 – 1	0.6 (0.5-0.7)	0.6 (0.5-0.7)	0.86 [D]	0.93

[A] Theoretically possible range of score, showing the lowest and highest possible score
[B] ICCs interpretation [26]: <0.20, negligible correlation; 0.20-0.34, weak correlation; 0.35-0.49, moderate correlation; 0.50-1.00, strong correlation
[C] Categorical variables: Sign rank test
[D] Continuous variables (non-parametric distribution): Wilcoxon test
* Significant difference between Internet and paper modes within children (p<0.05)

Evaluation of administration mode

Table 5.4 shows that the majority of the children preferred Internet with regard to the aspects "general preference" and "ease of use", but had no preference concerning "understandability" of the two modes. The children that started with Internet had a significantly higher preference for Internet with regard to "general preference" (59.8%) compared with children who started with the paper mode (48.0%, p<0.05).

Most children agreed with the positively directed and disagreed with the negatively directed evaluation aspects of the Internet mode (Table 5.4). The children starting with Internet perceived the Internet mode as being significantly more "interesting to use" (72.1%, p<0.05) and less "annoying to click on 'next' before continuing" (77.7%, p<0.01) compared to those starting with the paper mode (53.4% and 61.0%, respectively).

Table 5.3 Agreement of the asthma and fruit items between the Internet and paper modes at the individual level (n=249)

ITEMS	Cohen's kappa coefficients[A]	Exact agreement (%)	Global agreement (%)
ASTHMA SURVEY			
Asthma symptoms[B]			
Wheeze ever	0.82	93.3	100
Wheeze past year	0.65	84.8	91.4
Attack of wheeze past year	0.69	90.5	94.6
Sleep disturbed by wheeze past year	0.68	90.1	97.2
Speech limiting wheeze past year	0.68	90.5	90.9
Asthma ever	0.95	98.8	100
Exercise-induced wheeze past year	0.74	91.2	100
Waking with cough past year	0.77	90.2	100
Medical consumption[B]			
Visit physician ever	0.80	93.1	100
Visit physician past year	0.68	88.1	92.2
Medication past year	0.76	95.5	100
FRUIT SURVEY			
Fruit consumption			
Fruit			
Days per week	0.68	74.7	88.8
Pieces per day	0.58	66.1	83.0
Pieces past day	0.66	72.9	80.6
Fruit juice			
Days per week	0.62	69.5	84.0
Glasses per day	0.62	74.9	99.6
Glasses past day	0.65	74.3	83.6
Determinants of fruit consumption			
Awareness[C]			
How much fruit I eat	0.64	76.6	98.8
How much fruit I eat in comparison with peers	0.73	82.2	94.0
Attitude: I think[C]			
Eating fruit is good	- [D]	81.5	98.0
Eating fruit is pleasant	0.50	64.1	95.6
Fruit tastes good	0.63	79.8	98.8
Eating fruit is healthy	0.58	84.3	99.6

See Table 5.3 continued

Table 5.3 continued

ITEMS	Cophens' kappa coefficients[A]	Exact agreement (%)	Global agreement (%)
Eating fruit protects me from health problems...	0.60	71.9	94.4
It is annoying to get dirty hands from fruit	0.61	70.6	93.2
It is weird to eat fruit at school	0.53	64.8	89.8
Fruit is an interesting subject to obtain information on	0.58	67.9	94.8
Social influence[C]			
My caretakers think I should eat more fruit	0.61	76.8	93.0
My friends think I should eat more fruit	0.66	80.5	90.6
How much fruit is eaten at home	0.68	78.5	98.4
At home they pay attention to how much fruit I eat	0.50	61.3	91.2
Self-efficacy[C]			
Would succeed in eating more fruit	0.43	65.3	94.4
Intention to change			
Ever thought of eating more fruit[B]	0.65	82.4	100
Thinking of eating more fruit in the near future[C]	0.55	67.5	93.0
Family food rules: on[B]			
How much fruit to eat	0.67	89.4	100
When to eat fruit	0.67	90.7	100
Which kind of fruit to eat	0.45	97.2	100
Availability/accessibility			
Types of fruit or fruit juice bought at request[C]	0.70	80.9	97.6
Fruit usually available at home[C]	0.69	85.3	99.2
Fruit juice usually available at home[C]	0.56	70.4	96.0
Fruit that I like usually available at home[C]	0.55	73.2	98.0
Often take fruit to school yourself[E]	0.85	93.1	98.8
Often get fruit to take to school[E]	0.87	93.9	99.8

[A] Kappas interpretation [27]: <0.2, poor agreement; 0.20-0.40, fair agreement; 0.41-0.60, moderate agreement; 0.61-0.80, good agreement/substantial; 0.81-1.00, very good agreement/almost perfect
All kappas are significant at an alpha level of <0.01
[B] Items are/Item is binominal
[C] Items are/Item is formatted on a 5-point Likert scale
[D] Not possible to compute kappa because of non-symmetric 2-way table
[E] Item is formatted on a 6-point Likert scale

Table 5.4 Children's preferences for the Internet or paper mode and evaluation of the Internet mode (n=245)

Preference aspects	**Internet is preferred**	**No preference**	**Paper is preferred**
	% of n	% of n	% of n
General preference *	53.9	26.9	19.2
Best understandable mode	29.0	48.2	22.9
Easiest to use	46.8	33.3	19.9
Evaluation aspects of the Internet mode	**Disagree**	**Neutral**	**Agree**
	% of n	% of n	% of n
Positive direction			
Easy to use	7.0	9.9	83.0
Interesting to use *	18.8	18.3	62.9
Instructions were easy to follow	7.5	9.6	82.8
It was fun to use	10.0	10.4	79.6
Negative direction			
Hard to read	83.5	9.1	7.4
It took a long time	57.1	25.4	17.5
It was unclear (confusing)	84.2	9.6	6.3
It was difficult to use	84.6	8.3	7.0
It was annoying to click on 'next' before continuing **	69.5	15.5	15.1

* Significant difference between group starting with Internet and group starting with paper ($p<0.05$)
** Significant difference between group starting with Internet and group starting with paper ($p<0.01$)

5.4 Discussion

This randomized study showed for the first time that Internet administration of health and health behavior questionnaires is feasible, score equivalent, well accepted and preferred by children in the setting of elementary schools. Internet/Computer has previously been shown feasible in similar settings [8, 9], in clinical settings with "Quality of Life" questionnaires [14, 15], and in secondary schools [10, 13, 28].

The Internet questionnaire had some missing answers because some children did not logout properly. This could be due to for example slow Internet connection, network problems, a programming error, (older) computers, or forgetting to logout. This underlines that Internet use can be unpredictable and have shortcomings. Overall, previous studies among school children and adolescents (including adults) showed less (or equally as many) missing/non-unique responses with the computer questionnaire compared to the paper mode, which is in line with the current study [8, 9, 14, 15].

In the current study, the completion times did not differ between modes. The study of Caro et al. including adolescents also showed that the asthma quality of

life questionnaire was completed equally as fast between Internet and paper modes [14]. The generic health measure however was completed faster in the paper group, which was also reported by another study including adolescents [14, 15]. Strikingly, Caro et al. showed that nevertheless the electronic version was perceived as taking little time [14].

Scores to the asthma and fruit questionnaire were comparable between Internet and paper modes, except for one variable. Similarly, other score equivalence studies among school children and adolescents also reported one or more variables with significant differences between computer and paper modes, but these studies mostly focused on risk behaviors and sensitive issues [8-13, 29]. Only two of these studies were performed in elementary schools, of which McCabe et al. showed a decreased reporting of alcohol consumption for the Internet version, which is in contradiction with the general finding of sensitive issues being more honestly reported via computer [9]. Van Hattum and De Leeuw did show more honest (socially undesirable) answering regarding bullying for the computer version (disk by mail) in a non-randomized study [8]. In line with the current study, Mangunkusumo et al. neither found different reporting on presence of healthy diet and presence of one or more chronic conditions between modes among adolescents [28]. The present study showed strong correlations for the asthma and fruit variables between Internet and paper modes, which was also found by a study including adolescents regarding asthmatic symptoms (ICC 0.99) [14]. Still, the items had relatively low kappas in the current study. Therefore, it is recommended that the influence of computer or Internet on the respondents' reporting should still be tested. If different reporting exists, the reasons for this should be examined.

Children rated the Internet mode positively and preferred it to paper mode, especially when they started with Internet. This may reflect that children were more enthusiastic about or open to the Internet mode when receiving it the first time. Comparable to our study, Mangunkusumo et al. showed that the Internet version of a health and health behavior questionnaire was rated easier and more pleasant to use compared to a paper version among adolescents [28]. Ryan et al. also reported a preference for the computer mode of a generic health questionnaire among adolescents [15].

Our study population did not differ substantially in characteristics (gender, ethnic background, and living with both parents) from the general Dutch adolescent population when compared with nationwide data concerning school children in elementary schools [30]. However, this study was restricted to the school setting

and its (generally) healthy children. Therefore, the results of this study are mainly of interest for community health applications such as evaluations of preventive interventions in the general population, and applications in the daily practice of community medicine, for example applications by school-based nurses [13].
The current study has been restricted to the topics asthma and fruit consumption. Besides these topics, only questionnaires regarding risk behaviors such as alcohol, smoking and bullying have been compared between Internet/computer and paper mode among children so far. Therefore it is recommended to conduct further research with other topics.

Conclusions and implications

The Internet administration of the health and health behavior questionnaire performed well compared to the paper version in the elementary school setting. Besides the known advantages of Internet such as the efficiency of sampling data and the opportunity of giving tailored health advice, our results present a rationale for the use of Internet in health and health behavior research among children.

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6

Feasibility, Acceptability, and Quality of Internet-administered Adolescent Health Promotion in a Preventive-care Setting

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Abstract

Background An Internet tool for monitoring, personalized feedback, and referral was developed to support routine adolescent preventive care and was compared to usual practice using paper and pencil (P&P).

Methods A total of 1071 Students (average age 15 years) from seven secondary schools were randomly assigned to the Internet or P&P group. The Internet group received a health and health-behavior assessment, tailored feedback on health and health-behavior (specifically fruit consumption), and an on-line referral to see a physician/nurse if necessary. The P&P group received the same assessment, preprinted generic advice on fruit consumption and a mailed referral (where applicable). Students and physicians/nurses completed evaluation forms to assess indicators of feasibility, acceptability (i.e. satisfaction), and quality of each administration mode.

Results Student participation rate was 87%. The electronic health feedback was positively evaluated. Students perceived the Internet-tailored fruit advice as more pleasant, more personally targeted, and more enjoyable, but less credible than the generic preprinted advice ($p<0.01$). No differences in indicators of acceptability and quality of consultation were found ($p\geq0.05$).

Conclusions Thus the Internet can be a valuable tool to support physicians/nurses in the field of preventive care. It is recommended to further optimize and evaluate the Internet as a tool.

6.1 Introduction

Community and preventive health services can contribute to preventing diseases among adolescents, especially by promoting good health and a healthy lifestyle [1]. The approach in doing so varies by country.

The current Dutch preventive health care system monitors adolescents' self-reported health and health-behavior via printed questionnaires administered at schools. Based on the self-reported health (from physical to psychosocial health and sometimes also health behaviors), some municipal health services refer adolescents with a risky health profile. During such a consultation, adolescents may receive preprinted generic information on health and health-behavior topics. Monitoring data are not only used for individual care, but also for generating health profiles at the group level. Based on these health profiles, schools may decide to adopt specific preventive programs/interventions.

With the current strain on preventive health care and increasing demand for adolescent health promotion, preventive health care requires greater efficiency. The Internet can be highly beneficial for achieving this; it is very efficient for data sampling, may increase data quality, and may save on costs in the long term, and it provides the opportunity to enhance the quality of adolescent health promotion (e.g. by giving automated feedback on the adolescents' health to the physician/nurse to support the consultation) [2-9]. The Internet offers the opportunity to give immediate computerized, tailored feedback on health and health behavior, which various studies have shown to be more effective than generic (paper) health advice [10, 11].

This project aimed to develop an Internet tool to support the current adolescent preventive health care provided by Dutch municipal health services. The tool measured health and health-behavior, provided tailored health feedback to the students, immediately referred adolescents at risk to the physician/nurse (i.e. school doctor/nurse), and gave information to the physicians/nurses regarding individual students' health and health-behavior status to facilitate communication during consultation [12]. The tool also provided an SPSS-data file, which the municipal health services could use for subsequent analyses.

The topics chosen for this project corresponded to the current practice of municipal health services, namely generic health and a few thematic topics on health behavior. As physicians/nurses currently focus on generic health, the Internet tool was complemented with a separate computer-tailored [10] tool for

assessment and a tailored-advice component for one of the health behaviors (fruit intake in this project). Nutrition attracts the interest of adolescents [13, 14] and their parents [15]; yet adolescents do not reach recommended intake levels for fruit consumption [16].
The aim of this study was to evaluate indicators of feasibility (i.e. actual use), acceptability (i.e. adolescents' and physicians/nurses' satisfaction) and quality of the Internet-administered adolescent preventive health care procedure by comparing it with the current procedure, which uses printed questionnaires and no tailored online feedback.

6.2 Methods

Sample and setting

Two municipal health services participated in the study, each involving two physicians/nurses. The municipal health services were situated in a rural (Harderwijk) as well as an urban (Vlaardingen) area, in The Netherlands, and invited seven secondary schools of varying school types with respect to educational level and socio-economic background. These schools comprised 55 classes from the same grade with 1071 students (average age 15 years) and had adequate computer and Internet access facilities (Internet Explorer 5.0 or higher). The parents and students separately received written information about the project and were allowed several weeks to refuse participation (passive consent). The medical ethical committee of the Erasmus MC University Medical Center Rotterdam approved the study.

Study design

The study design is schematically illustrated in Fig. 6.1. Students within each class were randomly assigned to the Internet group or the paper and pencil (P&P) group. The procedures are introduced below and will be described in detail in the paragraph on 'Intervention'.
First, all students completed a questionnaire to assess their health and health-behavior status via either Internet or P&P mode in a classroom at school under supervision of a researcher and an assistant from the municipal health service.

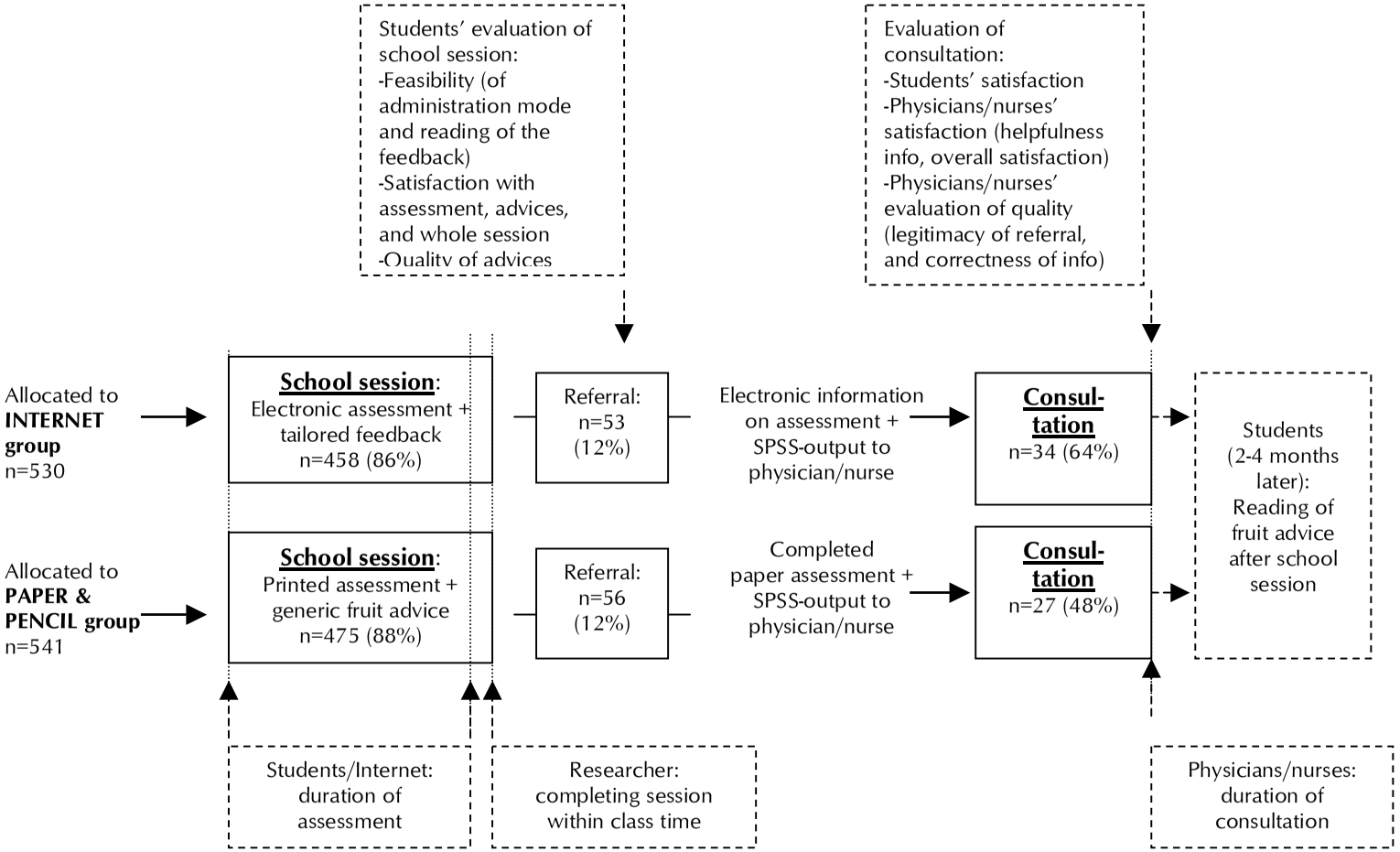

Fig. 6.1 Study design, attendance rates, and evaluations (broken border lines)

After completing the assessment, the students in the Internet group received computer-tailored feedback [10] on their answers via Internet immediately on screen, including personal advice about fruit consumption. Students in the P&P group only received generic preprinted advice about fruit consumption. Immediately after reading their advice, students in both groups completed a printed form for evaluation of the assessment and feedback. This part of the study is referred to as 'school session'.
In both groups, students with increased health risk (see for criteria the paragraph on 'Intervention' below) were identified and referred by the municipal health service. 'Consultation' took place at either an office at the school (Harderwijk) or at the municipal health service (Vlaardingen). Prior to the consultation, the physician/nurse received information on the potential health risks or unfavorable health-behaviors either via a short Web-based or written report (dependent on mode of administration). After consultation, students and physicians/nurses from both groups completed a printed evaluation form.

Intervention

Intervention contents of the school session

Students completed a questionnaire (via Internet or paper) to assess health and health-behavior on the following topics: 'generic health' was determined with the most widely used validated generic health measure called the Child Health Questionnaire-Child Form (CHQ-CF) including multiple scales [17, 18], a higher CHQ score indicated better health; The 'self-reported complaints/chronic conditions' addressed the presence of 10 complaints such as allergies and hearing impairment, in the last year. If the complaint was present, the student could indicate whether he/she had seen a physician for this in the last year. In addition, with asthma (being a highly prevalent chronic condition among youth), respiratory problems were more thoroughly assessed by applying the eight-item validated and widely used International Study of Asthma and Allergies in Childhood (ISAAC) asthma questionnaire [19]; selected topics on 'health-behavior' were 'smoking' and 'fruit consumption'. Students indicated the smoking behavior that resembled them the most on an eight-level scale ranging from 'I smoke at least once a day' to 'I have never smoked, not even one puff' and rated the number of cigarettes smoked in total [20]. Another item assessed intention to quit smoking. Students intending to quit completed eight extra items on the determinants of quitting based on the ASE-model [21]. The items on frequency of fruit consumption

were based on the validated measure from Bogers *et al.* [22] and several determinants were based on Oenema and Brug [23].

Further, items on age, gender, and countries of birth of respondent and parents to determine ethnic background [24] assessed socio-demographic characteristics. In addition, students registered their 'starting and finishing time' of completing the P&P assessment; these were automatically registered in the Internet-delivered mode.

The feedback of the Internet group contained online personal advice on fruit intake, feedback on the reported health for each topic including smoking, and a referral, if relevant. The fruit advice was derived from the Web-based, tailored food advice for adults from Oenema and Brug [23] with adjustments made for students. This advice is based on Weinstein's Precaution Adoption Process Model, which emphasizes the role of awareness as a prerequisite for contemplating behavioral change [25]. To influence the awareness of personal fruit intake, the fruit advice applied personalized and normative feedback as proposed by Weinstein's model. Students were encouraged to make a printout of their personal fruit advice. Furthermore, students were invited to click further to see their status for each topic that was assessed by the questionnaire (health risk appraisal) [26]. Students with a score indicating a risk (e.g. below a certain cutoff point) received feedback making them aware of the reported complaints (= risk-feedback). Table 6.I shows the risk-feedback topics, criteria and cutoff points, and the number of students who received risk-feedback. A score (e.g. above a certain cutoff point) indicating good health or health behavior would lead to positive feedback. A score in between the cutoff points for risk-feedback and positive feedback would generate feedback pointing to possible problems. CHQ scales selected for feedback were physical functioning, bodily pain, general behavior, mental health, self-esteem, and general health. Cutoff points for each CHQ scale were based on existing reference datasets of the CHQ among adolescents (D. Verrips, personal communication) [18]. The lowest 2% of each CHQ scale in the reference data indicated a score for each CHQ scale and this score (see footnote of Table 6.I for the exact score) was used as the cutoff point for risk-feedback. Health status based on CHQ scales was also summarized in a graph (see Fig. 6.2). Finally, the module for feedback on referrals included an appointment to see the physician/nurse for students at risk (for criteria see below), with the reason mentioned. If students were not referred based on their assessment, they could

check a box for a self-referral. The details on time and place of consultation were sent by mail (several weeks later).

Table 6.1 Number of students in the Internet group that received risk-feedback on health/health-behavior topics (n = 458)

	Number of students that received risk-feedback	
	N	%
HEALTH TOPIC		
Health-related quality of life[a]	50	10.9
Physical functioning	13	2.8
Bodily pain	15	3.3
General behavior	17	3.7
Mental health	11	2.4
Self esteem	10	2.2
General health	9	2.0
Complaints/chronic conditions[b]		
Asthma/chronic bronchitis	14	3.1
Migraine/serious headache	51	11.1
Allergies	48	10.5
Hearing impairment	17	3.7
Reduced visual acuity	16	3.5
Back complaints	41	9.0
Depressiveness/anxiety attacks	29	6.3
Negative sexual experience	8	1.7
Other complaints/chronic conditions	7	1.5
Respiratory complaints[c]	29	6.3
HEALTH-BEHAVIOR TOPIC		
Smoking[d]	98	21.4
Fruit consumption[e]	359	78.4

[a] Scores of CHQ scales range from 0 to 100, with a higher score indicating more (= better) health. Criterion for risk-feedback is scoring one or more of the scales with a risk-score: physical functioning ≤ 77.8, bodily pain ≤ 20.0, general behavior ≤ 56.3, mental health ≤ 39.1, self esteem ≤ 44.6, or general health ≤ 32.1.
[b] Criterion for risk-feedback is having the complaint, but not being checked by a physician for the complaint.
[c] Criterion for risk-feedback is if patient ever had wheezing and last year had wheezing during exercise or last year had wheezing and last year had dry cough or last year had wheezing during exercise and last year had dry cough and not being checked by a physician for asthma.
[d] Criterion for risk-feedback is at least smoking once in a while AND not already quitting smoking.
[e] Criterion for risk-feedback is eating less than two pieces each day.

Students in the P&P group received generic preprinted fruit advice, which emphasized the importance of eating sufficient fruit every day. When consultation was considered appropriate, a referral was sent by mail (several weeks later). All students in the P&P group had been offered the opportunity to self-refer themselves already in the assessment on health/health behavior.
In both groups, the criteria for referral were being at risk for one or more of the selected CHQ scales (referred to as 'health risk') or having self-referred.

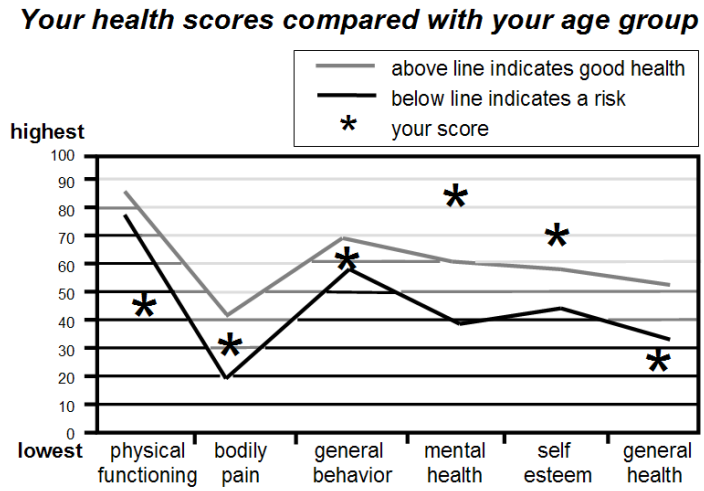

Fig. 6.2 Electronic feedback, example of graph on personal health status based on CHQ scales (translated from Dutch to English and changed from color to grey scale)

Intervention contents of consultation

As mentioned previously, the physician/nurse received the results of the assessment for each referred student prior to consultation via a different mode for each group. For referred students in the Internet group, the physician/nurse received via the Internet a printable summary of the self-reported health risks and problems. The physician/nurse also had access to the complete electronic feedback for students as well as to all individual items in a printed SPSS-output. For students in the P&P group, the physician/nurse used the students' completed printed health and health-behavior questionnaires and a printed SPSS-output summarizing the students' health risks and problems.

Consultation was the same for both groups, namely a medical examination, going into specific risk areas (e.g. health risks on CHQ scales were discussed), and referring students to other professionals when necessary.

Internet tool

The health and health-behavior questionnaire and feedback via Internet were developed using PHP (4.0.1 and higher), MySQL (3.22 and higher), and JavaScript (1.3). Access to the questionnaire was password protected, with the student's name not being recorded and only identifiable by the researcher and physician/nurse. Data were sent to the server in a scrambled format. The screen displaying the questionnaire used two separate frames, the left one displaying a list of topics, the right one displaying the questions per topic. Questions not relevant to the student were not displayed. Logging out after completing the questionnaire was only permitted after answering all items.

Each physician/nurse received a personal login code from the researcher to access the Internet tool.

Evaluation of intervention

Indicators of feasibility

The following aspects determined the feasibility (i.e. actual use) of the intervention.

Attendance/reach. The percentage of students completing the assessment was compared between the Internet and P&P groups. The same was done for students who were referred. The physician/nurse noted the attendance (students complying with the referral) of the consultation, which was compared between the Internet and P&P groups.

Duration. The completion times of the assessment and separately the consultation (noted by the physician/nurse) were compared between groups. In addition, a researcher registered after the school sessions whether the class finished the whole session (including reading of the feedback) within the class time.

Reading of the feedback. Students noted which parts of the feedback they had read. Two-four months later, students were asked whether they had referred to the fruit advice after the session. The reading of the fruit advice was compared between groups.

Administration mode.: Students evaluated the ease and pleasantness of the administration modes for the assessment, fruit advice and electronic advice separately. The answers ranged from e.g. 'very difficult' to 'very easy' on a five-point Likert scale. Comparisons between groups were made, except for the electronic advice.

Indicators of acceptability

Users (i.e. students and physicians/nurses) assessed various aspects of acceptability (i.e. satisfaction) of the intervention. Comparisons between groups were made between the students' evaluations of individualization (targeted specifically at me) and enjoyability of the fruit advice, formatted on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Additionally, whether the assessment and advice were found interesting was measured, with answers from 'not interesting' to 'very interesting' on a five-point Likert scale. In both modes students rated the whole session (assessment and feedback) on a scale from 1 to 10. These were compared between groups.

Satisfaction with consultation was assessed among students by the 18-item Satisfaction Form [27], with answers on a five-point Likert scale. An extra item measured whether the students appreciated knowing why they were referred, with answers on a five-point Likert scale ranging from 'very unpleasant' to 'very pleasant'.

The evaluation form completed by the health physician/nurse measured helpfulness and overall satisfaction with the session. Answers were on a five-point Likert scale, with 5 indicating the most-positive evaluation.

Indicators of quality of contents

The following selected indicators gave insight into whether the contents of the intervention were of sufficient quality: The number of students referred (including self-referrals) was compared between groups; students rated whether they understood the contents of the assessment, the fruit advice and the electronic health feedback. The answers ranged from 'very difficult' to 'very easy' on a five-point Likert scale. Comparison between groups was possible except for the evaluation of the health feedback; comparisons between groups were made between the students' evaluations of the personal relevance, usefulness and credibility of the fruit advice, formatted on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'; finally, two additional items addressed the physician's/nurse's evaluations of whether the referral was legitimate and whether the information on referred students was correct.

Analysis

Where possible, significant differences between the Internet and P&P groups were tested, using two-tailed tests with an alpha of 0.05. Differences in age,

duration of assessment, the mark for the school session and the scale score of the Satisfaction Form for consultation were determined through the Student's *t*-test. Mann-Whitney *U*-tests were used to assess data that were not normally distributed. These included assessment of differences between the two groups in duration of consultation, students' evaluation of administration modes and all the remaining acceptability measures. In addition, Mann-Whitney *U*-tests were used for differences in the quality measures, except for legitimacy of referral, and correctness of information, which were tested with logistic regression (Wald test). Comparisons of attendance rates, reading of the fruit advice, were also tested with logistic regression; characteristics of participants, except for age, were tested with the Chi-square test.
Odds ratios (ORs) were calculated for the dichotomous variables. ORs estimated the probability of an outcome between the administration modes, with the P&P group as the reference category.
SPSS version 11.0.1 was used for all statistical analyses.

6.3 Results

Sample
Of the 1071 eligible students, 933 (87%) participated in the school session; 458 participated in the Internet group and 475 participated in the P&P group. Registered reasons for absence were mainly 'unknown' and 'illness,' and 27 parents refused their child's participation. Table 6.2 lists the characteristics of the participating students by study groups.
Due to missing values, the number of student evaluation forms differed per analysis.

Indicators of feasibility
The percentage of students completing the health questionnaire (see Fig. 6.1) did not differ significantly between the Internet and P&P groups (*P*=0.499, OR=0.88, 95% confidence interval 0.62–1.26). The attendance at the consultation was higher in the Internet group (64%) than in the P&P group (48%), but this difference was not significant (p=0.095, OR=1.92, 95% CI 0.89–4.14) (see Fig. 6.1). Registered reasons for non-attendance were mainly 'unknown' or that the

student was 'already under treatment'. In most sessions (90%) the students attended without a parent.

Table 6.2 Characteristics of all participants and by groups*

	Total group (n = 933)	**Internet Group** (n = 458)	**P&P group** (n = 475)
	mean (range)	mean (range)	mean (range)
Age (years)	15 (13–17)	15 (13–17)	15 (13–17)
	% of n	% of n	% of n
Gender, Boys	46.2	43.9	48.5
Ethnic background [24]			
Dutch	76.5	76.5	76.5
Turkish	6.4	5.0	7.7
Moroccan	2.5	3.3	1.7
Surinamese	2.3	2.4	2.1
Antillean/Arubean	0.4	0.4	0.4
Other	11.9	12.3	11.5
Secondary school type			
Lower secondary/vocational education	58.4	59.1	57.7
Intermediate secondary education	19.2	18.6	19.8
Upper secondary education	22.4	22.3	22.5

*no statistically significant differences at an alpha level of p≥0.05.

Indicators of feasibility

The percentage of students completing the health questionnaire (see Fig. 6.1) did not differ significantly between the Internet and P&P groups (p=0.499, OR=0.88, 95% CI 0.62–1.26). The attendance at the consultation was higher in the Internet group (64%) than in the P&P group (48%), but this difference was not significant (p=0.095, OR=1.92, 95% CI 0.89–4.14) (see Fig. 6.1). Registered reasons for non-attendance were mainly 'unknown' or that the student was 'already under treatment'. In most sessions (90%) the students attended without a parent.

The completion times for the assessment did not differ significantly between the Internet (mean=19.8 minutes, 5.2 SD, n=426) and the P&P groups (mean=19.6 minutes, 5.2 SD, n=439) (p=0.587). In both groups the school sessions were completed within the class time. The duration of the consultation did not differ significantly between the Internet (median=25 minutes, n=33) and P&P groups (median=30 minutes, n=27) (p=0.470).

Most students (69%) using the Internet reported having read one or more parts of the health feedback, with the CHQ being read most often (50%) (see Table 6.3). In both groups, >85% reported having read the fruit advice during the school session. Two-four months later, at least 41% of the students reported they had

read the advice since the school session. No significant differences were found between the Internet and P&P groups (p≥0.05).

Students rated assessment via the Internet as an easier mode than via P&P (p=0.035) (see Table 6.4). The electronic fruit advice was a more pleasant mode to use (p=0.005) than the preprinted advice. Students evaluated the electronic health feedback as an easy and pleasant mode to use.

Table 6.3 Number of students having read feedback compared between groups

	Internet group N (%)	**P&P group** N (%)	**P value**	**Odds ratio** (95% CI)
READING OF FRUIT ADVICE	(n = 444)	(n = 465)		
During school session	379 (85%) (n = 417)	419 (90%) (n = 431)	0.054	0.7 (0.5–1.0)
After school session	193 (46%)	176 (41%)	0.107	1.3 (1.0–1.6)
READING OF HEALTH FEEDBACK	(n = 420)			
Number of topics				
Have not read advice	130 (31.0%)	NA		
Have read one topic	128 (30.5%)	NA		
Have read two topics	42 (10.0%)	NA		
Have read three topics	19 (4.5%)	NA		
Have read four topics	33 (7.9%)	NA		
Have read all topics	67 (16.0%)	NA		
Topics of health feedback				
Invitation	142 (33.8%)	NA		
General health (CHQ)	210 (50.1%)	NA		
Complaints/conditions	138 (32.9%)	NA		
Respiratory complaints	116 (27.6%)	NA		
Smoking	131 (31.2%)	NA		

NA = not applicable.
CHQ = Child Health Questionnaire.

Indicators of acceptability

In general, students evaluated the assessment and the fruit advice in both groups neutral/positive, but the Internet-tailored feedback on fruit consumption was evaluated as being more personally targeted and enjoyable than the preprinted generic advice (p<0.01) (see Table 6.5). Students evaluated the electronic health feedback positively. Students were satisfied with the consultation and appreciated knowing why they were referred and reasons for it. The health physicians/nurses evaluated the information as neutral/helpful and were satisfied with the overall session. No differences between groups were found (p≥0.05).

Table 6.4 Students' evaluation of administration modes compared between groups

	Internet group		**P&P group**		**P value[a]**
	Median (25–75th %)	Mean (SD)	Median (25–75th %)	Mean (SD)	
Assessment of health/health-behavior	(n = 444)		(n = 465)		
Was the mode easy to use?	4.0 (4.0–5.0)	4.2 (0.7)	4.0 (4.0–5.0)	4.1 (0.7)	0.035*
Was the mode pleasant to use?	4.0 (3.0–4.0)	3.7 (0.8)	4.0 (3.0–4.0)	3.7 (0.8)	0.115
Fruit advice	(n = 381)		(n = 418)		
Was the mode easy to use?	4.0 (4.0–4.0)	3.9 (0.6)	4.0 (4.0–4.0)	3.9 (0.7)	0.996
Was the mode pleasant to use?	4.0 (3.0–4.0)	3.8 (0.7)	4.0 (3.0–4.0)	3.7 (0.7)	0.005**
Electronic health feedback	(n = 314)				
Was the mode easy to use?	4.0 (4.0–4.0)	3.9 (0.6)	NA	NA	
Was the mode pleasant to use?	4.0 (3.0–4.0)	3.8 (0.7)	NA	NA	

Scores on five-point Likert scales ranging from 1 (most-negative evaluation) to 5 (most-positive evaluation).
NA = not applicable.
[a] Mann-Whitney *U*-test.
* statistically significant p<0.05, ** statistically significant p<0.01.

Indicators of quality of contents

In the Internet group, 50 students (10.9%) were at health risk and three (0.7%) had self-referred themselves; in the P&P group, this was 50 (10.5%) and six (1.3%) students, respectively. The percentage of students referred did not differ significantly between groups (p=0.523, OR=0.88, 95% CI 0.59–1.31) (see Fig. 6.1). To illustrate, the reference dataset from 1995 (444 adolescents aged 9-17 years) showed 7% to be at health risk [28], which was slightly lower than the proportion in the Internet group (p=0.039) and the P&P group (p=0.058).

Students evaluated the electronic fruit advice as more personally relevant, but less credible and useful than the preprinted fruit advice (all, p<0.05) (see Table 6.6). After the consultation, the physicians/nurses evaluated most (complied) referrals based on the CHQ scales as legitimate referrals and they evaluated the information as correct in most cases. No differences between groups were found (p≥0.05). Reasons for illegitimate referrals or incorrectness of the information were that students were already known/familiar with the municipal health service or that the complaints/problems had already been solved before the consultation (the CHQ scale 'bodily pain' had detected temporary problems, which had been solved by the time the consultation took place), or the answers to the questionnaire did not match what was said during the consultation.

Table 6.5 Acceptability (i.e. satisfaction) of different intervention components compared between groups

	Internet group		**P&P group**		**P value[a]**
STUDENT	Median (25–75th %)	Mean (SD)	Median (25–75th %)	Mean (SD)	
Assessment of health/health-behavior	(n = 444)		(n = 465)		
Did it interest you?	3.0 (3.0–4.0)	3.2 (0.9)	3.0 (3.0–4.0)	3.2 (0.9)	0.901
Fruit advice	(n = 376)		(n = 417)		
Did it interest you?	4.0 (3.0–4.0)	3.4 (0.9)	3.0 (3.0–4.0)	3.3 (0.9)	0.426
Was advice targeted to you?	4.0 (3.0–4.0)	3.5 (0.9)	3.0 (3.0–4.0)	3.3 (1.0)	0.000**
Did you enjoy it?	4.0 (3.0–4.0)	3.4 (0.9)	3.0 (3.0–4.0)	3.2 (1.0)	0.004*
Electronic health feedback	(n = 314)				
Did it interest you?	4.0 (3.0–4.0)	3.5 (0.8)	NA	NA	
Mark for whole school session (1–10)	(n = 435) 7.5 (7.0–8.0)	7.4 (1.1)	(n = 460) 7.5 (7.0–8.0)	7.3 (1.3)	0.295[b]
Consultation	(n = 34)		(n = 27)		
18-item Satisfaction Form[c]	4.4 (4.1–4.7)	4.4 (0.4)	4.3 (4.0–4.6)	4.3 (0.4)	0.476[b]
Did you appreciate knowing why you were referred?	4.0 (4.0–5.0)	4.2 (0.7)	4.0 (4.0–4.0)	4.0 (0.7)	0.271
PHYSICIAN/NURSE					
Consultation					
Was information helpful?	3.3 (4.0–4.0)	3.8 (0.4)	3.0 (4.0–4.0)	3.7 (0.5)	0.695
Were you satisfied with the session?	4.0 (4.0–4.0)	3.9 (0.3)	4.0 (4.0–4.0)	4.0 (0.3)	0.419

Scores on five-point Likert scales ranging from 1 (most-negative evaluation) to 5 (most-positive evaluation).
NA = not applicable.
[a] Mann-Whitney *U*-test; [b] Student's *t*-test; [c] Cronbach alpha-paper = 0.83, Internet = 0.86.
* statistically significant p<0.01, ** statistically significant p<0.001.

Table 6.6 Quality of intervention components compared between groups

	Internet group		**P&P group**		**P value[a]**
STUDENT	Median (25–75th %)	Mean (SD)	Median (25–75th %)	Mean (SD)	
Assessment of health/health-behavior	(n = 444)		(n = 465)		
Could you understand it?	4.0 (4.0–5.0)	4.1 (0.7)	4.0 (4.0–5.0)	4.0 (0.8)	0.980
Fruit advice	(n = 376)		(n = 417)		
Could you understand it?	4.0 (4.0–4.0)	4.1 (0.6)	4.0 (4.0–4.0)	4.1 (0.6)	0.165
Was it relevant to you?	4.0 (3.0–4.0)	3.5 (1.0)	4.0 (3.0–4.0)	3.3 (1.0)	0.049*
Was it credible?	4.0 (3.0–4.0)	3.6 (0.9)	4.0 (4.0–4.0)	3.8 (0.8)	0.003**
Was it useful information?	4.0 (3.0–4.0)	3.6 (0.9)	4.0 (3.0–4.0)	3.7 (0.9)	0.048*
Electronic health feedback	(n = 314)				
Could you understand it?	4.0 (4.0–4.0)	4.1 (0.6)	NA	NA	
	Internet group		**P&P group**	**Odds ratio (95% CI)**	**P value[a]**
PHYSICIAN/NURSE	N (%)		N (%)		
Consultation	(n = 34)		(n = 27)		
Was referral legitimate (based on CHQ-risk)? [b]	24 (75%)		20 (74%)	1.3 (0.3–6.0)	0.753[c]
Was information correct?	23 (68%)		17 (63%)	1.3 (0.4–4.7)	0.657[c]

Scores on five-point Likert scales ranging from 1 (most-negative evaluation) to 5 (most-positive evaluation).
[a] Mann-Whitney *U*-test; [b] n-Internet = 32; [c] Logistic regression (Wald test).
* statistically significant p<0.05, ** statistically significant p<0.01.

6.4 Discussion

The Internet-administered adolescent health promotion was successfully implemented in the preventive health-care setting by the municipal health services. It was feasible regarding the aspects attendance, duration, reading of the feedback and administration mode, and users were satisfied. Besides this, the quality of the contents was adequate, but the fruit advice may require some improvement.

Other studies among adolescents conducted in primary preventive-care settings in the United States [2, 4, 6] also showed that computerized adolescent health promotion was feasible and positively evaluated; however, these studies targeted health behavior while the present study covered multiple dimensions of health in combination with health behaviors and these studies did not apply a randomized control group to assess users' satisfaction with the intervention.

The consultation in the Internet group achieved a higher (non-significant) attendance rate compared to that in the P&P group. A review by Edwards *et al.* [29] suggests that individualized risk information increased participation in screening programs, but this was not statistically supported by the present study.

The consultation in the Internet group received positive evaluations from both students and physicians/nurses. Previous research indicated that physician/nurse's behavior is an important determinant of adolescents' satisfaction with their health care [30] and that interactive health communication could improve patient satisfaction [7, 12]. Nevertheless in the current study, the levels of the students' ratings of acceptability of the consultation in the Internet group were not higher compared to the P&P group.

The students positively evaluated both Internet-administered adolescent health promotion and the current paper procedure with relatively few and small differences between modes. Given the multiple comparisons made, only the differences with a p-value below 0.01 may be considered relevant; on three items the Internet version was somewhat more positively evaluated (regarding feasibility of administration mode and acceptability of fruit advice); however, concerning indicators of quality, the tailored fruit advice was regarded as less credible than the generic paper version. The latter difference was not seen for the almost identical fruit advice among adults [23]. Although the current study confirms that adolescents enjoy computerized evaluation, the literature also suggests that tailored advice is superior to generic instruction [10, 11], which the current study does not support convincingly. Additional analyses to assess whether the student evaluations by mode of administration interacted with gender, ethnic background (Dutch/non-Dutch) or school type (vocational/non-vocational) showed that only gender significantly interacted with mode of administration regarding 'individualization' ($p=0.019$) and 'enjoyability' ($p=0.032$) of the fruit advice; girls were more favorable toward Internet-tailored fruit advice compared with preprinted generic fruit advice than boys. This study did not evaluate the pathways by which tailored feedback may affect acceptability of the feedback, such as upwards or downwards social comparisons by students when confronted with their own health or behavior rating compared to norms. It is proposed to evaluate these pathways in more specific studies.

A few considerations should be made when interpreting the study results; the attendance was sufficient and relatively high at the school sessions; however, the proactive recruitment and restricted setting within school lectures of the present

study may have enhanced the response rate. Next, this study was performed within two specific municipal health services, each having two different physicians/nurses for the consultation. Differences between physicians/nurses may be expected; however, the number of participating students is too small to account for this. The relatively small number of students referred limits the evaluation of the consultation. Furthermore, even though our study population did not differ substantially in characteristics (age, gender, ethnic background, and educational levels) from the general Dutch adolescent population when compared with nationwide data concerning students in secondary schools [31], the study results are restricted to data collection conducted among adolescents in the Netherlands, at schools, and within a preventive-care setting. There were slightly more students at health risk than in the reference data (which were used to develop the cutoff points for risk-feedback) [13]. Other age groups and settings may show different results. Finally, the current results are restricted to certain topics and to certain health questionnaires being used.

In conclusion, this study was very much interweaved with the existing practice of preventive health care. This interconnection probably not only resulted in a higher participation rate, but also is promising for future implementation of the Internet tool. Using the Internet for the adolescent preventive health care procedure is feasible and positively evaluated by users. Moreover, the Internet has practical advantages in comparison with the standard approach. For example, the Internet is an efficient approach to sample data, it eliminates manual data entry by researchers thereby reducing transcription errors and workload, and its forced data entry results in complete data collection [9]. Potentially, once taken out of the research mode and implemented in the standard practice, it may be less labor intensive to administer the questionnaires. In short, the Internet can benefit preventive health care. It is recommended to further optimize the Internet tool in relation to the feedback/information given to the students and the physicians/nurses, and conduct more evaluation of the use and users' satisfaction with other health and health-behavior topics. Finally, the present study reports feasibility, acceptability, and quality while the health and health-behavioral effects of such integrated Internet-administered adolescent health promotion are highly important and should be investigated.

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7

School-based Internet-tailored Fruit and Vegetable Education Combined with Brief Counseling Increases Children's Awareness of Intake Levels

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Abstract

Background Children's fruit/vegetable intake is still below recommended levels. This study applied Internet-tailored advice for school children and Internet-supported brief dietary counseling (with child and parent) within preventive health care to promote fruit/vegetable intake.

Methods The study involved 30 seventh-grade classes (16 in the intervention group and 14 in the control group) with a total of 675 children, aged 9-12 years, of whom 495 were allowed to participate. A cluster-randomized baseline-post-test experimental design was applied. During school hours, all children completed Internet-administered questionnaires on fruit/vegetable intake and related determinants. Children in the intervention group received immediate online individually tailored nutrition feedback. For each child in the intervention group, a nurse received information concerning the assessment of fruit/vegetable intake via Internet to support a 5-minute counseling protocol to promote fruit/vegetable intake. Children completed a similar post-test questionnaire three months after the first assessment. Intention-to-treat analyses were conducted using multilevel regression analyses.

Results A total of 486 children (98% of 495) participated (263 in the intervention group, 223 in the control group); 240 child-parent couples in the intervention group attended the counseling. Awareness of inadequate fruit intake (OR=3.0; 95% CI=1.8-5.3) and knowledge of recommended vegetable intake levels (OR=2.7; 95% CI=1.8-4.1) were significantly more likely at post-test in the intervention group than in the control group. No significant effects were found on intake or other determinants.

Conclusions A compact, integrated two-component intervention can induce positive changes in knowledge and awareness of intake levels of fruit/vegetables among school children. To induce changes in intake levels, more comprehensive interventions may be needed.

7.1 Introduction

Sufficient intake of fruits and vegetables may contribute to prevention of cardiovascular diseases, certain cancers and obesity [1-4]. Across Europe, including the Netherlands, current intake levels among schoolchildren are below recommendations [5]. Adopting a health-promoting diet at a young age may help to establish healthy eating in later life [6, 7].

Various evidence-based interventions are available to encourage healthy dietary habits for schoolchildren, and tailoring of intervention messages is considered a promising approach for healthy eating among young people [8-10]. In general (mainly targeting adults) computer-tailored nutrition education is more likely to be read, processed more intensively, and appreciated better than more general intervention materials [11-13]. It also appears to have a positive impact on behavioral change [12, 14]. Since nurses (i.e. school nurses) already invite children for consultation as current practice in (Dutch) preventive health care, complementing this with computer-tailored nutrition advice and dietary counseling by a nurse may be an efficient approach in promoting a healthy diet. To our knowledge, studies regarding computer-tailored nutritional interventions for school children as well as the involvement of nurses in such school-based interventions are unreported.

The present study aimed to evaluate the effectiveness of a two-component intervention on fruit/vegetable intake by comparing a group receiving the intervention with a control group. It also explored effects on potential determinants of intake levels and self-reported intake as important initial steps towards behavioral change. In addition, we determined the level of exposure to the intervention.

7.2 Methods

Two-component intervention

This study applied a school-based intervention among children aged 9-12 years. The intervention consisted of a combination of Internet-tailored nutrition advice for the children followed by Internet-supported brief dietary counseling by the nurse in the presence of at least one parent. This two-component intervention

was informed by behavioral change theory and recent evidence that healthy behavioral change is more likely when children are aware of their inadequate intake levels, have knowledge of the recommended intake levels, like to eat fruit/vegetables, and when the fruit/vegetables they like are available and accessible [9, 15-18].

Internet-tailored advice

The Internet-tailored advice specifically aimed to increase knowledge of recommended intake levels, increase awareness of personal intake levels, and stimulate children's liking of fruit/vegetables and their availability in the home.

During school hours the children in both the intervention and control group completed Internet-administered questionnaires on fruit/vegetable intake and related determinants. Children in the intervention group received immediate online feedback about nutrition, individually tailored to each child's answers [12, 19]. First, the advice explained the recommended intake levels in order to increase knowledge and then compared the child's personal intake with the recommendations in order to increase awareness. The daily recommendations were two pieces of fruit and 150 grams (three 'serving spoons') of vegetables [5]. Second, the feedback encouraged the child to eat sufficient amounts of fruit/vegetables, e.g. by trying different types of fruit/vegetables, and asking their parents to buy/give them the fruit/vegetables that they like.

Children were encouraged to take home a printout of the advice. The teachers supervised the completion of the questionnaire, as well as the printing out of the advice. The assessment took place in either the classroom or in the school's computer area (depending on the school facilities).

Dietary counseling

The dietary counseling focused on increasing the child's knowledge about recommended intake levels, increasing awareness of personal intake levels, and motivating the child to eat sufficient fruit/vegetables and/or discussing any barriers in order to increase self-efficacy for behavioral change. An additional aim of the counseling was to involve the child's home in the process of behavioral change.

To support the counseling, the nurse had access to the data on the child's intake and related determinants that were assessed with the computer-tailored Internet tool; a website provided the nurse with a summary of the child's dietary status

and related determinants, the Internet-tailored advice, and the child's answer to each item.

About two weeks after the Internet-tailored advice, the child together with one parent attended the brief dietary counseling. The nurse applied a protocol in order to promote the child's fruit/vegetable intake. First, the nurse tried to reinforce knowledge on recommendations and increase awareness of the child's inadequate intake. The focus of the remaining counseling time depended on the child's (and parent's) motivation to eat sufficient fruit/vegetables. If the motivation to change was lacking, then the nurse explained the benefits of adequate intake and tried to dispel misconceptions. If motivation was present, the nurse discussed possible barriers to eating sufficient fruit/vegetables and how to overcome these barriers, in some cases resulting in defining personal goals to achieve behavioral change. This approach is based on the Minimal Intervention Strategy as applied, for example, in counseling to cease smoking [20].

In any case, the nurse would again give a printout of the Internet-tailored advice to the child and a leaflet on the importance of vegetable consumption to the parents. This counseling (which took about five minutes) occurred at the end of the periodic health examination, which is a routine contact moment of the municipal health services with parents/guardians and their child. Thus children in both the intervention and control groups received the periodic health examination, but only children in the intervention group received the additional dietary counseling. The counseling took place in a private room either at school or at the health service's premises.

Internet tool

The Internet tool of the two-component intervention was developed using PHP (4.0.1 and higher), MySQL (3.22 and higher) and JavaScript (1.3). Access to the questionnaire and advice was password protected. Data were sent to the server in a scrambled format. Logging out after completing the questionnaire was only permitted after answering all questions. Each nurse received a personal log-in code from the researcher to access the Internet tool and thereby the data for each child.

Study design and sample

A cluster-randomized baseline post-test experimental design was applied [21]. Two participating municipal health services, one in a rural area (Harderwijk) and one in

an urban area (Vlaardingen) in The Netherlands, invited 27 elementary schools from various socio-economic and religious background to participate. These schools comprized 30 classes from the seventh grade with 675 schoolchildren (aged 9-12 years) and all had adequate computer and Internet facilities. From the Vlaardingen region 14 classes participated involving two nurses, and from the Harderwijk region 16 classes participated involving three nurses. In each class all children received counseling from the same nurse, as this is the standard practice for municipal health services. After recruitment, the classes were randomly assigned ('within' nurses) to the intervention group with tailored nutrition advice and counseling (16 classes), or the control group (14 classes). This clustering was done to minimize contamination.
The parents and children, blinded to which group they belonged to, received information about the project and parents were allowed several weeks to actively give written consent for participation. This resulted in 495 (73%) children with permission to participate. The Medical Ethical Committee of the Erasmus MC University Medical Center Rotterdam approved the study.

Evaluation measures
All children completed (during school hours) an Internet-administered baseline questionnaire and about three months later a similar post-test questionnaire on: potential determinants and intake related to fruit/vegetables, as well as questions gender, age, type of family, and countries of birth of the child and parents to determine ethnic background [22]. The baseline questionnaire was also the questionnaire used for the assessment of the Internet-tailored advice. After receiving the Internet-tailored advice, the children completed a brief evaluation form to assess the level of exposure to the intervention. The nurses did the same after giving the counseling.

Primary outcome measures
The primary outcome measures were fruit/vegetable intake. Children completed the fruit/vegetable intake questions derived from (thus not the exact same, e.g. different categories) the fruit/vegetable food frequency questionnaire (FFQ) validated by Van Assema et al. [23] The relative validity of the FFQ was assessed as compared to 7-day dietary records. The correlations of the validity estimates ranged between 0.29 and 0.59 for citrus fruit and other fruit intake and between 0.22 and 0.35 for total vegetable intake (heated and raw/salad, last week).

In the present questionnaire children were asked about the number of days on which they ate fruit (such as apples, mandarins, pears, or oranges) the week before administration and the number of pieces of fruit on such days; multiplying the frequency and quantity and dividing this by seven assessed the 'fruit frequency last week' in servings per day. A pre-coded 24-hour recall assessed vegetable intake of the day before administration. The recall was divided into three parts: heated vegetables, salad, and vegetables in mixed dishes. Each part started with a general question such as "Did you eat heated vegetables (such as broccoli, French beans, and carrots) yesterday?" (yes/no), and if confirmed, followed by "How much of such vegetables did you eat yesterday?". Answers ranged from one serving spoon to three or more serving spoons. Standards were defined for the units in spoons: serving spoon of heated vegetables equaled 50 grams, serving spoon of salad equaled 20 grams, serving spoon of vegetables in mixed dishes equaled 15 grams. Summing the grams of these three types of vegetables assessed the '24-hour recall vegetable intake'. Finally, confirmation of the following two dichotomous items: "Do you eat fruit everyday during schooldays?" and "Do you eat fruit every Saturday and Sunday?" established the number of children reporting 'usual daily intake' for fruit. This was also done for vegetables.

Secondary outcome measures

As secondary outcome measures potential behavioral determinants of dietary intake were assessed for fruit and vegetables separately. One question measured whether the child thought that he/she ate a sufficient amount of fruit (in yes/no format). In combination with the child's actual intake (see above) being adequate or not, this determined the child's 'awareness' of inadequate intake for fruit in the previous week; the same was done for vegetable intake during the previous day. To assess 'knowledge' of recommended intake levels, children were asked (on an eight-point scale) how much fruit they should eat to have a healthy eating pattern. Response options ranged from no fruit to five pieces a day or more. This was subsequently re-coded into a dichotomous variable (amount too low versus the correct/higher amount); the same was done for recommended vegetable intake levels, dichotomized from response options ranging from no vegetables to five serving spoons (~250 grams) a day or more. Asking the children if they thought eating fruit every day was achievable or not assessed 'self-efficacy'. This was dichotomized from a 5-point Likert scale (negative or neutral scores = 0; positive

scores = 1); the same was done for vegetable intake. A single item assessing the child's 'liking' of fruit was dichotomized from a 3-point Likert scale to the child reporting liking many types (negative or neutral scores = 0; positive scores = 1); the same was done for liking vegetables. The 'availability' of fruit was assessed by an item on how often fruit was available at home. Response options were dichotomized from a 3-point Likert scale into the child reporting they always had fruit at home (negative or neutral scores = 0; positive scores = 1). Finally, the number of types of vegetables available determined the 'availability' of vegetables at dinner on a 4-point scale. Response options ranged from usually having no vegetables to more than two types of vegetables. This was subsequently recoded into a dichotomous variable (less than two types versus two or more types).

Measures to assess exposure to the intervention

After the Internet-tailored advice, the children completed an additional item on how much they had read of the advice, with four possible answers ranging from having read nothing to having read both the fruit and vegetable advice completely. After the counseling session, the nurses completed a form to assess the child's attendance to the counseling. Additionally, the nurses noted which of four topics they concluded the counseling session with: i.e. increasing motivation to change, increasing self-efficacy, setting goals, or sustaining/taking action to eat sufficiently.

Statistical analysis

To test for equality of groups at baseline, multiple logistic regression of treatment condition (yes/no) was conducted using SPSS (Chicago, IL) version 11.0.1. Baseline measures and socio-demographic characteristics were the independent variables. The same regression was done for dropout (yes/no) with baseline measures, socio-demographic characteristics, and treatment condition as independent variables. This allowed us to identify potential correlates of dropout and thereby potential biases in post-test data analyses.

In all effect analyses, we included children with a missing post-test value due to dropout by replacing the missing post-test value with the baseline value (i.e., the last observation carried forward method, 'intention-to-treat analyses' [24]).

Due to the study design, children were grouped within nurses and classes with a high probability of interdependence between children of the same class and/or of the same nurse. To take this into account, multilevel analyses with random

intercepts were conducted in MlwiN 2.02 [25] to assess the effects of the intervention on behavior and determinants of behavior, while controlling for region (i.e. municipal health service), gender, age, and baseline value of the outcome measures (except for knowledge and self-efficacy, for which no baseline measure had been assessed). The regression coefficient (beta) or odds ratio (OR) was used to describe effect size, with the control group as the reference category. An alpha level of 0.05 two-tailed or 95% confidence intervals (95% CI) was used to determine statistical significance.

The current data set was large enough to show a significant difference for individuals (while not taking the nurse and class levels into account) of, e.g., 8% for awareness of inadequate fruit intake and 0.17 for the mean servings of fruit intake per day, with a power of 80%.

7.3 Results

Participants

Of the 495 children with consent, 486 children (98%) participated in the baseline measurement including the Internet-tailored advice, of which 263 children belonged to the intervention group and 223 children to the control group. The post-test measurement included 469 children (97% of baseline participation). Reasons for absence were mainly illness.

Table 7.1 presents the characteristics of the children at baseline. There were no

Table 7.1 Characteristics of the children at baseline by study group

	Intervention group n=263	**Control group** n=223	**P-value**
Age (mean, sd)	10.3 (0.5)	10.3 (0.5)	0.65
Gender, boys (%)	45.6	48.9	0.32
Family status, two-parent family (%)	91.3	95.8	0.14
Ethnicity, Dutch background (%) [b]	88.6	84.6	0.19
Fruit frequency previous week (mean servings per day, sd)	1.1 (0.8)	1.2 (0.7)	0.53
Awareness of inadequate fruit intake previous week (%)	25.9	18.0	0.09
24-hour recall vegetable intake (mean grams, sd)	76.9 (66.7)	77.9 (64.6)	0.25
Awareness of inadequate vegetable intake previous day (%)	27.8	22.4	0.10

[a] Both parents are born in the Netherlands

significant differences between the intervention and control groups regarding socio-demographic characteristics and baseline measures (p≥0.05). Neither did the children who dropped out at post-test differ on socio-demographic characteristics, baseline measures, and study group, compared with children included at post-test (p≥0.05).

Outcome measures at post-test

Fruit and vegetable intake did not differ significantly between the intervention and control groups (Tables 7.2 and 7.3). Of the secondary outcome measures, children in the intervention group were three times more likely to be aware of their personal inadequate fruit intake level at post-test than children in the control

Table 7.2 Self-reported fruit intake and determinants at post-test compared between the intervention and control groups

	Intervention group n=263	**Control group** n=223	**Odds ratio** [a] (95% CI)	**Beta** [b] (95% CI)
Fruit intake				
Fruit frequency previous week (mean servings per day, sd)	1.1 (0.7)	1.2 (0.7)	NA	-0.05 (-0.16-0.06)
Usual daily fruit intake (%)	32.0	34.7	0.82 (0.45-1.49)	NA
Behavioral determinants				
Knowledge of recommendations, correct or higher amount (%)	57.1	50.7	1.30 (0.85-1.99)	NA
Awareness of inadequate intake previous week (%)	30.8	13.0	3.04 (1.75-5.26)	NA
Self-efficacy: daily fruit intake achievable (%)	76.0	79.5	0.83 (0.52-1.31)	NA
Liking many types of fruit (%)	73.4	76.7	0.73 (0.38-1.39)	NA
Availability, always fruit at home (%)	74.5	77.6	0.89 (0.53-1.51)	NA

NA = Not applicable.

[a] Odds ratio derived from multilevel logistic regression analyses adjusted for region, gender, age, and baseline measure (except for knowledge and self-efficacy) and allowing a random intercept for nurse and class level.

[b] Unstandardized regression coefficient derived from multilevel linear regression analyses adjusted for region, gender, age, and baseline measure (except for knowledge and self-efficacy) and allowing a random intercept for nurse and class level.

group (Table 7.2). Children in the intervention group were almost three times more likely to know the recommended vegetable levels at post-test than children in the control group (Table 7.3). Awareness of inadequate vegetable intake and knowledge of the fruit recommendation showed ORs in favor of the intervention

group, but these ORs were not significant. All the remaining behavioral determinants of fruit and vegetable intake showed ORs close to one.

Table 7.3 Self-reported vegetable intake and determinants at post-test compared between the intervention and control groups

	Intervention group n=263	Control group n=223	Odds ratio [a] (95% CI)	Beta [b] (95% CI)
Vegetable intake				
24-hour recall vegetable intake (mean grams, sd)	76.9 (68.7)	74.9 (69.7)	NA	3.55 (-7.90-15.00)
Usual daily vegetable intake (%)	28.1	28.7	0.81 (0.44-1.47)	NA
Behavioral determinants				
Knowledge of recommendations, correct or higher amount (%)	41.7	21.4	2.71 (1.79-4.11)	NA
Awareness of inadequate intake previous day (%)	31.9	24.2	1.42 (0.87-2.34)	NA
Self-efficacy, daily vegetable intake achievable (%)	60.5	59.5	0.98 (0.58-1.66)	NA
Liking many types of vegetables (%)	38.8	41.7	0.92 (0.60-1.42)	NA
Availability, usually 2 or more types of vegetables at dinner (%)	52.5	55.2	0.96 (0.63-1.44)	NA

NA = Not applicable.

[a] Odds ratio derived from multilevel logistic regression analyses adjusted for region, gender, age, and baseline measure (except for knowledge and self-efficacy) and allowing a random intercept for nurse and class level.

[b] Unstandardized regression coefficient derived from multilevel linear regression analyses adjusted for region, gender, age, and baseline measure (except for knowledge and self-efficacy) and allowing a random intercept for nurse and class level.

Exposure to intervention

After receiving the Internet-tailored advice, 210 of the 263 children in the intervention group registered whether or not they had read the advice concerning fruit/vegetables. This resulted in 84% reporting that they had read both advices completely, 8% had read part of the advice, 5% had read only the fruit or only the vegetable advice, and 3% had read nothing. Based on the nurses' registrations, 240 (91% of 263) children and one of their parents received at least some of the counseling. The nurses indicated that most of the counseling sessions concluded with encouraging the child's self-efficacy to change behavior (about 42%) and with stimulating goal setting (about 21%). This indicates that for most of the children and parents in the intervention group at least knowledge of recommendations, awareness of personal intake, motivation to change, and barriers to increase self-efficacy had been discussed.

7.4 Discussion

This cluster-randomized study indicated that an intervention combining Internet-tailored nutrition advice with dietary counseling by a nurse among elementary schoolchildren resulted in better knowledge of the recommended vegetable intake levels and awareness of inadequate fruit intake, but no effects were found regarding actual intake levels. We note that, although effects were found for awareness, there were in fact some (non-significant) differences in awareness at baseline between the intervention and control groups.

We are not aware of any other controlled studies on similar interventions. A non-controlled study on a similar intervention among adolescents in primary care settings in the USA reported indications of increased fruit and vegetable intakes [26].

Our two-component intervention was compact and embedded in the existing practice of the preventive health care at schools, offering the benefit of a large reach and increasing the chance of future implementation. Counseling the child in the presence of one parent enabled to involve the family; this is important because the social environment is a recognized facilitator for dietary behavior [9, 10, 27]. The study had a high response rate (after receiving consent to participate from the parents) and had a high level of exposure to the intervention. Potentially, once taken out of the research mode and implemented in standard practice, there may be an even higher participation rate since a less strict informed consent procedure would be applied than in our study. Our sample was a representative study population, as it does not differ substantially in socio-demographic characteristics (gender, family status, ethnicity) from the general Dutch adolescent population when compared with nationwide data on schoolchildren in elementary schools [28].

A possible limitation concerning the measures was the application of child self-reports. Self-administered questionnaires can be subject to response bias (socially desirable answers) thereby resulting in over-reporting of healthy behavior or positive beliefs. Unfortunately, the use of more reliable and valid measures often incurs greater costs and longer time investment, as well as increasing the burden for the participants (see also further below).

That only one outcome measurement (i.e. three months after the baseline measurement) was applied may be considered a limitation. Because our two-component intervention was very compact, perhaps only short-term effects of

intake levels were present, which we did not measure. In future studies outcome measurements should be made at several points in time, including short-term outcome measurements.

We discuss some possible explanations for the absence of effects of our two-component intervention regarding dietary intake, and suggestions for improvement. Although Patrick et al. [26] added mail and telephone contact to the two-component approach, this did not result in improved intakes. In contrast to that study, multi-component interventions with longer duration and more contact hours generally achieve better results than shorter programs [9, 10]. The current Internet-based two-component intervention may be regarded as an initial part of a broader approach, involving repetition of the current components or the addition of other components [8, 10]. Furthermore, to improve effectiveness regarding intake levels, the current intervention components may need improvement. For instance, relying on the vegetable intake of the previous day is generally regarded as valid, but may have some limitations, e.g. assessments that took place on Mondays might have resulted in lower reports of vegetable intake, in the Netherlands; Sundays are the 'easy or no cooking days', as is confirmed by Wind et al [17]. When parents or children "feel" that their assessment and therefore their personal advice is not representative, the advice may lack a positive effect. More comprehensive assessment may improve this, but this will also increase the burden on the respondents. Another solution may be to focus more on the advice and counseling concerning the relevance of eating sufficient vegetables 'every day'. Additionally, the nurses reported that some children of this age may have a poor recognition of vegetables, e.g. not knowing whether the food was a vegetable or some other type of food, or to which question the type of vegetable belonged to (e.g. heated, salad, or mixed). This has also been indicated in previous studies [10, 29]. Adding pictures and more explanation about the questions in the assessment as well as improvement regarding the wording of questions might avoid this. Another solution might be more advice on how to recognize vegetables [19]. More research is needed to test whether these suggestions would indeed improve the effect on vegetable intake.

In conclusion, this study was unique for its school-based intervention integrated within preventive health care. The dual approach of advice and counseling guaranteed a repetition of the main health message, combined written and oral feedback, and involved both the school and home environment. Linking the two components by means of the Internet allowed automatic support of the dietary

counseling, thus enhancing efficiency. The study showed that this compact, integrated two-component intervention induced positive changes in knowledge and awareness of dietary intake levels among schoolchildren. To induce changes in intake levels, more comprehensive interventions may be needed.

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8

General Discussion

8.1 Introduction

The objective of this thesis was to develop and evaluate E-health4Uth, involving Internet-based monitoring and prevention tools, to support youth health care (YHC). Fig. 8.1 (the YHC-quadrant, see also General Introduction) highlights the domain of YHC in which our project was located. We conducted several studies to apply the monitoring and prevention tools in elementary and secondary school settings. In order to evaluate whether our objective was reached, we attempted to answer the research questions, as listed in the General Introduction.

	MONITORING	**PREVENTION**
INDIVIDUAL	*Assessment of health/health behavior *(e.g. via questionnaires, consultation with physician/nurse)* *Detection of individuals at risk *(e.g. for referral to physician/nurse)*	*Individual education *(e.g. via preprinted leaflets)* *Individual counseling *(e.g. via interviewing techniques/protocols)*
	1	**3**
	2	**4**
GROUP / POPULATION	*Group profiles *(e.g. at school- or regional level)*	*Group education *(e.g. parental education at schools)* * Health-promoting schools *(e.g. integral approach for school interventions)*

Fig. 8.1 YHC-quadrant

In this Chapter we examine whether the objective and research questions were accomplished and discuss the strengths and weaknesses of the approaches used. This Chapter will discuss possible explanations for the findings, potential implications for further implementation of E-health4Uth and provide suggestions for further research, and present overall conclusions. Firstly, the main findings are briefly summarized.

8.2 Main findings

For each research question the main findings are discussed by integrating the results of the different studies. Research questions 1 and 2 (Q1 and Q2) are discussed in combination.

Q1. Are the Internet-based monitoring and prevention tools feasible?
Q2. How do users evaluate the Internet-based monitoring and prevention tools?

We found support for the feasibility of E-health4Uth; the monitoring and prevention tools were feasible within elementary and secondary school settings and within YHC, and users evaluated the tools positively, thereby enhancing the quality of care. This involved the following aspects:

- Monitoring health/health behavior via Internet among students,
- Personal feedback to students via Internet, based on the health/health behavior assessment, including information regarding referral via Internet,
- Provision of information to physician/nurse (i.e. school physician/nurse) via Internet to support counseling.

With respect to feasibility and users' evaluations, we expected the E-health4Uth monitoring and prevention tools to receive an equal or better evaluation than the current practice. Our study demonstrated that E-health4Uth was acceptable on all measured aspects: data quality, duration, attendance, reading of the feedback, and administration mode. Specifically, we found no differences between Internet and written procedures regarding duration of monitoring and counseling (Chapters 5 and 6) and attendance to different intervention components (Chapter 6). Concerning the data quality in three studies, the Internet mode had significantly less 'unusable' answers (i.e. missing or double answers) than the paper and pencil (P&P) mode (Chapter 3 and 5) while one study showed no differences in 'unusable' answers between modes (Chapter 4). Most students reported reading the feedback (Chapters 6 and 7). Concerning the administration mode, students regarded the Internet as an easier mode for the health and health behavior assessment than P&P modes (Chapters 2, 5, and 6), and as a more pleasant mode for fruit advice than preprinted generic fruit advice (Chapter 6). Also the risk selection/referral via Internet was feasible, but requires further evaluation and validation.

The evaluations by users (students and physicians/nurses) concerned their ratings of acceptability (i.e. satisfaction) and quality ratings of different components of E-health4Uth. Students evaluated the Internet-administered monitoring tool more positively compared to P&P versions and preferred monitoring via Internet to P&P (Chapters 2 and 5), these findings are comparable with previous studies among adolescents [1-3]. Concerning the interface of the Internet-administered questionnaire, a 'multiple-items per screen'-interface was favored over 'one-item per screen' by adolescents on perceived speed of mode of administration (Chapter 2). Additionally, students were satisfied with the Internet-based prevention tool (Chapter 6); regarding the Internet-tailored fruit advice, adolescents evaluated it as being more personally targeted and enjoyable than the pre-printed generic advice. A final important result was that generally we found evidence that the quality aspects (e.g. contents) of the Internet-based prevention tool were adequate, but some elements of the Internet-tailored fruit advice for adolescents may need improvement, since the effects were not very impressive (see below, Q4) and because adolescents' ratings regarding its credibility were significantly lower compared to ratings of the generic preprinted fruit advice.

Professional YHC-users consider both general health and health-related behavior topics as relevant. In contrast with other studies on computerized prevention tools for adolescents, we also included feedback on general health topics and chronic conditions in addition to health behavior. For instance, another Dutch project called E-MOVO focused mainly on anonymous monitoring of health and health behaviors and provided personalized feedback to the students regarding health behavioral topics and mental well-being three days after completing the questionnaire [4]. In two other studies personal counseling supported by an electronic summary of the student's answers to questions about health behaviors and emotional problems were added to the students' feedback, but these studies were conducted outside school settings (e.g. the mall, or preventive service) [1, 2]. Similarly to our E-health4Uth, the users of the feedback and counselling were content with the procedure and the feedback received.

In summary, we conclude that personalized feedback to students including information regarding risk selection and provision of information to physicians/nurses via Internet were feasible and evaluated positively.

Q3. Do Internet-administered monitoring tools yield equivalent scores with P&P versions of the same tools?

Before converting from P&P questionnaires to Internet-administered versions, one needs to determine whether respondents report equivalent scores by both modes. We assessed score equivalence for different health/health behavior questionnaires among elementary and secondary school children. Topics included health-related quality of life, problems at school and home, chronic conditions, respiratory problems, health care utilization, psychosocial health, different health-related behaviors, and specifically fruit intake and its determinants (only at elementary schools).

The current studies showed that monitoring health/health behavior via Internet questionnaires generally yielded equivalent scores to P&P versions of these questionnaires. This finding was in line with previous studies [1, 5-7]. A majority of the measures that were reported in the various studies (Chapters 2-5) thus showed no differences between administration modes, and when differences were significant, they were of a negligible or small magnitude, except for one measure (see Table 8.1). Additionally, two different types of interfaces (multiple-items per screen versus one-item per screen) yielded equivalent scores; one out of 21 measures showed a significant difference between these two interface modes, which is less than the 5% chance of a false association (Type I error at α=0.05) [8].

It is known that self-reports are subject to socially desirable responses. Social desirability refers to the tendency for respondents to please the interviewer by providing responses in accordance with perceived norms. The minor differences between Internet and P&P questionnaires that were found in our studies, were not all in the same direction. The overview in Table 8.1 shows that there was a tendency towards more negative reporting via Internet compared to P&P mode. If we presume that more negative (e.g. unhealthier) reporting is regarded as less socially desirable, our results are in agreement with results of some earlier studies that indicate that sensitive issues are answered less socially desirably via computerized methods [1, 5, 6, 9]. However, the questionnaires used for our studies generally did not focus on such sensitive topics; only few items may be considered as 'sensitive topics' (e.g. having a coercive sexual experience). Therefore we cannot confirm nor reject the suggestion that sensitive issues are reported more honestly via computerized methods. So although we found some statistically significant score differences between Internet and P&P modes, the current studies do not provide explanations for this.

Table 8.1 Topics from 4 studies (Chapters 2-5) showing a significant score difference between modes of administration

Measure (chapter)	Internet mode	P&P mode	P-value	Odds ratio	Effect size *
Perceived self-efficacy of eating sufficient fruit (5)	-	+	0.04		0.15
Having a sufficient number of friends (2)	+	-	<0.01	2.75	
Role functioning-physical CHQ scale (3)	-	+	0.02		-0.05
General behavior CHQ scale (3)	-	+	<0.001		0.21
Mental health CHQ scale (3)	-	+	0.01		0.12
Family activities CHQ scale (3)	-	+	0.03		0.11
	1-item per screen	**Multiple-items per screen**			
Satisfaction with appearance (2)	+	-	0.01	2.08	

* According to Cohen's guidelines effect sizes between 0.20 and 0.50 are considered to be small [10]; we consider
effect sizes below 0.20 as negligible.
- indicates a more negative (e.g. unhealthier) score in comparison to the other mode
+ indicates a more positive (e.g. healthier) score in comparison to the other mode

We conclude that the main findings with regard to research questions 1, 2 and 3 is that the Internet-administered monitoring tools generally yielded equivalent scores with the P&P versions of the same tools, resulting in relatively few (and small) score differences for (non-sensitive) health and health-behavioral topics. Additionally, monitoring via Internet was generally just as good as monitoring via P&P questionnaires, but students evaluated monitoring via Internet more positively.

Q4. What are the effects of the Internet-based prevention tool on students' health behavior and determinants?

We assessed the effects of a two-component intervention, consisting of a combination of Internet-tailored nutrition advice for children at elementary schools and counseling by a nurse (with parent and child together) supported by Internet (Chapter 7). The study showed that this compact and integrated (into YHC) intervention may induce some positive effects regarding determinants of health behavior. However, it can be concluded that the prevention tool did not have significant effects on health behavior itself; to induce such behavioral changes, more comprehensive or intensive interventions may be needed. The current Internet-based two-component intervention may be regarded as a

potentially promising part of a broader approach involving multi-component school-based interventions [11].
In this thesis, we have tested effects regarding dietary intake only for this compact elementary school-based intervention (Chapter 7), but not for other topics and not for secondary school students. We conclude that the effectiveness of Internet-supported feedback to students of different ages needs further investigation.

8.3 Strengths and weaknesses of the studies

Several strengths and weaknesses due to the methodology used and the process of data collection should be considered when interpreting the findings of the studies presented in this thesis. These strengths and weaknesses will be discussed first in relation to the designs used, then the measurements, and finally the generalizability of the studies' results.

Design
We were able to apply randomized designs in our studies, which resulted in comparable study groups - that were presented with the experimental E-health4Uth procedure or the current 'common practice' procedure. This ruled out several threats to internal validity, i.e. the certainty that the results of the evaluation can be attributed to the intervention [12].
Specifically, we will discuss the advantages and disadvantages of the two types of randomized study designs that were used for evaluating the monitoring tools:

1. A randomized parallel group study, where students were randomized to administration mode,
2. A randomized cross-over study, where students were randomized to complete one of the instruments first and then, after a diversionary activity to make them forget their responses, they completed the other instrument.

The parallel design is applicable when looking at differences between groups of subjects (such as the ISAAC study as applied in Chapter 4) and not looking for changes in status within a single student. The analyses of the parallel group design are straightforward. However, one needs to incorporate a relatively large number of students, in order to have sufficient power to detect meaningful differences.

The cross-over design is especially applicable when looking at differences within subjects. In preventive YHC aimed at ages 10 and 15 years old, questionnaires among students for individual assessment are not as common as for group profiles, but are being applied by some municipal health services (MHSs). To look at within-student variance between Internet-administered and P&P-administered questionnaires, the cross-over design is applicable. It has the advantage of requiring a smaller sample size than parallel designs while keeping the same power, as students serve as their own control. A consideration to be made with cross-over designs, is that they may induce carry-over effects, i.e. the intervention administered during the first period may carry over into the second intervention period. Senn [13] postulated that no adequate analyses are available to deal with carry-over effects. Therefore Senn recommended doing paired analyses without paying attention to carry-over effects; we applied that approach in our study (Chapter 5).
In conclusion, there is a place for both designs and this is contingent on the study purpose.

Measurements
In this thesis, we applied self-reports completed by students and physicians/nurses, not only for individual assessments such as general health or dietary intake, but also to evaluate our interventions by means of process and outcome measures. As mentioned previously, self-reports can be subject to response bias and socially desirable answering. This issue is a potential threat to the internal validity of the studies, leading to wrong interpretations [12]. For instance, when adolescents completed health/health behavior questionnaires, knowing they could be invited for consultation with the physician/nurse, they might to some degree have given socially desirable answers, thinking that being healthy and not being invited for consultation is desirable. Likewise, in the case of students evaluating the counseling with the physician/nurse, it is possible for some students to consider it socially desirable to give positive evaluations.
Unfortunately, the use of more valid measures may involve much greater cost and time investments, increasing the burden on participants, and therefore they are only usable in relatively small samples. Such investments are not feasible in routine health and health behavior monitoring and prevention in schools. To diminish the socially desirable answering, the privacy during completion of questionnaires at schools was ensured as much as possible. Further, confidential

conditions were created, for example the evaluation forms from children after counseling were in principle completed outside the office without the presence of a physician/nurse and put in closed boxes.
Besides validity issues, another methodological concern is reliability. The general health measure (Child Health Questionnaire, CHQ) applied in our studies has been developed as a measure for group data. As such, it has adequate psychometric properties. However, we also applied it for individual risk selection (Chapter 6), which would demand higher reliability of the CHQ [14]. Reliability and valid risk selection would require more attention in the future (see below, further research).

Generalizability

E-health4Uth was applied within a closed setting, with its benefits such as its integration with the existing practice of preventive YHC. Consequently, the studies resulted in a large reach and a high participation. Therefore the data can be considered to be representative for a large proportion of Dutch youth. Additionally the respondents involved a representative study population, as they did not differ substantially in socio-demographic characteristics (gender, ethnic background, family status, and educational levels of secondary schools) from the general Dutch adolescent population. This supports external validity, i.e. generalizability or applicability, which is the extent to which the results of a study can be generalized to other circumstances [12]. However, the results were restricted to data collection conducted among apparently healthy children in the Netherlands, at schools excluding special education, and within a preventive-care setting. Other age groups, settings and countries, and schools with special education may show different results.
Finally, the study results do not apply to other interventions concerning open access health education via Internet, as these may involve more problematic recruitment since response relies on participants accessing the web site on their own initiative.

8.4 Implications for further development and implementation of E-health4Uth

Some implications for further development and implementation of E-health4Uth are discussed below, separately for implications related to the monitoring tools, the prevention tools, and for some general implications.

Implications related to monitoring tools

Related to the monitoring tools, the following two implications will be discussed:

I Decrease respondent's burden,

II Large scale implementation of Internet-administered monitoring tools.

I Decrease respondents' burden

In preventive YHC, questionnaires for both individual and group targets are required. Each goal demands different types of questions as some topics may be relevant for individual assessments and others for group assessments. Valid and reliable individual assessments usually require more questions and therefore take more time/space, which usually is not available in the school setting. The Internet can potentially decrease the respondent's burden by means of automatically skipping questions irrelevant to the individual. In the current studies this was applied as follows: after a general question needed for group profiles, more in-depth assessment was done when applicable to that student; otherwise this personal assessment was skipped. This skipping depended on the answer to one initial questionnaire item.

In the future, a more advanced approach may be used, namely computerized adaptive testing (CAT) [15]. CAT provides the opportunity to select the most relevant next question (item) from a large pool of potential questions (item bank), depending on the combination of answers to all the previous questions. It allows providing an estimate based on relatively few, but relevant items for a specific person, that is almost just as reliable as the estimate provided by the full set of items [16]. CAT has been tested for only a few topics so far, involving scale-based questionnaires. We recommend exploration of CAT applications within monitoring and prevention systems such as E-health4Uth.

II Large scale implementation of Internet-administered monitoring tools

Score equivalence is of relevance for making group comparisons longitudinally between current P&P-collected data and future Internet-collected data. We recommend large-scale implementation of Internet-administered monitoring tools for (non-sensitive) health and health behavior topics, as these were feasible, well appreciated, provided equivalent scores (to P&P versions), and resulted in improved data quality.

Implementation of E-health4Uth-like systems is already progressing in the Netherlands; for instance the MHS of Rotterdam has tested their adolescent monitoring tool via Internet at five secondary schools, including 26 classes (personal communication Van der Looij-Jansen). Additionally, several MHSs in the east of the Netherlands (i.e. those participating in the "E-MOVO" project) developed a monitoring tool via Internet and tested this at 150 secondary schools [4].

Before 2010 all YHC providers, such as MHSs, in the Netherlands aim to convert their medical child files from written to electronic forms and work with electronic registration systems [17]. This makes converting to Internet-administered monitoring tools even more attractive, as the link with the electronic medical child file could be made automatically.

Implications related to prevention tools

Related to the prevention tools, four possible implications will be discussed:

I Optimize and implement personal feedback to student including information on referral via Internet,

II Improve effectiveness of health behavior feedback via Internet,

III Optimize and implement provision of information to physician/nurse via Internet,

IV Develop an Internet application to support group education and health-promoting schools.

I Optimize and implement personal feedback to student including information on referral via Internet

The feedback to students involved information on a referral based on an increased health risk, personal feedback regarding general health issues, and tailored advice on health-related behavioral topics (regarding the tailored advice, see further below). Inviting students for personal consultation with the school

physician/nurse (i.e. referral) via a web-based feedback system had not been done before within YHC. The invitation information in the present project concerned information regarding whether or not an invitation was warranted and if so, for which health topics. However, the time and date for the actual appointment with the physician/nurse were still sent by 'normal' mail, which is the current practice. We recommend making the complete referral invitation process electronic in future E-health4Uth versions, by linking a referral of a student to an electronic agenda and an automated mailing system, e.g. via e-mail. Doing this may enhance the efficiency of YHC.

Providing straightforward personal information to students regarding a possible referral, for which topics the referral is required, and basic summarizing feedback regarding general health issues based on a Health Risk Appraisal (HRA) [18], can be regarded as convenient and a minimal service to students. When reliable reference data are available, we recommend implementing basic summarizing (HRA) feedback via Internet. Additionally we recommend, once having established valid risk selections, implementing electronic information to students regarding a possible referral and for which topics the referral is required. A prerequisite would be for MHSs to first convert to electronic monitoring tools.

II Improve effectiveness of health behavior feedback via Internet

The health behavior feedback to the student needs optimization (see Chapters 6 and 7). As the effectiveness of Internet-administered health/health behavior feedback, including counseling, on health behavior is not established yet, we do not recommend implementation of this intervention tool on a large scale at this stage. We recommend further development and studies to test effects of more advanced versions of the health behavioural change feedback tool on improved health behavior.

Further, the Internet-tailored feedback and counseling tool by itself may be not robust enough to induce and maintain health behavioral change. The current Internet-based two-component intervention may be regarded as an initial part of a broader approach, involving repetition of the current components or the addition of other components. Therefore YHC should not only aim at these components, but also include a broader approach, such as the previously mentioned health-promoting schools, affecting also school health and health behavior policy and health behavioral environmental changes, which have shown to be effective [11, 19].

Finally, we recommend development and testing of Internet-tailored health education modules for other relevant topics. There are a lot of other health topics and health behaviors, which are also relevant for YHC, such as mental health issues including depression, physical activity, and non-smoking.

III Optimize and implement provision of information to physician/nurse via Internet

The current electronic information to the physician/nurse to support the counseling existed mainly of a summary of the student's health status. We recommend further development of this electronic information into a real counselling support system by integrating a counseling strategy/protocol into the summary. To illustrate, we use the prevention tool at elementary schools where nurses applied a theory-based counseling protocol regarding a health behavior (Chapter 7) as an example: The summary would be build up in a flexible way, where the nurse would first be provided with the necessary summative information (e.g. 'student is not aware of personal risk behavior'). Accordingly, the required first counseling step belonging to that information would also be provided on screen (e.g. 'promote awareness of personal behavior'). After the first counseling step, the nurse would fill in the result of that first step on screen (e.g. 'student is aware of personal risk behavior: yes/no'). As a result, the nurse would automatically be presented with the second counseling step and what to do on screen, and so on. Additionally, a formal training of the physicians/nurse would be needed for the use of such a protocol and Internet application.

As no negative side effects of the information to the physician/nurse are expected and efficiency can be increased, we recommend that, once MHSs convert to electronic monitoring tools, they should use the Internet to generate a summary of the health and health behavioral status at the individual level as well as access to all item-responses to support the counseling provided by the participating physician/nurse.

IV Develop an Internet application to support group education and health-promoting schools

Although we did put the school profiles that were automatically generated by Internet into practice, we have not formally evaluated this connection between monitoring and group education (i.e. prevention strategies at the school or region level) for this thesis. Concerning this aspect of E-health4Uth regarding feedback to schools about school profiles, we recommend further exploring such applications in the future. When MHSs convert to electronic monitoring tools, we recommend evaluating and implementing this aspect of E-health4Uth, as it involves straightforward information and can increase efficiency.

Further, we suggest developing an Internet-supported link that allows converting the monitoring results into school health policy or group education, by means of the following steps:

a. Develop an electronic database including school-based interventions or tutorials for school teachers. Such databases are already available in the Netherlands (e.g. 'www.gezondeschool.nl') and can be optimized for this Internet link [20],
b. Determine criteria to decide when a school runs a (health) risk for certain health/health behavioral topics, i.e. provide risk selections at the group level,
c. Optimize the feedback to schools by providing the data including risk-levels via Internet, and by storing these data in a well-organized database,
d. Develop web-based links between the outcomes of the school profile and the school-specific risk-levels and a database of intervention possibilities, so that in the feedback to a school, a list of suitable intervention possibilities will be shown electronically for each risk topic, including details of how and where to obtain these interventions.

We should take into account that merely providing information to schools about the results of the assessment and suitable interventions via Internet may not encourage schools to undertake the necessary action sufficiently. Currently school health educators from MHSs provide consultation with school teachers, which may allow involving self-perceived risks by teachers, parents and students before deciding on which topics to intervene. The Collaborative School Health Model, a model for whole-school health promotion that highlights the importance of

integral youth policy and of increasing the quality of tailored activities, may provide support for this [20, 21].

General implications

The following four possible implications that may be relevant in general (to both monitoring and prevention tools), will be discussed:

I Involve parents of elementary school children,

II Use other e-health applications,

III Explore implementation of E-health4Uth.

I Involve parents of elementary school children

For age 10 years old, our study tried to involve the child by letting the child complete a questionnaire. However, the current practice of YHC is that the parents complete questionnaires regarding the child's health for these ages. It is possible to support that current practice by having the parents complete Internet-administered questionnaires on aspects of their child's health and health behavior. Moreover, Internet-tailored feedback to the parents can be provided automatically and more personalized, instead of the current practice of giving generic preprinted leaflets/brochures. Involving both parents and children may increase the effectiveness of interventions.

As a consequence, the focus in E-health4Uth-like programs may be transferred from schools to homes, requiring adequate Internet facilities at homes. As more and more people have Internet-access [4, 22], this could be a feasible option. Another option may be having parents complete the questionnaires just before the consultation session at the health care service.

II Use other e-health applications

Internet-administered questionnaires and feedback proved to be feasible and positively evaluated. However, we need to think ahead, especially with youth being open for these types of communication, and consider other e-health applications applying different, more complex multi-media interfaces (such as audio and video technologies via Internet, chat rooms) [23]. So although students positively evaluated the present monitoring and prevention tools without these extras, we should take into account that in the future students' ability and affinity with computerized communications may be stronger. Sticking to the current basic

monitoring and prevention tools may result in less positive evaluations of the tool among students in future.

III Explore implementation of E-health4Uth

Although the effects of E-health4Uth on health behavior still need further investigation, based on the present evidence we do recommend exploring the possibilities of implementation of E-health4Uth, especially concerning the large-scale implementation of the monitoring tools.

Firstly, implementation requires a synthesis of available knowledge, possibly set out against available financing. This synthesis should involve, for instance, information regarding what may be barriers and prerequisites for continuation and possible implementation. Prerequisites may be e.g. protocols, training, programmer and/or data administrator, financing, and adequate Internet facilities at schools. Many schools already possess adequate facilities and, in time, this will only improve. However, some schools have put most student computers in one special computer classroom, and the space in between computers may need modification to ensure privacy when these computers are used for administration of health and health behavior questionnaires. Currently (Spring 2006) the Netherlands Organization for Health Research and Development (ZonMw; the main Dutch national government-linked organization for financing health research in the Netherlands) has started a synthesis of knowledge on Internet-based YHC monitoring and prevention activities in a project entitled "Internet-support of YHC: what to do next?". This synthesis should hopefully result in a stepwise plan for further development and implementation of Internet support in health and health behavior monitoring and prevention activities in (school-based) YHC.

Successful future implementation implies broad collaboration with all involved parties at the national as well as local level, and making use of results of national as well as local related projects. E-health4Uth was aimed at supporting YHC, therefore supporting the professionals (from MHSs and schools) in providing health care. Adequate guidance from experienced professionals for implementing E-health4Uth is essential. Attention needs to be paid to the attitudes and views from schools, MHSs, and its employees regarding implementation of (aspects of) E-health4Uth. Since they (e.g. school physicians/nurses, school health educators) have been involved from the start in the development of the interventions, the chance of large-scale implementation at a later stage may be increased. Continuation with and expansion of the involvement of these intermediate users

is recommended, complemented with important roles for current expertise centers for implementing interventions.

8.5 Recommendations for further research

The studies reported in this thesis have evoked several new research questions, which we will discuss by the following four topics:

I Explore score equivalence regarding sensitive issues,
II Evaluate and improve reliability and validity of questionnaires,
III Validate risk selections,
IV Improve effectiveness of students' feedback.

I Explore score equivalence regarding sensitive issues

Although a lot of research about score equivalence between Internet-administered and printed questionnaires has been conducted, first among adults and now also among youth, score equivalence regarding more sensitive issues among youth has not been determined sufficiently yet. Examples of such sensitive issues that may be interesting for preventive YHC are criminality, abuse, or sexual misconduct. In addition, we recommend evaluating whether these topics are indeed considered to be sensitive by the children/adolescents themselves and whether the children/adolescents would report less socially desirably to such questions with an Internet-administered questionnaire compared with the current practice of P&P-administered questionnaires.

II Evaluate and improve reliability and validity of questionnaires

Regarding the individual assessments of risk factors, health behavior, and determinants, validity should be high, since the assessments form the basis for risk selection and personal feedback. For such valid representations, maybe more objective assessment tools are needed, and it requires at least further research on validation of health behavior questionnaires. Unfortunately, valid assessments of behaviors such as dietary intake and physical activity are usually quite extensive. Although the current individual assessments (including the reading of the advices) were feasible within the time constraints (e.g. one school hour) and Internet provides the opportunity to decrease respondents' burden (see earlier

paragraphs), we recommend investigating whether using more valid and thus extensive assessments will still be feasible.
Additionally, the Internet-administered monitoring tools may require further attention (and if necessary further improvement) regarding the assessment of the reliability and validity of the specific questionnaires (measures) that are being applied; e.g. by means of parent-child proxy comparisons, test-retest comparisons, and validation by diagnosis of physician/nurse.

III Validate risk selections

The study described in Chapter 6 implemented an individual risk selection for general health based on a health-related quality of life measure. Future research should focus on validating individual risk-assessments. A recommended approach for this could be applying questionnaires with established sufficient reliability and validity, followed by risk selection based on available norms of reference data. Afterwards via, for example, consultation or physical examination of each student (including the ones not being at risk), one may confirm whether the classifications of students at risk and not at risk were valid, referred to as the questionnaires' sensitivity and specificity, respectively [24].
Once valid risk selections for health/health behavior are established, one can think of further research regarding effectiveness of risk selection in combination with interventions such as theory-based counseling.

IV Improve effectiveness of students' feedback

For this thesis, we only assessed effectiveness of an Internet-tailored advice combined with counseling regarding one health behavioral topic (fruit and vegetable intakes). We recommend further effectiveness research after optimization of the current available modules, but also of new (to be developed) modules regarding other health behavioral topics. It would be most insightful to focus on the 'short-term' effectiveness regarding health behavior of Internet-tailored health education on screen for separately including and excluding the counseling. Additionally, the effects of personal feedback about general health topics and chronic diseases were not evaluated yet. It can be expected that the current type of information based on a Health Risk Appraisal may increase knowledge/awareness of students' personal health status; we recommend determining possible effects on students' knowledge/awareness of personal health.

Some of the implications including further research related to the monitoring and prevention tools are put in the YHC-quadrant in Fig. 8.2.

	MONITORING	PREVENTION
INDIVIDUAL	*Link electronic monitoring with electronic medical child file *Explore score equivalence regarding sensitive issues *Improve psychometric properties of questionnaires for individual assessments *Validate risk selections **1**	*Optimize and implement basic personal feedback including information on referral to student via Internet *Optimize existing Internet-tailored health education *Develop Internet-tailored health education for other relevant topics *Optimize and implement personal feedback including information on referral to student via Internet *Improve effectiveness of feedback via Internet regarding students' health behavior and conduct effect-studies to establish improved health behavior *Optimize and implement provision of information to physician/nurse via Internet, include integration of theory-based counseling with Internet-supported information **3**
GROUP / POPULATION	**2** *Decrease respondents' burden by e.g. CAT applications *Implement electronic monitoring tools	**4** *Evaluate and possibly implement electronic feedback to schools about school profiles *Develop Internet-support for group education and health-promoting schools by e.g. connecting school profiles to decision making on interventions by linkage to existing databases of effective interventions *Include Health Promoting Schools models

Fig. 8.2 YHC-quadrant: what to do next?

8.6 General conclusions

E-health4Uth was applied in the current practice of Dutch preventive YHC, which made reaching most of the target group possible. This Internet-administered intervention was designed to support this current practice by enhancing efficiency

of data collection, involving children in their development (instead of only aiming at the parents) by offering immediate and automatic tailored health promotion, providing electronic information to the physician/nurse to support the counseling, and with the possibility of generating automatically a group profile per school by means of Internet to inform the teachers. E-health4Uth was feasible, positively appreciated by users, provided equivalent scores compared with P&P questionnaires, and had impact on behavioral determinants of nutrition. Summarizing, we conclude:

1. Electronic monitoring was, overall, just as good as P&P monitoring, while students evaluated monitoring via Internet more positively.
2. The Internet-administered monitoring tools generally yielded equivalent scores with the P&P versions of the same tools, resulting in relatively few (and small) score differences. However, more evidence regarding 'sensitive issues' is needed.
   Given the advantages that Internet offers, we recommend implementing this nationally for non-sensitive topics,
3. Feedback to students including information on referral and provision of information to physicians/nurses via Internet were feasible and positively evaluated,
4. Effectiveness of feedback on health behavior could not be established, more research is needed.

E-health4Uth scored equally or better on the measured aspects compared to the current procedure, except for some aspects of the contents of the Internet-tailored advice on health behavior. We conclude that Internet-based monitoring tools can support YHC and that prevention tools are promising; E-health4Uth can successfully contribute to the integration of monitoring and prevention in YHC. Distinct elements of E-health4Uth such as the monitoring tool are already being implemented in YHC practice. We recommend further research on the validity and the effectiveness of the monitoring and prevention tools.

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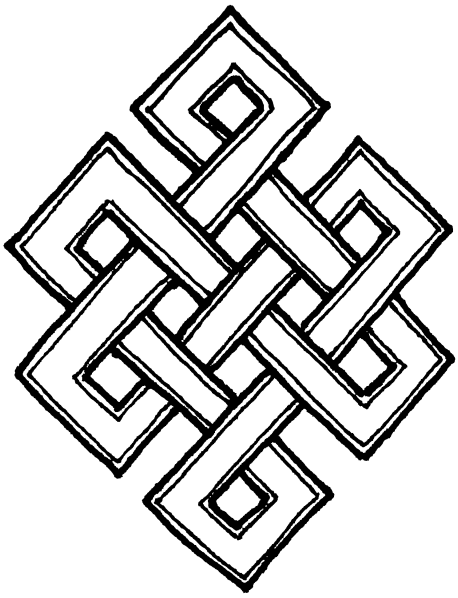

Summary

E-health4Uth is an Internet tool developed by us to support monitoring and prevention within preventive youth health care (YHC). Our project targeted elementary school children (mean age 10 years old) and adolescents from secondary schools (mean age 15 years old); when referring to both ages, we use the term 'students'.

First we investigated monitoring tools (Chapters 2-5), which involved assessment by means of Internet-administered health and health behavior questionnaires among students. Then we investigated prevention tools (Chapters 6 and 7). The prevention tools involved the total practice of E-health4Uth: assessment among students (which is also the monitoring tool), feedback/information to students and physicians/nurses, and counseling by physicians/nurses. Feedback to students involved personal feedback, which meant specific education based upon personal traits of the student. This could be three types of feedback: firstly information on a referral based on an increased health risk (only applied at secondary schools), secondly basic feedback regarding general health issues, where the given answers were compared with existing norms, thirdly a more in-depth advice to promote healthy behavior which we call tailored advice.

To evaluate the interventions (monitoring and prevention tools) we investigated the following research questions:

1. Are the Internet-based monitoring and prevention tools feasible?
2. How do users evaluate (appreciate) the Internet-based monitoring and prevention tools?
3. Do Internet-administered monitoring tools yield equivalent scores with paper and pencil (P&P) versions of the same tools?
4. What are the effects of the Internet-based prevention tool on students' health behavior and determinants of health behavior?

To evaluate the monitoring and prevention tools, we compared the E-health4Uth procedure with the current procedure, such as P&P questionnaires and generic preprinted leaflets. The studies were conducted with the participation and cooperation of two municipal health services, in Vlaardingen (urban area) and Harderwijk (rural area). Various research methods were used to answer the research questions: Internet-administered and P&P questionnaires, and Internet-based and written registrations.

Chapter 1 of this thesis is an introductory Chapter. It describes the current YHC, the wide range of e-health, and how aspects of e-health were applied within monitoring and prevention of YHC, resulting in the Internet tool E-health4Uth. Additionally, the different applications of E-health4Uth and the methods to evaluate whether E-health4Uth can be of support for YHC are described.

Part I of this thesis (**Chapters 2, 3, 4, and 5**) focuses on **monitoring tools**. A study on equivalence of scores (i.e. outcomes) of an Internet-administered adolescent health questionnaire versus scores obtained via P&P, is described in **Chapter 2**. Scores were also compared between two different interfaces of the Internet-administered questionnaire, a version with one-item per screen versus a version with multiple-items per screen. Furthermore, the study compared adolescents' evaluations of modes of administration. Adolescents (n=565) completed questionnaires on psychosocial well-being (KIVPA), self-reported problems, health care utilization, and health-related behavior and supplementary evaluation surveys (on the given health questionnaire mode) in the computer classrooms. Adolescents in the Internet one-item per screen mode more frequently reported satisfaction with their own appearance compared to the Internet multiple-items per screen mode ($p<0.01$). More adolescents in the Internet group indicated that they have a sufficient number of friends than in the P&P group ($p<0.01$). The Internet mode received more favorable evaluations by adolescents than the P&P mode. The multiple-items per screen format was favored over the one-item per screen format on perceived speed of the administration mode. We concluded that health questionnaires via Internet were positively evaluated and resulted in equal scores, with one exception, of health status/health behavior compared to the P&P mode.

In **Chapter 3** we report of an Internet (that signals missing answers) versus P&P mode of administration of the Child Health Questionnaire-Child Form (CHQ-CF), a measure of adolescent health status and health-related quality of life. We compared the number of missing answers, score distributions, internal consistency of multi-item scales and discriminative validity of both versions of the CHQ-CF. Adolescents (n=933) were randomly assigned to completing the CHQ-CF and items on chronic conditions either by an Internet or P&P questionnaire at school. Internet showed less missing answers than P&P ($p<0.01$). Score distributions, internal consistency of scales, and discriminative validity compared well between groups using P&P or Internet. The P&P version resulted in

significant higher (i.e. healthier) scores regarding 4 out of 10 CHQ-CF scales compared to Internet ($p<0.05$); however, the effect sizes of these differences were small. We concluded that, overall, Internet and P&P modes yielded comparable results. However, some small but statistically significant score differences need further exploration.

Score equivalence from Internet-administered versus P&P questionnaires about respiratory symptoms is reported in **Chapter 4**. In addition to eight items from the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, two items on the presence of doctor visits (medical attention) with regard to asthma respectively allergic disease during the past 12 months were included. Adolescents (n=933) were randomly assigned to complete either an Internet-administered or a P&P questionnaire. The Internet version of the questionnaire showed fewer missing answers than the P&P version, but this was not statistically significant. The respiratory items did not show statistically significant score (i.e. outcome) differences between the Internet and P&P modes of administration. These results confirm that respiratory questionnaires may be provided to adolescents electronically as well as via P&P.

Chapter 5 involves Internet-administered versus identical P&P-administered (asthma/fruit) questionnaires at elementary schools. A randomized cross-over design was applied, with children (n=249) starting with one administration mode before completing (five minutes later) the other mode. The Internet mode had significantly less missing/non-unique answers than the P&P mode ($p<0.01$). The completion times did not differ significantly between both modes. Except for perceived self-efficacy to eat sufficient fruit ($p<0.05$), no differences in the asthma and fruit scores were found between the two modes. All variables showed strong intraclass correlation coefficients between modes and most items had good to very good agreement. The majority of children preferred the Internet mode over P&P mode and rated the evaluation aspects of the Internet mode positively. Thus, Internet administration of a health and health behavior questionnaire is feasible at elementary schools, gives comparable responses to P&P administration, and is well accepted by children.

Part II of this thesis (**Chapters 6 and 7**) focuses on **prevention tools**. In **Chapter 6** an Internet tool for monitoring, personalized feedback (including tailored advice), and referral was developed to support routine adolescent preventive care and was compared to usual practice using P&P. Students (n=933) from seven

secondary schools were randomly assigned to the Internet or P&P group. The Internet group received a health and health-behavior assessment, personal and tailored feedback on health and health-behavior (specifically fruit consumption), and an on-line referral to see a physician/nurse if necessary. The P&P group received the same assessment, preprinted generic advice on fruit consumption and a mailed referral (where applicable). Students and physicians/nurses completed evaluation forms to assess indicators of feasibility, acceptability (i.e. satisfaction), and quality of each administration mode. The electronic health feedback was positively evaluated. Students perceived the Internet-tailored fruit advice as more pleasant, more personally targeted, and more enjoyable, but less credible than the generic preprinted advice ($p<0.01$). No differences in indicators of acceptability and quality of consultation were found ($p\geq0.05$). We concluded that the Internet can be a valuable tool to support physicians/nurses in the field of preventive care.

Children's fruit/vegetable intake is still below recommended levels. In **Chapter 7** we present a two-component intervention to promote fruit/vegetable intake: an Internet-tailored advice complemented with Internet-supported brief dietary counseling (with child and parent). The effects of this intervention were evaluated in a cluster-randomized baseline-post-test experimental study design. Thirty seventh-grade classes with a total of 486 elementary schoolchildren participated. During school hours, all children completed Internet-administered questionnaires on fruit/vegetable intake and related determinants. Children in the intervention group received immediate on-line individually tailored nutrition feedback. For each child in the intervention group, a nurse received information concerning the assessment of fruit/vegetable intake via Internet to support a 5-minute counseling protocol to promote fruit/vegetable intake. Children in the control group received no advices on fruit/vegetable intake. Three months after the first assessment again all children completed the questionnaires on fruit/vegetable intake. Awareness of inadequate fruit intake (Odds ratio (OR)=3.0; 95% Confidence interval (CI)=1.8-5.3) and knowledge of recommended vegetable intake levels (OR=2.7; 95% CI=1.8-4.1) were significantly more likely at post-test in the intervention group than in the control group. No significant effects were found on intake or other determinants. We concluded that a compact, integrated two-component intervention can induce positive changes in knowledge and awareness of intake levels of fruit/vegetables among schoolchildren. To induce changes in intake levels, more comprehensive or intensive interventions may be needed.

Finally, the last part of this thesis contains a **General Discussion** (**Chapter 9**) of the results of the studies described. In summary, E-health4Uth was feasible, positively appreciated by users, provided equivalent scores compared with P&P questionnaires, and had impact on behavioral determinants of nutrition. Below we answer our research questions more extensively.

Firstly, overall, the feasibility of electronic monitoring was just as good as P&P monitoring. Users evaluated both methods of monitoring positively and students evaluated monitoring via Internet more positively.

Secondly, the Internet-administered monitoring tools generally yielded equivalent scores with the same P&P versions, resulting in relatively few (and small) score differences. However, our studies were not developed to investigate how scores of 'sensitive issues', such as criminality or abuse, compare between Internet and P&P questionnaires. Therefore we conclude that Internet-administered monitoring tools generally resulted in comparable scores with traditional P&P questionnaires for (non-sensitive) health and health behavior topics.

Given the advantages (e.g. eliminating manual data entry by researchers thereby reducing transcription errors and workload) that Internet offers, we recommend implementing electronic monitoring tools nationally for (non-sensitive) health and health behavior topics.

Thirdly, Internet-administered monitoring allowed prevention by offering immediate automatic personal feedback, providing electronic information to the physician/nurse to support the counseling, and generating automatically a group profile per school by means of Internet to inform the teachers. Personal feedback to students, including information on referral and information to physicians/nurses via Internet were feasible and positively evaluated. Along with implementation of Internet-administered monitoring tools, we recommend the following:

- Implement Internet-supported provision of the feedback on relatively straightforward information to physicians/nurses and schools,
- Implement the basic personal feedback regarding general health issues whenever reliable reference data are available,
- Information regarding a referral can be implemented as soon as valid risk selections are established,
- Further develop and test Internet-tailored advices regarding health behaviors.

Finally, the effectiveness of feedback (i.e. Internet-tailored advice) on health behavior to students is still uncertain. To induce changes in health behavior, more comprehensive interventions may be needed.

Recommendations for further research included gaining broader insight in score equivalence regarding sensitive issues (such as criminality or sexual abuse) between Internet-administered and P&P modes, improving the psychometric properties of questionnaires, research on validation of risk selections, and the effectiveness of Internet-administered personal feedback to students.

We conclude that Internet-based monitoring tools can support YHC and that prevention tools are promising; E-health4Uth can successfully contribute to the integration of monitoring and prevention in YHC. Distinct elements of E-health4Uth such as the monitoring tool are already being implemented in YHC practice. We recommend further research on the validity and the effectiveness of the monitoring and prevention tools.

Samenvatting

E-health4Uth is een Internetsysteem dat door ons is ontwikkeld om monitoring en preventie binnen de jeugdgezondheidszorg (JGZ) te ondersteunen en te integreren. Ons project richtte zich op basisschoolkinderen van gemiddeld 10 jaar en adolescenten (van middelbare scholen) van gemiddeld 15 jaar; we gebruiken de term 'leerlingen' wanneer we naar beide leeftijden verwijzen.

Eerst hebben we systemen voor monitoring onderzocht (Hoofdstukken 2 t/m 5), die het afnemen van vragenlijsten over gezondheid en gezondheidsgedrag onder leerlingen betroffen. Daarna hebben we systemen voor preventie onderzocht (Hoofdstukken 6 en 7). De systemen voor preventie betroffen de gehele praktijk van E-health4Uth: vragenlijstafname (wat tegelijkertijd een systeem voor monitoring is), feedback/informatie aan leerlingen en artsen/verpleegkundigen, en counseling door artsen/verpleegkundigen. Feedback aan leerlingen betrof persoonlijke feedback, d.w.z. specifieke voorlichting op basis van persoonlijke kenmerken van de leerling. Dit kon uit drie soorten feedback bestaan: ten eerste informatie over een doorverwijzing gebaseerd op een verhoogd risico (alleen op het voortgezet onderwijs toegepast), ten tweede basale feedback over algemene gezondheidskwesties waarbij de gegeven antwoorden werden vergeleken met bestaande normen, ten derde een diepgaand advies ter bevordering van gezond gedrag wat we advies-op-maat noemen.

De evaluatie van de interventies (systemen voor monitoring en preventie) verliep aan de hand van de volgende onderzoeksvragen:

1. Zijn de Internetgestuurde systemen voor monitoring en preventie uitvoerbaar?
2. Hoe evalueren gebruikers de Internetgestuurde systemen voor monitoring en preventie?
3. Beantwoorden leerlingen Internetgestuurde systemen voor monitoring hetzelfde als papier-en-pen (P&P) versies van dezelfde systemen?
4. Wat zijn de effecten van Internetgestuurde systemen voor preventie op het gezondheidsgedrag en de determinanten van gezondheidsgedrag van leerlingen?

Bij de evaluatie hebben we de E-health4Uth procedure vergeleken met de op dit moment gangbare procedures, zoals P&P vragenlijsten en algemene voorgedrukte folders. We gebruikten verschillende methoden om de onderzoeksvragen te beantwoorden: Internetgestuurde vragenlijsten, Internetgestuurde registraties, P&P vragenlijsten en geschreven registraties. De

studies zijn uitgevoerd in samenwerking met de GGD in Vlaardingen (stedelijk gebied) en de GGD in Harderwijk (niet-stedelijk gebied).

Hoofdstuk 1 van dit proefschrift is een inleidend Hoofdstuk. Het beschrijft de huidige JGZ, het brede spectrum van e-health, en de manier waarop aspecten van e-health zijn toegepast binnen monitoring en preventie van de JGZ, wat resulteerde in het Internetsysteem E-health4Uth. Daarnaast worden de verschillende toepassingen van E-health4Uth en de methoden om te evalueren of E-health4Uth de JGZ kan ondersteunen, beschreven.

Deel I van dit proefschrift (**Hoofdstukken 2, 3, 4, en 5**) beschrijft de **systemen voor monitoring**. Onderzoek naar vergelijkbaarheid van scores (m.a.w. antwoorden) van een Internetgestuurde gezondheidsvragenlijst voor adolescenten versus de scores verkregen via P&P, wordt beschreven in **Hoofdstuk 2**. Tevens werden scores vergeleken tussen twee verschillende interfaces van de Internetgestuurde gezondheidsvragenlijst, een versie met één-item per scherm versus een versie met meerdere-items per scherm. Daarnaast vergeleek deze studie de waarderingen van adolescenten over de methode van afname. Adolescenten (n=565) vulden vragenlijsten in over psychosociaal welbevinden (KIVPA), zelfgerapporteerde problemen, gebruik van de gezondheidszorg (m.a.w. medische consumptie), en gezondheidsgerelateerde gedragingen en aanvullende evaluatieformulieren (over de waardering van de ontvangen vragenlijst-methode). De vragenlijsten werden ingevuld op school in klaslokalen cq. pc-ruimtes. Adolescenten in de Internet één-item per scherm methode rapporteerden vaker tevredenheid met hun eigen uiterlijk dan adolescenten in de Internet meerdere-items per scherm methode ($p<0.01$). Internet en P&P resulteerden in vergelijkbare antwoorden, op één uitzondering na: in de Internet groep gaven meer adolescenten aan een voldoende aantal vrienden te hebben dan in de P&P groep ($p<0.01$). De Internet methode ontving gunstigere waarderingen van adolescenten dan de P&P methode. De leerlingen waardeerden ervaren snelheid van de methode met meerdere-items per scherm gunstiger dan de één-item per scherm methode. We concludeerden dat gezondheidsvragenlijsten via Internet positief werden geëvalueerd en dat Internet en P&P op één uitzondering na in vergelijkbare scores van gezondheidsstatus en gezondheidsgedrag resulteerden.

Hoofdstuk 3 betreft een studie naar een Internet (die ontbrekende antwoorden signaleert) versus P&P methode van afname van de Child Health Questionnaire-Child Form (CHQ-CF), een meetinstrument voor gezondheidsstatus en gezondheidsgerelateerde kwaliteit van leven van adolescenten. Hierbij werden het aantal ontbrekende antwoorden, de score verdeling, de interne consistentie van multi-item schalen en de validiteit (in dit geval onderscheidend vermogen) van de beide versies van de CHQ-CF vergeleken. Adolescenten (n=933) werden a-select toegeschreven aan het invullen van de CHQ-CF en items over chronische condities via een P&P of een Internet vragenlijst op school. Internet resulteerde in minder ontbrekende antwoorden dan P&P ($p<0.01$). Score verdeling, interne consistentie van de multi-item schalen van de CHQ-CF, en onderscheidend vermogen waren goed vergelijkbaar tussen de groepen. Bij 4 van de 10 CHQ-CF schalen had de P&P versie significant hogere (d.w.z. gezondere) scores dan de Internet versie ($p<0.05$); echter, de relatieve groottes van deze verschillen (het absolute verschil in gemiddelde scores gedeeld door het gewogen gemiddelde van de standaard deviaties) waren klein. We concludeerden dat, over het algemeen, P&P en Internet methoden vergelijkbare resultaten hebben. Echter, een aantal kleine maar statistisch significante score verschillen behoeven verdere exploratie.

Hoofdstuk 4 rapporteert de score vergelijking van Internetgestuurde en P&P vragenlijsten over luchtwegsymptomen. Naast acht items van de International Study of Asthma and Allergies in Childhood (ISAAC) vragenlijst, werden twee items over de aanwezigheid van bezoeken aan de dokter aangaande astma respectievelijk allergische ziekte in de afgelopen 12 maanden toegevoegd. Adolescenten (n=933) zijn a-select toegeschreven aan het invullen van een Internetgestuurde of P&P vragenlijst. De Internet versie van de vragenlijsten had minder ontbrekende antwoorden dan de P&P versie, maar dit was niet statistisch significant. De scores op de items over luchtwegsymptomen lieten geen statistisch significante verschillen zien tussen de methodes van afname. Deze resultaten bevestigen dat vragenlijsten over luchtwegsymptomen zowel via Internet als via P&P kunnen worden afgenomen bij adolescenten.

Hoofdstuk 5 betreft afname van Internet versus identieke P&P (astma/fruit) vragenlijsten op basisscholen. Een gerandomiseerd cross-over design werd toegepast, waarbij kinderen (n=249) startten met de ene manier van afname alvorens (5 minuten later) op de andere manier over te stappen. De Internet methode had significant minder ontbrekende en niet-unieke antwoorden dan de

P&P methode ($p<0.01$). De benodigde invultijd verschilde niet significant tussen beide methodes. Behalve voor de vraag over de door het kind waargenomen 'eigen-effectiviteit' om voldoende fruit te eten ($p<0.05$), zijn er geen verschillen gevonden in de astma en fruit scores tussen de twee methodes. Alle variabelen lieten sterke intraclass correlatie coëfficiënten tussen methodes zien en de meeste items hadden een goede tot zeer goede overeenkomst. De meeste kinderen gaven de voorkeur aan de Internet methode boven de P&P methode en gaven positieve waarderingen voor verschillende aspecten van de Internet methode. Oftewel, Internet- toediening van een gezondheids- en gezondheidsgedragsvragenlijst is haalbaar op basisscholen, geeft vergelijkbare antwoorden met P&P-toediening, en wordt gewaardeerd door kinderen.

Deel II van dit proefschrift (**Hoofdstukken 6 en 7**) legt de nadruk op **systemen voor preventie**. **Hoofdstuk 6** beschrijft een Internetsysteem voor monitoring, persoonlijke feedback (inclusief advies-op-maat), en doorverwijzing, ontwikkeld om de praktijk van JGZ te ondersteunen. Het nieuwe systeem werd vergeleken met de huidige praktijk waarbij gebruik wordt gemaakt van P&P. Leerlingen (n=933) van zeven middelbare scholen zijn a-select toegeschreven aan de Internet of P&P groep. De Internet groep ontving een gezondheids- en gezondheidsgedragsvragenlijst, persoonlijke feedback over gezondheid en gezondheidsgedrag (inclusief advies-op-maat module over fruit consumptie), en indien nodig een on-line doorverwijzing om de jeugdarts/verpleegkundige te zien. De P&P groep ontving dezelfde vragenlijst via papier, voorgedrukt generiek advies (d.w.z. voor iedereen gelijk) over fruit consumptie en een doorverwijzing via de post, indien nodig. Leerlingen en jeugdartsen/verpleegkundigen vulden evaluatie formulieren in om indicatoren van haalbaarheid, acceptatie (m.a.w. tevredenheid), en kwaliteit van beide methoden van afname vast te stellen. De elektronische gezondheidsfeedback werd positief gewaardeerd. Leerlingen vonden het fruitadvies-op-maat via Internet plezieriger, persoonlijker bedoeld, en leuker, maar minder geloofwaardig dan het generieke voorgedrukte advies ($p<0.01$). Er zijn geen verschillen gevonden in indicatoren van acceptatie en kwaliteit van het gesprek tussen leerling en de jeugdarts/verpleegkundige (consult) ($p\geq0.05$). We concludeerden dat Internet een waardevolle methode kan zijn om jeugdartsen/verpleegkundigen te ondersteunen in het veld van de preventieve gezondheidszorg.

Kinderen nemen nog steeds minder fruit en groente in dan aanbevolen. In **Hoofdstuk 7** bespreken we een twee-componenten interventie om fruit/groente inname te bevorderen: een advies-op-maat via Internet aangevuld met 'face-to-face' korte voedingsvoorlichting aan kind en ouder. De effecten van deze interventie werden geëvalueerd in een gerandomiseerde experimentele studie met een voor- en nameting. Dertig klassen uit groep 7 met totaal 486 leerlingen deden mee. Alle kinderen vulden onder schooltijd Internetgestuurde vragenlijsten over fruit/groente inname en gerelateerde determinanten in. Kinderen in de interventiegroep ontvingen direct individueel voedingsadvies-op-maat on-line. De verpleegkundige ontving voor ieder kind uit de interventiegroep via Internet informatie aangaande de ingevulde fruit/groente vragenlijst ter ondersteuning van een 5-minuten voorlichtingsprotocol om fruit/groente inname te bevorderen. Kinderen in de controlegroep ontvingen geen adviezen over fruit/groente inname. Drie maanden na de eerste meting vulden alle kinderen wederom de vragenlijst over fruit/groente inname in. Op deze nameting waren bewustzijn over onvoldoende fruitinname (Odds ratio (OR)=3.0; 95% Betrouwbaarheidsinterval (BI)=1.8-5.3) en kennis van aanbevolen hoeveelheden groenten (OR=2.7; 95% BI=1.8-4.1) significant groter in de interventiegroep dan in de controlegroep. We vonden geen significante effecten op fruit/groente inname of andere mogelijke determinanten. We concludeerden dat deze compacte, geïntegreerde twee-componenten interventie positieve veranderingen ten aanzien van kennis en bewustzijn van hoeveelheden fruit/groente inname onder kinderen kan bewerkstelligen. Voor veranderingen in hoeveelheden inname zijn waarschijnlijk uitgebreidere of intensievere interventies nodig.

Het laatste deel van dit proefschrift betreft een **Algemene Discussie** van de resultaten van de beschreven studies. Samenvattend luidt de conclusie dat E-health4Uth haalbaar is, positief werd gewaardeerd door gebruikers, resulteerde in vergelijkbare scores op vragenlijsten als P&P versies, en effect had op enkele relevante gedragsdeterminanten van voeding. Hieronder beantwoorden we onze onderzoeksvragen uitgebreider:
Allereerst, doorgaans waren de uitvoerbaarheid van elektronische en P&P monitoring even goed. Betrokkenen evalueerden beide vormen van monitoring positief en de leerlingen waardeerden monitoring via Internet positiever dan via P&P.

Ten tweede, er waren relatief weinig score verschillen en het kleine aantal verschillen dat wel statistisch significant was, liet kleine tot zeer kleine verschillen zien tussen Internet en P&P vragenlijsten. Echter, onze studies waren niet ontwikkeld om te onderzoeken hoe de beantwoording van 'gevoelige kwesties', zoals criminaliteit of mishandeling, zich verhoudt tussen Internet en P&P vragenlijsten. We concluderen dus dat, voor (niet-gevoelige) onderwerpen die gezondheid en gezondheidsgedrag betreffen, Internetgestuurde systemen voor monitoring over het algemeen scores opleverden die vergelijkbaar zijn met de traditionele P&P vragenlijsten.

Gezien de praktische voordelen die Internet biedt, zoals minder datainvoer-fouten en personele inzet door het uitsluiten van handmatige data invoer door onderzoekers, bevelen we aan om Internetgestuurde systemen voor monitoring landelijk te implementeren voor (niet-gevoelige) onderwerpen die gezondheid en gezondheidsgedrag betreffen.

Ten derde, Internetgestuurde monitoring bood de gelegenheid tot preventie door middel van het direct geven van automatische persoonlijke feedback aan de leerling, het verschaffen van elektronische informatie aan de jeugdarts/verpleegkundige ter ondersteuning van de voorlichting, en het automatisch genereren van een groepsprofiel per school met behulp van Internet om de leerkrachten te informeren. Persoonlijke feedback aan leerlingen, inclusief informatie over doorverwijzing en informatie aan jeugdartsen/verpleegkundigen via Internet waren haalbaar en werden positief gewaardeerd door gebruikers. Bij implementatie van Internetgestuurde systemen voor monitoring, bevelen we het volgende aan:

- Internetondersteunde verschaffing van de feedback aangaande de relatief eenvoudige informatie aan jeugdarts/verpleegkundige en scholen implementeren,
- De basale persoonlijke feedback aangaande algemene gezondheidskwesties implementeren mits er betrouwbare referentiedata beschikbaar zijn,
- Informatie over een doorverwijzing aan de leerling kan worden geïmplementeerd zodra valide risicoselecties ten aanzien van gezondheidskwesties zijn vastgesteld,
- De adviezen-op-maat over gezondheidsgedragingen verder ontwikkelen en uittesten.

Tenslotte, de effectiviteit van advies-op-maat via Internet op gezondheidsgedrag aan leerlingen is nog onzeker. Om daadwerkelijke veranderingen in gezondheidsgedrag te bewerkstelligen zijn waarschijnlijk uitgebreidere interventies nodig.

Aanbevelingen voor toekomstig onderzoek betreffen het verkrijgen van breder inzicht in vergelijkbaarheid van Internet versus P&P scores ten aanzien van gevoelige kwesties (zoals criminaliteit of seksueel misbruik), verbetering van de psychometrische eigenschappen van vragenlijsten, onderzoek naar validatie van risicoselecties ten aanzien van gezondheidskwesties, en de effectiviteit van Internetgestuurde persoonlijke feedback aan leerlingen.

Wij concluderen dat Internetgebaseerde monitoringsystemen de JGZ kunnen ondersteunen en dat systemen voor preventie veelbelovend zijn; E-health4Uth kan succesvol bijdragen aan de integratie van monitoring en preventie in de JGZ. Verschillende elementen van E-health4Uth zoals het monitoringsysteem worden reeds geïmplementeerd in de JGZ praktijk. We bevelen verder onderzoek aan naar de validiteit en de effectiviteit van de systemen voor monitoring en preventie.

Dankwoord

Zo, dat klusje is geklaard!!! Nu nog op naar de verdediging. Ik hoop dat ik er net zo ontspannen mee om kan gaan als St-Fransiscus van Assisi waarschijnlijk zou doen, die zei:

'Gelukkig ben je
als je even gelukkig bent wanneer ze je prijzen,
als wanneer ze je verachten'.

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En dan de mensen waar dit hele project op gestoeld en voor bedoeld was: de GGD'en en de bijbehorende scholen. Het was leuk om twee verschillende GGD'en (Harderwijk en Vlaardingen) in het project te hebben, iedere GGD had haar eigen goeie inbreng wat het in balans hield. Soms was het wel lastig om de praktijk en de wetenschap op één lijn te krijgen, maar het lijkt ons toch te zijn gelukt. Ik heb erg veel plezier gehad maar ook veel geleerd van onze samenwerking, en ik zal niet alle namen noemen van wie heeft meegewerkt, maar ik zal jullie me stuk voor stuk herinneren. Bedankt!
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Wat betreft mijn fijne collega's: Superbedankt voor jullie betrokkenheid, behulpzaamheid, gezellige wandelingen, lunches en etentjes, en voor het gewoon zo vriendelijk zijn. In het bijzonder wil ik mijn ex-holbewoners Suzie, Rian en Carola bedanken. Jullie waren altijd lief voor mij en creëerden een stimulerende omgeving die mij heeft geholpen om te focussen. Also my personal editorial-tutor Katrina for all the English corrections and advices on anything: thank you for being such a good friend. Judith, het was heerlijk om zo samen op dezelfde werkplek te hebben gezeten, dank je voor alle gezelligheid, steun en logeerpartijtjes. En er waren nog meer vrienden die collega's werden (Mirjam, Laetitia, Susanne!) en zelfs collega's die vrienden werden (Astrid, paranimfje Ida, Frank, Miranda en Fanny!). Dit is mij zeer dierbaar en ik wil jullie allemaal bedanken voor er zijn voor mij. Jullie zijn schatjes!
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In het speciaal wil ik nog lieve Harm, mama, Margot en Kim bedanken. Jullie kennen mij inmiddels door en door, en het is bijzonder om jullie als klankbord te mogen hebben. Hopelijk blijven jullie mij nog lang bijstaan in al mijn wel en wee. Ik hoop er ook voor jullie te mogen blijven zijn.

Als laatste wil ik jou, Hein, bedanken. Jij hebt op alle manieren, direct en indirect, meer bijgedragen dan jij je waarschijnlijk beseft. Zoals jij met mensen omgaat, zo respectvol en liefdevol, heeft er mede voor gezorgd dat ik bij MGZ wilde blijven om met jou dit werk af te ronden in een promotie. We hebben écht samengewerkt, de brainstormsessies waren heel inspirerend, ook jouw manier van opbouwend feedback geven, kunnen velen nog een puntje aan zuigen. Daarnaast heb je mij heel veel vertrouwen gegeven en mij vrij gelaten waardoor ik het beste uit mijn kannetje kon halen. Jouw kwaliteit is volgens mij dat jij een ander laat stralen. Dank je wel daarvoor!!!

Ik heb erg veel plezier gehad in het werk op MGZ, en ik ben dankbaar dat ik deze kans heb gekregen. Ik hoop ten diepste dat het werk ook van verder nut kan zijn voor vele anderen.

Over de auteur

Resi Mangunkusumo werd op 4 februari 1978 geboren in Zeist. Ze behaalde in 1996 haar VWO diploma aan het Revius Lyceum in Doorn. Vervolgens startte zij haar studie Gezondheidswetenschappen in Maastricht en specialiseerde zich in Gezondheidsvoorlichting. In het kader van deze studie volbracht zij een wetenschapsstage aan de afdeling Public Health van de Queensland University of Technology in Brisbane, Australië. Tijdens deze stage onderzocht zij de effectiviteit van een schoolprogramma ter preventie van geweld en pesten. In 2000 behaalde zij haar doctoraal examen. Naast het studeren werkte Resi in de thuiszorg als verzorgende. In mei 2001 begon zij als junior onderzoeker op de afdeling Maatschappelijke Gezondheidszorg van Erasmus Medisch Centrum Rotterdam. Hier verrichte zij het onderzoek beschreven in dit proefschrift. Naast haar onderzoekswerk, werkte Resi in de thuiszorg als vrijwilliger in de terminale zorg. Vanaf augustus 2006 werkt zij bij De Grift, Gelders centrum voor verslavingszorg in Arnhem, als preventiewerker.

Appendix

Description of Internet tool E-health4Uth

1 Background

This appendix provides a description of the Internet tool E-health4Uth. As described in the General Introduction of this thesis, the Internet tool supported preventive youth health care by means of the following features:

1. Questionnaire assessment for student,
2. Feedback to student,
3. Information to physician/nurse (i.e. school physician/nurse) to support the counseling,
4. Generator of SPSS datafile with group results,
5. Feedback to schools about group results (in comparison to region) using graphs and tables (not evaluated in this thesis).

The feedback to the student (feature 2) had several optional aspects throughout the different studies:

a. Information on a referral based on an increased health risk (only applied at secondary schools,
b. Personal feedback regarding general health issues, based on Health Risk Appraisal [1],
c. Tailored advice on health-related behavioral topics (in our case nutrition) including print option, based on the computer-tailoring approach [2-3].

The information to the physician/nurse (feature 3) included an overview of which students were at health/health behavioral risk or not and printable information for each student. This information for each student involved the following aspects:

a. A summary of the health and/or health-behavioral status,
b. All individual items including answers in an overview,
c. The complete electronic feedback of the student.

The purpose of the Internet system is to support monitoring and prevention by providing web-based questionnaires generated from definitions and descriptions stored in a database, and to provide tailored feedback. The answers are collected in a database and can be retrieved as an SPSS (Statistical Package for Social Sciences) data file. Special informative overviews are provided for supervisors, in this case school physicians/nurses, epidemiologists and school health educators. Additionally, the system contains a maintenance module called “Editor”, also

accessed through a web-based interface, which is used to design the questionnaires and to manage user accounts (user number and password). A web server contains the PHP scripts and interacts with a MySQL database server where the definitions of the questionnaires, the user accounts and the answers are stored. For this we used PHP 4.0.1 and higher, MySQL 3.22 and higher, and JavaScript 1.3.
At this moment the defining and generating of questionnaires is generic, i.e. it requires no programming. The feedback, however, is not yet completely covered by a generic tool but requires additional programming.

1.1 Getting started

The system is started by using Internet explorer version 5.0 or higher and typing the URL of the website in the address field of the browser. In the case of administrators (such as researchers or supervisors) they type 'www.gezondejeugd.nl/admin'. The first screen is a logon screen. After logon, administrators can select the required module/function from an extra select box in the logon screen. Administrators have access to the following functions:

1. Complete a questionnaire (registration) and receive personal feedback
2. Design questionnaires, forms, questions and answers
3. Manage users accounts
4. View feedback for supervisors
5. Specify SPSS syntax and generate an SPSS data file for statistical analysis of the answers

The first function is also referred to as the Internet-tailored advice, similar to what the students received in Chapters 6 and 7 of the thesis. The second and third functions are accessed via the Editor, for administrators only. The fourth function includes two types of feedback: information to support the counseling (including risk-selection, a summary of the answers, all items with answers, and the feedback for students) and feedback for schools on group profiles (including graphs and tables with data of the school in comparison with the region, and comparison between boys and girls).
The following paragraphs will describe the above functions of the Internet system, in the same order. The illustrations in this appendix are screenshots from the system and therefore in Dutch. The most important features will be explained

using the example of the so-called Fruit and Vegetable questionnaire (as applied in Chapter 7 of the thesis).

2 Complete a questionnaire and receive personal feedback

The first paragraph will describe an example of a questionnaire, followed by a paragraph showing a fictitious example of personal feedback.

2.1 Example of a questionnaire

The questionnaire system as used by students is started by typing the URL of the website in the address field of the browser (in this case 'www.gezondejeugd.nl').

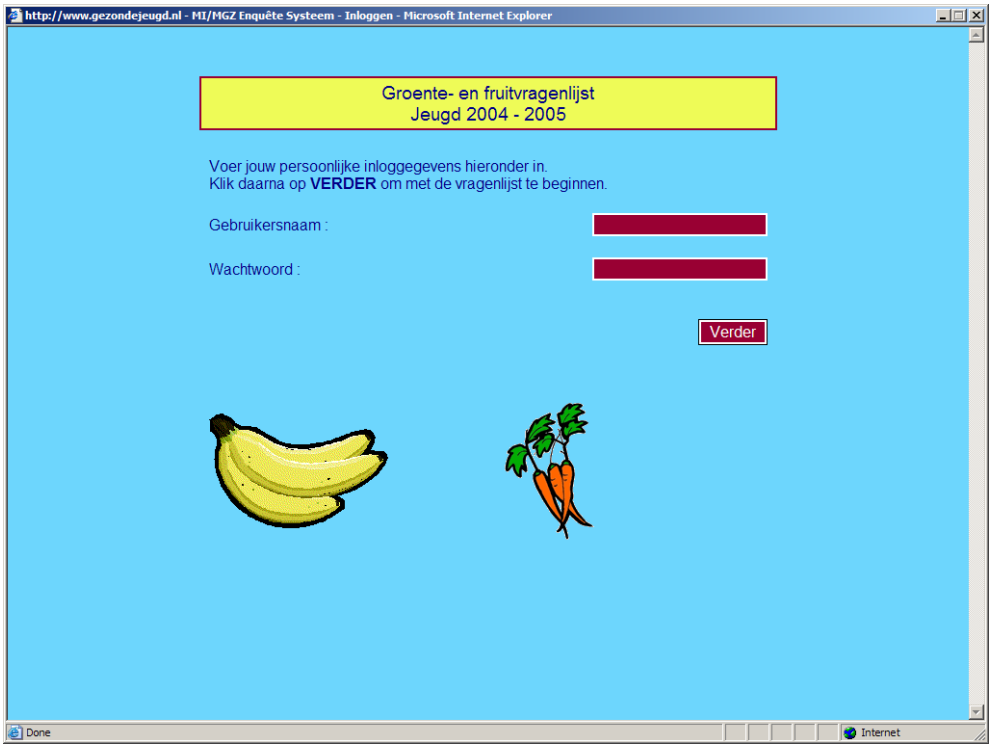


Fig. 1 Example of a login screen where user number and password are requested

The first screen is a logon screen (see Fig. 1). After logon the first form of the questionnaire will be displayed. If the user (student) has access to multiple

questionnaires, the appropriate questionnaire must be selected first. All answers given are immediately stored into the database to ensure that a student can continue where left off, when completion of the questions was accidentally or on purpose interrupted. All screens are checked for missing answers before the user can proceed to the next screen. After the last screen, the system will check once more for forgotten/missing questions before the personal feedback is generated. Once the questionnaire is completed the student can logon again, but can only view his or her own feedback and cannot change the answers.

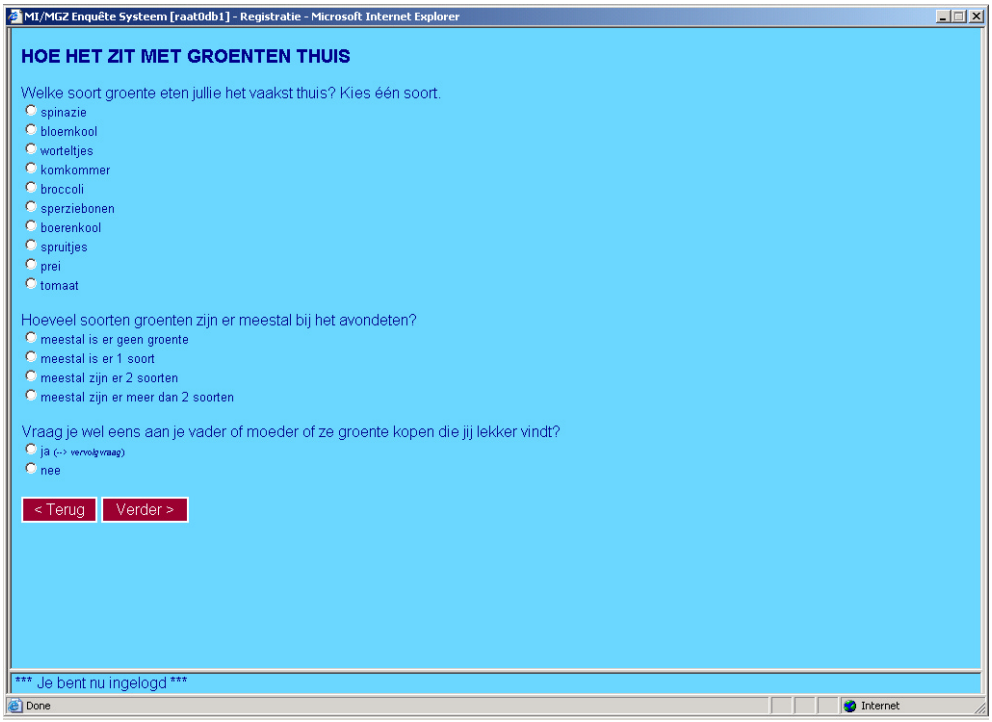


Fig. 2 Example of a form of the fruit and vegetable questionnaire

In the example of Fig. 2 the introduction consists of only a title. Below the introduction, three multiple choice type questions are displayed. The two navigation buttons at the bottom are intended to return to the previous form (in Fig. 2: **<Terug**) or to continue with the next form (**Verder>**).
The third question has two possible answers Yes (**Ja**) and No (**Nee**). When a student clicks the "Yes" button, a follow-up form (**-> vervolgvraag**) will be

displayed with more detailed questions related to that answer, else these questions will be skipped.

The following question types are distinguished:

1. Text (i.e. question without answer). This type is used to generate an introduction on a form or text between groups of questions
2. Multiple choice question where multiple answers can be given
3. Multiple choice question where only one question is allowed
4. Question with an input field for a number
5. Question with an input field for a calendar date
6. Question with an input field for one line of text
7. Question with an input field for multiple lines of text

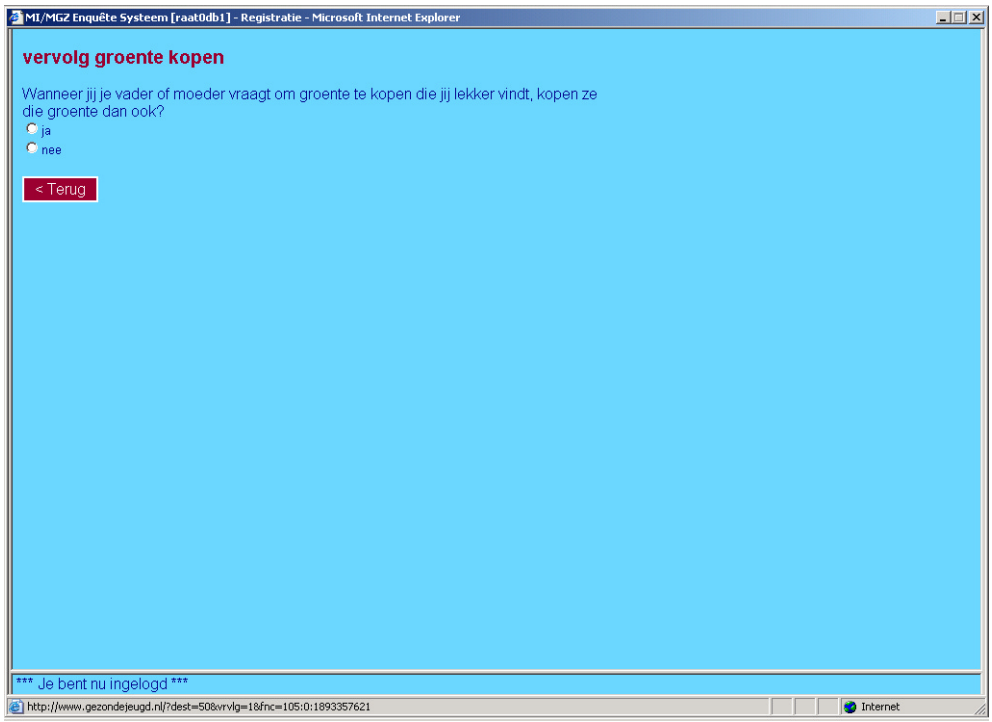


Fig. 3 Example of a follow-up form with only one follow-up question

Note that in Fig. 3 only the navigation button "Return to previous form" (<**Terug**) is displayed.

When the "next" (**volgende**) button in a questionnaire is clicked, the current form is checked for forgotten or missed answers. If there are forgotten or missed answers, a pop-up window is displayed with a warning. When the last question is answered, applicable feedback is displayed.

2.2 Example of personal feedback

Fig. 4 and 5 show examples of personal feedback that students received immediately after completing a questionnaire.

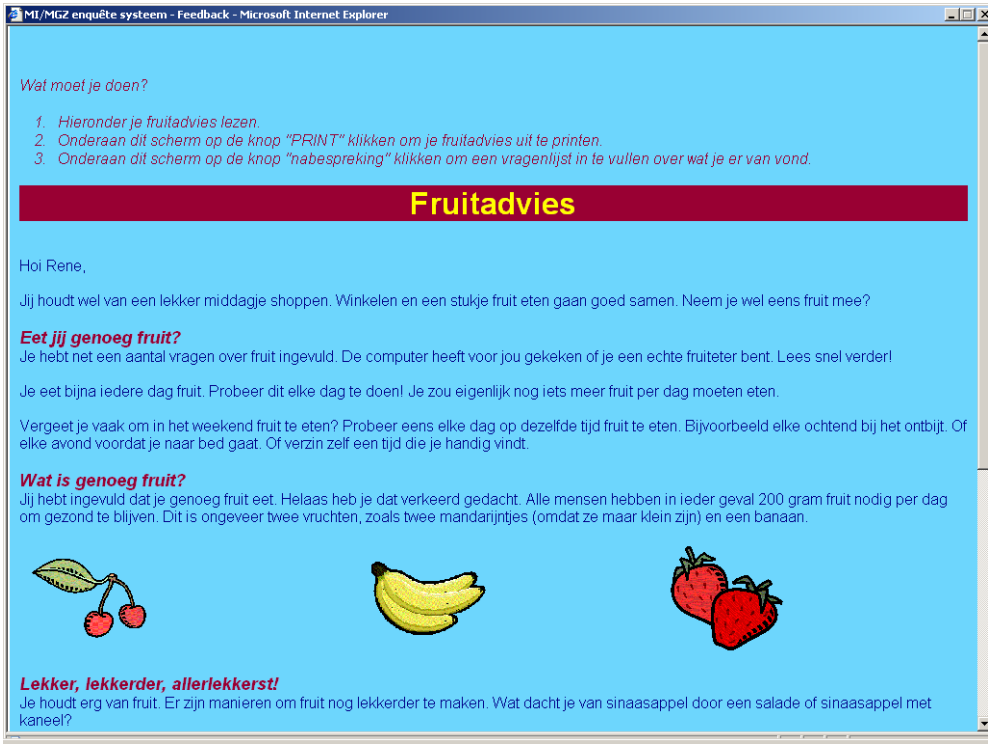


Fig. 4 Example of personal feedback of the fruit and vegetable questionnaire illustrating the start of the fruit advice

The generated text is based on the answers given, driven by predefined algorithms to select the appropriate text fragments. The button at the bottom left

is used to print feedback; the button next to the print button is used to return to the fruit advice.

Fig. 5 Example of personal feedback of the fruit and vegetable questionnaire illustrating the end of the vegetable advice

3 Design questionnaires with the Editor

The Editor has functionality for designing questionnaires and managing user accounts. In this paragraph the design functionality will be described. Forms are grouped by category, only for administrative purposes, and questions are linked to a form. The first step is therefore to define at least one category and to define a form.

3.1 Composing a form

Forms belong to a category, have a title, and have a field for descriptive text. A (new) form has to be created first, before questions can be added to it.

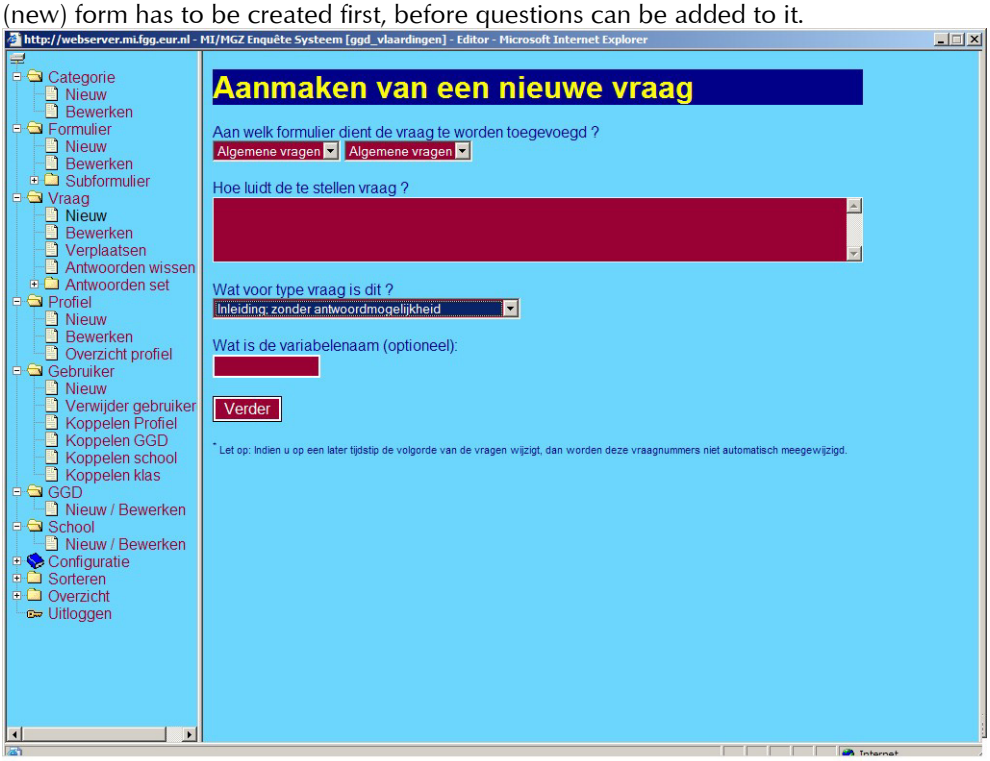


Fig. 6 Example of a screen to add a new question to a form

The left side of the window is a menu for all functions of the editor, including designing questionnaires, with submenus per category (see Fig. 6). We use the option “new question” (**Vraag Nieuw**) to define the question text and type. With the two drop-down combo boxes at the top, the category and form are selected to which the question has to be added. The text of the question can be typed in the textbox below these boxes. With the drop-down combo box below this text field, one of the question types listed (see paragraph 2) can be selected. The text field thereafter is intended to give a variable name, which is later on used to retrieve data for SPSS. With the option “edit question” (**Vraag Bewerken**) we can modify the attributes of questions or delete questions and in case of a multiple choice type answers we can add and delete answers. Frequently used sets of

answers like “yes” and “no” can be predefined for repetitive use, so called answer set (“**Antwoorden set**”).

3.2 Composing a questionnaire from available forms

In the example of Fig. 7 the left frame of the screen is again the Editor menu.

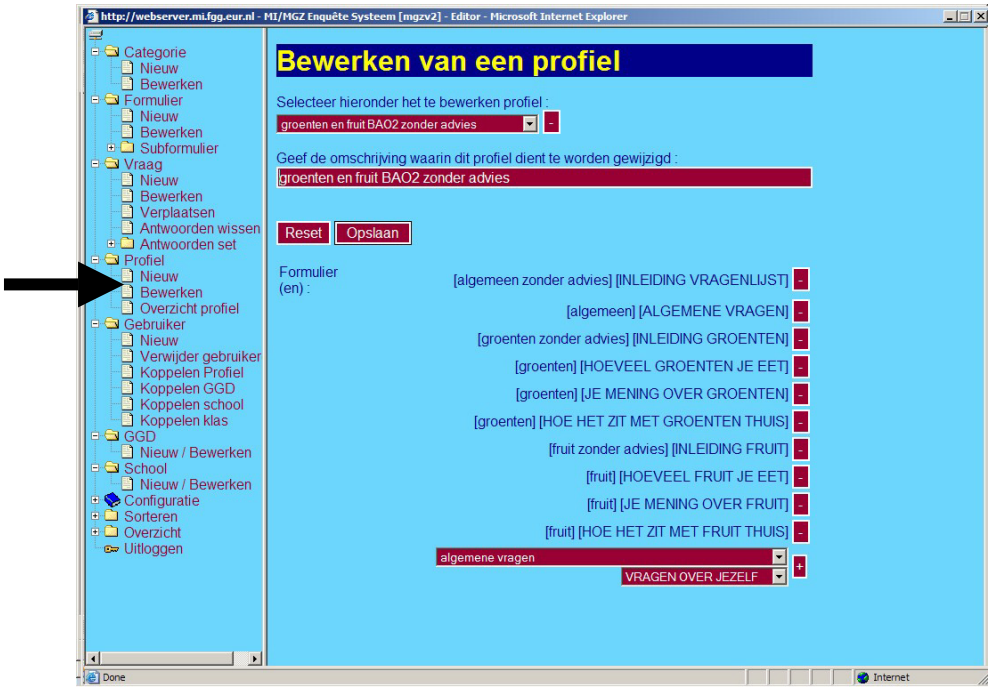


Fig. 7 Example of an Editor screen for composing a questionnaire from available forms

The menu-item for composing a questionnaire (**Profiel**) is selected with submenu items for “new” (**Nieuw**), “modify” (**Bewerken**) and “print/overview” (**Overzicht profiel**). In this example the submenu item “modify” is selected, which consequently displays the frame at the right side of the window. In the right frame, the first drop-down combo box is used to select a questionnaire by the descriptive title. The questionnaire can be deleted by clicking the button with a minus sign right to this field. The title can be modified by editing the title in the

text field below the drop-down combo box and by clicking the "store" (**Opslaan**) button.
Below the "store" (and the "cancel") button the titles of the forms used by this questionnaire are displayed. A form can be deleted from the questionnaire by clicking the button with a minus sign right to the title of that form. The form itself is not deleted, since a form can be used in more than one questionnaire.
Forms are grouped per category to avoid long lists of forms when selecting a form with a drop-down combo box. We therefore add a form to the questionnaire by selecting first a category, then a form from the selected category and then clicking the button with the plus sign next to these drop-down combo boxes at the bottom of the screen.

4 Manage user accounts in the Editor

All users (administrators and students) of the system have to be registered with user number, password and authorization level specification before they can use the system. The authorization specifies which part of the functionality can be used and from which students the given answers can be viewed (by an administrator). The authorization function levels are:

- Editor
- Registration (i.e. completing a questionnaire)
- Feedback
- SPSS output

The system is intended for health/health behaviour questionnaires in schools organized by municipal health services (MHSs). A user has attributes for "Organization" (in our case a MHS), "school" and "class". The data access rights are based on these attributes.
With the screen of Fig. 8 one ore more user accounts with the same authorization can be defined. The system will generate the user account numbers and passwords.

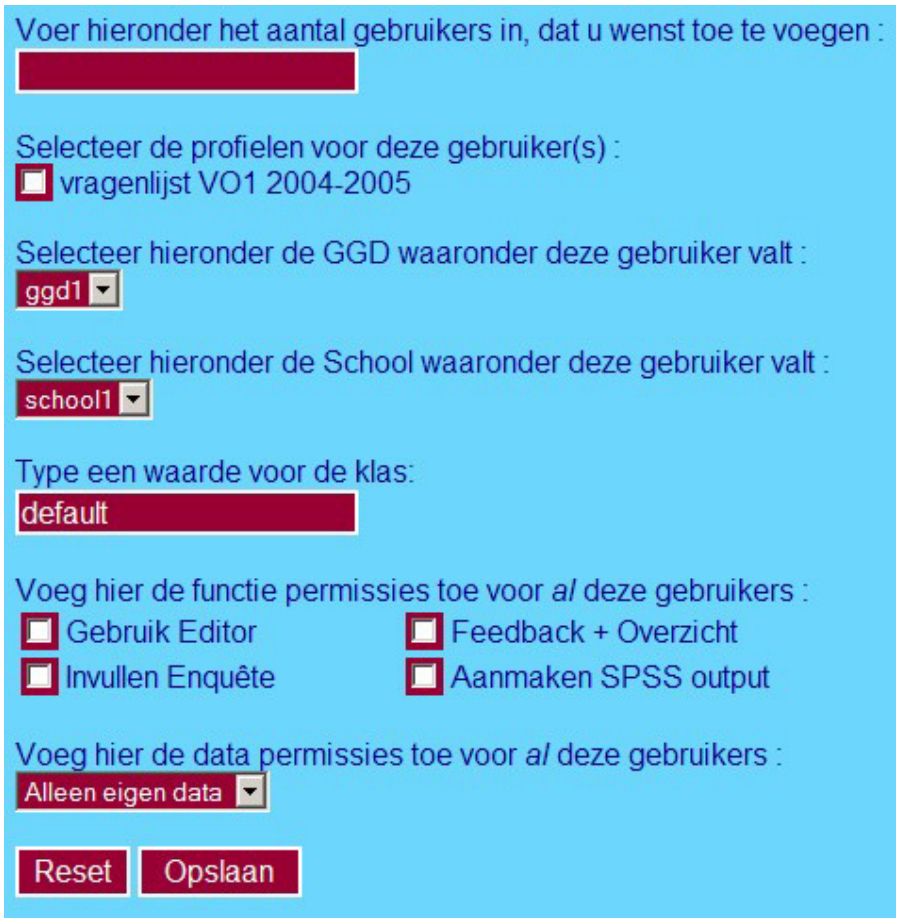


Fig. 8 This is an example of a screen to define users. The functionality and data access rights are specified plus the questionnaires to which the user has access

The description of the fields from top till bottom is as follows:

1. Top field is used to specify the number of accounts to be generated
2. List of available questionnaires. In this example only one. Questionnaires are selected by marking the check box
3. Drop-down combo box to select the health service to which the user belongs
4. Drop-down combo box to select the school to which the user belongs

5. Text field to give the name of a class to which the user belongs
– The user is given access to the functions for which the check boxes are marked. In this version of the system there are 4 functions (Editor, Registration, Feedback, SPSS output)
6. The drop-down combo box below the functions is used to select the data access rights:
   – Access to all data
   – Access to data of the health service or organization for which the user is registered
   – Access to data of the school for which the user is registered
   – Access to data of the class for which the user is registered
   – Access to data of the registered user of user list only

After clicking the button "store" (**Opslaan**), the accounts are generated and a list with user numbers and passwords is displayed and can be printed. Users can be removed individually or per class, school or health service. With the sub menu items "link to" (**Koppelen**) (see Fig. 7) we can change for a group of users the access rights to questionnaires and the attributes for MHS, school and class.

Other functionality of the editor is available for managing the tables for health service, and school and to provide overviews of users, questionnaires, forms and questions. However, this will not be further described in this appendix.

5 Feedback for supervisors

Supervisors can have access to individual data (to support physicians/nurses in giving counseling to students) and to predefined analysis of a selected school compared with all the participating schools of the same region (to support school health educators in informing the schools on the results from the questionnaires). The feedback for supervisors cannot yet be designed with the editor, but is programmed for this particular questionnaire.

5.1 Feedback for schools

The screen of Fig. 9 (see left top of the screen) is used to select a participating school from its region (in this example the MHS (**GGD**)), where after a simple statistical comparison of the school results with the region (including data from all schools of that region) is displayed, in free text, summarized in bar graphs and also in matrix format. In the bar graphs the school results are printed in red (see light grey bar) and the regional results in blue (see dark grey bar).

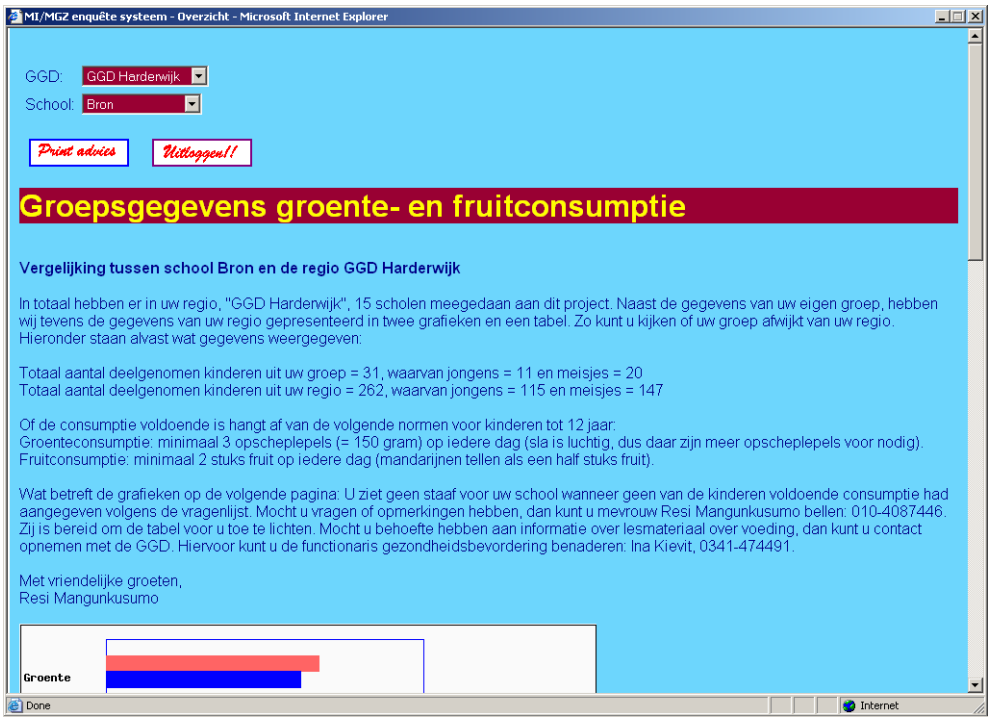
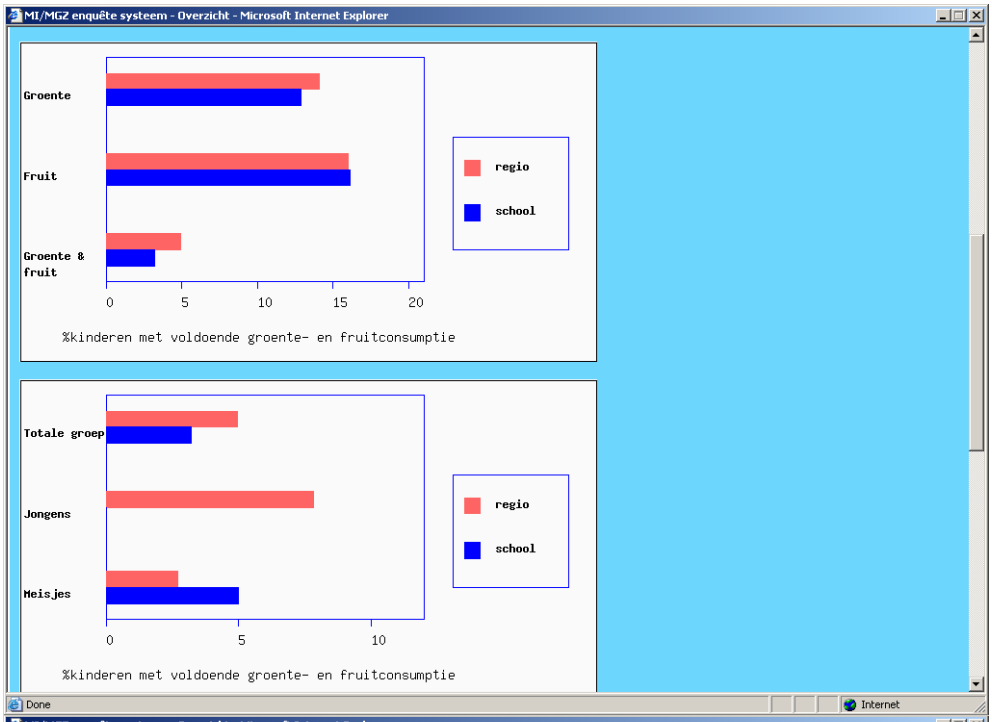
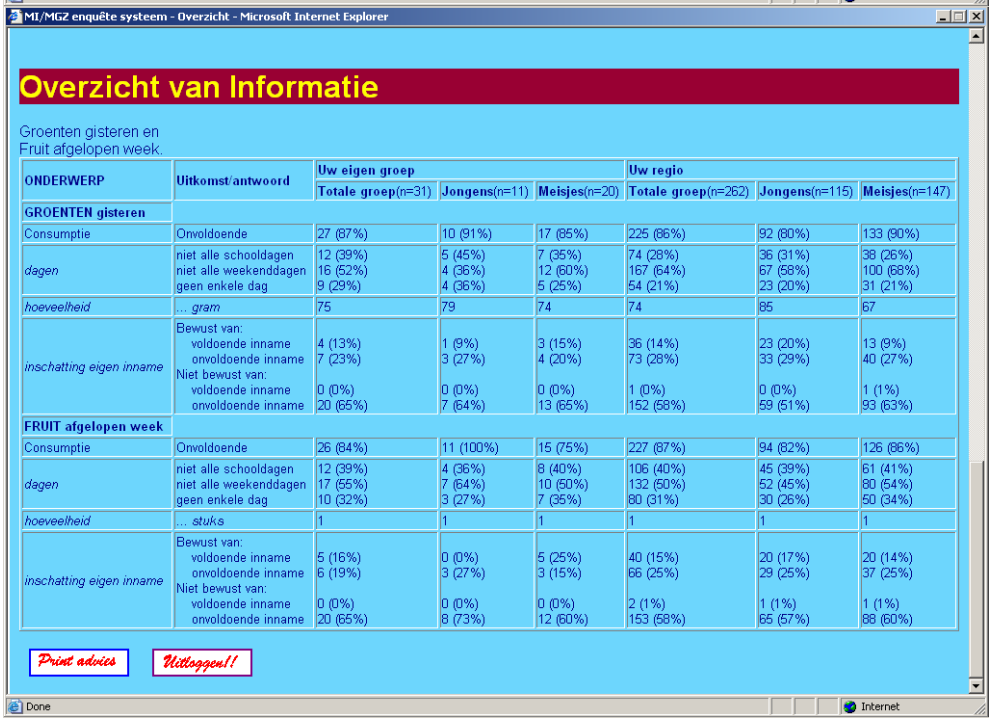


Fig. 9 Example of feedback for schools (see Fig. 9 continued on next page)





MI/MGZ enquête systeem - Overzicht - Microsoft Internet Explorer

Overzicht van Informatie

Groenten gisteren en
Fruit afgelopen week.

ONDERWERP	Uitkomst/antwoord	Uw eigen groep			Uw regio		
		Totale groep(n=31)	Jongens(n=11)	Meisjes(n=20)	Totale groep(n=262)	Jongens(n=115)	Meisjes(n=147)
GROENTEN gisteren							
Consumptie	Onvoldoende	27 (87%)	10 (91%)	17 (85%)	225 (86%)	92 (80%)	133 (90%)
dagen	niet alle schooldagen niet alle weekenddagen geen enkele dag	12 (39%) 16 (52%) 9 (29%)	5 (45%) 4 (36%) 4 (36%)	7 (35%) 12 (60%) 5 (25%)	74 (28%) 167 (64%) 54 (21%)	36 (31%) 67 (58%) 23 (20%)	38 (26%) 100 (68%) 31 (21%)
hoeveelheid	*... gram*	75	79	74	74	85	67
inschatting eigen inname	Bewust van: voldoende inname onvoldoende inname Niet bewust van: voldoende inname onvoldoende inname	4 (13%) 7 (23%) 0 (0%) 20 (65%)	1 (9%) 3 (27%) 0 (0%) 7 (64%)	3 (15%) 4 (20%) 0 (0%) 13 (65%)	36 (14%) 73 (28%) 1 (0%) 152 (58%)	23 (20%) 33 (29%) 0 (0%) 59 (51%)	13 (9%) 40 (27%) 1 (1%) 93 (63%)
FRUIT afgelopen week							
Consumptie	Onvoldoende	26 (84%)	11 (100%)	15 (75%)	227 (87%)	94 (82%)	126 (86%)
dagen	niet alle schooldagen niet alle weekenddagen geen enkele dag	12 (39%) 17 (55%) 10 (32%)	4 (36%) 7 (64%) 3 (27%)	8 (40%) 10 (50%) 7 (35%)	106 (40%) 132 (50%) 80 (31%)	45 (39%) 52 (45%) 30 (26%)	61 (41%) 80 (54%) 50 (34%)
hoeveelheid	*... stuks*	1	1	1	1	1	1
inschatting eigen inname	Bewust van: voldoende inname onvoldoende inname Niet bewust van: voldoende inname onvoldoende inname	5 (16%) 6 (19%) 0 (0%) 20 (65%)	0 (0%) 3 (27%) 0 (0%) 8 (73%)	5 (25%) 3 (15%) 0 (0%) 12 (60%)	40 (15%) 66 (25%) 2 (1%) 153 (58%)	20 (17%) 29 (25%) 1 (1%) 65 (57%)	20 (14%) 37 (25%) 1 (1%) 88 (60%)

Print advies Uitloggen!!

Done Internet

The first bar graph shows respectively the percentage of children with sufficient fruit consumption, sufficient vegetable consumption, and both combined. The lower bar graph shows the percentage of children with sufficient fruit and vegetable consumption respectively for both boys and girls, for boys alone and for girls alone. The feedback is printable (**Print advies**).

5.2 Feedback for physicians/nurses

The Internet tool includes a module for physicians/nurses to support the counseling. The first part of this module includes a screen for selecting students at risk (based on their self-reported answers to the questionnaire) (see Fig. 10).

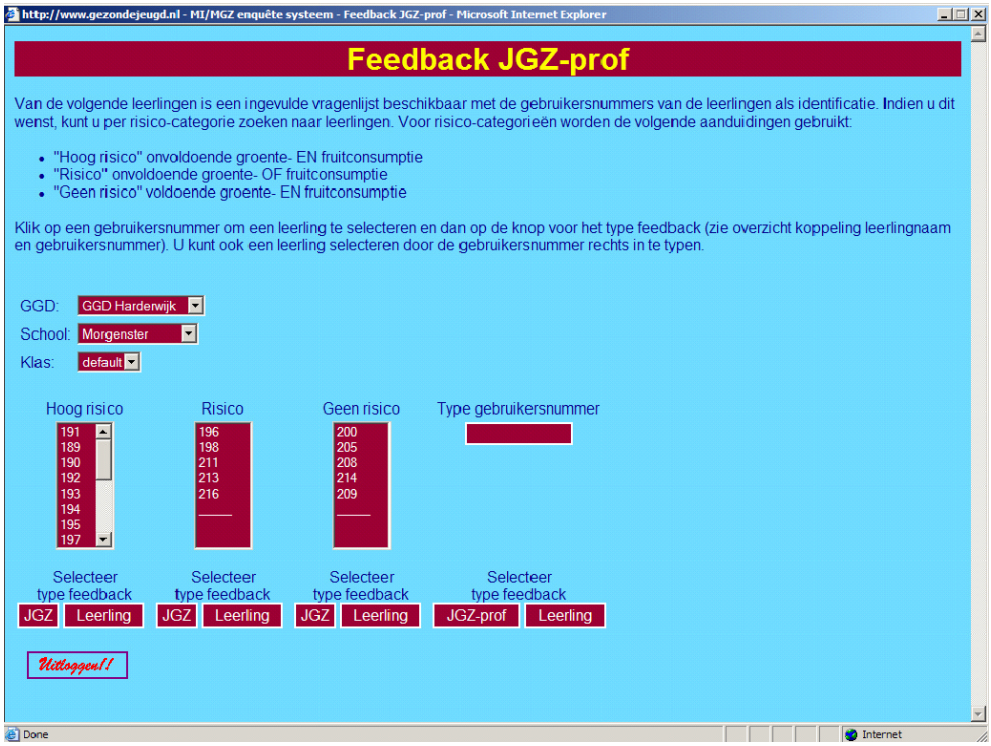


Fig. 10 Example of the overview of students divided in risk categories

For this particular questionnaire, risk profiles are defined as “High Risk“ (**Hoog risico**), “Risk“ (**Risico**) and “Not at Risk“ (**Geen risico**). The screen below is the output of the program that analyses the data and divides the students in the three

mentioned risk categories. The student population can be selected per MHS, per school and per class. The list of student numbers (i.e. user name) is displayed per category in selection boxes.

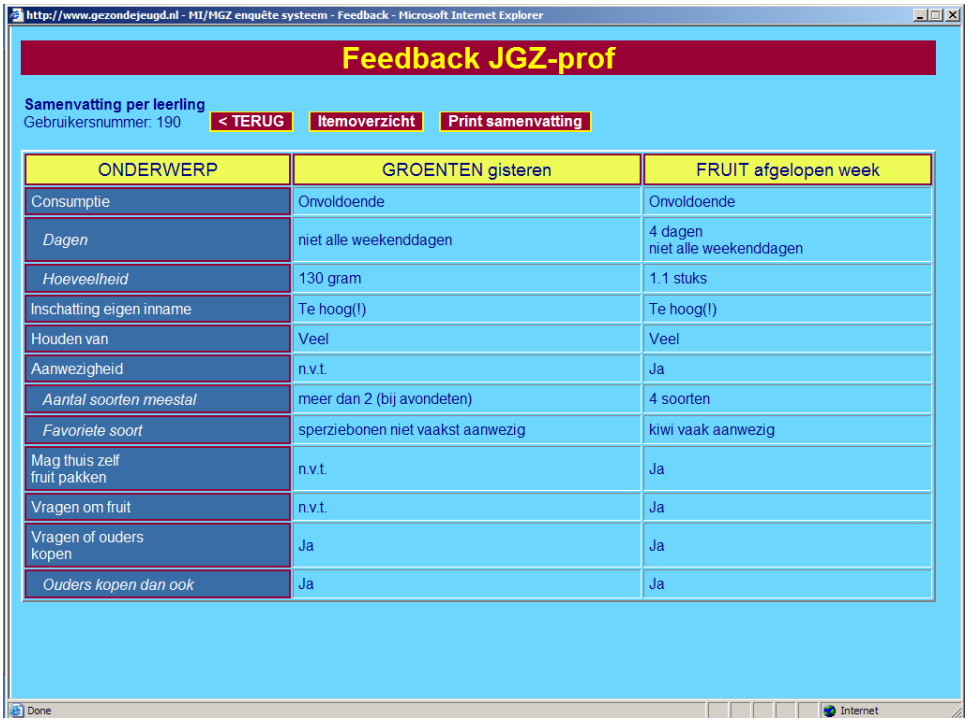


Fig. 11 Example of the summary output intended for physicians/nurses

The second part of the module to support the counseling consists of a summary of results for each student (see Fig. 11). The supervisor can select a student and select a summary (**JGZ** button of Fig. 10) or view the feedback that was also offered to the student (**Leerling** button of Fig. 10).

The left column (**Onderwerp**) in Fig. 11 describes the topics of the questionnaire to discuss during the counseling, the middle column shows the student's scores for the vegetable consumption, and the right category the scores for the fruit consumption. The three buttons at the top are respectively:

- **< TERUG** *return to the previous screen*
- **Itemoverzicht** *show the exact answers to questionnaire*
- **Print samenvatting** *print summary*

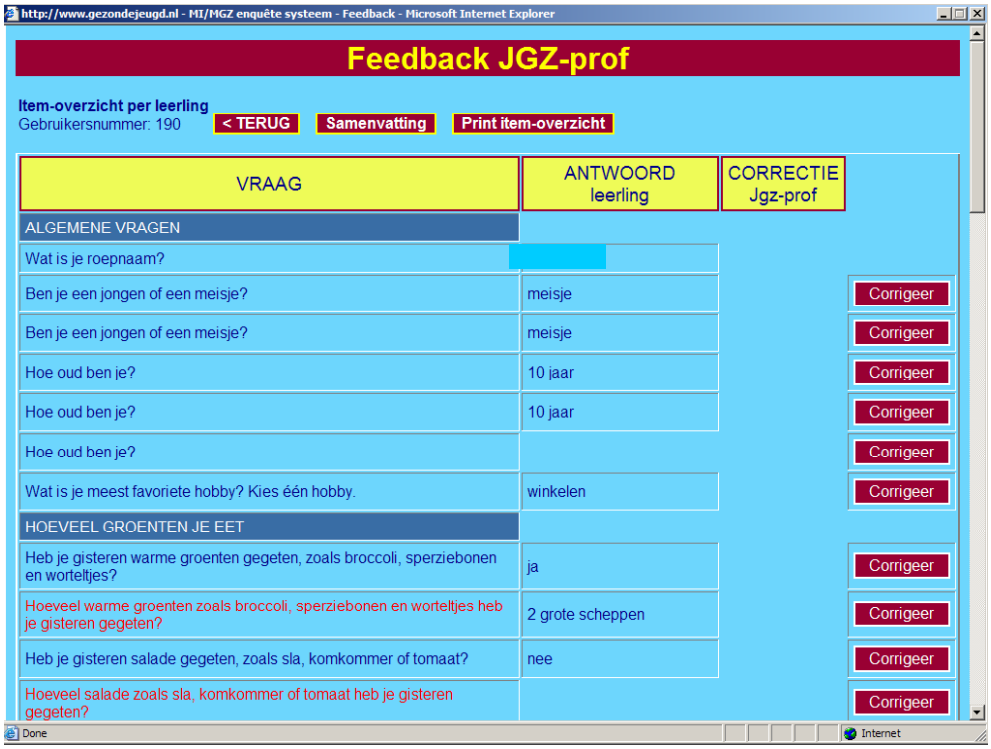


Fig. 12 Example of display of completed questionnaire that can be edited by a physician/nurse

The third part of the module for the physician/nurse allows viewing and editing of the exact answers given by a student. Clicking on the button '**Itemoverzicht**' in the example of Fig. 11 will display the completed questionnaire in a condensed format of Fig. 12. The physician/nurse can modify the answers given by a student, when in a personal counseling session it turns out that questions were not correctly answered. The feedback in that case is adjusted with the corrected

answer. The original answer of the student is, however, also kept in the database. In Fig. 12, the left column displays the question text (**VRAAG**), the second column contains the answer of the student (**ANTWOORD** leerling), and the third column is the corrected answer of the physician/nurse (**CORRECTIE JGZ-Prof**). With the button to the right of each question (**Corrigeer**), a screen is displayed allowing the physician/nurse to answer the question.

6 Designing and generating SPSS data files

This module or functionality is intended to retrieve data for statistical analysis. The data to be retrieved can be specified. For each item, the corresponding SPSS format specification can be given. To assist the administrator, a default syntax specification can be generated including all the variables belonging to the selected questionnaire (see Fig. 13). With the buttons in the first column (**Delete**) variables can be deleted. With the buttons in the second column (**Modify**), the specification of a variable is moved to the red fields at the bottom of the matrix and can be edited and stored again by clicking the **insert** button. New variables can also be added in the empty fields to the right from the insert button. Prefixes for the variable name in the last column are used to specify certain operations on the data, before they are written to the syntax file. These are operations like date and time conversion.

With the two list boxes at the bottom right the MHS (**Kies GGD**) and the school (**Kies school**) can be selected.
With the select boxes at the bottom on the left of the screen, the administrator can select the fully completed forms/questionnaire (**Complete formulieren**) and/or the partly completed forms (**Incomplete formulieren**). The full completion of questionnaires depends on whether the student followed the formal logout procedure, including the check on missing answers.

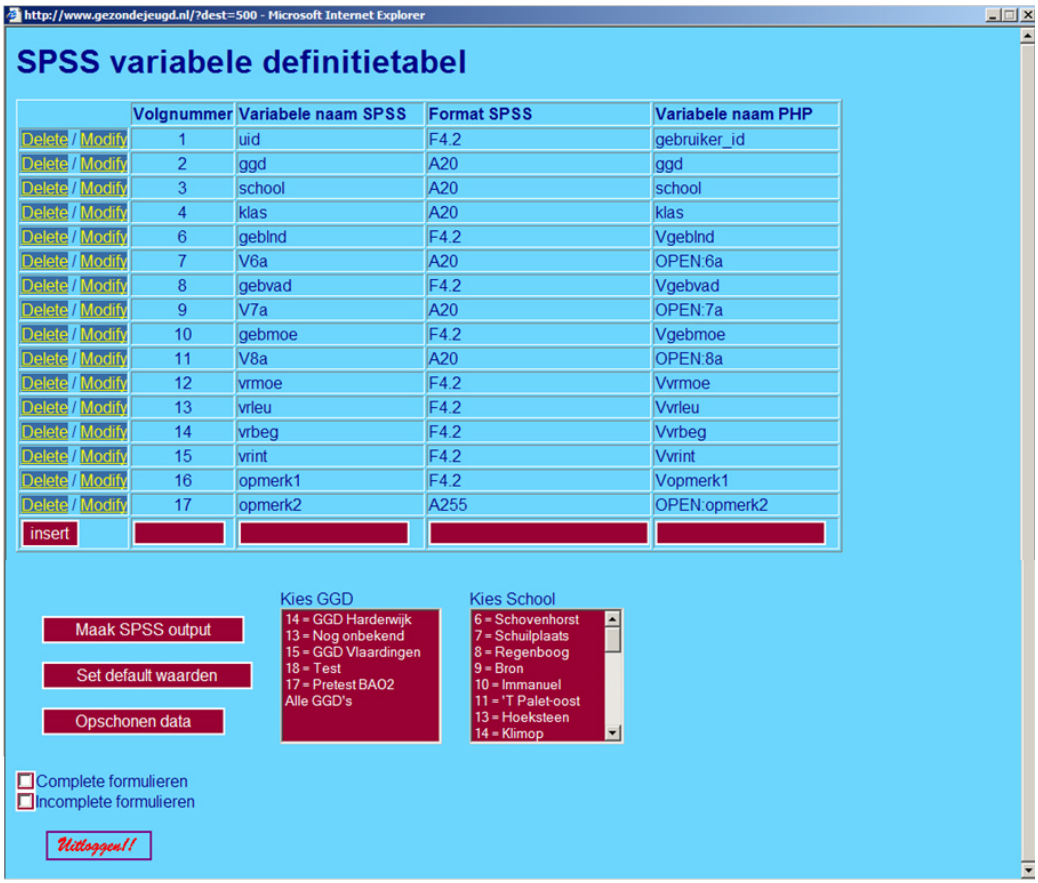


Fig. 13 Example of SPSS output specifications

By clicking the button "Generate SPSS output" (**Maak SPSS Output**), a file is generated and downloaded to the computer of the administrator. The downloaded file contains SPSS syntax to specify the data format, label values and full text of the questions etc. and the data itself. The user can separate and modify this file into an SPSS syntax and data file, which SPSS requires to be stored in a directory/map specified by the syntax file.

References

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