The influence of medical professionals' perception on the use of mobile self-assessment health applications

by

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Abstract

The use of mobile health applications for assessing one's health is a growing phenomenon in public healthcare. There are various types of health apps available and this research is interested in the health apps which cannot only be used to measure, for example one's calorie intake, but the apps which are able to provide medical advice via self-assessment functions to regular people. Current literature acknowledges the potential of using mobile health and self-assessment health apps in public healthcare as it for instance could reduce the workload at the general practices. However, self-assessment apps are not extensively recommended by medical professionals at general practices or adopted by people yet. Furthermore, the rather scarce literature on this topic suggests that these medical professionals might be more reluctant to recommend these apps to their patients as they perhaps perceive certain trust issues regarding these apps. The aim of this study is to investigate to what extent medical professionals trust the use of self-assessment health apps and to what extent this would influence, as a subjective norm, the adoption of it by patients. Therefore, the following research question has been formulated; *Which factors explain the level of trust of medical professionals at a general practice in the use of self-assessment health apps and to what extent does this trust influence the adoption of such apps by patients in the Netherlands?* To answer this question, semi-structured interviews were conducted with 13 medical professionals from general practices and an online survey has been distributed among patients which lead to a sample size of N=90. The collected data was analyzed using qualitative methods. The results indicated that generally medical professionals do trust the use of self-assessment health apps but that this trust is very likely to be influenced by their previous knowledge and experience regarding these apps. Furthermore, patients indicated to be quite willing to follow a health app advice by their GP and the medical professionals had rather mixed feelings if every patient would follow such advice. It was concluded that it is likely that the trust level of medical professionals, as a subjective norm, could be an influential factor on the patient's willingness to adopt self-assessment health apps. This study adds to the current public health literature by providing more insights on the trust level of medical professionals at general practices regarding self-assessment health apps and the influence of this trust on the app adoption by patients.

Table of contents

1. Introduction

The use of mobile health applications is an increasing phenomenon in the public healthcare. Such "mHealtcare apps can be patient/consumer-facing apps or those which target health-care professionals providing them with quicker access to patient information and triaging, patient monitoring, and medical information" (Sheppard, 2020, p. 550). There are more than 350,000 apps available for individuals which can be easily downloaded on their smartphone and keep for instance track of your steps, heartbeat or provide a medical diagnosis (Sheppard, 2020). So to say, there are many types of health apps on the market and the current academic literature does not provide one clear distinction between for example a health or wellness app. According to the EU and WHO, Mobile Health apps (mHealth) covers "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices" (EuropeanCommission, 2014, p. 3). This definition includes wellbeing apps as well as self-assessment apps. The EU sees potential of mHealth, as it can assist the European healthcare systems with for instance the challenge of the ageing population and budgetary pressures by creating more efficiency via self-assessments and diagnosis sharing tools (EuropeanCommission, 2014). The literature states that there is no official classification of the types of mHealth apps and therefore are these often categorized based on their function (Dehzad, Hilhorst, Bie, & Claassen, 2014). In this research we are not interested in the health apps which medical professionals or healthcare organizations can use for themselves in terms of decision making or in relation with their patients, but the applications which are used by individuals for tracking their (diet) activities, monitoring (sleep) cycles or providing medical advices (Innovatemedtec, 2020). More specifically, the apps which provide medical advice via self-diagnosis and so self-assessment functions of the application are here of interest. This means that individuals can 'assess' themselves about certain health symptoms because they fill in their symptom data in an app which in turn provides advice based on that data.

These self-assessment health apps can be seen as a disruptive technology since it can change the doctor-patient relationship as people seek for medical advice via an app on their phone by entering their medical data and symptoms instead of contacting a general practice (Sheppard, 2020). Furthermore, there is a certain level of trust and risk-assessment involved when approving the use and corresponding results of such an app since there is a chance that it provides an incorrect outcome (Wattanapisit et al., 2020). These concerns are also among medical professionals because one can question if advice from a mobile app is comparable to the diagnoses of the medical professional (Wattanapisit et al., 2020). Although, some self-assessment apps such as *Ada*, *Babylon* or *Symptomate* could for example be seen as trustworthy applications since they provide advice comparable to a real general practitioner (Gilbert et al., 2020). Nevertheless, the implementation and recommendation of self-assessment health apps by medical professionals is still proceeding rather slowly, suggesting that they might perceive certain issues (Gagnon, Ngangue, Payne-Gagnon, & Desmartis, 2016). These 'trust' issues among, for example GPs, are of relevance since the first health diagnosis is important and should be correct as it can lead to serious

health consequences for a citizen. A consequence could be that the condition of the patient gets worse and that could lead to other unintended social-economic costs for that individual such as health costs or absenteeism (Foot, Naylor, & Imison, 2010). GPs are the first step in the diagnosis process as they have the task to "marginalise danger by recognising and responding to signs and symptoms of possible serious illness" (Foot et al., 2010, p. 3). Moreover, GPs can choose to referral their patient with certain symptoms which is a "process with very direct consequences for patients' experience of care, and an important cost-driver in the health system" (Foot et al., 2010, p. 4).

In the Netherlands at the general practices, the GPs are not the only ones who can provide the first diagnosis or prescribe medication to a patient. The administrative worker of the practice can also send a potential patient to a Physician assistant (PA). These PAs are medical professionals who are also able to make a diagnosis or prescribe medication, thereby somewhat reducing the workload of the GPs at the practice (KOH, 2020). Furthermore, PAs have, like GPs, their own consultation hours and can perform small medical operations (Bot, 2020). They are working independently and can consult with the GP if necessary. Since 2018, they are able to register themselves in the *BIG-register* in the Netherlands, which means that they have, like the GP, a legally protected professional title and are subject to disciplinary law (Bot, 2020). This register describes the tasks which they are allowed to perform independently.

Besides these PAs, there are also *Praktijkondersteuners* (POH) working at a general practice who advise patients. These people are more specialized in patients who have a chronic condition such as cardiovascular disease, diabetes, asthma/COPD or patients who have psychological complaints (CZ, 2018). The POH is, unlike the PA, not able to make a diagnosis or prescribe medication but advises the GP on these matters as the GP remains the person who is ultimately responsible (CZ, 2018). Nevertheless, the POH is still of importance for many patients as he or she provides advice and guidance to the patients related to their medical condition and medication during their own consultation hours. Furthermore, they also keep track of the patients' health and gather patient data about one's medical condition during their consultation hours. This makes POHs relevant as many current health apps also claim to be able to perform such tasks. Given the expertise of these POHs, they could have an interesting perception on the use of self-assessment health apps which are more related to their own specialization area. Next to the rather general self-assessment apps such as *Ada*, they could have a perception on apps which are developed for people with diabetes, asthma or mental health problems.

So besides the GP, the physician assistants and praktijkondersteuners are also closely involved with patients at a general practice regarding the provision of advice on medical issues. This makes their vision on types of self-assessment health apps relevant since they can also advise a patient to use such an app or not in the rather 'first diagnosis stage' of a person. These three important actors in a general practice are together referred to as medical professionals in this research.

1.1. Research questions

In general, patients trust their doctor at a general practice and take their advice seriously as long as they have the feeling of being taken seriously as well (Croker et al., 2013). This could mean that a patient for instance does not think about downloading a self-assessment health app when their medical professional does not trust these apps. At the moment, only 10% of the people in the Netherlands use health apps which comprise self-assessment functions (ICT&health, 2019). One could question if the perception of healthcare professionals about these apps might influence the use of these apps among their patients. To investigate if the perception of medical professionals regarding self-assessment apps might influence the use of these types of apps among their patients, the following research question is established;

Which factors explain the level of trust of medical professionals at a general practice in the use of self-assessment health apps and to what extent does this trust influence the adoption of such apps by patients in the Netherlands?

The purpose of this question is to explain which factors influence the level of trust of medical professionals in self-assessment health apps and if this trust influences the adoption of it among their patients. Within the first part of the research question, the units of analysis are the medical professionals. Here, the level of *trust* is the dependent variable since it will be investigated which factors influence their level of trust. Within the second part of the research question, the units of analysis are the patients. The independent variable is then the level of *trust* of the medical professionals and the dependent variable *adoption* by the patients regarding self-assessment health apps. Furthermore, *the Netherlands* can be identified as the setting in this research question. Moreover, several sub questions are formulated to better understand the components of the main research question.

The corresponding sub questions are;
1. To what extent do medical professionals studied trust the apps in question?
2. Which factors influence the trust in self-assessment health apps of medical professionals?
3. To what extent can we say that the patient population studied has adopted one or more health apps?
4. To what extent does the medical professionals' trust influence technology adoption of patients?

1.2. Scientific and societal relevance

This research will add to previous research since not much current scientific literature addresses the trust in self-assessment health apps from a medical professional's point of view (Boeldt et al., 2015). Current literature provides only some indication of general perceptions of medical healthcare providers about

these types of apps but not from the medical professionals at general practices alone (Boeldt et al., 2015). Furthermore, it is also not quite known to what extent this trust leads to a recommendation of self-assessment apps by the medical professionals, which in turn could influence the potential adoption of these apps among patients. By investigating the influence of these perceptions, this research could add to the public health literature as it creates an understanding of the influence of the primary healthcare providers, who are among others the medical professionals at general practices, on the general public in the area of mHealth. In this way, this research has scientific relevance. Additionally, these medical professionals and their opinion are of relevance because, as mentioned, they are the one who provide the 'first' diagnosis to a possible ill citizen and are therefore making crucial decisions at that moment if any proceeding steps are needed for the sake of the patient's health (Foot et al., 2010). When an app would do this instead, such advice must be correct since an incorrect recommendation can have unintended health consequences. Correct advice in turn could be beneficial because people might not go unnecessary to their general practice which can reduce some of the medical professionals' workload (van der Velden, Verheij, & Teunis, 2019). The perspectives of medical professionals at the general practice are needed to better understand and gain insight if these apps would be a valuable contribution to the public health when they are used by the citizens thereby adding to the societal relevance of this research.

2. Theory

In section, the current literature will be discussed and the important theoretical concepts are conceptualized. Furthermore, expectations are formulated and different types of self-assessment apps are described.

2.1. Theoretical background

Currently, there is not much literature available on how medical professionals think about the use of self-assessment applications by their patients. A study which provides some insights regarding this is focused on the perceptions of consumers and medical providers such as doctors, practitioners, nurses, physician assistants and medical students about the use of medical technologies like mobile applications which have so called 'self-diagnostic' functions which people can use to assess themselves (Boeldt et al., 2015). It appeared that "consumers were more likely to prefer using technology for self-diagnosis of non-life-threatening medical conditions compared with providers, with more health providers than consumers reporting feeling uneasy about consumers using technology for self-diagnosis" (Boeldt et al., 2015, p. 5). Furthermore, the majority of the "providers preferred a diagnosis be made by a professional" (Boeldt et al., 2015, p. 5) compared with less than half of the consumers having this perception. This is an interesting finding since it shows that consumers and healthcare professionals in general think

differently about the use of self-diagnosing apps to assess oneself whereby the healthcare professionals seem to have more concerns.

These medical professionals, especially at a general practice, could be considered as a way to promote the use of health apps among their patients (Zhang & Koch, 2015). As mentioned earlier, some self-assessment apps are considered as reliable and could be beneficial for the general practice as it reduces some of their workload. However, when medical professionals cannot trust these apps in terms of their correct outcomes, they are not inclined to recommend them to their patients as the patients' wellbeing is their priority (Zhang & Koch, 2015). Trusting such apps means for instance that they know if the apps and the source they came from are reliable and if the patient's personal health data has been handled safely (Byambasuren, Beller, Hoffmann, & Glasziou, 2020). When they do trust these apps, they could express this trust by choosing to suggest certain self-assessment apps in generic terms or recommend them specifically by name to a patient (Byambasuren et al., 2020).

The literature is more rich on theoretical explanations about why individuals are willing to adopt certain technologies (Beldad & Hegner, 2018). New technology adoption studies regularly use the *Technology Acceptance Model* (TAM) which is derived from the Theory of Planned Behaviour and Theory of Reasoned Action, to explain why a new technology is accepted and adopted. An article by Beldad and Hegner (2018) for instance also included trust, social influence and health valuation into the TAM to explain the use of health and fitness apps. The TAM implies that the willingness to adopt a technology is influenced by "the perceived ease of use and perceived usefulness" (Beldad & Hegner, 2018, p. 883) and this means that one can expect that an individual would adopt a particular health app when the app has certain benefits for that person and that the complexity of using it is not that high. Furthermore, their study included social influence, also known as subjective norm, as a predictor of technology adoption. This social influence entails that individuals choose to behave in a certain way when they think that significant others expect them to do so (Beldad & Hegner, 2018). Their study found that the perceived usefulness and ease of app use significantly influence the willingness to adopt a health app and the social influence was found to be significant as well (Beldad & Hegner, 2018). Another study also made use of this TAM to research the adoption of health apps and thereby included the subjective norm and one's health consciousness, health information orientation, eHealth literacy and internet health information use efficacy as predictors (Cho, Quinlan, Park, & Noh, 2014). The regression results of the subjective norm also appeared to be significant in this study, meaning that when a person who is important to the individual thinks he or she should use a health app, the individual is then more likely to do so (Cho et al., 2014). One could argue that this subjective norm perceived by individuals could be the perception and so trust in a health app by the medical professionals since diverse studies showed that in general, an individual trusts their general practice doctor thereby seeing him or her as a significant other (Croker et al., 2013).

Several studies also indicate that the willingness to adopt health apps can be related to the demographic background such as age or educational level of the adopting individual (Bol, Helberger, &

Weert, 2018). The study by Bol et al. (2018) for instance found that, among a sample of the Dutch population, generally young and highly educated people are more likely to use various types of health apps. Furthermore, it appears that older individuals were more likely to use health apps related to self-care and monitoring of vital signs but there was no significant relation between particular types of health apps, with exception of mindfulness apps, and one's educational level (Bol et al., 2018). Nevertheless, another study from the Netherlands found that elderly still do have an intention to use health apps and that this is, among other predictors, influenced by the subjective norm (Askari, Klaver, van Gestel, & van de Klundert, 2020).

2.2. Factors influencing the trust of medical professionals

2.2.1. Familiarity

The level of trust in self-assessment apps by the medical professionals can in turn also be influenced by other factors. The literature provides diverse explanations which are for instance related to personal or organizational factors that can influence someone's trust (Li, Hess, & Valacich, 2008). Moreover, these factors are in turn related to different circumstances and stages of a person's 'trust formation' (Li et al., 2008). Prior studies in the rather related context of E-commerce and Health information technology have researched the influence of familiarity with a technology on the level of trust (Gefen, 2000; Xie, Prybutok, Peng, & Prybutok, 2020). Familiarity is often seen as an understanding "based on previous interactions, experiences, and learning of what, why, where and when others do what they do" (Gefen, 2000, p. 727). This familiarity is different from trust as it "deals with an understanding of the current actions of other people or objects, while trust deals with beliefs about the future actions" (Gefen, 2000, p. 727). In the context of technology, it is thus about the experience and additional knowledge one has acquired from interacting with a particular technology. It must be noted that this familiarity can also be obtained in a more indirect form as some persons might not have personal experience with for instance health apps. When that is the case, people will try to become familiar with the technology by relying on information and experiences of others (Xie et al., 2020). In either way, the familiarity with the technology will help to create a certain 'background' with expectations about the technology which is important for people to have when trusting an object, in this case a health app, to perform as expected (Gefen, 2000). So to say, the familiarity with mobile health applications, thereby having a certain experience and knowledge background about it, could influence perception and so level of trust in a particular health app.

2.2.2. Risk perception

Another possible influential factor is the risks one can perceive since these are often closely related to someone's level of trust or uncertainty. In the context of trusting technologies and eHealth, several studies mentioned that certain risks are also perceived by for instance physicians, especially risks

regarding the privacy of patients data (Egea & González, 2011). Literature suggest that "the uncertainty in medical professionals' use of health information technology will result mostly from the lack of confidence in the adequate functioning (e.g., privacy and security of patient identifiable data) and benefits (e.g., efficiency improvements and reduction of medical errors) provided by different health IT applications" (Egea & González, 2011, p. 323). These thoughts from medical professionals about the adequate functioning and provided benefits of a technology say something about the level of uncertainty and so trust in that particular technology (Mcknight, Carter, Thatcher, & Clay, 2011). Perceived risks are often seen as "necessary conditions for trust to be predictive of human behaviour, that is, trust is only needed in risky situations" (Egea & González, 2011, p. 323). So to say, risk perceptions can influence the perception and so the level of trust regarding the functioning of a technology (Egea & González, 2011). The literature acknowledges many 'types' of risks which a person can perceive, but in this research, we investigate the level of trust of medical professionals related to the mobile app adoption by patients which makes the type of risk regarding the privacy of patient data most interesting. Furthermore, these health apps partly deal with medical data since the inserted data by patients is related to their medical issues which makes perceived privacy risks especially important. The perceived privacy risks could be an influential factor on the level of trust of the medical professionals.

One could also argue that medical professionals might perceive other risks, such as the risk that a self-assessment health app would provide incorrect advice. However, current literature rather sees this possibility of incorrect advice and so reliability of the application as a dimension of the general trust perception and did not, to our knowledge, write extensively about it as a separate risk factor (Mcknight et al., 2011). Moreover, given the scope and timespan of this thesis, it is not possible to investigate all the possible risks a medical professional could perceive in detail and therefore it was focused on the perceived privacy risk.

2.3. Conceptual framework

The literature describes that the TAM functions as a solid model to explain why people, or in this case patients, want to adopt a health app based on for instance the perceived subjective norm. As mentioned, this subjective norm could be linked to the perception of the medical professionals. Furthermore, this perception of medical professionals and so their trust can in turn be influenced by their familiarity and perceived privacy risks regarding these apps. The level of adoption according to the TAM is also influenced by the perceived ease of use and perceived usefulness, meaning that one could consider adopting a self-assessment health app when it is easy to use and comes with certain benefits. The following conceptual framework will visually show the relations between the variables that are derived from the reviewed literature.
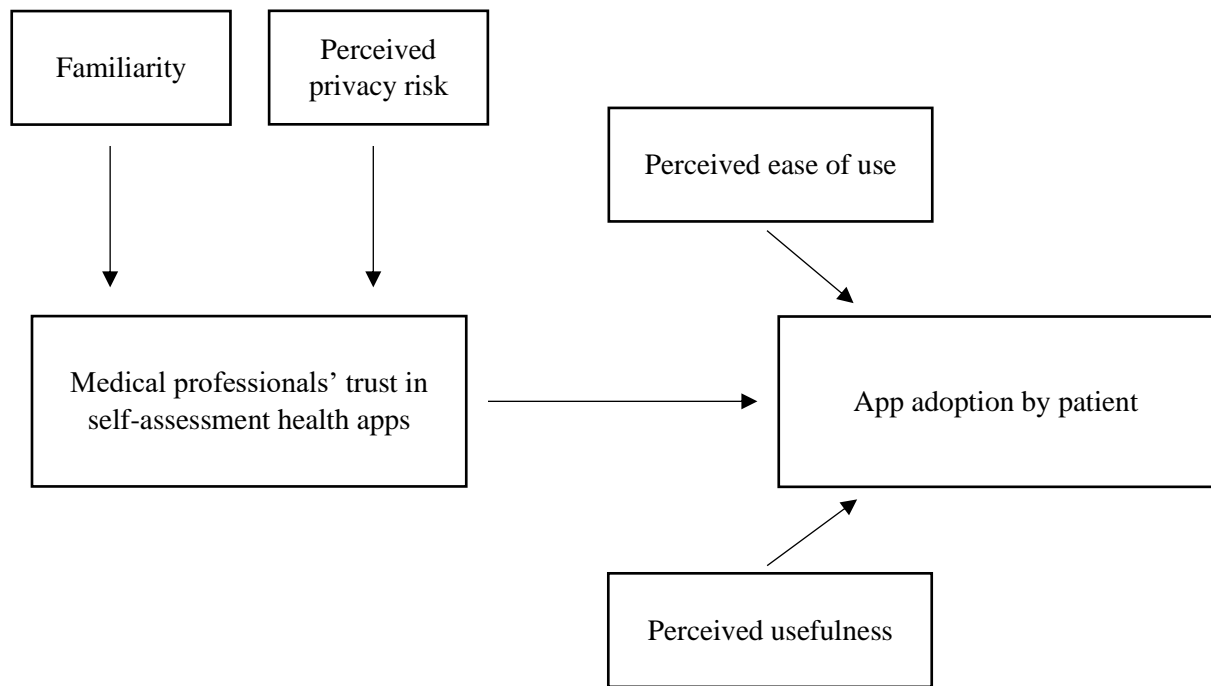
Figure 1: Conceptual framework

2.4. Conceptualization

The most important variables which need to be conceptualized are the 'familiarity', 'perceived privacy risk' and the 'trust' of the medical professionals and the 'adoption' of the patients. The concept of *adoption* refers to "the individual's decision whether to integrate an innovation into his or her life" (Straub, 2009, p. 629). This means that a person adopts a certain technological innovation, in this context a self-assessment health app, when he or she accepts it by using it. Furthermore, this adoption and so acceptance does not mean that the technology is a replacement (Straub, 2009) but an additional tool that one uses to assess him or herself when having certain health symptoms. When one adopts such an app, it does not automatically mean that the individual never goes to a general practise again. Furthermore, it is also possible that the individual decides to adopt regardless of the opinion of the medical professional or that the opinion only can trigger a change in mind when the individual already hesitates. Moreover, it is possible that the individual is fully likely to follow the perception of the medical professional regardless of their own level of trust. Or that the individual is fully likely to never listen to the opinion of a medical professional and only relies on that of their own.

The concept of *trust* in relation to technology means "beliefs that a technology has the attributes necessary to perform as expected in a situation" (Mcknight et al., 2011, p. 125). So the medical professional relies on the health app to complete its task of providing correct advice to the patient. The underlying dimensions of this concept are functionality, helpfulness and reliability. In this context 'functionality' means that "one expects the technology to have the capability to complete a required task" (Mcknight et al., 2011, p. 129) so the app has the right functions by which it is capable of providing advice. The dimension 'helpfulness' entails the belief that the technology "provides adequate help for

users", so that the advice is of use for the patients (Mcknight et al., 2011, p. 128). The dimension 'reliability' means the belief that it "will consistently operate properly" (Mcknight et al., 2011, p. 129) in terms of the outcomes the app provides to the patients. The advice produced by the apps are then believed to be correct. This does not include the possibility that the patient itself filled in wrong data but assuming that when the symptoms are filled in correctly, the app does provide reliable advice. All these dimensions together explain the perceived trust of the medical professionals in the use of self-assessment health apps by patients.

The concept of *familiarity* in the context of technology is "a specific activity-based cognizance based on previous experience or learning" (Gefen, 2000, p. 727) of how to use a technical object. This means that a person has a certain level of experience and knowledge regarding health apps because they have been interacting with it before. Furthermore, as mentioned earlier this experience and knowledge can also be based on secondary information of others, meaning that even if a person has not used a health app before, he or she can still be familiar with it based on someone else's knowledge and experience (Xie et al., 2020). The familiarity with health apps is thus always present to a certain degree even if it comes from either personal or secondary knowledge and experience sources.

Generally, the concept of perceived privacy in the context of technology refers to "the perceptions about the protection of individually identifiable information on the internet" (Riquelme & Román, 2014, p. 137). Individuals then consider the risk of their information being exposed and or shared with third parties (Riquelme & Román, 2014). This means that one can perceive privacy risks when they are not sure how their personal data is handled by, in this case, a mobile health app. As mentioned, such perceived risks can emerge when there is a lack of confidence in the correct functioning of the technology (Egea & González, 2011). The concept of *perceived privacy risks* then refers to the confidence level of the medical professionals towards the adequate protection of the individually identifiable information of patients by the health app.

2.5. Expectations

As the conceptual framework indicates, the trust of a medical professional regarding the use of self-assessment health apps is linked to the app adoption by the patient. The literature indicated that according to the TAM the app adoption of an individual is influenced by the perceived ease of use and perceived usefulness of the app and according to literature by the subjective norm (Beldad & Hegner, 2018; Cho et al., 2014). The perceived ease of use and perceived usefulness are considered as the basic components of the TAM, meaning that these influences on the level of adoption have been tested and confirmed frequently in academic research (Marangunić & Granić, 2015). Also in the context of mobile health, several studies tested and showed that these two factors significantly impact the actual use of a health app by a person (Beldad & Hegner, 2018). One then expects that when a particular mobile health app is easy to use, one would be more likely to adopt it. Additionally, one expects that when a particular mobile health app is seen as beneficial to someone, one would be more likely to adopt it. Given the

scope and timespan of this study, we chose to not test these expectations in detail as they are also not the main focus in this research. Not formally testing these two variables could be considered as a limitation, which future research could consider. Nevertheless, this research does include these two factors as control variables on which data have been collected so it is controlled for when testing the influence of the main variable of interest, the subjective norm.

This subjective norm means that "people may choose to perform a behaviour, even if they are not themselves favourable towards the behaviour or its consequences, if they believe one or more important referents think they should, and they are sufficiently motivated to comply with the referent" (Beldad & Hegner, 2018, p. 883). So when a health app is easy to use, found to be useful and if an important person to the patient approves the use of it (subjective norm), the individual will probably adopt it. The important person to the patient could then be the medical professionals from the general practice since they are the one who provide important health recommendations when needed (Krot & Sousa, 2017). Moreover, the perception and so trust of the professional in the health apps could then be the subjective norm influencing the patient because of this doctor-patient relationship. This reasoning leads to the following expectation;

H1: When a medical professional trusts the use of self-assessment health apps, patients are more likely to adopt one.

The familiarity with health apps can create a certain background with expectations about the particular technology which can be of influence on the level of trust of the medical professional. Literature suggests that when this background of knowledge and experience based on their own interactions or on the interactions of others is rather positive, it would increase people's trust (Gefen, 2000; Xie et al., 2020). Being more familiar with the health apps means having a better understanding about this technology in terms of interacting with it. When this familiarity is for instance positive, in the sense that a person knows and experienced favourable outcomes, one can argue that this leads to an increase of trust regarding the technology (Gefen, 2000; Xie et al., 2020). Therefore the following expectation has been formulated in which familiarity is seen as a positive construct;

H2: A higher degree of positive familiarity with self-assessment health apps by a medical professional, will increase their level of trust in these health apps.

Perceived risks and so perceived privacy risk can influence the level of trust one has in a certain technology (Egea & González, 2011; Riquelme & Román, 2014). According to the literature, higher risk perceptions can reduce one's level of trust in the functioning of the technology and also when these risk perceptions are privacy related, one is less likely to trust the technology (Egea & González, 2011; Riquelme & Román, 2014). So when one perceives more risks that a health app will not

carefully handle the inserted personal data of the patients, this could lead to a lower level of trust in that health application. This leads to the following expectation;

H3: A higher degree of perceived privacy risks by the medical professional, will decrease their level of trust in self-assessment health apps.

2.6. Different types of self-assessment health apps

This research is interested in health apps which generally have more functions than only storing data or keeping track of one's inserted data. The health apps of interest provide recommendations and so advice to a person as well. This means that these apps have a 'self-assessment' (Dutch; *zelfevaluatie*) function, since patients are able to get advice about their general or specific health condition from the health app after inserting their data and answering questions by themselves. Below, there are few health apps described which can be used for self-assessments by patients. The first app example is designed for rather general medical complaints and the other three are related to more specific health conditions that individuals already can have such as diabetes, asthma or mental health issues. The latter three apps are then of special relevance for the POHs from a general practice since, as described earlier, they are the medical professionals who are more specialized in certain medical conditions.

Some of these health apps have a CE mark, which means that the app, as a product, is seen as a medical device that complies with the European product safety regulations (van Drongelen, de Bruin, Roszek, & Vonk, 2018). A health app can be seen as a medical device when it performs any action on the data, that is for instance data inserted by the patient, to create a diagnosis or advice (van Drongelen et al., 2018). So an app which only stores data is not considered a medical device. For manufacturers, the CE mark comes with extra responsibilities since the quality and safety of the app should be upheld according to the regulations (van Drongelen et al., 2018).

Moet ik naar de dokter? (General advice app)

The *Moet ik naar de dokter?* mobile application will let the user know if they have to contact their general practitioner or not after filling in a short questionnaire (van der Velden et al., 2019). Patients have to indicate in the app on a picture of the human body where they have any symptoms and the app will ask several questions related to that area. Based on individual's provided answers and personal characteristics such as age and gender, the application will provide advice (van der Velden et al., 2019). This advice will indicate if you have to go to a GP, have to wait if the symptoms worsen, or how to reduce the current symptoms. Additionally, it shows where the nearest general practice is with the use of one's GPS. In this way, according to the app, unnecessary waiting at the general practice can be avoided as the app already indicated if you should contact the GP or not. An advantage of this app is that it could reduce to some extent the workload of the GPs and saves time of patients (van der Velden et al., 2019). Furthermore, this application has a CE mark, which means that it complies with the

European product safety regulations and the application has been validated by GP associations (van der Velden et al., 2019). Such a CE mark can play a role when forming a perception regarding the trustworthiness or reliability of the app. A disadvantage of this application is that it only provides advice regarding the one area which was selected on the picture in the app and not multiple areas at the same time. Furthermore, the application could provide more extensive information on what to do, especially in situations where there is non-urgent advice given (van der Velden et al., 2019). These disadvantages could influence the perception of how useful or helpful the app could be.

MySugr (Diabetes app)

The application *MySugr* is designed for people with diabetes and keeps track of one's nutrition, medicine use, blood values and can provide recommendations for insulin dosages (DigitaleZorgGids, 2016). Additionally, it has a function whereby it can motivate the patient by providing certain challenges to achieve personal health goals (DigitaleZorgGids, 2016). It can help the patient by showing 'trends' in their blood sugar values by calculating the Hemoglobine bA1c value and it has a bolus calculator which provides advice regarding the amount of insulin units you need to add before each meal (Doctorpedia, 2020). These functions are an advantage for diabetes patients as they give a clear oversight related to their medical condition which can also be shared with their healthcare provider (DigitaleZorgGids, 2016). Moreover, this application has the CE-mark, meaning that it complies with the European product safety regulations for medical devices which can increase its trustworthiness (Drimpy, 2017). A disadvantage of this application is that when the user wants more elaborate functions and advice, he or she has to get the pro-version for which one has to pay (Doctorpedia, 2020).

Astma Zelfcheck (Asthma app)

The *Astma Zelfcheck* application is developed for patients who want to keep track of and control their asthma (DigitaleZorgGids, 2018). By answering six questions in the app, a so-called ACQ-score (Asthma Control Questionnaire) is calculated and shown to the patient which indicates to what extent their asthma is under control (DigitaleZorgGids, 2018). The sore will tell the patient that their asthma is completely under control, sufficiently under control or not under control whereby the advice is given to contact their GP. An advantage of this application is that, because of this score, a patient can estimate for themselves if their current asthma treatment is useful. Moreover, this ACQ score is also regularly used by GPs which makes it easy to share results when needed. During the consultation hours of for instance the POH, they control the airway complaints of the asthma patient by performing, among other procedures, these ACQ score tests and discuss the results with the patient (Bottema et al., 2020). The score can range from 0 till 6 where a score of 0.75 and above is considered as unsatisfactory, meaning that a change in medication might be needed (Bottema et al., 2020). The Astma Zelfcheck application, however, has no official CE-mark which could be considered as a disadvantage since it cannot really officially be seen as a medical device which could question the quality of the provided advice (van

Drongelen et al., 2018). Nevertheless, the app is displayed on diverse websites of patient organizations as an example for asthma related health apps (DigitaleZorgGids, 2018). The only application for asthma which has the CE-mark is the app called *Astmaatje* which is designed for children. (Roukema & Barnhoorn, 2018). This application contains a logbook function, provides tips for children and also has a control test but this one is called the Asthma Control Test (ACT) which has one question less compared to the ACQ test. Both control tests are comparable and used by medical professionals to control asthma complaints, the main difference concerns that the ACQ focuses on asthma complaints from the last seven days and the ACT on the complaints from the last four weeks (Bottema et al., 2020).

NiceDay (Mental health app)

The mobile application *NiceDay* is designed for people who struggle with negative thoughts, especially in situations that evoke anxiety and stress (MIND, 2020). The application offers personal and professional mental support by setting goals and providing information while keeping track of your feelings and movements (MIND, 2020). An advantage of this app is that it can provide useful supportive information links at all times and it assists in recognizing certain mental patterns which you could improve in your lifestyle (MIND, 2020). The application, however, does not automatically remind you every day to fill in your feelings and movements which could be seen as a disadvantage. This rather lacking function could influence the perception of the usefulness of the app because if the app needs to recognize patterns, every day data should be registered. Furthermore, the app does not have a CE-mark but many apps related to mental health do not always get this as they are often not seen as a medical device (van Drongelen et al., 2018). Nevertheless, the Dutch healthcare organization for mental health (*De Nederlandse Geestelijke gezonheidzorg* (GGZ)) who treats patients with these types of problems has developed their own quality mark for apps related to mental health to which the app NiceDay belongs (GGZ, 2021). The quality mark has been presented by the GGZ and the Dutch MIND foundation to create a better oversight in the growing supply of mental health apps. The GGZ app guide displays apps which are tested by the GGZ panel of professionals with a background in mental healthcare and the apps get a score between 0 to 100 related to for instance their data security, usability and reliability (GGZ, 2021).

In summary, there are different types of self-assessments health apps which patients could use in order to assess themselves regarding their general or more specific health condition. Each of these apps have their advantages and disadvantages. The app *Moet ik naar de dokter* and *MySugr* have for instance also a CE mark, meaning that they comply with the European product safety regulations, which could increase the trustworthiness in these apps. The apps *Astma Zelfcheck* and *NiceDay* however, do not have this mark but they are displayed on the websites of official patient organizations, which could indicate their reliability.

3. Methodology

The following section will discuss the research design and case selection of this research. Next, it is described how the variables are operationalized, the data is collected and analyzed.

3.1. Research design and case selection

This research is interested in to what extent the trust of the medical professional in the use of self-assessment health apps influences the adoption of these apps among patients. Thereby it is focused to explain this possible relation in detail and therefore has this study a qualitative approach. Moreover, other studies in this research field also often use qualitative methods as this topic of mobile health apps is quite new and understudied. To answer the sub-questions of this research, cases related to the question have been selected on which the necessary data was collected via semi-structured interviews with the medical professionals and a survey among patients. In this way, data have also been collected regarding the assumed causal path between the trust and adoption variables by asking questions about it both to the medical professional and the patient. This creates a richer understanding of the existence of the assumed relationship.

The medical professionals are the units of analysis and observations when answering sub-question 1 and 2 and hypothesis 2 and 3. Data have been collected on the familiarity, the perceived (privacy) risks and level of trust of the professionals regarding the self-assessment apps to measure to what extent these two factors would influence their trust level. When answering sub-question 4 and hypothesis 1 regarding the causal relation between trust and adoption, the units of analysis are the Dutch patients because it is researched if their level of adoption is influenced by the medical professional's trust. The units of observations are the medical professionals and the patients as data have been collected on both to not only explain and measure the variables related to them but also the possible relationship between them. The collected data on the patients were also used to answer sub-question 3 since it provides insight into the adoption level of the patents. Furthermore, the data collection was at one moment which makes the research design cross-sectional. Given the time span of this research project, collecting data at one moment in time is the most suitable. The causality of the questions is measured by analyzing the perceptions of the respondents and asking the respondents directly about the assumed causal relationship.

The typical cases for the interviews have been selected by contacting various general practices in the Netherlands which resulted in 13 medical professionals. A typical case was selected based on how representative it could be for this research as the interest in this study lies within the case, so explaining a stable cross-case relationship in general and the phenomenon of the influence of the trust. Medical professionals who have an interest in health apps with self-assessing functions, and are a GP, PA or POH at a general practice, are here the 'typical case'. Given the current COVID-19 circumstances, all interviews were held via online means. The selection of the medical professionals is based on purposive

sampling as it was looked at for instance their function (GP, PA or POH) and the geographical area they live in so that not all professionals are only from bigger cities, in order to have a representative sample.

In the ideal situation, the patients who fill in the survey are selected via these medical professionals so that the patients are more closely related to the interviewed professionals, thereby improving the strength of the assumed relationship. However, it turned out in practice that, due to the current COVID-19 pandemic and vaccinations provided by the general practices, the medical professionals preferred to not send the surveys to their patients because they were too occupied. Furthermore, they mentioned that because of the ongoing situation and measures, less people would physically visit the general practices as many consultations were done by means of (video)calling, meaning that handing out the surveys at the practice itself was also not desirable. An alternative strategy was to distribute the survey in the geographical areas and so cities in which the interviewed medical professionals work. In the Netherlands, citizens are able to choose a general practice of preference as long as the GP is able to reach the patient within 15 min in case of emergency (Nuijten, 2019). It turned out that the interviewed medical professionals work in cities where their general practices would cover the entire city regarding the 15 min rule. Therefore, it was chosen to reach the citizens from these cities by sending the survey via online social media channels. By collecting the survey data in this way, it is no longer possible to link the patients to the specific medical professional or practice which has implications for the validity when testing the assumed causal relationship between trust and adoption. Nevertheless, the survey can indicate in more general terms to what extent the patients from these cities would be willing to adopt self-assessment apps or follow their medical professionals' recommendation which is still relevant for answering the formulated research questions and hypotheses. The survey contains a question regarding in which city one's practice is located so that the right sample of patients will be reached.

The selection of the patients is based on voluntary response sampling as they voluntarily respond to the survey which has been distributed via the social media channels of the researcher. A limitation of this method is that the sample could become somewhat biased because the sample could contain more higher educated people because of their connection to the researcher.

A disadvantage of a small sample size concerning the interviews and survey is that it influences the generalizability of the research outcomes. Nevertheless, an advantage of a small sample size is that it allows to research the problem in depth and provides a more detailed understanding of the studied phenomenon from both the medical professional and patient side by collecting interview data on the trust perceptions and survey data on the level of app adoption. Given that that is the purpose of this research, having a small number of cases is suitable for the research design.

3.2. Operationalization

For this research, the concepts and dimensions of the variables 'adoption', 'trust', 'familiarity', and 'perceived privacy risk' were operationalized. The complete list with all the questions and in which order they were asked during the interviews with the medical professionals can be found in the Appendix (Appendix A) as well as the complete set of questions of the patient survey (see Appendix B).

Besides the questions which are directly related to the operationalization and so the conceptualizations of the variables, additional questions were asked as well both to the medical professionals and the patients to create a richer understanding in this rather new topic. As mentioned before, it is possible that the medical professionals also perceive other risks which could influence their level of trust. Therefore, an open question regarding the perceived risks concerning self-assessment health apps has been asked to understand which possible risks there could be. Other additional questions were related to the main causal relationship in which this research is interested, the relation between trust and adoption, in order to gain insight in the assumed causal path.

Before the start of the interview questions, the participants have been informed on what self-assessment health apps exactly are, including examples. The before mentioned *Moet ik naar de dokter?* application was used as an example of a general self-assessment app. The POHs also heard about the mentioned app examples which are more applicable to their field of expertise, such as apps for *MySugar* app for diabetes patients, the *Astma Zelfcheck* for asthma patients, and the *NiceDay* application for patients with mental health issues. In this way, they were better able to provide an opinion regarding their trust in these health applications. If it appeared during the first interview questions that a respondent had a specific app in mind which can provide advice, it was asked to them which one this was and the remaining questions were then applied to that specific app. When they did not know a specific app, one of the described app examples was used as an example on which the respondents based their answers. The choice of a certain app example depended on the interest of the respondent. The type of app discussed during the interviews was noted so that it is known upon which type of app the answers of the respondents are based.

The participants of the survey have been informed on what self-assessment health apps are before the start of the survey and received short explanations of each app example when answering that particular survey question. Furthermore, the possible follow up questions in this survey were only shown to the respondent when necessary. Given that the survey has closed questions, the respondents were able to choose between preformulated answers or Likert scales which for example ranged from "Completely disagree" to "Completely agree" (see Appendix B). Moreover, the questions related to the assumed main causal relationship were formulated in a more general and specific way. This means that questions were asked to see whether the subjective norm in general, so an important person influences one's behaviour, would influence the adoption of patients and more specific questions were asked if the perception of a medical professional, as the subjective norm, would influence their adoption. In this way, something could be said about the general or specific influence of the subjective norm on the technology adoption.

Additionally, given that some participants of the survey might have never used a health app before, the questions regarding the variables "perceived ease of use" and "perceived usefulness" had a slightly different formulation so that respondents were better able to answer the question. This means that the words "I find/think" were for instance replaced with "I expect".

3.3. Data collection and analysis

The data has been collected by means of interviews and surveys. The data was not retrieved from a secondary source but was collected by the researcher herself, meaning that the data is primary data. The medical professionals were interviewed face to face (via online means) while using a semi-structured interview. Furthermore, this type of interview structure has been chosen so that there was room for asking additional questions to follow up on the pre-formulated questions for clarification of the answers when needed. This improves the validity and reliability of the provided answers which are of qualitative nature. Data related to other characteristics of the medical professionals such as gender and type of function (GP, PA or POH) were retrieved from the email communication or the general practice websites since the name with salutation and function of the respondents is displayed on their website or it was provided when they reacted to the invitation mail to participate in this research. The data on the patients have been collected via an online survey which was distributed via the researcher's social networks. The survey included a small text about the aim of the research and informed the respondents about their rights such as being able to withdraw from the survey at any time. Given that the survey has closed questions, this collected data is mainly quantitative. It was chosen to provide the patients a survey and not to conduct an interview because the operationalization is not too complex.

The gathered survey data has been analyzed by looking at the descriptive overviews and so frequencies of the adoption level among the patients. Furthermore, attention has been paid to their perceived ease of use and usefulness regarding self-assessment apps and if they were familiar with the health apps examples. The conducted interviews have been transcribed by hand and the notes which were taken by the researcher during the interviews supported this process. Every transcript received a random number so that the anonymity of the respondents is assured. The content of the transcripts has been analyzed by assigning codes to the text fragments which are based on the operationalization of the variables and new codes that emerged from the data itself when something significant was mentioned by a respondent. This means that some codes are theory-driven and some data-driven codes (Swanson & Holton, 2005). In this way the most important insights and themes from the data which is needed to accept or reject the formulated expectations has been collected, with room for new insights to create a richer understanding about the level of trust among the medical professionals. The computer program ATLAS.ti was used to assist this coding process.

Furthermore, the provided perceptions of both the interview and survey respondents regarding the asked causal questions have been analyzed in order to understand to what extent the participants perceive the causal relationship between the variables and where these perceptions come about. By

analyzing the variables and the causal relationship between them, an answer to the research question can be found.

3.4. Ethical issues

Since the data collection involved data directly derived from humans, namely the medical professional and patients, there are ethical issues to consider. The anonymity and confidentiality regarding the collected data should be respected as well as the privacy of the participants. Furthermore, it is important that the participants of the study provided their informed consent when collecting their answers. The participation of the individuals is entirely voluntary, and they have been informed about their rights and the research they are participating in. This informed consent from the participants does not have to be obtained in an explicit form since the gathered data is completely anonymous. Before the start of the interviews, it was asked to the participant if they give permission to record the audio of the conversation since this is needed when transcribing the spoken text anomalously. Moreover, the independent ethical commission of the university approved the request (request number: 210216) for the data collection method.

4. Results

In this chapter, the result of the analysed data will be presented per sub-question and the corresponding hypothesis will be accepted or rejected.

4.1. Population characteristics interview respondents

The definitive number of conducted interviews was 13 of which 7 were POHs, 5 GPs and 1 PA. Among the respondents were 10 females and 3 males. A possible reason for this more skewed gender distribution is that POHs are more often likely to be female (van Hassel, Batenburg, & van der Velden, 2016). All the POH respondents were female in this study which makes the gender distribution for the GP/PA more equal as there were 3 females and 3 males in this group. Furthermore, the participants' ages ranged from 27 to 63 with a median of 47. The interviews were held during a period of four and half weeks and the interview duration ranged from 16:36 to 50:27 minutes with a median duration of 28 minutes. The respondents worked in the eastern Dutch cities Losser, Enschede and Oldenzaal.

4.2. Sub-question 1

The first sub-question in this research was formulated as the following; *To what extent do medical professionals studied trust the apps in question?* As explained in the theory chapter, the medical professional's level of trust has three underlying dimensions namely, functionality, helpfulness and reliability. During the semi-structured interviews the respondents answered questions about these three

dimensions and the following sections will describe the main results of each dimension and the overall level of trust.

It must be noted that only 6 out of 13 respondents knew the app example of the general self-assessment app "*Moet ik naar de dokter?*" and no one knew the specific self-assessment app examples. This means that the provided answers of the respondents are mainly based on either their general idea of self-assessments apps, after the provided definition of it by the researcher, or general self-assessment apps such as the stated example. The section regarding sub-question 2 will discuss in more detail the respondents' knowledge of self-assessment health apps.

Functionality

The respondents indicated various functions which they believed should be generally present in a self-assessment health app. The most frequent named function, mentioned by 11 out of 13, was 'simplicity', meaning that such an app should be simple and clear for every user to understand how it works. According to the respondents, this simplicity could be achieved when the app itself and the corresponding questions that are asked to the user would be written in plain language and short sentences and perhaps with the support of several pictures. Furthermore, 3 of these respondents mentioned that the used language should not only be simple but also available in multiple languages so that people who do not speak Dutch (yet) would be able to use such an app as well.

"I think that such an app should be very simple, it should have clear language and not too many tabs with text, so to speak". […] "It must of course also be legible, so large letters and text with maybe pictures" (Respondent POH).

Another function which 9 out of 13 respondents mentioned as important is that the app should ask the right set and number of questions, meaning that the app has a well-functioning decision tree which correctly filters the medical issue before providing advice to the user. Moreover, this function is often accompanied with the function that the app should ask questions about someone's medical and or lifestyle background. This entails that a self-assessment app should take into consideration if someone has for instance a chronic disease or how often one exercises when providing advice. Half of the respondents (6 out of 13) believed that questions about one's background are an important function for these types of apps. This attitude is reflected in the following statements by a GP respondent:

"So it must be asked, for example, when you have a red spot, if there are other complaints. There must be a good flowchart behind it so to say, that when you answer yes or no, that other further relevant questions are asked (by the app)". […] "Also if someone has complaints of shortness of breath, it should be asked for example what is your lifestyle, so are you sportive or are you that 80-year-old who sits on a chair all day" (Respondent GP).

The respondents also named a few other functions they found to be important[1]. However, these were only mentioned by one or two other respondents as well and are therefore not extensively discussed here.

Regarding the overall perceived functionality of self-assessment apps in general, 8 out of 13 respondents believed that current self-assessment apps would generally have the right functions to provide advice. Four respondents doubted this and a possible underlying reason, according to the respondents, could be that there are too many apps available, often without a clear overview, which makes one doubt if all the apps would function well. Only 1 respondent believed that generally these types of apps have not the right functions since to the knowledge of that respondent these apps lack for instance the function regarding the medical background of the user.

In summary, the respondents considered the simplicity of an app, the right decision tree and questions about one's medical and lifestyle background as most important functions which self-assessment health apps should have. Furthermore, the overall perceived functionality was rather positive as more than half of the respondents (8 out of 13) believed that these types of apps have the right functions.

Helpfulness

Regarding the perceived helpfulness of self-assessment apps for patients, almost every respondent (11 out of 13) mentioned that these types of apps could be helpful for people to take away any doubt when one is not sure what to do about their medical issue or condition. For instance, the "*Moet ik naar de dokter*" app was mentioned to be useful for people when they are not sure whether to go to the doctor or not with their complaints because many people have for instance no medical knowledge. Furthermore, 9 out of 13 respondents mentioned that self-assessment apps such as the "*Moet ik naar de dokter*" app can be especially useful for small medical issues which are not life-threatening such as having the flu or a fever for one day. Moreover, this line of thinking was often mentioned simultaneously with the belief that it is useful for people to take away their doubts.

"People who go to the doctor very often for every little thing, such an app is then useful that people can determine for themselves, on the basis of a good triage scheme, like oh I can wait for a few more days or no I need to go to a doctor" (Respondent GP).

The simplicity of an app in terms of that the app would be easy to use, was also mentioned by 6 out of 13 respondents as a feature which would be very helpful for patients. The respondents who stated this

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[1] A function which entails that an app should consider one's age, that it should provide additional background information about the complaint, that it indicates what one can do themselves to reduce their symptoms, and that in the case of doubt the app would still advise to contact the GP.

are the same respondents who stated that simplicity is an important function of the app. Furthermore, 6 out of 13 respondents believed that these apps could be helpful for patients as a source of information to read certain advice again about one's medical complaint or issue or to read information regarding what one can do themselves about their complaints.

The overall perceived helpfulness of self-assessment apps was quite positive as 11 out of 13 respondents believed that these types of apps in general could be very helpful for patients and only 2 doubted whether this was the case. Reasons for this doubt relate to the belief that these apps would only be helpful for some specific incidents, such as the mentioned small medical issues, or that the respondent thought that patients would perceive the advice from medical professionals as more helpful than from an app. Moreover, 5 out of 13 respondents stated that they believed that the use of these apps would not only benefit the patients but also themselves since when patients use these apps for small issues or when having doubts, it could take some pressure away at the general practice, especially outside office hours or during the weekend. This attitude is reflected in the following statement by a GP respondent:

"So for insecure people with small things, such apps can be useful. For example with the flu you do not always have to see a doctor immediately, sometimes a paracetamol can also be enough. So for these things I would be willing to recommend such an app so that it also decreases the pressure in the practice" (Respondent GP).

To recapitulate, the respondents considered self-assessment health apps as most helpful as a source of information, especially in non-life-threatening medical issues, or to take away doubt when one is not sure what to do about their medical complaints. Furthermore, the overall perceived helpfulness was quite positive among the respondents as almost every respondent (11 out of 13) believed that these apps could be helpful.

Reliability

The respondents mentioned various conditions which they believed would make self-assessment apps more reliable. One condition was mentioned by all 13 respondents, namely that these apps should use the same medical advice and protocols they are using in the general practice. In that way, the respondents believe that the app would be able to provide reliable advice. The mentioned and used protocols by the respondents are from the Dutch GP society, or called in Dutch; *Nederlandse Huisarten Genootschap (NHG)* which also has a website that displays all their protocols (NHG, 2021a). Furthermore, 6 out of 13 respondents believed that these apps should, as an addition, indicate the source of the provided advice thereby showing the user of the app that the advice is derived from, for instance, the official medical protocols. Moreover, 6 out of 13 respondents indicated that an app would be more reliable when the official GP organization or society such as the NHG has approved the use of particular health apps or

when other general practices would approve its use as well. These attitudes are reflected in the following statements by two POHs:

"I do think it is important that the advice of an app is linked to the advice of the GP association and therefore also the protocols that we use ourselves, which makes it reliable" (Respondent POH).

"I do think that the current apps can give reliable advice, especially if it clearly states that they have, for example, been approved by an organization or that they used the advice from the NHG. Or if an app is recommended by a practice, you can assume that the advice corresponds with that of the practice, so it will be more reliable" (Respondent POH).

A few respondents, 3 out of 13, believed that a quality mark assigned to an app would make it more reliable as well. However, 2 other respondents doubted this as they believed that there are already enough quality marks available in general and therefore questioned if it would have any added value.

Concerning the overall perceived reliability of self-assessment apps in general, 8 out of 13 respondents believed that these apps could be reliable and 5 doubted this. Reasons for this doubt according to the respondents echo the doubt expressed on the dimensions functionality and helpfulness, namely that there are too many apps available which makes it impossible to know if all are reliable and that the reliability of an app depends on certain conditions, such as the approval of the NHG.

So, similar to the overall perceived functionality, the overall perceived reliability is rather positive among the respondents as more than half (8 out of 13) believed that self-assessment health apps are reliable. Furthermore, conditions such as when an app uses the same medical protocols as the general practices and when an app indicates the source of used information, were considered as most important to make an app more reliable.

4.2.1. Conclusion

The combination of the three dimensions indicates the level of trust of a medical professional in self-assessment health apps. As mentioned, the level of trust is rather measured by more general perspectives regarding self-assessment apps since not every respondent was familiar with the mentioned examples, with the exception of the general app. As answer to sub-question 1, one could argue on the basis of the overall perceived functionality, helpfulness and reliability, that the interviewed medical professionals have generally a moderate to high level of trust in self-assessment health apps. Furthermore, the underlying connections between the three trust dimensions were also visible during the interviews as many respondents often mentioned that for instance certain functions, such as simplicity, are perceived as helpful or would make an app more reliable and eventually trustworthy. However, it must be noted that the trust in self-assessment apps by the respondents oftentimes depends on certain conditions. This means that a respondent would generally trust self-assessment apps but the apps in question must for

instance use the same NHG protocols or should be known by the respondent itself. Moreover, almost every respondent (11 out of 13) indicated that there is not always a clear overview of apps that are good which makes it harder to formulate a solid opinion regarding one's level of trust. This already indicates that the familiarity with self-assessment apps could play a role in the level of trust which will be discussed in the next section.

4.3. Sub-question 2

Sub-question 2 of this research has been formulated as the following; *Which factors influence the trust in self-assessment health apps of medical professionals?* and the factors of 'familiarity' (H2) and 'perceived privacy risks' (H3) were expected to be possible influences according to the discussed theory. Besides these two factors, the respondents were also asked if they expected any other risks regarding self-assessment apps in order to better understand their perceptions in this rather understudied topic.

Familiarity

The reviewed literature indicated that the concept of familiarity exists out of the dimensions 'knowledge' and 'experience' which one could gain from own interactions with, in this case self-assessment health apps, or from the interaction of others.

The respondents were asked if they have any knowledge about or experience with apps that could provide medical advice to patients. While asking these questions, some of the example apps were mentioned as well to see if these sounded familiar. Among the 13 respondents, 7 indicated that they have heard of these types of self-assessment apps in general and 6 have heard of the "*Moet ik naar de dokter*?" application of which 4 recommended this app sometimes. Neither of these 7 people have heard about the other app examples or could provide concrete self-assessment app examples by themselves. Eleven out of thirteen respondents stated that they know health apps which are used for measurements only, such as measuring one's heart rate or calorie intake. Furthermore, every respondent mentioned that they know the website "*Thuisarts.nl*" at which people also could read information or advice regarding their medical complaints (NHG, 2021b). Moreover, all 13 respondents claimed that they found this website to be reliable since they are certain that it references the NGH protocols and therefore often recommend it to patients.

Among the 13 respondents, 9 indicated that they have some experiences with other health apps or websites, than the mentioned examples or "*Thuisarts.nl*", which they have been using or advising in the practice. Most of these apps were named by the POHs since they are more often in contact with patients who have for instance diabetes for which they recommend various measurement health apps that are available from the *Dutch Nutrition Centre Foundation* (Voedingscentrum). This is an institution subsidized by the Dutch government which provides information about nutrition (Voedingscentrum, 2021). These apps are mainly for measuring the calorie intake and are named "*Kies Ik Gezond?*" and "*Mijn Eetmeter*". Additionally, 4 out of the 7 POHs explained that they also use the apps *Vaatrisico* or

U-prevent as a tool for themselves to calculate their patients' 10-year risk score for cardiovascular disease which is relevant when prescribing medication. All 13 respondents, however, indicated that they would not use self-assessment health apps for personal use since they have medical expertise of their own which makes these apps redundant for them.

To answer H2; *A higher degree of positive familiarity with self-assessment health apps by a medical professional, will increase their level of trust in these health apps,* it was considered whether respondents who are more positively familiar with self-assessment apps would generally have a higher level of trust towards them. As mentioned earlier, respondents found it sometimes difficult to give a concrete answer to what extent they believe that current apps are functional, helpful or reliable since they do not know all the apps which are available.

"I find it difficult to say because I don't know very much about it, I think it is an interesting development but I am not yet much confronted with it in the practice" (Respondent GP).

This indicates that the role of knowledge and experience and thus familiarity with self-assessment apps does play a role when one is formulating their level of trust about these apps. Moreover, every respondent indicated that their willingness to advise health apps mainly depends on the extent to which they know or have tried the app for themselves. This attitude is reflected in the following statement by a POH respondent:

"I think that is also difficult, namely what shows that an app is better than any other app, that is difficult. That is why, as a general practice, we first look at how such an app works before recommending it" (Respondent POH).

It seems that respondents who were positively familiar with self-assessment apps were more inclined to believe that these apps are generally trustworthy and would be helpful, reliable and have the right functions. Among the 6 people who heard of the "*Moet ik naar de dokter?*" app, 5 respondents had positive experiences or knowledge regarding this app and believed on the basis of that that these types of apps would be generally trustworthy. Moreover, 4 of them claimed to recommend this app sometimes in their practice indicating that they find this app trustworthy. One respondent who also knew this app had however a negative experience with it as the respondent found the app rather unclear. Because of this, the respondent was more reluctant if these types of apps would function well in general and this negative experience therefore influenced somewhat the general trustworthy perception regarding self-assessment apps. Furthermore, 2 other respondents, who were not familiar with self-assessment apps, indicated that they also had a negative previous experience but with a particular health app pilot at their practice. It appeared that they were more inclined to state that these self-assessment apps probably missed certain important functions or would be only reliable under specific conditions.

As we see from above, respondents who have a high level of positive familiarity appear to have a high level of trust and respondents with a lower level of positive (negative) familiarity appear to have a lower level of trust. Furthermore, there is a convincing link between the level of familiarity and trust since the respondents indicated that they are more likely to recommend or form an opinion about health apps when they are (positively) familiar with it. Based on this reasoning, H2 is accepted.

Perceived privacy risks

The respondents were also asked if they would perceive any privacy risks regarding patients' data concerning self-assessment apps. It appeared that among the 13 respondents, 8 believed that there are generally no privacy risks connected to these types of apps and 5 believed there were some privacy risks. However, it should be noted that 3 of these 8 respondents who believed there are no privacy risks did not completely rule out the possibility of these risks as they indicated that these days 'every' digital system could be hacked. Moreover, 8 out of 13 respondents indicated that they would perceive some or more privacy risks if actual personal data of the patients are involved which goes beyond only one's gender or age.

"I don't know whether that is completely AVG-proof and also whether it can be completely prevented because if the tax authorities can be hacked easily, I wonder whether an app can be that safe when you have to enter all those personal data in it. But with the Moet ik naar de dokter? app, you only have to enter gender and age, so I do not think that's very sensitive to privacy issues" (Respondent PA).

To answer H3; *A higher degree of perceived privacy risks by the medical professional, will decrease their level of trust in self-assessment health apps,* this study aimed to find out if respondents who perceived some privacy issues would also have a lower level of trust in self-assessment apps. Nevertheless, this assumed causal path was not clearly visible in the collected interview data as 3 out of 13 respondents believed there were generally no privacy risks still were not certain if these apps would be trustworthy and 3 other respondents who perceived some privacy risks were still of the opinion that self-assessment apps could function well, are helpful or reliable. Furthermore, before the respondents answered the question about their perceived privacy risks, they were asked about whether they perceive any risks in general regarding these apps. None of them mentioned privacy risks by themselves as a possible risk factors and it was only discussed as a topic after the 'privacy question' by the interviewer. This could also indicate that perceived privacy risks do not play a great role in the level of trust in self-assessment health apps.

Following this reasoning, respondents who perceived some privacy risks did not automatically perceive a higher level of trust or vice versa. Moreover, there is not a strong convincing link between the two variables as no respondent raises the risk of privacy as an issue by themselves during the open question about perceived risks. This means that H3 is rejected.

Other perceived risks

Besides privacy risks, the respondents mentioned other risks which they believed could be present with regards to self-assessment health apps. The most frequent perceived risks, mentioned by 8 out of 13 respondents, was that patients would interpret these apps and their advice wrongly with a result that they would get incorrect ideas about their health. Furthermore, 6 out of 13 respondents questioned if these self-assessment apps would always have the right decision tree leading to the right advice, especially for patients with more specific medical issues. However, this risk was often combined with the risk of a wrong interpretation by people, meaning that not the app itself but the inaccurate interpretation and provided answers by the people would lead to incorrect advice. Additionally, 4 out of 13 respondents indicated that these incorrect interpretations could even lead to a discussion between them and the patients. These perceived risks are reflected in the following statements by two GP respondents:

"It could be the case that people already think in a certain angle and maybe fill in the app incorrectly, which leads to the wrong advice" (Respondent GP).

"The only thing that can be difficult is interpreting all the data of an app. So there is for example no risk of errors in the diagnosis of such an app, but that you should interpret such results together with your healthcare provider, otherwise it is more likely to go wrong" (Respondent GP).

So, besides 'positive familiarity', the risk that these apps would not have a correct decision tree or that patients incorrectly interpret the questions and or advice of the self-assessment apps could have an influence on the trust level of medical professionals. Nevertheless, it must be noted that the latter reason is rather related to the app user and not the app itself.

4.3.1. Conclusion

To answer sub question 2, being familiar with self-assessment health apps is very likely to be an influential factor on the trust level of the medical professionals. More specifically, the acceptance of H2 suggests that when one is more 'positively familiar' with self-assessment apps, he or she is more likely to have a higher level of trust regarding these apps. Moreover, every respondent stressed the importance of knowing or trying a certain app before recommending it, showing again the essential role of familiarity. The rejection of H3 suggests that the factor of 'perceived privacy risks' is not very likely to be an influence on the medical professionals' trust as there was no convincing link found between perceiving more or less privacy risks and higher or lower levels of trust. Other risks that were perceived by the respondents regarding self-assessment apps were that the app and its advice would be interpreted incorrectly by its user or that the app has not a correct decision three. These risks could also be of influence on the level of trust but were not formally tested in this research.

4.4. Sub-question 3

Besides the conducted interviews with the medical professionals, an online survey was distributed to gain some insights and gather information about the level of app adoption and so the use of health apps among patients which is needed to answer sub-question 3 of this research; *To what extent can we say that the patient population studied has adopted one or more health apps?*

Sample population

The survey collected a total of 102 responses. Only meaningful cases were selected for further analysis which means that people who did not complete the survey or have their GP somewhere else located than the three cities Losser, Enschede and Oldenzaal, were left out[2]. This resulted in a sample of N=90. Furthermore, the "I don't know" choice option which could be filled in for certain questions were reported as missing values.
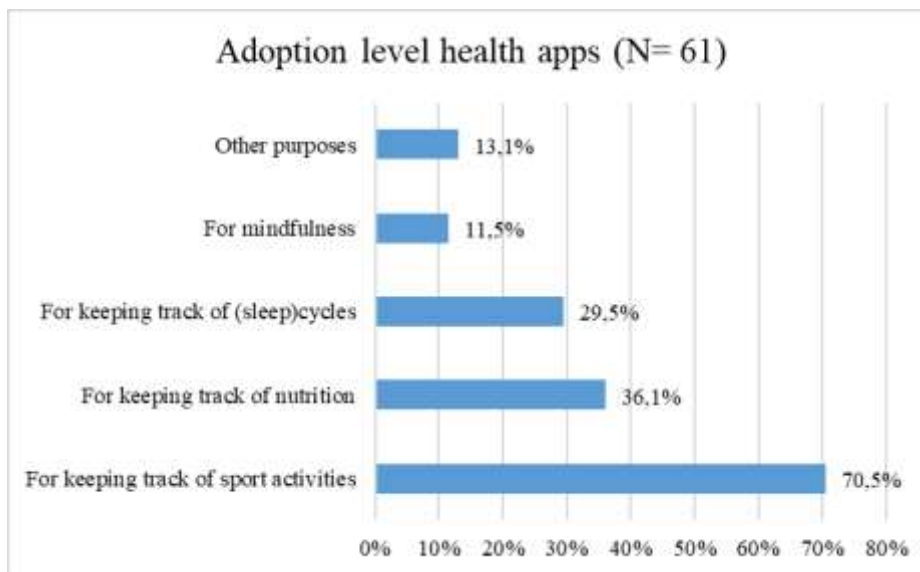
Among the survey respondents, 38 have their general practice located in Losser, 28 in Enschede and 24 in Oldenzaal. The female gender (64.4%) was somewhat more represented than the male gender (34,4%) which should be considered when interpreting the results. Furthermore, the age categories "Younger than 25" (27.8%), "46-55 years" (28.9%) and "56-65 years" (23.3%) were the most represented in this sample and the remaining frequencies were rather fairly distributed in the other categories "26-35 years" (7.8%), "36-45 years" (5.6%) and "66-75 years" (6.7%). The age distribution of people in the Netherlands is more evenly distributed alongside these six age categories as they range from 11,8% to 14,2% per group (CBS, 2020a), which means that this difference should be considered when drawing conclusions. A possible reason for this age distribution is that the survey has been distributed through the personal network of the researcher, meaning that people from the age of the researcher herself (younger than 25) and that of her relatives (46-65) are then most likely to fill in the survey. The age category "75 years and older" had no participants, for which a possible reason could be linked to the fact that this age category does not use social medical channels as much as other age categories do (CBS, 2020c).

Regarding the educational level of the respondents, 14.4% attained university education, 33.3% higher professional education, 17.8% higher secondary education, and 32.2% secondary education. One could argue that this distribution is somewhat representative since in the Netherlands, around 12% has attained university education, 21% has higher professional education, 10% higher secondary education and almost 30% secondary education (CBS, 2020b). Nevertheless, it must be noted that our sample is not entirely representative since it does not contain people from the lowest category "primary education" and only 2 from the category "preparatory vocational education".

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[2] The respondents who were left out did not significantly change the data when they would be included since they did not complete the survey. Four respondents who did complete the survey but had their GP practice somewhere else had similar results to the overall data set.

Adoption of health apps in general

The respondents were asked about their use of health apps in general, meaning that they could also indicate the use of apps which only have measurement purposes. Moreover, the respondents were able to select multiple answers which implies that some only use one health app and others multiple. Among all 90 respondents, 29 (32.2%) indicated that they currently do not use any health apps at all, meaning that 61 (67.8%) respondents do use one or more health apps. Furthermore, among these 61 respondents 70.5% indicated that they use a health app to keep track of their sport activities, 36.1% for keeping track of nutrition, 29.5% for keeping track of (sleep)cycles, 11.5% for mindfulness and 13.1% indicated that they use health apps for other than the four aforementioned purposes. These results show that more than half (67.8%) of all the respondents have adopted one or more health apps and as evident from figure 2, among the app users are the apps for tracking sport activities the most prevalent as 70.5% use at least one.

Figure 2: Percentage of respondents who uses particular types of health apps (in percentages)

Adoption of self-assessment health apps

Regarding the adoption of self-assessment health apps, only 6 out of 90 respondents indicated that they currently use, every now or then, a health app on their mobile phone that is able to provide medical advice. Among these 6 respondents, 2 indicated that they use the "*Moet ik naar de dokter?"* app and 2 others mentioned the website "*Thuisarts*". The remaining two respondents named the apps "*Cardiac diagnose*" and "*Medgemak*" of which the first can measure and provide advice about someone's heart rate (Jewell, 2020) and the latter is connected to one's general practice and is used, among other things, to asks questions about health matters (MijnGezondheid, 2020). These results indicate that the studied patient population hardly uses any self-assessment health apps at the moment of data collection. However, as mentioned earlier, currently only 10% of the people in the Netherlands use health apps with self-assessment functions which is a rather small portion as well (ICT&health, 2019).

All respondents did also receive questions about to what extent they know the four example self-assessment apps. The displayed figures in figure 3 indicate how many respondents have heard or not about these apps or have used it sometime before. As evident from figure 3, not an overwhelming majority of the respondents is familiar with these types of self-assessment apps and when a person did use one of these apps, they indicated that they used it rarely, with the exception of one respondent who uses the "*MySugr*" app every now or then. It should be noted that the apps "*Astma Zelfcheck*" and "*MySurgr*" are designed for people with a chronic disease, meaning that this could be a contributing factor to why these apps are less known as not everyone has asthma or diabetes.
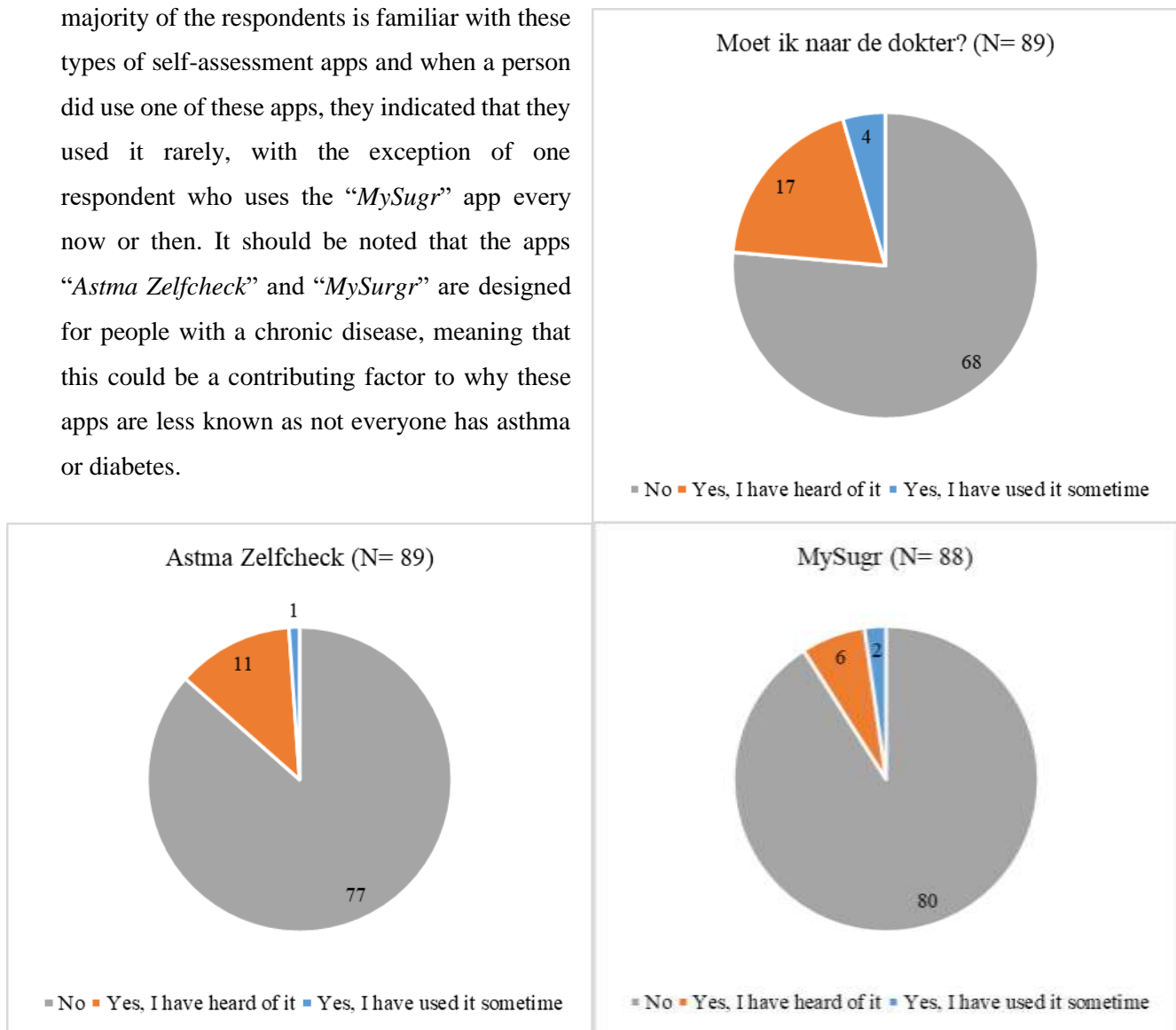

Figure 3: Respondents' familiarity with self-assessment health apps (in frequencies)

4.4.1 Conclusion

The survey results provide insight to what extent the studied patient population uses health apps and more specifically, knows and uses self-assessment health apps. To answer sub-questions 3, it appears that among the 90 survey respondents, 67.8% uses one or more health apps and apps that can track one's sport activities are found to be the most prevalent as 70.5% of this group uses at least one. The use of self-assessment health apps, however, were not overwhelming since only 6 out of 90 respondents indicated that they currently use these types of apps. Furthermore, less than a quarter of the respondents indicated that they are familiar with the self-assessment app examples suggesting that these types of

apps are not very well known or used among this studied patient population. This might be related to the rather healthy patient sample, meaning generally young and somewhat higher educated individuals, which could suggest that they are less likely to use and so know apps for self-care (Bol et al., 2018).

4.5. Sub-question 4

The last sub-question of this research; *To what extent does the medical professionals' trust influence technology adoption of patients?* has been formulated to provide an answer to the assumed causal relationship between a medical professional's trust and adoption level of patients (H1). The interviewed medical professionals answered questions about this causal relationship and in which instances they would be willing to recommend a self-assessment app. The patients who participated in the survey also answered questions regarding the assumed relationship and their willingness to adopt self-assessment apps.

Medical professional's perspective

Among the interviewed medical professionals, 7 out of 13 indicated that they do recommend health apps which have measurement purposes and 4 of them also recommend self-assessment apps. The measurement apps were mostly related to calorie trackers and the self-assessment app was the "*Moet ik naar de dokter*?" app. All 13 respondents indicated that they recommend the website "*Thuisarts.nl*" to their patients. Furthermore, 8 out of 13 respondents believed that they would rather recommend a specific self-assessment health app than a more general one to their patients. This could be linked to the fact that 7 out of the 13 respondents are POHs, which means that specific apps for, for example, chronic diseases would be more valuable to them to recommend since they have themselves also more specific expertise about these types of medical problems.

As mentioned before, all respondents indicated that they would be willing to recommend a self-assessment app when they know and tried the particular app for themselves. This shows the important role of familiarity with apps in the decision to trust and so recommend a health app to patients. Moreover, 9 out of 13 respondents stated that they also would look at the personal needs of a patient before recommending an app to them in order to decide if the app would be indeed a supportive tool. Among the 13 respondents, 9 did not experience that their patients asked for information about certain health apps during consultation hours. Six respondents did mention that their patients have been asking about certain websites, such as "*Thuisarts.nl*", at which patients found information regarding their medical complaint. When a patient does mention certain sites or apps, at which he or she has looked on before the consultation hour, the medical professionals indicated that they often look together at these searches with their patients. Furthermore, 3 out of 13 respondents explicitly mentioned that they believed that the interest in using health apps would come from their side rather than from the patients.

When the respondents were asked if they thought if their recommendation of self-assessment apps would lead to adoption of it by their patients, the perceptions were rather diverse as 5 respondents

believed that this is very likely, 4 believed this is not so likely and 4 respondents thought that perhaps a moderate portion of their patients would follow such an advice. Regarding the 'type' of patients who would be more interested to use and follow a recommendation about health apps, 10 out of 13 respondents believed that this could depend on one's educational level, and 7 respondents mentioned that it could depend on the motivation and interest of a patient to take care of their own health. Moreover, 9 out of 13 respondents believed that one's digital skills, meaning being able to use and understand apps in general, would play a role in the intention to follow a recommendation to use health apps. It was not believed that the age of patients would play a great role in the intention to use apps, as 6 out of 13 respondents experienced that for instance 70 year old patients were perfectly capable of using digital means. These respondents indicated that the young might show more interest, but are not directly more capable. These perceptions are reflected in the following statement by a POH respondent:

"It depends, I have people over the age of 70 who are very mobile and handy with the digital world and I have patients who are in their 50s and don't know how to deal with it. I think it mainly depends on the educational level or the interest of people, not so much on their age" (Respondent POH).

Even though the perceptions of the respondents were rather mixed concerning the question if they would expect that patients would follow their advice regarding self-assessment apps, 10 out of 13 respondents indicated that they sometimes experienced that a patient got back to them about certain apps or sites which were previously discussed during a consultation hour. However, it must be noted that these experiences were mainly linked to the recommendation of websites such as "*Thuisarts.nl*".

In summary, 7 out of 13 respondents indicated that they do recommend health apps of which 4 respondents also recommend self-assessment apps. All 13 respondents stated that they consider their own familiarity with an app before recommending it and 9 out of 13 respondents also consider the patient's personal needs. Furthermore, the respondents mentioned that patients ask more often about particular health sites than apps and their beliefs regarding if patients would follow an app recommendation were rather mixed. Moreover, 10 out of 13 respondents believed that following such a recommendation would depend on one's educational level, 7 believed it could depend on one's interest in their own health and 9 believed that one's digital skills has an influential role.

Patient's perspective

The respondents of the survey indicated to what extent they are willing to adopt self-assessment apps and to what extent they think or expect that these will be easy to use and are useful. As seen in table 1, it appears that 45.9% of the respondents agreed to the willingness to adopt a self-assessment app that can provide medical advice to them whereas 28.2% felt neutral about this and only 11.8% disagreed. This shows a rather positive view on the willingness to use self-assessment apps.

Table 1: Respondents' willingness to adopt self-assessment health apps

|	Frequency	Valid percent
1 Completely disagree	2	2.4
2 Disagree	10	11.8
3 Neutral	24	28.2
4 Agree	39	45.9
5 Completely agree	10	11.8
Total	85	100
6 I don't know	5	
Total	90	

As mentioned, the survey questions regarding the perceived ease of use and perceived usefulness of self-assessment apps were formulated in two ways (I think vs. I expect) based on the previous apps use of a respondent so that the question would be more understandable to answer. Figure 4 and 5 display the results regarding the perceived ease of use and perceived usefulness questions, both for the respondents who "think" (N= 61) or "expect" (N= 29) that these self-assessment apps are easy to learn, would not be problematic to use, provide helpful medical advice and are a useful tool for getting medical advice.

Figure 4: Respondents' perceived ease of use of health apps (in percentages per I think/expect)
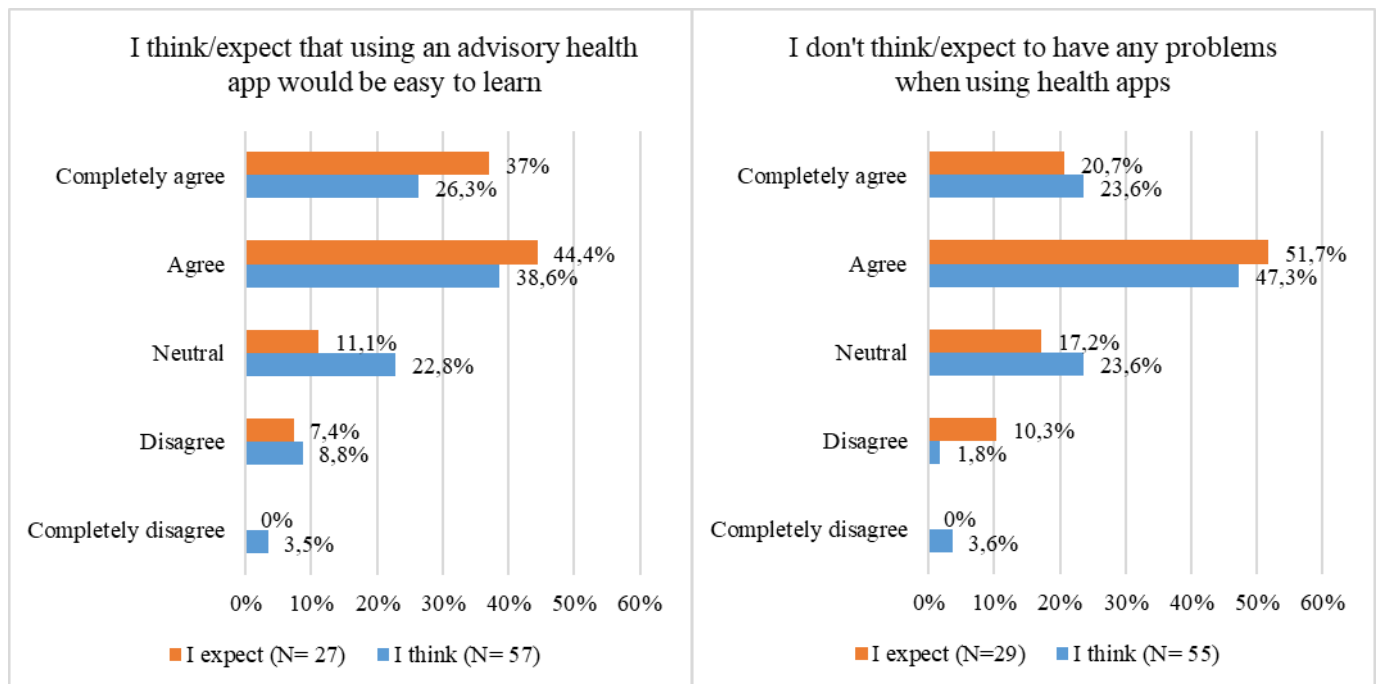
As evident from figure 4, the answers of the "I expect" respondents seem to be more skewed to the positive (agree) side of the completely agree – completely disagree scale than the "I think" respondents. This suggests that the "I expect" respondents have a slightly more positive view on the perceived ease of use than the "I think" respondents. Nevertheless, this difference is quite small and both types of respondents have generally a rather positive perception on the perceived ease of use.

Figure 5: Respondents' perceived usefulness of health apps (in percentages per I think/expect)
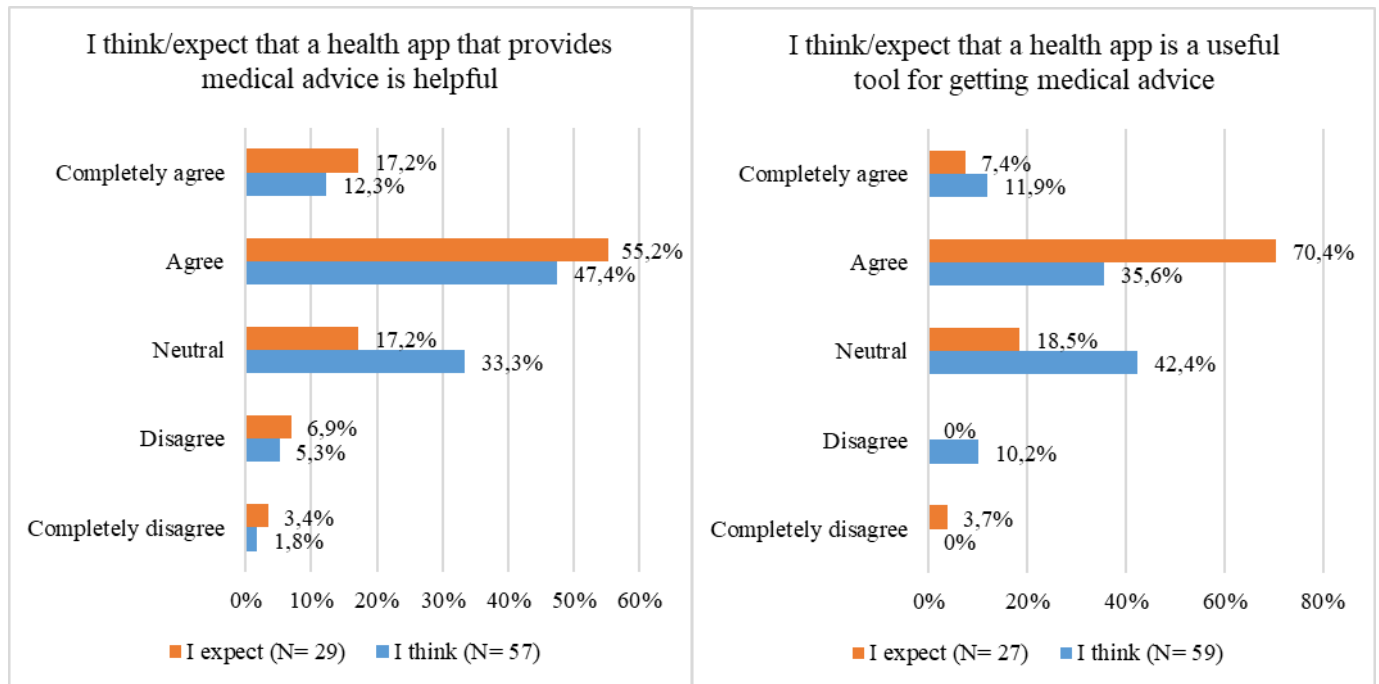

As evident from figure 5, the answers of the "I expect" respondents also here seem to be more skewed to the positive (agree) side of the completely agree – completely disagree scale than the "I think" respondents who take a more neutral position. This suggests that the "I expect" respondents are more likely to perceive these apps as helpful for getting medical advice than the "I think" respondents. However, also here both types of respondents generally have a rather positive perception on the perceived usefulness.

When considering the correlations between these two control variables and the willingness to use self-assessment apps, it appears that the perceptions that these apps are easy to learn (R= .283) and not problematic to use (R= .224) have a positive and a rather weak to moderate correlation which is significant at a 0.05 alpha level. This suggests that the risk of assuming that the relationship that a higher level of the perceived ease of use regarding health apps means a higher willingness to adopt self-assessment apps is true when it actually is not, is small. The correlations between the willingness to adopt and the perceptions that these apps provide helpful medical advice (R= .672) and are a useful tool for medical advice (R= .488) are also positive but rather moderate to strong and significant at the 0.01 alpha level. This suggests that the risk of assuming that the relationship that a higher level of the perceived usefulness regarding health apps means a higher willingness to adopt self-assessment apps is true when it is actually not, is very small.

With regards to the theorised influence of the subjective norm and so the app recommendation by a medical professional on the adoption among patients, the survey respondents were rather positive in the sense that they would be willing to use a certain health app when for instance an important person to them or their GP would recommend it. Figure 6 (below) displays the percentages of the four questions

about the assumed causal relationship which were asked to the patients. When comparing the mean scores of these results on a 1 to 5 scale, where 5 is completely agree and 1 completely disagree, the statement "*I am willing to use a health app when my GP/ general practice recommends it*" scores the highest with a 4,22 indicating that the respondents agreed with this statement the most. The mean scores of the other statements are somewhat closer to each other as the statement regarding '*a recognized doctor*' had a score of 3,63, the statement about '*someone important to me*' had a score of 3,6 and the statement concerning '*someone from my personal circle*' had a score of 3,57.

Figure 6: Respondents' answers to the four causal questions (in percentages)
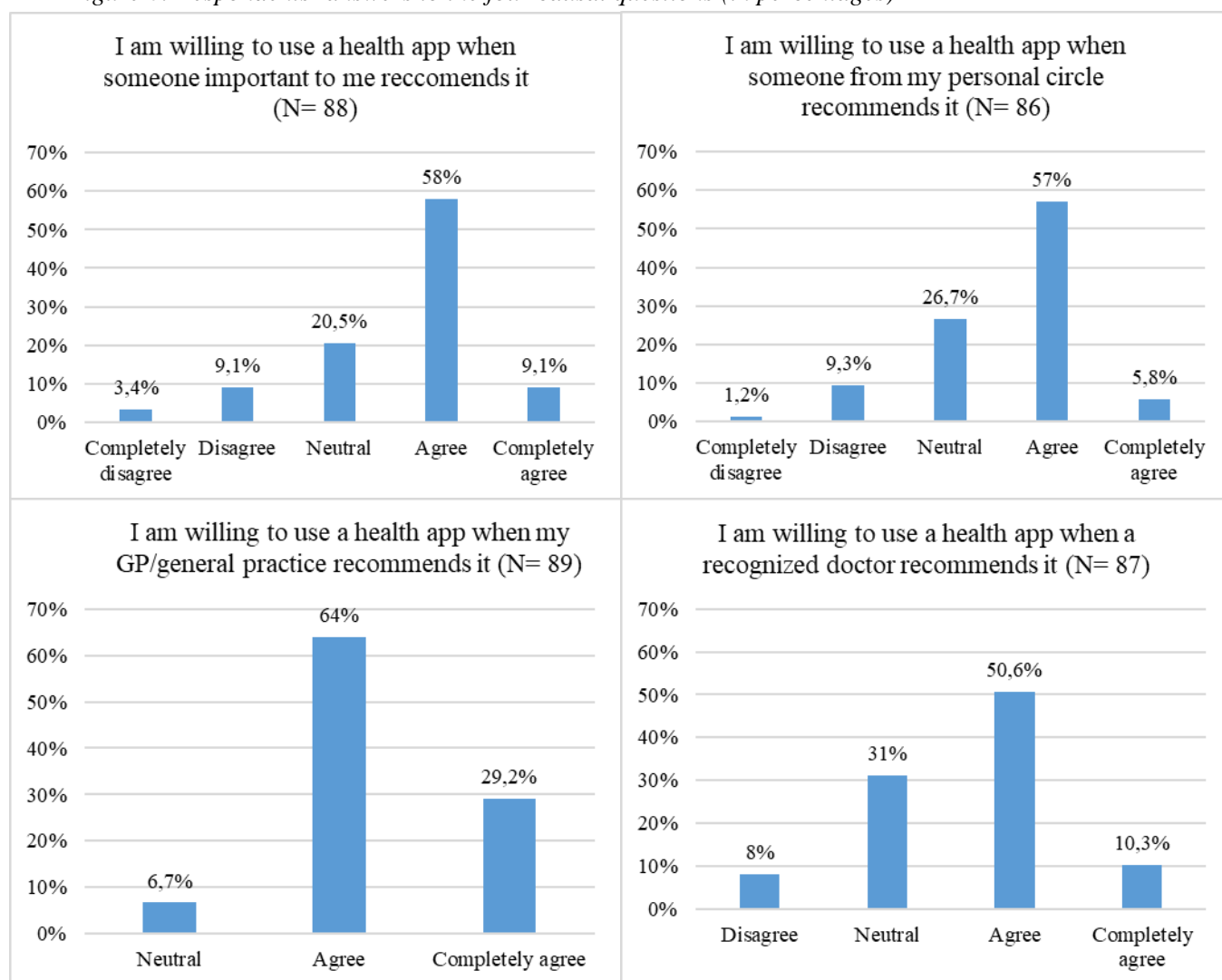
Moreover, it is interesting to note that there was no respondent who disagreed or completely disagreed with the statement regarding the recommendation of one's own GP/general practice suggesting that the respondents do, to some extent, value the opinion of their GP[3].

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[3] There was no significant correlation found between the level of education or age and the willingness or actual use of health apps. Neither regarding the answers to the causal questions.

To recapitulate, more than half (57.7%) of the survey respondents agreed to have an interest in using self-assessment health apps. Furthermore, the studied patient population generally have a rather positive view regarding the perceived ease of use and perceived usefulness of self-assessment since approximately half of them agreed to think or expect that these self-assessment apps are easy to learn, would not be problematic to use, provide helpful medical advice and are a useful tool for getting medical advice. Moreover, these two variables were found to correlate positively and significantly with the willingness to use self-assessment apps. The mean scores regarding the four causal questions also indicated a rather positive view, suggesting that the respondents do value the perspective of others and especially of their GP in the context of adopting health apps.

4.5.1. Conclusion

As mentioned earlier in the methods chapter, it is not possible to perfectly link the patients of the survey directly to the interviewed medical professionals as it is not sure if the patients belong to the medical professionals. Nevertheless, the patients do live in the same geographical areas, the cities Losser, Enschede and Oldenzaal, in which the medical professionals' practices are located. This means that the assumed causal relationship might not be formally tested however, still a valuable answer but a more general one, can be formulated for sub-question 4 and corresponding H1: *When a medical professional trusts the use of self-assessment health apps, patients are more likely to adopt one.*

The results of the previous sub-questions indicated that the interviewed medical professionals generally do trust the use of self-assessment health apps but under the conditions that they know that it comes from a reliable source such as the NHG and have tried the apps for themselves. Moreover, when these conditions are in place all 13 medical professionals indicated that they would be willing to recommend self-assessment apps to their patients. Their perceptions about if patients would indeed follow this recommendation is rather diverse as 4 out of 13 professionals believed that this was not so likely and 5 believed it is likely leaving 4 respondents in doubt. Also, the medical professionals stated that following such a recommendation is very likely to depend on certain factors such as the patients' digital skills, educational level and personal interest. The patient respondents of the survey indicated that more than half of them (67.8%) already use health apps in general and more than half (57.7%) of them agreed to have a willingness to adopt a self-assessment one. Moreover, almost every patient (93.3%) indicated that they would be willing to use a health app when it is recommended by their GP.

So, the results from the interviews indicate that when a medical professional has a high level of trust in a particular self-assessment health app, they would be very likely to recommend it to their patients. The results from the surveys indicate that almost 60% showed an interest and a willingness to adopt a self-assessment app and only 14.2% had no willingness to adopt one. There is a convincing link between this trust level and adoption level since no survey respondent disagreed to be willing to use a health app when their GP recommends it. Furthermore, 10 out of 13 medical professionals indicated that they sometimes experienced that patients got back to them about apps or sites which were previously

discussed during consultation hour suggesting that their recommendations lingered to a certain extent. Following this reasoning, H1 is accepted. This acceptance of the hypothesis also answers sub-question 4, namely that it is likely that a medical professional's trust in a technology influences the adoption of it by patients. Nevertheless, this acceptance must be interpreted generally since it was not possible to exactly compare if app recommendations by a particular medical professionals would indeed lead to an app adoption by their patients. Also, the medical professionals give reasons to assume that the relationship might be influenced by certain patient characteristics such as one's educational level. Yet, the results of this research do suggest that this relationship between the level of trust and adoption is very likely to be present.

5. Discussion and Conclusion

This chapter will provide an answer to the main research question while reflecting on the analysed results and conclusions of the four sub-questions. Furthermore, the insights of this research are further discussed and limitations and directions for future research are described.

5.1. Conclusion

This study aimed to answer the research question; *Which factors explain the level of trust of medical professionals at a general practice in the use of self-assessment health apps and to what extent does this trust influence the adoption of such apps by patients in the Netherlands?* Furthermore, this question was divided into four sub-questions; (1) To what extent do medical professionals studied trust the apps in question? (2) Which factors influence the trust in self-assessment health apps of medical professionals? (3) To what extent can we say that the patient population studied has adopted one or more health apps? and (4) To what extent does the medical professionals' trust influence technology adoption of patients?

Thirteen semi-structured interviews were conducted with medical professionals on which data was collected to answer the first part of the main research question and so sub-question 1 and 2. Regarding sub-question 1, the analysed results indicated that generally, the interviewed medical professionals believed to have a moderate- to high level of trust towards self-assessment health apps. The respondents believed that these apps are helpful for patients (11 out of 13), would generally function well (8 out of 13) and are reliable (8 out of 13). Moreover, questions about one's medical and lifestyle background, a correct decision tree and the simplicity of a self-assessment app were found to be the most important functions by the medical professionals. Furthermore, self-assessment apps were believed to be most helpful for patients as a source of information, especially for small problems such as having a fever for one day, or for patients who have doubts regarding their medical issues and wonder which next step needs to be taken. The professionals indicated that they find these apps especially reliable when it uses the same medical protocols as they do in the general practice or when the app shows the

used information sources. It must be noted that even though the medical professionals were overall rather positive regarding self-assessment apps, they indicated that providing a solid trust perception depends on their knowledge and experience with certain health apps.

This notion of having a factor which could influence the level of trust relates to sub-question 2, where it was assumed that positive familiarity with self-assessment apps (H2) and perceived privacy risks (H3) would influence the level of trust. The acceptance of H2 and rejection of H3 in the results chapter indicated that having positive knowledge and experience (familiarity) regarding self-assessments apps is very likely to lead to a higher level of trust in these apps. Being familiar with self-assessment apps was believed to be a very important factor and so condition for the medical professionals to formulate a trust perception towards the apps as every medical professional mentioned that they need to know or have tried a health app by themselves before recommending it. Perceived privacy risks on the other hand was not found to be an influential factor on the professionals trust level since no clear link between higher or lower levels or perceived privacy risks was found with higher or lower level of trust. Another risk which was mentioned by the medical professionals is that the app user would interpret the question of the app and its advice incorrectly leading to an incorrect health perception. However, this risk is rather related to the app user than the app itself, meaning that it could be an external factor which influences the willingness of the medical professional to recommend an app but not a factor that would influence the trust in the app itself.

Next to the interviews, an online survey was distributed among the patients (N=90) from the same geographical area to collect additional data for answering the second part of the research question and so sub-question 3 and 4. Regarding sub-question 3, it was found that 67.8% of the studied patient population uses one or more health apps of which the most prevalent one were sport apps (70.5%). Nevertheless, only six patients indicated that they use self-assessment apps and less than 25% of the respondents were familiar with the stated self-assessment apps examples. This means that a significant portion of the studied patient population has adopted one or more health apps, however these were mainly for measurement purposes only. Regarding the patients' willingness to adopt self-assessment apps, 57.7% agreed that they were prepared to do so.

The answer to sub-question 4 sheds light on the assumed main causal relationship between level of trust and technology adoption where it was assumed that a medical's professionals trust in self-assessment apps would influence adoption of it among patients (H1). The interviewed medical professionals had however a rather diverse line of thinking regarding if a patient would follow an app recommendation since 4 professionals believed that this is not so likely, 5 believed it is likely and 4 professionals were in doubt. Additionally, they believed that following such advice would rather depend on one's educational level, technical skills or interest in personal health. However, they did mention that sometimes patients got back to them about certain apps and sites which were discussed in a previous consultation hour. The studied patient population showed a more positive perception regarding the causal relationship since none of them disagreed with the statement concerning the willingness to adopt

a health app when their GP recommends it. Ultimately, H1 was accepted with the recognition that the relationship could be influenced by one of the named patient characteristics as moderating factors.

Following the results and conclusions from the sub-questions, it can be concluded with regard to the main research question that the factor of positive familiarity is very likely to have a positive influence on the level of trust in self-assessment health apps of the medical professionals. Furthermore, when this trust level is high, a medical professional is very likely to recommend a self-assessment app to their patients and patients are in turn likely to follow such a recommendation. Nevertheless, this assumed relationship has to be interpreted in general as the studied patient population cannot be directly linked to the interviewed medical professionals.

5.2. Discussion

In this study, it was identified that being familiar with self-assessment apps is very likely to influence the trust level of medical professionals in these types of apps. The interviewed medical professionals who were already familiar with self-assessment apps were found to have a more positive perception and a higher level of trust towards these apps. Furthermore, all 13 professionals stated that knowing and trying an app is an important condition to formulate their trust perception which is needed when recommending apps to their patients. These findings are in line with previous research which states that having a certain 'background' with regard to a technology would influence one's trust level towards the technology (Gefen, 2000). Additionally, when this background of previous knowledge and experience with the technology is positive, it would lead to a higher level of trust (Xie et al., 2020). In relation to this, 11 medical professionals mentioned that having a clear overview of the available apps which are perceived as good would also improve their ability to formulate a more solid trust perception with regards to these apps. Previous literature has found that this lack of knowledge of prescriptible apps can be considered a barrier for general practitioners to prescribe apps (Byambasuren et al., 2020).

Next to familiarity, the literature suggests other factors that could influence the trust level of medical professionals and it was theorized that perceived privacy risks, in the context of patients' personal data, was one of them (Egea & González, 2011). Nevertheless, in this present study we did not find that perceived privacy risks would significantly influence the trust level of medical professionals. The interviewed professionals who did perceive some privacy risks were not automatically less likely to trust self-assessment apps or vice versa. A possible reason for this unobserved relationship between perceived privacy risks and trust level is that the personal data in question is not that of the medical professional itself but that of a patient, meaning that the patient could be rather seen as responsible to consider their privacy risks. Although the interviewed professionals were not completely certain if these types of apps would store or share the patient's personal data, 3 out of 13 indicated that they would perceive more privacy risks if an app shares patients data. Furthermore, 3 out of 13 medical professionals believed that 'every' digital system these days is hackable and that third parties often find ways to obtain one's personal information. Next to that, it is possible that the absence of the relationship is related to

the possibility that the respondents perceived other risks as more important. The literature states that perceived risk in general is an influential factor on one's trust level (Riquelme & Román, 2014), but perhaps in the context of self-assessment apps, other than privacy risks might have a stronger relationship to the trust level. Three interviewed medical professionals mentioned for instance the risk that these apps are, for different reasons, not usable for everyone which might lead to a risk of inequalities among population groups. The medical professionals' trust might also be influenced by other factors which are for instance related to the organizational environment or personal cost and benefit calculations (Xie et al., 2020).

Alongside the factors which can influence the medical professionals' trust level, we indicated to what extent the studied professionals do trust these self-assessment apps in terms of the dimensions functionality, helpfulness and reliability. A self-assessment app was perceived as most functional when it is simple and has a right decision tree, it was perceived as most helpful for taking away any doubt and for small medical issues, and it was perceived as most reliable when the official medical protocols were used. These results are considered as a valuable contribution to current literature since little is known about this trust perspective only in general terms (Boeldt et al., 2015). Furthermore, 5 out of 13 medical professionals indicated that the use of these apps can benefit the practice since it could reduce some of their workload as patients would be able to assess themselves especially for small medical issues. Current literature also suggest that self-assessment apps can be beneficial or for the general practices in terms of reducing workload (Byambasuren et al., 2020; van der Velden et al., 2019) thereby also offering a solution for the general public and public health systems which often faces budgetary pressures (EuropeanCommission, 2014).

In this study, we used the TAM to explain the influence of the medical professionals' trust, as the subjective norm, on the app adoption of patients. In addition, the perceived ease of use and perceived usefulness of self-assessment apps were considered as influential factors on the adoption level. Although the in influence of these two factors were not extensively tested but used as control variables in this study, significant positive correlations with the "willingness to adopt" variable indicated that it is likely that the perceived ease of use and perceived usefulness could be contributing factors for the result that more than half (57.7%) of the studied patient sample were willing to adopt a self-assessment app. Current literature has often tested and found the influence of the perceived ease of use and perceived usefulness to be significant factors (Beldad & Hegner, 2018; Cho et al., 2014).

The influence of the level of trust, as the subjective norm, was the main focus in our study and the results indicated that more than half of the survey respondents agreed that the perception of a, to them, important person would influence their own perception to use a health app. These results are in line with existing theory regarding the subjective norm which suggests that an individual is more likely to adopt a certain behaviour when an important person to them believed he or she should do so (Beldad & Hegner, 2018; Cho et al., 2014). Moreover, there was no patient respondent who disagreed with the statement regarding their willingness to adopt a health app when their GP/general practice recommends

it, suggesting that the respondents value their medical professional's opinion. Current literature does indicate that in general patients do trust and value the opinion of their doctor, especially when they have the feeling of being taken seriously (Croker et al., 2013). The recommendation of a medical professional could be an important additional motivation for patients to use a certain health app as some individuals might not consider using a health app especially when they do not perceive it as easy to use or as useful. Furthermore, this high reliance of patients on the advice from their GP suggests that a GP should actively consider whether they would become more active in providing app recommendations to their patients.

As the results exhibit, the interviewed medical professionals were willing to advise self-assessment apps, especially when conditions such as knowing the app in question were met. However, it must be noted that even in the scenario in which a medical professional completely trusts an app, it does not mean that he or she automatically recommends it to their patients or that the patients will directly follow a recommendation. The medical professionals indicated that they also consider for instance the personal needs of a patient before recommending something. Next to that, 8 out of the 13 medical professionals believed that there is genuine risk that the patients themselves will interpret the app incorrectly leading to incorrect advice which could be a reason for a professional to not recommend it. Furthermore, the medical professionals believed that following a recommendation would depend on level of education, technical skills and motivation suggesting that the influence by the subjective would be more likely for particular patient groups. This means that there could be factors which influence the willingness to recommend or the willingness to follow a recommendation of self-assessment apps which are perhaps not related to the app itself but to the involved parties. Our study did not investigate these external factors and was only able to compare if higher educated patients from the survey would be more willing to adopt self-assessment apps. Current literature suggests that generally highly educated people are more likely to use health apps (Bol et al., 2018), however we did not find a similar relationship in our research.

5.3. Limitations

This study has found some limitations which should be considered. The first limitation is related to the main causal relationship between the medical professionals' trust and app adoption by patients. As explained in the methods chapter, it was not possible to directly link the interviewed medical professionals to the patients who responded to the survey. When the respondents of the survey are the actual patients of the medical professionals, the validity would then increase when testing the assumed causal relationship between trust and adoption. This is because it would then be possible to compare the collected data on if particular medical professionals who trust and recommend self-assessment apps would have patients who actually adopted these apps as a result of a recommendation. In this research, it is only possible to interpret the relationship in a more general matter since the patients might have other medical professionals from the cities than the ones who were interviewed. Furthermore, some of the medical professionals were not familiar with self-assessment health apps, which made it sometimes

more difficult for them to formulate a concrete trust perception which could be seen as a limitation and should be considered when interpreting the relationship. Nevertheless, this lack of familiarity was considered as a supportive finding for the first part of the central research question and H1 where it is concluded that 'familiarity' with self-assessment apps is very likely to influence the trust formulation of the medical professionals.

A second limitation of this research is the rather small sample size of the patients (N= 90). This means that the patient sample might not be fully representative for the cities Losser, Enschede and Oldenzaal which could harm the reliability and validity in this study. Furthermore the patient sample was not equally distributed with regards to the gender and age categories, meaning that men and patients aged 26-45 and aged 66 and older were less represented. The categories regarding the location of the general practice and the educational level were rather more equally distributed and representative with exception of the lowest educational level which has no participants. Because of the rather underrepresentation of the older age category and the lowest educational level, it is possible that some overstatement with regards to the perceived ease of use and perceived usefulness variables was created[4] which could be considered as a limitation. A more representative patient sample might result in more equal distributions of the perceived ease of use and usefulness variables.

The third limitation is related to the scope and time span of this study. As mentioned, it is possible that there are factors which influence the willingness of the medical professional to recommend a self-assessment app which are not related to the trust in the app itself but for instance the belief of the professionals that patients would interpret the app incorrectly. Additionally, it is very likely that other factors or risks than the 'perceived privacy risk' which was found to be not influential, could have an influence on the trust level of the medical professionals. Given the time span and scope of this study we did not investigate all these possibilities and focused only on two factors which could influence the trust level and investigated this level of trust in self-assessment health apps as the primary incentive to recommend these types of apps to patients. In this way, a rather narrow although more specific insights regarding the level of trust were provided which are valuable for a better understanding of a medical professional's trust toward self-assessment health apps and their motivations to recommend them.

5.4. Directions for future research

The results and limitations of this study brings up some considerations and suggestions for future research. For instance, to improve the validity when testing the relationship between level of trust and app adoption, future research should aim to have a direct connection between the medical professionals and their patients. In this way, the relationship between trust and adoption could be more accurately measured. Additionally, a larger and more representative patient sample could then be helpful when

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[4] Weak positive and significant ($\alpha = 0.05$) correlations were found in our sample between the educational level and perceived ease of use. Weak to moderate positive significant ($\alpha = 0.05$) correlations were found between age and perceived ease of use and the perception that the providence of medical advice by an app is helpful.

investigating the relationship so that more clear comparisons between the level of trust and adoption can be made and investigated.

Furthermore, future research could consider other risks or factors which influence the trust perception of medical professionals to more extensively understand how the trust perception comes into being. Next to that, attention could be paid to possible factors which influence the recommendation of self-assessment apps by the medical professionals as our findings indicated these do not have to be related to apps themselves but perhaps to the app users. Several medical professionals indicated to believe that patients could wrongly interpret the apps and the professionals stated that they consider one's personal needs before recommending an app. Also, there might be certain 'types' of patients, who have for instance more digital skills, that are more inclined to follow an app recommendation.

Given that this topic of trust in and recommendation of self-assessment health apps in public health is a rather new and understudied topic, many questions still remain unanswered. Nevertheless, this research provides some insights in the trust level of medical professionals by investigating it via three trust dimensions. In this way it became clearer in which instances they would perceive self-assessment health apps as functional, helpful and reliable thereby shedding light on the overall trust perspective of the professionals at a general practice. Additionally, this research provided insights on the influence of this trust, as the subjective norm, on the app adoption by patients. Future research could consider the mentioned suggestions to better investigate the level of trust and its influence on the level of app adoption while taking into account factors which influence the provision and following of a self-assessment health app recommendation.

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Appendices

Appendix A: Interview questions for the medical professionals

	Questions in English	**Questions in Dutch**	**Reason for the asked question**
Variable; Familiarity			To learn to what extent medical professionals are familiar with self-assessment health apps.
Dimension; Knowledge	Do you know any health apps which can give advice to people with medical complaints?	Bent u bekend met gezondheidsapps die een advies kunnen geven aan mensen met medische klachten?	This information is relevant for sub-question 2 and hypothesis 2.
	- When yes; Which specific apps do you know? - How does that app work? - Are these also related to diabetes/ asthma/ mental health? _____	- Zo ja; Welke specifieke app kent u? - Hoe werkt die app? - Zijn deze ook gerelateerd aan diabetes/ astma/ mentale gezondheid? _____	Knowledge To learn what they already know regarding self-assessment health apps and if they know any particular apps.

Dimension; Experience	Have you ever personally used a health app to get advice on a medical issue?
	
	 - When yes;
	 - Which one?
	 - How often?
	 - How was that experience?
	
	 - When no;
	 - Has someone you know from your personal circle ever shared their experiences with these types of apps?
	    - How were those experiences?
		Heeft u ooit persoonlijk een gezondheidsapp gebruikt die een advies kan geven?
		
		 - Zo ja;
		 - Welke?
		 - Hoe vaak?
		 - Hoe was die ervaring?
		
		 - Zo nee;
		 - Heeft ooit iemand uit uw persoonlijke omgeving zijn of haar ervaring met dergelijke gezondheidsapps met u gedeeld?
		    - Hoe waren deze
			Experience
			 To learn what their experiences are regarding self-assessment health apps and if this is based on their own experiences or that from others.
			
			 Also, to gain information regarding in which situation(s) they would be interested to use these apps.

	Why positive or negative?	ervaringen? Waarom positief of negatief?	
	- When would you be interested in using one?	-Wanneer zou u geïnteresseerd zijn om een dergelijke gezondheidsapp te gebruiken?	
Variable; Perceived privacy risk	What do you consider as possible risks that these (diabetes/ asthma/ mental or general) self-assessment apps could have? - How great do you estimate the presence of these risks? - To what extent do you think there are privacy risks regarding the inserted data in the app?	Wat zijn volgens u mogelijke risico's die deze (diabetes/ astma/ mentale of algemene) zelfevaluatie apps met zich meebrengen? - Hoe groot schat u de aanwezigheid van deze risico's in? - In hoeverre denkt u dat er privacy risico's zijn met betrekking tot de ingevulde gegevens in de app?	To learn to what extent medical professionals associate and perceive risks in relation to self-assessment health apps. Also, if they perceive any privacy risks. This information is relevant for sub-question 2 and hypothesis 3.
Variable; Trust Dimension; Functionality	What kind of functions shouldn't be missing from these (diabetes/ asthma/ mental or general) self-assessment apps so that they can give advice? - Which of these aspects would you say is the most important and why?	Welke soort functies zouden er niet moeten ontbreken bij deze (diabetes/ astma/ mentale of algemene) zelfevaluatie apps zodat ze een advies kunnen geven? - Welke van deze eigenschappen vindt u het meest belangrijkste?	To learn to what extent medical professionals trust self-assessment health apps. This information is relevant for sub-question 1 and hypothesis 1. Functionality To learn if they believe that these apps have the right functions to provide advice. Also, which functions they think are the most

	- To what extent do you think that these self-assessment apps currently miss important functions? _____	- In hoeverre denkt u dat deze zelfevaluatie apps momenteel belangrijke functies missen? _____	important and if they believe that the current apps do have the right functions.
Dimension; Helpfulness	Which features would make a (diabetes/ asthma/ mental or general) self-assessment app especially helpful to patients? - Do you believe that current apps could provide such useful advice to a patient? _____	Welke eigenschappen zouden volgens u een (diabetes/ astma/ mentale of algemene) zelfevaluatie app vooral nuttig maken voor patiënten? - Denkt u dat de huidige apps in staat zijn om een nuttig advies te geven aan patiënten? _____	Helpfulness To learn if they believe that the advice of a self-assessment health app would be helpful to patients. Also, if they think that current apps can provide useful advice to patients.
Dimension; Reliability	Which features do you think are needed that would make a (diabetes/asthma/mental /general) self-assessment app reliable? - Do you think that the current self-assessment apps would be able to provide reliable advice to patients?	Welke eigenschappen zijn er volgens u nodig om een (diabetes/ astma/ mentale of algemene) zelfevaluatie app betrouwbaar te maken? - Denk u dat de huidige zelfevaluatie apps in staat zijn om een betrouwbaar advies te geven aan patiënten?	Reliability To learn if they believe that the advice of a self-assessment health app would be reliable and consistently correct. Also, if they think that current apps would be reliable.
Recommendation	What would make you more likely to recommend a self-assessment app? - Did you ever recommend a self-assessment app?	Waardoor zou u meer bereid zijn om een zelfevaluatie app aan te bevelen? - Beveelt u wel eens een zelfevaluatie app aan?	To learn to what extent the medical professionals would recommend self-assessment health apps. Also, if they ever did recommend one.

	- Which type (diabetes/ asthma/ mental or general) of health apps would you be more likely to recommend?	- Welk type diabetes/ astma/ mentale of algemene gezondheidsapp zou u eerder aanbevelen?	This information is relevant for sub-question 4 and hypothesis 1. It is relevant for understanding of the possible causal relationship since the recommendation of an app can be the result of the trust in the app and can promote app adoption.
Causality	Have your patients ever asked you for information about particular health apps? - When yes; what kind of apps were these? For monitoring purposes or advice? - When no; Have patients of colleges ever asked them for information about particular health apps? To what extent do you think that your recommendation of a self-assessment app would result in the actual app use among your patients? - Among which patients do you think that this influence is most likely?	Hebben uw patiënten u ooit om informatie gevraagd over bepaalde gezondheidsapps? - Zo ja; Wat van soort apps waren dit? Gaven die advies of houden die alleen gegevens bij? - Zo nee; Heeft u ooit van collega's gehoord dat patiënten naar bepaalde gezondheidsapps hebben geïnformeerd? In hoeverre denkt u dat uw aanbeveling van een zelfevaluatie app zou resulteren in daadwerkelijk app gebruik onder uw patiënten? - Bij welke patiënten verwacht u dat dit het meest waarschijnlijk is?	To gain more insight in the assumed causal relationship. If medical professionals believe that their trust will have an influence on app adoption or if they have experienced this. This information is relevant for sub-question 4 and hypothesis 1.

	Have you ever experienced or heard that a patient started to use a health app as a result of your or some other healthcare professional's recommendation?	Heeft u ooit meegemaakt of gehoord dat een patiënt een gezondheidsapps ging gebruiken na een aanbeveling van u of ander zorgpersoneel?	
Age	What is your age?	Wat is uw leeftijd?	To gain demographic insight of the population group.

Appendix B: Survey questions for the patients

	Questions in English	Questions in Dutch	Choice option (Dutch)
Variable; Adoption	Do you ever use a health app on your mobile phone?	Gebruikt u wel eens een gezondheidsapp op uw mobiele telefoon?	- Nee - Ja, voor het bijhouden van sportactiviteiten - Ja, voor het bijhouden van voeding - Ja, voor het bijhouden van (slaap)patronen - Ja, voor mindfulness - Andere doeleinden [Multiple options possible] _____
	(When choice option 'nee' is not selected) Do you use any health apps on your mobile phone which can provide medical advice? - When yes; Which app do you use? - When yes; How frequently do you use this health app?	*(Wanneer optie 'nee' niet is geselecteerd)* Gebruikt u een gezondheidsapp op uw mobile telefoon die een medisch advies kan geven? - Zo ja; Welke app gebruikt u? - Zo ja; Hoe vaak gebruikt u deze app?	Ja/ Nee _____ Open _____ Zelden Zo nu en dan Vaak Altijd (elke dag) _____
	Have you ever heard of the following health apps that can provide advice? - Moet ik naar de dokter? - MySugr - Astma Zelfcheck - NiceDay	Heeft u wel eens gehoord van de volgende gezondheidsapps die advies kunnen geven? - Moet ik naar de dokter? - MySugr - Astma Zelfcheck - NiceDay	[Answer per app] Nee Ja, wel eens van gehoord Ja, ook wel eens gebruikt - *(Hoe vaak gebruikt u deze app?)* - Zelden - Zo nu en dan - Vaak - Altijd (elke dag) _____

	(To what extent do you agree or disagree with the following statements?) I would be willing to use a health app that can provide medical advice.	*(In hoeverre bent u het eens of oneens met de volgende stellingen?)* Ik ben bereid om een gezondheidsapp te gebruiken die een medisch advies kan geven.	Helemaal mee oneens Oneens Neutraal Eens Helemaal mee eens Weet ik niet
Variable; Perceived ease of use	*(To what extent do you agree or disagree with the following statements?)* I find it easy to learn how to use an advisory health app. I have no problems using health apps.	*(In hoeverre bent u het eens of oneens met de volgende stellingen?)* Ik vind het gemakkelijk om het gebruik van een adviserende gezondheidsapp te leren. Ik ondervind geen problemen in het gebruik van gezondheidsapps.	Helemaal mee oneens Oneens Neutraal Eens Helemaal mee eens Weet ik niet
Variable; Perceived usefulness	*(To what extent do you agree or disagree with the following statements?)* I find a health app that provides medical advice helpful. I think that a health app is a useful tool for getting medical advice.	*(In hoeverre bent u het eens of oneens met de volgende stellingen?)* Ik vind een gezondheidsapp die medisch advies geeft nuttig. Ik vind een gezondheidsapp een zinvol hulpmiddel om medisch advies te krijgen.	Helemaal mee oneens Oneens Neutraal Eens Helemaal mee eens Weet ik niet

Causality	*(To what extent do you agree or disagree with the following statements?)*	*(In hoeverre bent u het eens of oneens met de volgende stellingen?)*	Helemaal mee oneens Oneens Neutraal Eens Helemaal mee eens Weet ik niet
	I am willing to use a health app when someone important to me recommends it.	Ik ben bereid om een gezondheidsapp te gebruiken wanneer een voor mij belangrijk persoon het aanbeveelt.	
	I am willing to use a health app when someone from my personal circle recommends it.	Ik ben bereid om een gezondheidsapp te gebruiken wanneer iemand uit mijn persoonlijke omgeving het aanbeveelt.	
	I am willing to use a health app when my GP/general practice recommends it.	Ik ben bereid een gezondheidsapp te gebruiken wanneer mijn huisarts/huisartspraktijk het adviseert.	
	I am willing to use a health app when a recognized doctor recommends it (e.g. from the media).	Ik ben bereid om een gezondheidsapp te gebruiken wanneer er een erkende arts het aanbeveelt (bijv. uit de media).	
Practice	Where is your general practice located?	In welke plaats bevindt uw huisartspraktijk zich?	- Losser - Oldenzaal - Enschede - Ergens anders
Age	What is your age?	Wat is uw leeftijd?	Jonger dan 25 jaar 26-35 jaar 36-45 jaar 46-55 jaar 56-65 jaar 66-75 jaar Ouder dan 75 jaar
Gender	What is your gender?	Wat is uw gender?	Vrouw Man Anders Zeg ik liever niet

Educational level	What is your highest level of education?	Wat is uw hoogst genoten opleiding?	- Basisonderwijs / lagere school - LBO / VBO / VMBO - Middelbaar beroepsonderwijs (MBO) - Hoger voortgezet onderwijs (HAVO of VWO) - Hoger beroeps onderwijs (HBO) - Wetenschappelijk onderwijs (Universiteit)

Appendix C: Code themes

Code Group/ Theme	Description
Knowledge	The level of awareness of the respondent regarding self-assessment apps
Experience	The previous encounters with self-assessment apps by the respondent
Functionality	The extent to which the respondent expects the technology to have the capability to complete a required task
Helpfulness	The extent to which the respondent beliefs that the technology provides adequate help for users
Reliability	The extent to which the respondent believes that the advice produced by the apps are correct.
Perceived privacy risk	Confidence level of the respondent towards the adequate protection of the individually identifiable information of the app users
Perceived risks	Perceived risks by the respondent regarding self-assessment apps
Recommendation	An instance in which the respondent is willing to suggest a self-assessment app to patients
Perceived use after advice	To what extent and when the respondent thinks that a patient would use an app when they have recommended it
Interest apps	An instance in which one shows curiosity in self-assessment apps
Self-assessment apps	Certain general believes which the respondent has regarding self-assessment apps

Appendix D: Syntax

DATASET ACTIVATE DataSet1.

* Filter out meaningless cases*

USE ALL.
COMPUTE filter_$=(Finished = 1).
VARIABLE LABELS filter_$ 'Finished = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.

* Frequencies population demographics*

FREQUENCIES VARIABLES=Q10 Q11 Q12 Q13
 /STATISTICS=MEAN MEDIAN MODE
 /ORDER=ANALYSIS.

* Frequencies app adoption general*

FREQUENCIES VARIABLES=Q1_1 Q1_2 Q1_3 Q1_4 Q1_5 Q1_6
 /STATISTICS=MEAN MEDIAN MODE
 /ORDER=ANALYSIS.

Frequencies self-assessment apps

FREQUENCIES VARIABLES=Q2 Q2.1 Q2.2 Q3 Q3.1 Q4 Q4.1 Q5 Q5.1 Q6
 /STATISTICS=MEAN MEDIAN MODE
 /ORDER=ANALYSIS.

Creation adoption variable

COMPUTE Adoption=sum.1(Q7_3,Q7.1_3).
EXECUTE.

Frequencies adoption level

FREQUENCIES VARIABLES=Adoption
 /STATISTICS=MEAN MEDIAN MODE
 /BARCHART FREQ
 /ORDER=ANALYSIS.

Frequencies perceived ease of use and perceived usefulness (I think)

FREQUENCIES VARIABLES=Q7_1 Q7_2 Q7_4 Q7_5
 /STATISTICS=MEAN MEDIAN MODE SUM
 /ORDER=ANALYSIS.

Frequencies perceived ease of use and perceived usefulness (I expect)

FREQUENCIES VARIABLES=Q7.1_1 Q7.1_2 Q7.1_4 Q7.1_5
 /STATISTICS=MEAN MEDIAN MODE SUM
 /ORDER=ANALYSIS.

Combined answerers of 'I think' and 'I expect' for correlations

COMPUTE Ease_of_use_L=sum.1(Q7_1,Q7.1_1).
EXECUTE.

COMPUTE Ease_of_use_NP=sum.1(Q7_2,Q7.1_2).
EXECUTE.

COMPUTE Usefulness_AP=sum.1(Q7_4,Q7.1_4).
EXECUTE.

COMPUTE Usefulness_AD=sum.1(Q7_5,Q7.1_5).
EXECUTE.

Correlations perceived ease of use and usefulness with adoption

CORRELATIONS
 /VARIABLES=Adoption Ease_of_use_L Ease_of_use_NP Usefulness_AP Usefulness_AD
 /PRINT=TWOTAIL NOSIG
 /MISSING=PAIRWISE.

Frequencies causal questions

FREQUENCIES VARIABLES=Q8_1 Q8_2 Q8_3 Q8_4
 /STATISTICS=MEAN MEDIAN MODE
 /BARCHART FREQ
 /ORDER=ANALYSIS.

Correlations age and education level with adoption

CORRELATIONS
 /VARIABLES=Q13 Q11 Adoption
 /PRINT=TWOTAIL NOSIG
 /MISSING=PAIRWISE.

Correlations age and education level with causal questions

CORRELATIONS
 /VARIABLES=Q13 Q11 Q8_1 Q8_2 Q8_3 Q8_4
 /PRINT=TWOTAIL NOSIG
 /MISSING=PAIRWISE.

Correlations perceived ease of use and usefulness with age and education level

CORRELATIONS
 /VARIABLES=Q11 Ease_of_use_L Ease_of_use_NP Usefulness_AP Usefulness_AD
 /PRINT=TWOTAIL NOSIG
 /MISSING=PAIRWISE.

CORRELATIONS
 /VARIABLES=Q13 Ease_of_use_L Ease_of_use_NP Usefulness_AP Usefulness_AD
 /PRINT=TWOTAIL NOSIG
 /MISSING=PAIRWISE.