eHealth lifestyle interventions used in nursing from type 2 diabetes patients' perspective- A literature review

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Laurea University of Applied Sciences **Abstract**
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Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder with insulin resistance and high blood glucose level. T2DM can lead to fatal health complications, such as cardiovascular disease, blindness, kidney failure and lower-limb amputation. Except the genetic factors, T2DM is highly affected by one's lifestyle such as diet and physical activities.

The global prevalence of diabetes, shortage of nursing workforce, and the ubiquitous internet usage, many studies have evidenced that eHealth has the potential to promote healthy lifestyle to manage chronic diseases, to improve communication through the efficient delivery, to optimize healthcare related processes, reach more people and cost effectiveness.

The purpose of this paper is to explore eHealth lifestyle interventions used in nursing from T2DM patients' perspective. The aim of this study is to study and describe eHealth lifestyle interventions used in nursing from T2DM patients' perspective. Hence, the research question is what kind information do T2DM patients need regarding eHealth lifestyle interventions used in nursing?

A literature review was carried out in the study. Data was retrieved from reliable database via EBSCOhost (CINAHL) from January 2015 to September 2022. Ten relevant peer reviewed published articles were selected as the primary data for the thematic analysis.

The findings are that regarding eHealth lifestyle intervention used in nursing, T2DM patients highly desire patient-centered care and social support; in addition to abundant clinical nursing skills, the nurses' knowledge concerning motivational interviewing and health-coaching skills is highly required by T2DM patients; the measurement tools that patients use during eHealth lifestyle intervention is blood glucose level, blood pressure level, body mass index and waist circumstance; eHealth intervention can be considered as an instrumental supportive tool for health lifestyle intervention for T2DM patients along with the traditional face-to-face health interventions.

Keywords: eHealth lifestyle interventions used in nursing, eHealth interventions, healthy lifestyle, type 2 diabetes mellitus (T2DM), patients' perspective.

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CDC: American Disease Control and Prevention

IDF: International Diabetes Federation

mhealth: mobile health

eHealth: electronic health

WHO: World Health Organization

THL: Finnish Institute for Health and Welfare

T2DM: type 2 diabetes mellitus

BMI: body mass index

1 Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder, which is characterized by insulin resistance and high blood glucose level. It is estimated that 10% of the entire world population will have diabetes in 2045. In addition, half of the population living with diabetes do not know that they have diabetes. 50% of people with prediabetes will develop type 2 diabetes mellitus. Such phenomena are called diabetes prevalence, which directly affects the global economic burden. (IDF Diabetes Atlas 2021.)

T2DM is mainly caused by currently sedentary lifestyle and increased in obesity (Afshin et al. 2017). T2DM is the main cause of infections, kidney insufficiency, blindness, foot ulcerations, and non-traumatic amputations, it is associated with high morbidity and mortality (Park & Peters 2014). T2DM decreases life expectancy, on average of eight years less than the non-diabetic population (Franco, Steyerberg, Hu, Mackenbach, Nusselder 2007).

AT2DM has a latent, asymptomatic period of sub-clinical stages which remains undiagnosed for several years, many T2DM patients do not perceive their conditions to be serious but consider T2DM as relatively controllable with minor consequences, such mindset can postpone patients' lifestyle changes until irreversible complications appear late ((IDF Diabetes Atlas 2021). Because the difficulties in monitoring patients' lifestyle, shortage of nursing workforce, and hectic of the nursing environment in general, many studies found out there is lack of active nursing follow-up for T2DM patients (du Pon, Wildeboer & van Dooren 2019; Martos-Cabrera et al. 2021).

Patient's lifestyle is one important part of patient's self-care. Nowadays, eHealth lifestyle interventions used through the information technology via telephone, tablet, web-based interventions have the potential to promote healthy lifestyle and improve patients' health behaviors to some extent, such as regular self-monitoring, healthy diet, physical activity, and subsequent health outcomes in terms of weight, glycemic control, and emotional release (Pal et al. 2013; Ramadas, Quek, Chan & Oldenburg 2011). eHealth intervention can reach more people and achieve cost effectiveness (Glasgow, Bull, Piette & Steiner 2004). However, there is lack of study regarding eHealth lifestyle interventions used in nursing, particularly from T2DM patients' point of view globally (Solomon 2008; Skär & Söderberg 2017.) Therefore, the purpose of this paper is to explore eHealth lifestyle interventions used in nursing from T2DM patients' perspective.

2 Theoretical framework

To connect with the research question, this paper will first give a general overview of T2DM, such as its symptoms and diagnoses, risk factors and treatment. Because lifestyle is such important factor for managing T2DM, this paper will also provide the healthy lifestyle information for T2DM patients in terms of healthy diet, more physical activity, smoking cessation, and moderated alcohol usage. Furthermore, this study will explain the eHealth interventions used in nursing, such as its definition and types of eHealth interventions.

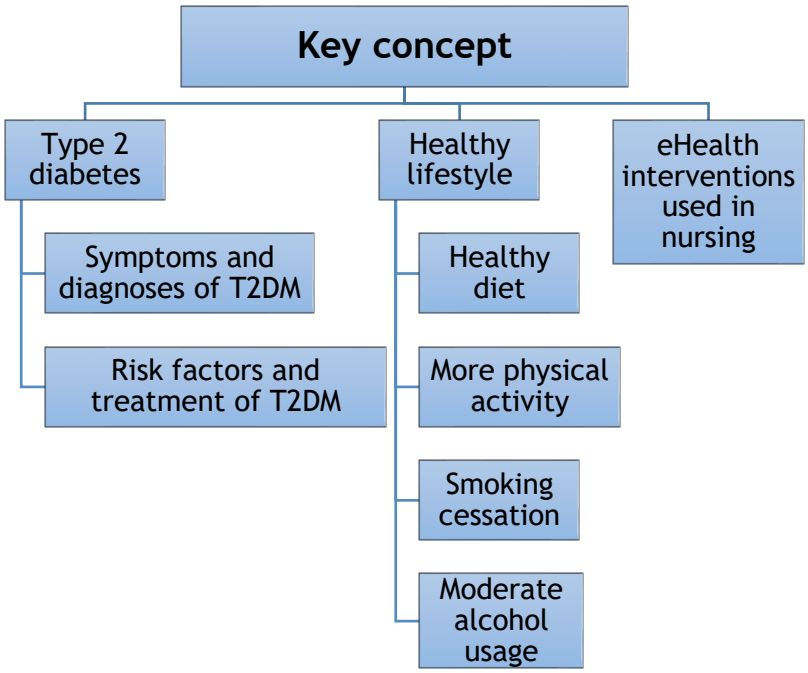

Figure 1: key concept used in our study

2.1 Type 2 diabetes Miletus

T2DM is characterized by insulin resistance and high blood sugar (American Diabetes Association 2018). It is the most common form of diabetes mellitus, accounting for approximately 90% of the diabetic population (IDF Diabetes Atlas 2021). According to Finnish Institute for Health and Welfare (THL), the insulin that pancreas produces cannot work properly, or the pancreas cannot produce enough insulin. This means that the blood glucose (sugar) levels keep rising above the normal threshold levels, and eventually cause blood vessel damage. This can lead to long-term damage and potentially fatal health complications, such as cardiovascular disease, blindness, kidney failure and lower-limb amputation. T2DM costs high healthcare expenditures, and if diabetes complications occur, both direct and indirect costs increase significantly. (THL 2022.)

T2DM patients have high concentration of glucose level in their blood, mostly occurs in adulthood, which is formerly named as non-insulin-dependent or adult-onset diabetes. Adult

people are more prone for reduced insulin secretion from the pancreas, and insulin is not utilized properly in the muscle and fat cells. This leads to excessive glucose level in the blood. When fatty acids are oxidized to produce energy, ketone bodies are released, and it may cause ketoacidosis and diabetic coma. (THL 2022.)

Vugt, Wit, Cleijne and Snoek (2013) explain that insulin resistance may be present for many years before the onset of diabetes mellitus and relatively lack of insulin secretion due to the slow response of Beta cells to glucose rise in the bloodstream. In addition, excessive secretion of glucagon after a meal due to lack of suppression of glucagon. This leads to the increased production of glucose in the liver and hyperglycemic spikes. Patients who are diagnosed with T2DM often do not need insulin as treatments to survive, but many require controlling their blood sugar regularly. Insulin resistance may improve with weight reduction and pharmacologic treatment which result in stabilizing of glycaemia. (Wondmkun 2020.)

2.1.1 Symptoms and Diagnoses of T2DM

According to American Center for Disease Control and Prevention (CDC) (2021), diabetes symptoms are: urinating frequently, getting thirsty and hungry often, losing weight without trying, having blurry vision and dry skin, having numb or tingling hands or feet, feeling fatigue, having sores that heal slowly, and having more infections than usual.

CDC (2021) further explain that those aforementioned T2DM symptoms often take several years to develop. Some people do not notice any symptoms at all for the first few years. Because symptoms are hard to spot, it is important to have the blood laboratory test to diagnose it, namely hemoglobin HbA1C test, fasting plasma blood glucose test, glucose tolerance test and random blood glucose test. See the blood glucose range for diabetes, prediabetes, diabetes and normal in the following table 1.

Laboratory result	A1C Test %	Fasting blood glucose Test		Glucose tolerance test		Random blood glucose test
Diabetes	≥ 6.5	≥ 126 mg/dL	≥ 7mmol/l	≥200 mg/dL	≥ 11.1mmol/l	≥200 mg/dL
Prediabetes	5.7 – 6.4	ten0 – 125 mg/dL	5.5-7mmol/l	140 – 199 mg/dL	7.71-11mmol/l	N/A
Normal	< 5.7	≤ 99 mg/dL or below	3.8-5.5mmol/l	≤ 140 mg/dL	≤ 7.7mmol/l	N/A

Table 1: Modified version of blood glucose level among healthy, prediabetes and diabetes (Based on CDC 2021)

2.1.2 Risk factors and treatment of T2DM

Some risk factors are unmodifiable, and some are modifiable to cause T2DM. According to THL (2021), unmodifiable risk factors are ethnicity, race, age, family history of diabetes (genetic), metabolic syndrome (increased blood pressure, blood lipid disturbances, impaired fasting glucose, impaired glucose tolerance), history of gestational diabetes and low birth weight. The modifiable risk factors are lifestyle-related, such as unhealthy diet, sedentary lifestyle, obesity, smoking, insufficient sleeping, and stress (THL 2021.)

Therefore, the key factor in diabetes prevention and treatment is to eliminate those modifiable risk factors, namely a sustained lifestyle change (THL 2021). The Finnish Diabetes Prevention Study (2021) showed that aimed to achieve these following five goals can reduce the risk of diabetes greatly: lose weight (≥ 5% reduction from baseline weight), reduce dietary fat (< 30% of total energy consumed), reduce saturated fat (< 10% of total energy consumed), increase dietary fiber intake (≥ 15 g/1000 kcal), increase physical activity (≥ 30 minutes/day).

In practice, in accordance with general dietary recommendations for the normal population, diet to prevent and treat T2DM includes handful fiber-enriched diet (whole grains); sufficient fruit and vegetables, using low and soft fat (plant-based fat), minimizing use of hard fat (animal-based fat), salt intake is maximum 5gram per day. (THL 2021.) Our study will explore the eHealth lifestyle intervention used in nursing field from the T2DM patients' perspective. The eHealth intervention can put more effort on the patients' education regarding what is the healthy lifestyle to T2DM patients.

2.2 Healthy lifestyle of diabetes self-care

T2DM patient's lifestyle is an important part of patient's self-care. Hu and Manson (2003) summary the treatment of T2DM patients is largely depended on the patient's daily self-care, by means of lifestyle modification (such as diet and physical exercise) and taking oral medication to normalize blood pressure, cholesterol, and triglycerides, and/or insulin to lower the blood glucose. People with prediabetes can reduce their risk of developing T2DM through lifestyle changes, such as regular physical activity and healthy eating. Therefore, health lifestyle is recognized as the cornerstone of the overall diabetes management. (IDF Diabetes Atlas 2021.)

The Association of American Diabetes Educators (2009) has defined seven key self-management behaviors: namely, eating healthy, being active, monitoring blood glucose, taking medicine, existing problem solving, reducing modifiable risk factors, and mentally

healthy coping mindset. The Dietary Guidelines for Chinese Residents (2016) also provide the similar healthy lifestyle guidance for T2DM patients in China.

However, changing one's lifestyle requires one's deep devotion in terms of motivation, energy, and time. Motivation is an intrinsic driver for taking such action. Meanwhile, to promote T2DM patients' daily self-care, educational and behavioral support programs have been developed and shown to be effective for behavioral and medical outcomes (Norris, Lau, Smith, Schmid & Engelgau 2002; Deakin, McShane, Cade & Williams 2005).

Diabetes self-management is an ongoing process of facilitating knowledge, skills, and abilities necessary for diabetes patients' self-care, delivered by specialized healthcare professionals. Patients, by making their own decisions and performing self-chosen actions that aimed at improving their health and improving the quality of life, self-management enables patients to take control of their chronic disease in terms of their treatments, the physical and psychological symptoms. (Powers et al. 2016.)

Health education interventions are comprehensive programs that health care providers deliver to patients aimed at improving patients' clinical outcomes through the increase and maintenance of health behavior. Diabetes 2018 Canada Clinical Practice Guidelines Expert Committee (Ivers et al. 2019) describes that self-management education and self-management support are the two cornerstones for managing T2DM patients' blood glucose level. Nowadays, increasing research indicate that the combination of both self-management education and self-management support is most beneficial for improving glycemic control, patient's self-efficacy, self-care behaviors regarding monitor of blood glucose and eating healthy, and reducing diabetes stress and foot, dental complications. (Power et al. 2016.) eHealth interventions used in nursing can focus on the patients' self-management education and supports for T2DM patients (Hao & Xu 2018).

2.2.1 Healthy diet

Dietary habits are essential elements for individual cardiovascular and metabolic risk. An individual's food choices and energy balance affect one's body weight, blood pressure, and lipid levels directly. Carbohydrate intake has a direct effect on postprandial glucose levels in people with diabetes and is the principal macronutrient of worry in glycemic management. (Holman, Paul, Bethel, Matthews & Neil 2008.) Higher-fiber diets are an important component of diabetes management, resulting in improvements in glycemic control, blood lipids, body weight, and inflammation, as well as a reduction in premature mortality. These benefits were not confined to any fiber type or to any type of diabetes. Hence, increasing daily fiber intake by 15 grams or to 35 grams might be a reasonable target that would be expected to reduce risk of premature mortality in adults with diabetes. (Reynolds, Akerman and Mann 2020.)

A healthy diet helps us to protect against malnutrition and as well as noncommunicable diseases including diabetes, heart disease, stroke, and cancer. Energy intake (calories) should be in balance with energy expenditure. To avoid unhealthy weight gain, total fat should not exceed 30% of total energy intake. Intake of saturated fats should be less than 10% of total energy intake, and intake of trans-fats less than 1% of total energy intake, with a shift in fat consumption away from saturated fats and trans-fats to unsaturated fats, and towards the goal of eliminating industrially produced trans-fats. (WHO 2020).

Limiting intake of free sugars to less than 10% of total energy intake is part of a healthy diet. A further reduction to less than 5% of total energy intake is suggested for additional health benefits. (WHO 2020).

Consumption of fruits and vegetables may protect the development of T2DM, as they are rich in nutrients, fiber and antioxidants which are considered as protective barrier against diabetes (Sanchez-Villegas et al.2008). Numerous health benefits have been observed to the Mediterranean diet (abundant intake of fruit and vegetables) over the last decades. A study suggested that intake of virgin olive oil diet in the Mediterranean area has a beneficial effect on the reduction of progression of T2DM retinopathy The beneficial effects of using fish and olive oil have been reported to be associated with improved glucose metabolism and decreased risk of T2DM, obesity and cardiovascular disease. (Martín-Peláez, Fito & Castaner 2020.)

Nseir, Nassar and Assy's research (2010) suggested a linkage between the intake of soft drinks with obesity and diabetes, resulting from large amounts of high fructose corn syrup used in the manufacturing of soft drinks, which raises blood glucose levels and body mass index to the dangerous level. Furthermore, high intake of red meat, sweets, and fried foods, contribute to the increased risk of insulin resistance and T2DM (Panagiotakos et al. 2005).

The recommended dietary pattern is to increase the consumption of fish, poultry, various vegetables, and fruits, using the planted-based oil, avoiding animal-based fat, and minimizing the intake of red meat and salt. It is worth to mention that low-fat does not mean healthy. Moreover, the western dietary pattern was characterized by an increased consumption of processed red meat, chips, dairy products, refined grains, sweets, and desserts, which is highly contributed to obese and chronic diseases. Hence, this provides nurses a great opportunity to implement various eHealth interventions to persuade westerners in adapting a healthy lifestyle. Through the mutual efforts from both health care providers and patients, health-care professionals can help their patients in achieving health goals by individualizing or customizing their nutrition interventions and continuing the support for changes by adapting the plates model, in where a plate is divided into four portions, 1 /4 of the plates is

wholegrain and 1/4 healthy protein, and then 2/3 of the other half plates is vegetables, and 1/3 is fruits. (Turnbull et al. 2009; Harvard 2022.)

In addition, Finnish nutrition recommendation highly promote The Heart Symbol products, as it is a better choice in its product group regarding fat (quantity and quality), salt, sugar, and fiber. (Sydanmerkki 2022.)

All those mentioned healthy diet such as less carbohydrates, more fibers, plates model and The Heart Symbol products can help the T2DM patients optimize their blood glucose level. Hence, eHealth intervention can focus on those healthy nutrition areas to promote health diet to T2DM patients globally. (Pal et al. 2013.)

2.2.2 Physical activity

According to WHO (2022), physical activities are any bodily movement produced by the contraction of skeletal muscle that substantially increases energy consumption. Such term is interchangeable with exercise, which is defined as a subset of physical activity done with the intention of developing physical fitness (such as strength and flexibility training).

All adults should aim for at least 150 minutes of moderate intensity activity each week (five times a week, 30 minutes per time), or this can also be achieved by 75 minutes of vigorous activity across the week. In addition, all adults should undertake muscle strengthen activity such as exercising with weights, yoga or carrying heavy shopping, at least two days a week. Meanwhile, to minimize the amount of time spent sedentary sitting for extended periods. (WHO 2022.)

WHO (2022) further explains that regular physical activity is proven to help prevent and manage noncommunicable diseases such as heart disease, stroke, diabetes, and several cancers. It also helps prevent hypertension, maintain healthy body weight, and can improve mental health, quality of life and well-being. Colberg et al's (2010) studies prove that exercise plays a major role in the prevention and control of insulin resistance, prediabetes, T2DM, and diabetes-related health complications. eHealth intervention for the physical activity promotion can focus on the WHO recommendations for T2DM patients to optimize their blood glucose level globally (Cotie et al. 2018).

2.2.3 Smoking cessation

Smoking or not is also a one's lifestyle. Cigarettes increase a person's risk of cancer, as well as causing diseases of heart, lungs, and all the other organs. Smokers are 30-40% more likely to develop T2DM than nonsmokers. Smoking with diabetes is like adding fuel to the fire, which is absolute dangerous. The chemicals in cigarettes cause harm to our body's cells and can interfere with their normal function. This can cause inflammation throughout the entire

body, which may decrease the effectiveness of insulin, such affect causes smokers to need more insulin to regulate blood sugar levels. Additionally, when chemicals from cigarette smoke meet oxygen in the body, this process can also cause cell damage, called oxidative stress. Both oxidative stress and inflammation may be related to an increased risk of diabetes. (Surgeon General's Report 2020.)

Just like other unhealthy habits, quitting smoking is difficult, but possible, and it is beneficial at any age. Whether one has T2DM or not, the sooner one quits smoking, the sooner one's body can fast to start to heal. Studies have found insulin to become more effective at lowering blood sugar levels just eight weeks after one quits smoking (Xie, Liu, Wu & Wakui 2009). eHealth intervention in nursing has a positive influence on helping one to quit smoking as a lifestyle intervention (Webb 2020).

2.2.4 Moderated alcohol use

Standard-drink definitions vary widely across countries, from eight grams of alcohol in Iceland to 20 grams in Austria. The Dietary Guidelines for Americans (CDC 2022) defines moderate alcohol consumption as one 5% of alcohol drink (330ml) per day for women and two drinks per day for men. Additions and recovery (2022) also mention that one standard drink is equal to 330ml of one canned regular beer with 5% alcohol; or 140ml with 12% alcohol of red/white wine; or 40ml liquor with 40% alcohol.

It is worthy to mention that a study contacted by Holst and his colleagues (Holst, Becker, Jørgensen, Grønbæk & Tolstrup 2017), they took data from a health survey for over 70,000 Danish adults and observed fewer new cases of diabetes with moderate alcohol intake than with abstinence over the course of five years, the lowest risk of developing diabetes was seen in people consuming moderat amounts of alcohol, which is 14 drinks per week for men (43% lower risk), and nine drinks per week for women (58% lower risk). Gustafson et al.'s (2011) study show that eHealth intervention has the potential to help the individual to regulate their alcohol usage to some extent. Regarding the eHealth lifestyle intervention in the nursing field, the promotion of the moderated alcohol use can also be one concentrated area to help T2DM patients with monitoring their blood glucose level (Glass et al. 2022).

2.3 eHealth interventions used in nursing

2.3.1 Definition of eHealth intervention and the "e" in eHealth

Definitions of eHealth are many and varied. Electronic health (eHealth) interventions, defined as health services and information delivered or enhanced through the internet and related technologies. It is also called e-health intervention or digital health interventions. A consumer-centred model of health care where stakeholders collaborate, utilizing information

communication technology including internet technologies to manage health, arrange, deliver, and account for care and manage health care systems. (Alvarez 2002.)

Digital and mobile technologies are being used to support health system needs amongst healthcare providers and patients. The "e" in eHealth does not only stand for "electronic," smart and connected devices, but also implies a number of other "e's," such as efficiency; enhancing quality of care; evidence based - eHealth interventions; empowerment of the patients; encouragement of a new relationship between the patient and health professional, towards a true partnership, where decisions are made in a shared manner; educating healthcare provides through online sources (continuing medical education) and consumers (health education, tailored preventive information for consumers); enabling information exchange and communication in a standardized way between health care establishments; extending the scope of health care beyond its conventional boundaries from both a geographical and conceptual perspectives; ethics, eHealth involves new forms of patient-healthcare professionals interaction and poses new challenges and threats to ethical issues such as online professional practice, informed consent, privacy and equity issues. In addition to those essential e's, eHealth should also be easy to use, entertaining, exciting and it should exist. (Eysenbach 2001.)

2.3.2 Nursing workforce shortage and the prevalence of internet usage worldwide

Today, there are approximately 28 million nursing workforce shortage globally. COVID-19 pandemic has made the fragile state of the global nursing workforce even worse, which is up to 13 million more nurses will be required over the next decade. Moreover, the pre-existing shortages exacerbated the impact of the pandemic and burned-out nurses are leaving the profession. Such phenomena are considered as a global nursing crisis. (International Council of Nurses 2022.)

In addition, the hectic nursing working environment urges a more efficient new way to communicate with their patients, particularly 63.1% of the global population is using internet. For the last three years, the outbreak of the coronavirus disease 2019 has spread across the entire world and has curtailed most individuals' daily life activities and movements. The coronavirus has transformed many aspects of our daily routines and lives. It shut down schools, businesses and workplaces and forced millions to stay at home for extended lengths of time. Public health authorities recommended to limit on social contact to try to constrain the spread of the virus, and these profoundly altered the way many worked, learned, connected with loved ones, carried out basic daily tasks, celebrated and mourned. The Covid have had a great impact on using the internet which is essential for our daily lives. (Broadbandsearch 2022.)

2.3.3 eHealth intervention in different countries

More than half of WHO member states have an eHealth strategy, the actual implementation of the strategies is not always followed. Low- and middle-income countries account for 3/4 of the rapidly expanding internet and mobile cellular subscriptions globally. However, the implementation of eHealth in those low-resource countries is challenged by limited resources and infrastructure, lack of focus on eHealth agendas, ethical and legal considerations, lack of common system interoperability standards, unreliable power, and shortage of trained workers. (Archer, Lokker, Ghasemaghaei & DiLiberto 2021.)

The Statista Global Consumer Survey (2020) has found that Chinese citizens use health apps the most (65%), with over 40% paying for the service. In China, WeChat is the most widely used application and a powerful communication tool, which has been substantially utilized in the eHealth, such as medical initiatives client education and behavior change to improve patient medical treatment outcomes and appointment reminders. The eHealth interventions related to infectious diseases, chronic respiratory diseases and maternal/child health are underrepresented in eHealth in comparison to the burden of disease in China. (Yang & Kovarik 2021.)

Digitization of health services in the EU has been on the rise with the adoption of eHealth agenda across the EU members (Varnai et al. 2019.) For instance, Apotti electronic patients' record app is used by all healthcare professionals in Uusimaa area Finland. Patients can log into Maisa and Omakanta to make own appointment, send emails and messages to manage their medical treatment, various text-messages regarding appointment reminders are normally sent to patients, and feedback of the service is collected via information communication technologies. (City Of Helsinki 2021.)

2.3.4 Type of eHealth interventions used in nursing

In this paper, an eHealth intervention is defined as any specific technology applied in the context of health care interventions. In other word, when health care providers and patients are not directly in contact with each other, and their interaction is mediated by electronic medias, eHealth provides the delivery of health care to the patient by using modern electronic information and communication technologies. American Centers for Disease Control and Prevention CDC (2022) provides some eHealth examples, such as internet-based interventions, electronic medical records, interactive voice response and educational video games, video conference, advanced computing, big data analytics, artificial intelligence, patient portals, and personal health records, mobile health (mHealth) including mobile phones, tablets, and computers to use applications (apps), wearable tracking devices, and texting services. (CDC 2022.)

eHealth interventions help individuals to access services and support from their own home. In addition, eHealth interventions may provide more cost-effective treatment options, reducing the requirement for travel and direct health care professional involvement. Particularly, corona pandemic appears to have been a significant catalyst for the temporary implementation of eHealth interventions into routine practice. eHealth offers a large range of solutions to be used by the patient, nurses and other health professionals when providing care and follow-up for patients, families, and communities. Hence, eHealth interventions have the potential to optimize health-related processes, reach more people and achieve cost effectiveness. (Kip, Kelders, Sanderman & Van Gemert-Pijnen 2018.)

As an increased prevalence of chronic diseases and sedentary lifestyle, the benefits of eHeath intervention holds promise to overcome the challenges that healthcare systems facing regarding the increased pressure and costs. World Health Organization WHO (2016) also promote eHealth interventions as key elements that drive the achievement of the sustainable development goals. Nurses, as the largest group of health care providers, have a particular responsibility in the research, development, and implementation on eHealth interventions. Nurses hold a wide variety of roles and are involved in many different contexts of the health care system. Their core tasks include offering care for patients and their families, as well as providing care and follow up around the clock, which make nurses have a central role in patient care coordination. To widely realize the full potential of nursing, it is vitally important that nurses have knowledge, access, premises for and are active users of eHealth. (Richards & Hallberg 2015.)

eHealth interventions have shown promising results in providing patients with self-care support (Whitehead & Seaton 2016), symptom management (Fridriksdottir, Gunnarsdottir, Zoega, Ingadottir & Hafsteinsdottir 2018), enabling online patient-provider communication, monitoring and shared decision making (Noar & Harrington 2012).

eHealth intervention has been shown to be beneficial for chronic disease management, such as in diabetes management in children, outcomes in women with gestational diabetes mellitus, in management of uncontrolled hypertension and paired with self-monitoring of blood pressure. In addition, e-monitoring is one of the categories for eHealth interventions, which remotely monitors individual via info-communication technology, any abnormal health status trend detected via e-monitoring can alert the patients and their care providers, enabling them to take remedial measures to prevent complications. Thus, eHealth intervention provides the patients to self-monitor and managing their self-care beyond the clinical setting, which is important for surveillance of chronic disease such as diabetes mellitus and hypertension. (Losiouk et al.2018; Al-Ofi, Mosli, Ghamri & Ghazali 2019; McKinstry et al. 2013.) The mentioned benefits of eHealth interventions provide a great opportunity for this study to explore eHealth lifestyle interventions globally.

3 Aim and purposes of the research

The purpose of this paper is to explore eHealth lifestyle interventions used in nursing from T2DM patients' perspective. The aim of this study is to describe eHealth lifestyle interventions used in nursing from T2DM patients' perspective.

3.1 Research question

Hence, the research question is what kind information do T2DM patients need regarding eHealth lifestyle interventions used in nursing?

4 Research methodology

The passion towards the eHealth intervention in the nursing field, and lack of the existing literature studies on the theoretical development of the topic regarding eHealth lifestyle interventions used in nursing fields for T2DM patients, this study will explore and gather information on this topic of the existing research. Therefore, the literature review is considered as a suitable research methodology.

4.1 Descriptive literature review

According to Paré and Kitsiou (2017), literature reviews are essential for determining what has been written on a subject or topic, determining the extent to which a specific research area reveals any interpretable trends or patterns, gathering empirical facts relevant to a specific research question to promote evidence-based practice, developing new frameworks and theories, and highlighting subjects or concerns that require additional research. The literature review is considered an appropriate research method to answer the research question.

Furthermore, Templier and Paré (2015) explain that doing a review article involves six generic steps: establishing the research question(s) and objective(s), exploring the existing literature, screening for inclusion, assessing the quality of primary studies, extracting data, and analyzing and synthesis data. The literature review in this study is based on those mentioned guidelines.

4.2 Data search and selection

Bhandari (2020) describe that data collection is a systematic approach or process of collecting, gathering, or collating of information, observation, or measurements, either qualitative or quantitative, or both, and use the same information, observation, or measurements as evidence to answer the research question. The data used for this paper is

retrieved from reliable database via EBSCOhost (CINAHL), and searching date was 1.9.2022. See the data searching and selection process in the modified PRISMA flow chart.

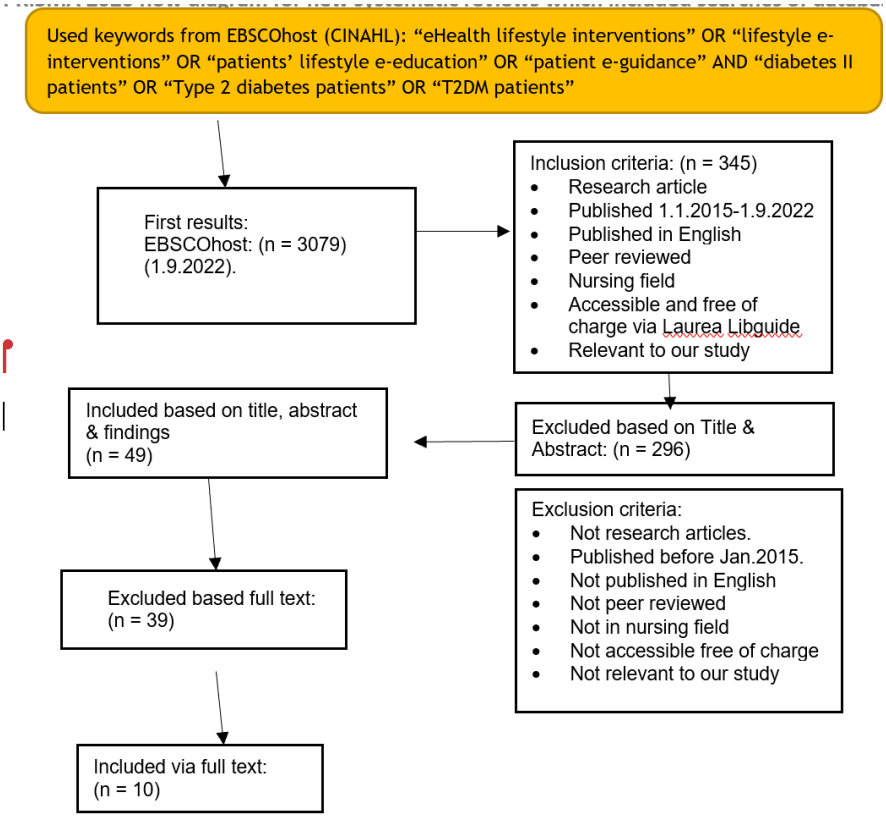

Figure 2: Modified PRISMA follow chart for selecting articles (Page et al. 2020)

During the article selecting process, the searching keywords "eHealth intervention" OR "patient e-guidance" OR "patient e-education" were used, the synonyms words such as "e-Health" OR "digital health" OR "telehealth" OR "internet-based intervention", AND "healthy life" OR "healthy habit" OR "healthy lifestyle" OR "lifestyle changes" OR "lifestyle modification" OR "lifestyle choices" OR "nutrition diet" OR "healthy diet" Or "physical activities" AND "diabetes type 2" OR "diabetes mellitus type 2" OR "diabetes 2" OR "T2DM" OR "type II diabetes", and a total of 3079 articles were retrieved from EBSCOhost CINAHL on 01.09.2022. The number of existing articles is already sufficient for this study purpose. Due to the limited time, this study did not search for articles from the other sources.

Inclusion of chosen articles	Exclusion of articles
eHealth lifestyle interventions used in nursing for T2DM patients	Other diseases than T2DM
Research articles	Blogs or normal websites

Published between January 2015-September 2022	Published before January 2015.
English	Other language than English
Text fully accessible, and free of charge via Laurea's Libguide	Not accessible, not free, not full text
Nursing field	Not nursing field
Peer viewed	Not peer viewed

Table 2: Inclusion and exclusion criteria of selecting articles

In phase two, after reading the first-round of article headlines, to filter out the irrelevant articles, the inclusion-exclusion criteria were used (table 2), such as text fully accessible in English language in nursing field, and free of charge via Laurea's Libguide in EBSCOhost (CINAHL). To gain the credibility of the study, only the research and peer reviewed articles were selected. In addition, by rolling out of the other diseases, such as type one diabetes, prediabetes, women pregnant diabetes, pediatric illness, mental illness, brain injury, cancer, stroke, cardiovascular, dialysis, physical therapy, depression management, over-weight and obese, covid and so on. To this end, a total of 345 articles were retrieved.

In phase three, after screening every article title, 49 articles were chosen for further assessment. In phase four, after reading the abstract and findings of those papers, a total of 19 articles were selected for eligibility. Based on the in-depth reading of the full text, ten articles (table 3) which is relevant to this study is selected. Figure 2 can illustrate the searching and selecting process regarding the selected articles by using modified PRISMA flow chart.

4.3 Thematic data analysis

When commencing literature review as a research method, data is collected from already existing data, and to be re-used again as a source of new raw data. Data analysis is based on answering the research question of this study, and the analysis can be done either qualitatively or quantitively. It can also be considered as summarizing the findings of selected articles. (Aveyard 2010.) The data of this paper was acquired from published articles, journals, and reports. However, due to the lack of qualitative research contacted from the patients' perspective, the chosen mixed-method studies of both quantitative and qualitative features have been analyzed thematically, with a special focus on qualitative data.

Thematic analysis is a qualitative research method that can be widely used across a range of epistemologies and research questions. It is a method for identifying, analyzing, organizing, describing, and reporting themes found within a data set (Braun & Clarke 2006). Boyatzis also (1998) described thematic analysis as a translator for those speaking the languages of qualitative and quantitative analysis, enabling researchers who use different research methods to communicate with each other. A rigorous thematic analysis can produce trustworthy and insightful findings (Braun & Clarke 2006).

Thematic analysis is a useful method for examining the perspectives of different research participants, highlighting similarities and differences, and generating unanticipated insights. Thematic analysis is also useful for summarizing key features of a large data set, as it forces the researcher to take a well-structured approach to handling data, helping to produce a clear and organized final report. (King 2004.)

Thematic analysis allows the researcher approach large data sets more easily by sorting them into broad themes. It is usually applied to a set of texts, such as an interview or transcripts. The researcher closely examines the data to identify common themes, such as topics, ideas, and patterns of meaning that come up repeatedly. There are various approaches to conducting thematic analysis, but the most common form follows a six-step process: familiarization, coding, generating themes, reviewing themes, defining and naming themes, and writing up. (Caulfield 2019.)

In the data analysis stage, thematic analysis approach was used. Articles were read in-depth for four times; notes were made every time. By combining the notes and reading through articles again, the original data was cross checked with the written notes.

To select the needed information for this study, meanwhile, to make interpretations and develop concepts, themes, or models, thematic analysis requires familiarization with the original documents. Data was coded by using the shorted label to describe the content, we went through the transcript of every interview and highlighted everything that is relevant or potentially interesting with the purpose of the study. New codes were updated every time when read through the text. The codes in this study are the result of the most frequently mentioned concepts, phrases, or sentences in the selected articles.

During the next stages, after creating the codes, identifying the similarities among them, and concluding the codes with similar meaning into one theme. Vague and irrelevant codes were deleted. In the next phrase, the themes and original data were crossed checked to ensure the accurate representations of the data. It is worth to mention that easy understandable and succinct names were given for each theme. Figure 7 can illustrate the data analysis process in this study.

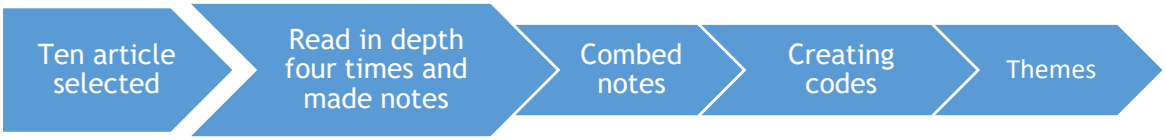

Figure 3: Data analysis process of this study

Table 3: Selected article for this study and summaries of the article

Authors, year, & countries	Article title	Aim of the research	Main results
Article 1: Sin et al. 2020 Singapore	Assessment of willingness to Tele-monitoring interventions in patients with type 2 diabetes and/or hypertension in the public primary healthcare setting.	Aim to determine the prevalence of willingness of patients with type 2 diabetes mellitus and/or hypertension towards the use of tele-monitoring, and the factors influencing their uptake.	53.0% of the patients were willing to use tele-monitoring. Personal beliefs on technology, prior technology utility, patient's requirements to be accompanied, cost considerations and technological literacy were associated with willingness to use tele-monitoring.
Article 2: Daud et al. 2020 Malaysia	The empower-sustain eHealth intervention to improve patient activation and self-management behaviors among individuals with metabolic syndrome in primary care: study protocol for a pilot randomized controlled trial	The aim of this pilot study is to evaluate the feasibility and potential effectiveness of the empower-sustain self-management eHealth intervention in improving activation and self-management behaviors among patients with metabolic syndrome.	The primary outcome is the mean change in patient activation score using the Patient Activation Measure short form Malay version (PAM-13-M) questionnaire. The secondary outcomes include the changes in waist circumference, body mass index, blood pressure, patient physical activity level, eating behaviors, perception of chronic illness care, satisfaction with patient–physician interaction, and perceived absolute ten-year cardiovascular disease risk.
Article 3: Thomson et al. 2018 UK & India	Protocol for a clinical trial of text messaging in addition to standard care versus standard care alone in prevention of type 2 diabetes through	The aim of the study is to assess the efficacy and user acceptability of text messaging employed in this way for	The efficacy of tailored text messaging in addition to standard lifestyle advice to reduce the progression from prediabetes to

	lifestyle modification in India and the UK	people with diabetes in the UK and India.	type 2 diabetes in the UK and India.
Article 4: Swoboda, Miller & Wills 2017 Midwestern United States	Impact of a goal setting and decision support telephone coaching intervention on diet, psychosocial, and decision outcomes among people with type 2 diabetes	To evaluate a telephone-based goal-setting and decision support coaching intervention among adults with T2DM, to evaluate the impact of these approaches for diet and physical activity behavior changes in relation to an attention control group..	Setting specific diet-related goals may promote dietary change, and telephone coaching can improve psychosocial outcomes related to diabetes self-management.
Article 5: Suseelal & John 2018 India	A study to assess the impact of home-Based education on lifestyle modification among adults with diabetes mellitus at selected villages in Kancheepuram District, Tamil Nadu, India	To educate the adults with diabetes mellitus on low carbohydrate diet and to evaluate the impact of home-based education on lifestyle changes.	There are significant changes on lifestyle practice after individual video teaching and dietary counseling among the intervention group. The study suggested that nutritional counseling and healthy lifestyle factors must be taught by all health care professionals to increase awareness and to control diabetes mellitus among Indian population.
Article 6: Nelson et al. 2016 Tennessee United State	Development and usability of REACH (Rapid Education/Encouragement and Communications for Health): A tailored theory-based text messaging intervention for disadvantaged adults with type 2 diabetes	To develop REACH and test REACH's usability to make improvements before evaluating its effects.	Testing technology-delivered interventions with disadvantaged adults revealed preferences and concerns unique to this population.
Article 7: Kapadia, Gao & Cumming 2021 London, UK	A remotely delivered community action project to promote a diabetes lifestyle intervention program in northwest London: basis, process, and outcomes	To directly promote the Reducing Weight with Intensive Dietary Support (REWIND) program to patients in Northwest London and collect the feedback on the promotion.	Remote promotion of the REWIND program directly to patients successfully raised awareness, enhanced knowledge, and increased likelihood of enrolment. The webinar approach fostered direct engagement and was highly valuable.
Article 8: Yasmin et al.	The influence of mobile phone-based health reminders on patient adherence to	To investigate how mobile phone-based health intervention could increase	A significant improvement in patient adherence to diet, physical exercise, the cessation of use of tobacco and betel nut,

2020 Dhaka, Bangladesh	medications and healthy lifestyle recommendations for effective management of diabetes type 2: a randomized control trial in Dhaka, Bangladesh.	patient adherence and thereby improve the disease outcomes for diabetes type 2 in Bangladesh.	and blood glycemic control was found in the intervention group, whereas no such significant improvement was found in the control group. Cost and other co-morbidities were found to be the main reasons for non-adherence.
Article 9: Kelly, Jenkinson & Morley 2018 UK	Experiences of using web-based and mobile technologies to support self-Management of type 2 diabetes: qualitative study	To understand the impact of using web-based and mobile technologies to support the management of type 2 diabetes for the patients.	Technology supported the users to maintain individualized and tailored goals when managing their health. A total of 7 themes were identified as important to participants when using technology to support self-management: (1) information, (2) understanding individual health and personal data, (3) reaching and sustaining goals, (4) minimizing disruption to daily life, (5) reassurance, (6) communicating with health care professionals, and (7) coordinated care.
Article 10: Welzel et al. 2021 Germany	Using a brief web-based 5A (ask, assess, advise, agree, assist) intervention to improve weight management in primary care: results of a cluster-randomized controlled trial	To investigate the effectiveness of a short and flexibly usable 5A-based online tutorial for patients	A stand-alone low-threshold minimal eHealth intervention for patients' weight management in the long term

Ten articles were summarized based on the research method, methods of e-intervention used in the article, lifestyle intervention, data collected from the settings of the health care, see the following table 4:

• Numbers of articles • Patients' perspective	Research method	▪ Number of participants ▪ Follow up frequency ▪ Length of study ▪ Incentives for participation	Type of eHealth intervention	• Lifestyle intervention	Health care setting
Article 1 Yes	Quantitative & qualitative questionnaire "what would make you less/more willing to use	▪ 899 ▪ No follow up ▪ Not mentioned ▪ Not mentioned	Tele intervention	• Healthy lifestyle	Public primary health care

	tele-monitoring services?"				
Article 2 Yes	Quantitative & qualitative Patient recording of their PA and diet, discuss with the nurses every time when they have followed up visit, self-management goals and clinical outcomes.	▪ 232 (Control group: 116. Intervention: 116). ▪ Every 3 months ▪ 1 year ▪ Not mentioned	Web-based self-management mobile application	• Physical activity, diet	Primary
Article 3 Yes	Quantitative & Qualitative (Text message is modified based with the questionnaire in each follow up)	▪ 2268 (Control group: 1134. Intervention: 1134) ▪ Every 6 months ▪ 2 years ▪ Not mentioned	Text message	• Lifestyle improvement • Yes	India: occupational health care UK: primary health care
Article 4 Yes	Pilot study, qualitative & quantitative	▪ 54 (control group: 27. Intervention: 27) ▪ every 2 weeks ▪ 4 months ▪ Not mentioned	Coaching call	• Diet • Yes	Not mentioned
Article 5 Yes	Randomized controlled trial and self-structured interview questionnaire.	▪ 400 (control group: 200. Intervention: 200) ▪ 1 year ▪ Not mentioned	Video teaching	• Nutritional counseling & lifestyle • Yes	Primary health care

Article 6 Yes	Qualitative interview and questionnaire Transcript	▪ 36 ▪ 70 £	Text message	• Self-management of lifestyle • Yes	Primary health center
Article 7 Yes	Qualitative and quantitative combination data analysis	▪ 45	Free Zoom webinar	• Lifestyle • Yes	Primary health care
Article 8 Yes	Mixed method (quantitative 415 and 18 qualitative in-depth interviews)	▪ 273 (control group: 131 ▪ Intervention group: 142) ▪ 1 year study	Mobile based reminder	• Healthy lifestyle • Yes	Primary health care
Article 9 Yes	In-depth interview	▪ 15 ▪ £20 voucher	Web-based and mobile technologies	• Lifestyle • Yes	Not mentioned
Article 10 Yes	Mixed: an interactive study among patients and nurses.	▪ 135 (control group: 65. Intervention: 54) ▪ every 6 months ▪ 1 year ▪ 30 euros	5A online tutorial	• Weight management • Yes	Primary
		Total: 4303 participants			

Table 4: Summary of the selected ten articles in terms of research method, form of e-intervention, healthcare setting etc.

5 Findings

In this section, data was retrieved from the selected ten articles which is relevant to the research topic, namely, the information that T2DM patients' mostly desire regarding eHealth lifestyle interventions. Findings were coded into five themes as illustrated in table 5, and the number in the following table means article numbers of the selected articles.

The findings are that regarding eHealth lifestyle intervention used in nursing, T2DM patients highly desire patient-centered care and social support; in addition to abundant clinical

nursing skills, the nurses' knowledge concerning motivational interviewing and health-coaching skills is highly required by T2DM patients; the measurement tools that patients use during eHealth lifestyle intervention is blood glucose level, blood pressure level, body mass index and waist circumstance; eHealth interventions can be considered as an instrumental supportive tool for health lifestyle interventions to T2DM patients, and patients also desire the traditional healthy intervention methods.

Raw data	Reduction	Codes	Themes
Perceived usefulness of technology, convenience, ease of use, cost savings (1). Informed, activated patient (2), User-friendly interface (2), Empower patients and tailored to individual patients' needs (2), My Treatment Targets, My Check-Up, My Weight Management, My Smoking Habit, My Self-Management, and My Medication (2). Goal setting, personal strategy, self-monitoring (3). Patient empowerment (4), goal tailored & "SMART" (specific, measurable, attainable, realistic, and timely) (4). Self-monitoring (6) tailored messages (6). Patient-centered (7). Supporting patients in their daily decisions (9). Self-reported (2, 10). Tailoring weight counseling (10).	User-friendliness, convenience, Empowering, personalized goal setting. Tailored self-monitoring	Tailored patients' needs	Patient-centered care during eHealth intervention.
Patient-nurse collaboration, problem-solving assistance (2); Educational, motivational, and supportive content (3), Delivering personalized diet and exercise advice (3), Positive reinforcement or encouragement for healthy behaviors (3); adherence user feedback (6); inspirational message (6); avoided complex terms and jargon (6); a redesigned patient facing leaflet (7).	Collaboration, feedback, problem solving with patients	Co-creation with the patient	

Perception of non-intrusion to personal privacy (1); disturbance (3); repetition of message and disclosure of privacy (6).	Respect of the patients' privacy	Non-intrusion feeling of patient's privacy	
Incorporation of interactivity (2). Diabetes-related interpersonal distress (4); increase bonding between the patient and healthcare professionals (6); live, interactive, and engaging webinar (7), facilitate communication (9).	Be interactive and facilitating communicatio n	Interaction needs	Patient's social needs during eHealth intervention.
Seeking support from others, particularly from family members (4); feel supported, motivated, and not alone living with diabetes (6);	Support from others	Social support	
Proactive and prepared health care teams (2) motivational interviewing (2); one-to-one in-depth interview (3)	Getting to know the patients' more	Motivational interviewing	Required skills for nurses during eHealth intervention.
Healthy coach skills (2); decision support health-coaching (4); more diabetes education (5); tailoring weight counseling (10).	Diabetes healthy knowledge	Health coaching skills	
Changes can be seen from blood sugar, BMI (body mass index), waist circumstance, blood pressure (2); improvement in A1c (4); being active, healthy eating, problem solving, and blood glucose control (9).	Physical measurement	Blood glucose level, blood pressure level, BMI, waist circumstance.	Most-used measurement tool for T2DM patients during eHealth intervention.

Multifaceted eHealth intervention (2); Booklet, follow up visit (2); Standard written material (3); a leaflet (7); in-person delivery (9).	Always combined with the traditional method: face-to-face physical intervention	Blended eHealth interventions.	eHealth intervention is a supportive tool, patients also desire the traditional healthy intervention methods.

Table 5: summary of the findings

5.1 Patient-centered care during eHealth intervention

According to NEJM Catalyst (2017), many countries adopt eHealth applications to support patient-centered care. Patient-centered care encourages the active collaboration and shared decision-making between patients and healthcare providers to design and manage a customized and comprehensive care plan. In the selected articles, co-creating solutions with the patient and encourage the patient's involvement during their self-care management process is frequently mentioned and highly appreciated.

5.1.1 Tailored patients' needs and co-creation of eHealth intervention content

The selected articles emphases the importance of tailored patients' needs during co-creating the content together with the patient, for instance, "perceived usefulness of technology, convenience, ease of use, cost savings" (Sin et al. 2020); "informed, activated patient and user-friendly interface, empowering patients" "My Treatment Targets, My Check-Up, My Weight Management, My Smoking Habit, My Self-Management, and My Medication (Daud et al. 2020); goal setting, personal strategy (Thomson et al. 2018); "patient empowerment and goal tailored by "SMART" (specific, measurable, attainable, realistic, and timely)" (Swoboda, Miller & Wills 2017); "self-monitoring"(Thomson et al. 2018; Nelson et al. 2016); "tailored messages (Nelson et al. 2016); patient-centered(Kapadia, Gao & Cumming 2021); supporting patients in their daily decisions (Kelly, Jenkinson & Morley 2018); self-reported (Daud et al. 2020; Welzel et al. 2021); tailoring weight counseling (Welzel et al. 2021). In other words, nurses need to get to know their patients first, adapting a tailored eHealth intervention content for that specific patient, to empower T2DM patients to see how sustainable healthy behavior can be achieved.

In addition, the selected articles also frequently described the co-creation process with the patient, such as “patient-nurse collaboration, problem-solving assistance, tailored to individual patients’ needs” (Daud et al. 2020); “educational, motivational, and supportive content”, delivering personalized diet and exercise advice” (Thomson et al. 2018); “positive reinforcement or encouragement for healthy behaviors”(Thomson et al. 2018); “adherence user feedback”(Nelson et al. 2016); “inspirational message” (Nelson et al. 2016); “avoided complex terms and jargon” (Nelson et al. 2016); a redesigned patient facing leaflet (Kapadia, Gao & Cumming 2021).

5.1.2 Patients’ non-intrusion feeling towards eHealth interventions

When using eHealth intervention, the privacy issue is highly concerned by T2DM patients. The nurses need to pay special attention on “the perception of non-intrusion to personal privacy” (Sin et al. 2020); “disturbance” (Thomson et al. 2018); “repetition of message and disclosure of privacy” (Nelson et al. 2016), how often the reminder of the intervention is best accepted by this specific patient, and at what time, by using which tool and so on, which kind eHealth intervention content is best suitable for this specific patient. It is wise for the nurses to document those items for their further intervention as references. Also, nurses need to let the patients know in advance regarding the existing eHealth intervention is confidential and anonymous, and not to intrude the patient’s privacy.

5.2 Patient’s social needs to be considered during eHealth intervention

5.2.1 Interactive

Interaction with others and belonging to a group is an innate human need (Ryan & Deci 2000). Mobile devices brought groundbreaking change to human interaction due to the innate nature of always being connected to the digital world via an easy-to-carry device that one carries around. The western individualism culture makes the individuals want to connect more, particularly with their healthcare professionals regarding their health issues. In the selected articles, T2DM patients desire “the incorporation of interactivity” (Daud et al. 2020); “diabetes-related interpersonal distress” is often mentioned (Swoboda, Miller & Wills 2017); “increase bonding between the patient and healthcare professionals” (Nelson et al. 2016); “live, interactive and engaging webinar” (Kapadia, Gao & Cumming 2021), “facilitate communication” (Kelly, Jenkinson & Morley 2018). All those words represent that the patients are thirst for an effective interaction with their healthcare professionals. Therefore, nurses need to pay special attention on the interaction with their patients during eHealth lifestyle interventions.

5.2.2 Support from others- particularly from family members

Most of the self-management occurs within the family environment. The patients' perceptions of support or lack of support usually refer to the family. T2DM is a lifestyle illness affecting the whole family, causing mental health stresses and comorbidities. How the patient and family perceive T2DM, how they share knowledge and support each other is particularly important for diabetic self-care. Poor management of blood glucose leads to emotionally distress. When people stressed, they tend to eat more, and unhealthily. (Powers et al. 2016.)

Moreover, according to Karlsen, Oftedal and Bru (2012), interactions between adult patients and their family play a major role in maintaining lifestyle changes and optimizing diabetes self-management. Thus, family support regarding meal-planning, medication reminders, glucose checking, and physical activities affects the patient's self-management adherence and the well-being of both the patient and their family (Costa, Pereira & Pedras 2012). In addition, good family function is associated with adequate patient support (Rosland, Heisler, Choi, Silveira & Piette 2010). Patients are "seeking support from others, particularly from family members" (Swoboda, Miller & Wills 2017); they want to "feel supported, motivated, and not living alone with diabetes "(Nelson et al. 2016).

5.3 Needed skills for nurses during eHealth intervention

In addition to the abundant clinical skills, T2DM patients also hope that nurses to have motivational interviewing and health-coaching skills. The following chapter will explain the findings regarding this domain.

5.3.1 Motivational interviewing techniques

Motivational interviewing is a guiding style of communication, which sits between following (good listening) and directing (giving information and advice). Motivational interviewing is designed to empower people to change by drawing out their own meaning, importance, and capacity for change. The cornerstone of the motivational interviewing is based on a respectful and curious way of being with people, which facilitates the natural process of change and honors individual autonomy. (Miller & Rollnick 2013.) In the selected articles, "proactive and prepared health care teams" (Daud et al. 2020) "motivational interviewing" (Daud et al. 2020); "one-to-one in-depth interview" (Thomson et al. 2018) are frequently mentioned as one skill that T2DM patients deeply hope that the nurses to have, and to train themselves and eventually to possess such skills.

5.3.2 Health-coaching skills

Good coaching is a state of art. A good coach is an active listener, adept at asking open-ended and reflective questions. By establishing a trust atmosphere to be genuine concern

about the patient's wellbeing, clarifying the purpose of the coaching, reaching an agreement/commitment of the improvement, exploring solution-based alternatives, and providing timely feedback to the patients without being judgmental, it is also recommended nurses to clearly draw the bottom line regarding the acceptable and unacceptable behavior for the specific patient. (Sherman & Cohn 2016.) In the selected articles, "healthy coach skills" (Daud et al. 2020); "decision support health-coaching" (Swoboda, Miller & Wills 2017); "more diabetes education" (Suseelal & John 2018); "tailoring weight counseling" (Welzel et al. 2021) are highly mentioned by the participants. Hence, when there is such need, nurses need to educate themselves and practice for the effective health-coaching skills with their patients.

5.4 Measurement tools for patients during eHealth interventions

T2DM patients' blood glucose level is heavily affected by their lifestyle, in a short-term and long-term, the change can be seen from "blood sugar, BMI, waist circumstance, blood pressure" (Daud et al. 2020); "improvement in hemoglobin A1c test" (Swoboda, Miller & Wills 2017); "being active, healthy eating, problem solving, and blood glucose control" (Kelly, Jenkinson & Morley 2018) are frequently mentioned in the articles. In other words, nurses need to pay more attention on the e-education or e-guidance on those aforementioned areas for T2DM patients.

5.5 eHealth intervention is an instrumental supportive tool

Even through participants' willingness to use eHealth intervention is high, it is worth to mention that all the selected articles also implemented the other traditional forms of intervention such as "multifaceted eHealth intervention" (Daud et al. 2020); "booklet and follow up visit" (Daud et al. 2020); "Standard written material" (Thomson et al. 2018); "a leaflet" (Kapadia, Gao & Cumming 2021); "in-person delivery" (Kelly, Jenkinson & Morley 2018). Therefore, due to the social needs and bund needed amongst the healthcare professionals and patients, eHealth intervention can be considered as an instrumental supportive tool, patients also desire the traditional healthy intervention methods, such as face-to-face clinical visit. Such finding is also in line with the result regarding patient's social needs in 5.2.

6 Discussion

The method used in the selected ten articles are the combination of quantitative and qualitative approach, of which eight of them are mainly quantitative research with large study sample. In addition to it, all ten articles have used qualitative approach such as

interview, feedback to gain more insight on their study focuses. This study covers large amount of sample, in total of 4303 participants, including 15 of in-depth interview.

The patient-centric view by involving the patients to co-create the content together with healthcare professionals and listen to patients' feedback or voice continuously, is consistent with Eysenbach's study (2005), which is the attrition can be problematic in web-based interventions and should be considered during the creation process.

The findings regarding the support from others as enablers, particularly from the family members is consistent with acknowledging individual reactions promotes a sense of responsibility and family cohesion (Santos & Silva 2014). This finding is also consistent with Masri's (2020) survey, receiving instructions in patients' native language, having family support, family members' understanding of healthy food choices, and employment status were found to be important predictors of the perceived importance of diabetes lifestyle self-care. When contacting an eHealth intervention, nurses need to focus on the interactive communication and try to motivate the patients' social circles, particularly their family members.

Nurses not only needs to have the sufficient clinical skills, but also needs to have the motivational interviewing and health-coaching skills in terms of getting to know the patients better, and find out patients' intrinsic motivation, by showing respect, non-judgmental attitude along with providing the solution based reflective feedback, together nurses and patients can reach a committed goal towards a healthier lifestyle. Based on Miller and Rollnick (2013), nurses need to establish a collaborative, goal-oriented style of communication with particular attention to the language of change. By eliciting and exploring the person's own reasons for change within an atmosphere of acceptance and compassion, such interaction is designed to strengthen personal motivation for and commitment to a specific goal.

The finding regarding the measurement tools that patients use during eHealth lifestyle intervention is blood glucose level, blood pressure level, body mass index and waist circumstance is also consistent with Miyamoto, Dharmar, Fazio, Tang-Feldman and Young's study (2018): optimal glycemic level is critical in preventing diabetes-caused complications and mortality. Regular monitoring of vital parameters (such as blood sugar, blood pressure, temperature, and pulse) via eHealth technology allows patients to gain better insights into their real-time diabetes in relation to their treatment.

Even through T2DM patients are willing to use eHealth intervention, however, all the selected articles have also applied the other traditional forms of intervention such as "multifaceted eHealth intervention"; "booklet and follow up visit"; "Standard written material"; "a leaflet"; "in-person delivery". Due to the social needs and bund needed from the healthcare

professionals, eHealth intervention can be considered as an instrumental supportive tool, but not the only tool to the health lifestyle intervention. This finding also supports a recent study carried by Rombouts et al. (2022) that participants and healthcare professionals were predominantly positive about the acceptance and use of the eHealth instrument, and consistent with van Buul et al.'s (2020): by tailoring eHealth interventions to patients' needs, such as self-monitoring, reminder functions and the possibility to share information with others as blended care (e-interventions and traditional face-to-face visit).

7 Ethical considerations

The Finnish National Board on Research Integrity TENK (2019) regarding ethical principles for research with human participants, the researcher respects the dignity and autonomy of human research participants. Such rights laid down in the Finnish Constitution (731/1999) for everyone, which is right to life, personal liberty and integrity, freedom of movement, freedom of religion and conscience, freedom of expression, protection of property and the right to privacy. In addition, the research does not cause significant risks, damage or harm to research participants, communities, or other subjects. This study is a literature review from the peer-reviewed and published journal articles. It follows all the mentioned ethical principles and bring no harm and risk to the others or communities.

In addition, this study respects the others' work and cited others' work correctly based on the Laurea's guidance of reference to avoid plagiarism. Reference used in this study were checked one-by-one to make sure that all the references are correctly written. This study focused on the adult population, which does not involve minors and people with limited capacity. In addition, the personal data was processed completed anonymously and confidentially to protect the participants. This study has also truthfully presented the existing data from ten selected articles without any personal bias. (TENK 2019.) It is worth to mention that the searching keywords were mentioned in the data searching section 4.2. and the searching date was 01.09.2022.

8 Data reliability, limitations, and suggestions for future studies.

Eight out of ten selected articles focused on primary health care, similar reviews can be done for the secondary health care or private sectors. In addition, seven out of ten articles are mobile phone intervention, including two text message and two web-based mobile app., and four articles are web-based health interventions. Due to the limited number of selected articles, in this study, e-intervention focus is wider than one specific eHealth intervention

method. Future study can focus on mobile health intervention, and web-based intervention separately to gain more insight on this matter.

Regarding the non-intrinsic feeling from the patient's point of view, some studies have evidenced that peer reminder monthly or quarterly, about the right moment of the intervention, which one more active are still vague (Wang et al. 2021). The reminder or recall system can be used by clinic staff, by computer, through patient portals, or through centralized programs, in the form of App, email, text, letters, and postcards etc. Therefore, the future study can focus on this domine for deeper exploration.

The uniqueness of every patient and diversity of various culture, globalization and multiculturism provides nurses a great opportunity to implement appropriate patients' cultural centered nursing e-interventions. Future studies can explore how nurses can use eHealth interventions during the patient's admissions process, involve the patient in development of the plan of care, which is based on the patient's diagnosis and findings from the health assessment and implement culturally appropriate nursing eHealth interventions.

According to Biedron (2021), patients are customers for nurses, as such they are respected, cared for, and made to feel included in decisions that impact their wellbeing and health. Nurses should guide, support and care for them. Therefore, this study focused on patients' perspective. However, the similar study can be carried out in future from the nurse's point of view.

References

Addiction and Recovery. 2022. Accessed on 03 November 2022. https://www.addictionsandrecovery.org/moderate-drinking.htm

Afshin, A., Forouzanfar, M.H., Reitsma, M.B., Sur, P., Estep, K. & Lee, A. 2017. Health effects of overweight and obesity in 195 countries over 25 years. N Engl J Med. 377; 1:13-27.

Al-ofi, E.A., Mosli, H.H., Ghamri, K.A., Ghazali, S.M. 2019. Management of postprandial hyperglycaemia and weight gain in women with gestational diabetes mellitus using a novel telemonitoring system. Journal of International Medical Research. 2019;47(2):754-764. doi:10.1177/0300060518809872

Alvarez, R.C. 2002. The promise of e-Health – a Canadian perspective. Ehealth International. Accessed on 22 October 2022. http://www.pubmedcentral.nih.gov/picrender.fcgi?artid=135525&blobtype=pdf.

American Centers for Disease Control and Prevention CDC. 2022. eHealth Literacy. Accessed on 03 November 2022. https://www.cdc.gov/healthliteracy/researchevaluate/eHealth.html

Archer, N., Lokker, C., Ghasemaghaei, M., DiLiberto, D. 2021. eHealth Implementation Issues in Low-Resource Countries: Model, Survey, and Analysis of User Experience. J Med Internet Res. Jun 18;23(6):e23715. doi: 10.2196/23715

Aveyard, H. 2010. Doing a literature review in health and social care: A practical guide. (2nd ed.) Open University Press. Accessed on 21.10.2022. https://ebookcentral.proquest.com/lib/Laurea/detail.action?docID=771406#

Bhandari, P. 2020. A step-by-step guide to data collection. Accessed on 15 October 2022. https://www.scribbr.com/methodology/data-collection/

Biedron, J. 2021. Are Patients Customers? Accessed on 10 September 2022. https://pxacademy.com/are-patients-customers/

Boyatzis R. 1998. Transforming qualitative information: Thematic analysis and code development. Thousand Oaks, CA: Sage.

Braun, V. & Clarke, V. 2006. Using thematic analysis in psychology. Qualitative Research in Psychology, 3, 77–101. doi:10.1191/1478088706qp063oa

Broadbandsearch. 2022. 2022 general internet usage statistics. Accessed on 17 October 2022. https://www.broadbandsearch.net/blog/internet-statistics

Buchholz, K. 2022. Which countries use health apps the most? Accessed on 13 December 2022. https://www.weforum.org/agenda/2020/10/where-health-app-usage-is-most-common.

Caulfield, J. 2019. How to Do Thematic Analysis | Step-by-Step Guide & Examples. Accessed on 27 October 2022. https://www.scribbr.com/methodology/thematic-analysis/

CDC. 2021. Diabetes Tests. Accessed on 9 September 2022. https://www.cdc.gov/diabetes/basics/getting-tested.html

CDC. 2022. Dietary Guidelines for Alcohol. Accessed on 12 September 2022. https://www.cdc.gov/alcohol/fact-sheets/moderate-drinking.htm

City of Helsinki. 2021. Apotti has been taken into use for the social and health care services in Helsinki. Accessed on 22 November 2022. https://www.hel.fi/uutiset/en/social-services-and-health-care/apotti-taken-into-use

Colberg, S.R., Sigal, R.J., Fernhall, B., Regensteiner, J.G., Blissmer, B.J., Rubin, R.R., Chasan-Taber, L., Albright, A.L., Braun, B. 2010. American College of Sports Medicine; American Diabetes Association. Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement. Diabetes Care. 2010 Dec;33(12):e147-67. doi: 10.2337/dc10-9990

Costa, V., Pereira, M.G. & Pedras, S. 2012. Partner support, social-cognitive variables and their role in adherence to self-monitoring of blood glucose in type 2 diabetes. Eur Diabetes Nurs. 2012;9(3):81–86. doi: 10.1002/edn.212.

Cotie, L.M., Prince, S.A., Elliott, C.G., et al. 2018 The effectiveness of eHealth interventions on physical activity and measures of obesity among working-age women: a systematic review and meta-analysis. Obes Rev. 2018 Oct;19(10):1340-1358. doi: 10.1111/obr.12700

Daud, M.H., Ramli, A.S., Abdul-Razak, S. et al. 2020. The EMPOWER-SUSTAIN e-Health Intervention to improve patient activation and self-management behaviours among individuals with Metabolic Syndrome in primary care: study protocol for a pilot randomised controlled trial. Trials 21, 311. https://doi.org/10.1186/s13063-020-04237-x

Deakin, T., McShane, C.E., Cade, J.E. & Williams, R.D. 2005. Group Based Training for Self-Management Strategies in People with Type 2 Diabetes Mellitus. The Cochrane Database of Systematic Reviews, 2, Cd003417. Accessed on 04 September 2022. https://doi.org/10.1002/14651858.CD003417.pub2

Diffen. n.d. Type 1 Diabetes vs. Type 2 Diabetes. Accessed on 03 November 2022. https://www.diffen.com/difference/Type_1_Diabetes_vs_Type_2_Diabetes

du Pon, E., Wildeboer, A.T. & van Dooren, A.A. 2019. Active participation of patients with type 2 diabetes in consultations with their primary care practice nurses – what helps and what hinders: a qualitative study. BMC Health Serv Res 19, 814. doi: 10.1186/s12913-019-4572-5

Eysenbach, G. 2001. What is e-health? J Med Internet Res;3(2):e20. Accessed on 04 September 2022. https://www.jmir.org/2001/2/e20. doi: 10.2196/jmir.3.2.e20

Finnish Constitution 731/1999. Accessed on 27 November 2022. https://www.finlex.fi/fi/laki/kaannokset/1999/en19990731.pdf

Finnish National Board on Research Integrity TENK guidelines. 2019. Accessed on 27 November 2022. https://tenk.fi/sites/default/files/2021 01/Ethical_review_in_human_sciences_2020.pdf

Franco, O.H., Steyerberg, E.W., Hu, F.B., Mackenbach, J. & Nusselder, W. 2007. Associations of diabetes mellitus with total life expectancy and life expectancy with and without cardiovascular disease. Arch Intern Med.167; 11: 1145-1151.

Fridriksdottir, N., Gunnarsdottir, S., Zoëga, S., Ingadottir, B. & Hafsteinsdottir, E.J.G. 2018.Effects of web-based interventions on cancer patients' symptoms: review of randomized trials. Support Care Cancer. 2018 Feb;26(2):337-351. doi: 10.1007/s00520-017-3882-6

Glasgow, R.E., Bull, S.S., Piette, J.D. & Steiner, J.F. 2004. Interactive behavior change technology. A partial solution to the competing demands of primary care. Am J Prev Med. Aug;27(2 Suppl):80-7. doi: 10.1016/j.amepre.2004.04.026

Glass, J. E., Tiffany, B., Matson, T. E., Lim, C., Gundersen, G., Kimbel, K., Hartzler, A. L., Curran, G. M., McWethy, A. G., Caldeiro, R. M., & Bradley, K. A. (2022). Approaches for implementing digital interventions for alcohol use disorders in primary care: A qualitative, user-centered design study. Implementation Research and Practice, 3. https://doi.org/10.1177/26334895221135264

Gustafson, D.H., Boyle, M.G., Shaw, B.R., Isham, A., McTavish, F., Richards, S., Schubert, C., Levy, M. & Johnson, K. 2011. An e-health solution for people with alcohol problems. Alcohol Res Health. 2011;33(4):327-37. Accessed on 22 November 2022 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3536059/

Hao, Y., Xu, H. 2018. A Prospective Cohort Study on the Management of Young Patients with Newly Diagnosed Type 2 Diabetes Using Mobile Medical Applications. Diabetes Ther 9, 2099–2106. https://doi.org/10.1007/s13300-018-0506-1

Harvard. 2022. Healthy Eating Plate. Accessed on 03 November 2022. https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/

Holman, R.R., Paul, S.K., Bethel, M.A., Neil, H.A. & Matthews, D.R. 2008. Long-term follow-up after tight control of blood pressure in type 2 diabetes. N Engl J Med. 2008 Oct 9;359(15):1565-76. doi: 10.1056/NEJMoa0806359.

Holst, C., Becker, U., Jørgensen, M.E. Grønbæk, M. & Tolstrup, J.S. 2017. Alcohol drinking patterns and risk of diabetes: a cohort study of 70,551 men and women from the general Danish population. Diabetologia 60, 1941–1950 (2017). https://doi.org/10.1007/s00125-017-4359-3

Hu, F.B. & Manson, J.E. 2003. Management of diabetes: diet and lifestyle modification. In: Pickup JC, Williams G, editors. Textbook of Diabetes. Malden, MA: Blackwell Science; 36.1-36.13.

IDF Diabetes Atlas. 2021. Accessed on 2 September 2022. https://diabetesatlas.org/atlas/tenth-edition/

IDF Diabetes Atlas. 2021. Map of global diabetes prevalence of people ages 20-79. Accessed on 12 September 2022. https://ourworldindata.org/grapher/diabetes-prevalence

International Council of Nurses. 2022. Accessed on 17 October 2022. https://www.icn.ch/sites/default/files/inline-files/PR_01_JB%20report%20Jan%202022_FINAL.pdf

Ivers, N.M., Jiang, M., Alloo, J., Singer, A., Ngui, D., Casey, C.G. & Yu, C.H. 2019. Diabetes Canada 2018 clinical practice guidelines: Key messages for family physicians caring for patients living with type 2 diabetes. Can Fam Physician. 2019 Jan;65(1):14-24.

Jansson, S., Andersson, D. & Svärdsudd, K. 2010. Mortality trends in subjects with and without diabetes during 33 years of follow-up. Diabetes Care. 33; 3: 551-556.

Kapadia, S.J., Gao, Y. & Cumming, E. 2021. A remotely-delivered community action project to promote a diabetes lifestyle intervention programme in northwest London: basis, process and outcomes. Health Promotion Perspectives, 2021, 11(2), 250-255 doi: 10.34172/hpp.2021.30 https://hpp.tbzmed.ac.ir.

Karlsen, B., Oftedal, B. & Bru, E. 2012. The relationship between clinical indicators, coping styles, perceived support and diabetes-related distress among adults with type 2 diabetes. J Adv Nurs. 2012;68(2):391–401. Accessed on 04 November 2022. https://pubmed.ncbi.nlm.nih.gov/21707728/

Kelly, L., Jenkinson, C. & Morley, D. 2018. Experiences of Using Web-Based and Mobile Technologies to Support Self-Management of Type 2 Diabetes: Qualitative Study. JMIR Diabetes 2018;3(2):e9. URL: https://diabetes.jmir.org/2018/2/e9 doi: 10.2196/diabetes.9743

King, N. 2004. Using templates in the thematic analysis of text. In Cassell C., Symon G. (Eds.), Essential guide to qualitative methods in organizational research (pp. 257–270). London, UK: Sage.

Kip, H., Kelders, S.M., Sanderman, R., & van Gemert-Pijnen, L. (Eds.). 2018. eHealth Research, Theory and Development: A Multi-Disciplinary Approach (1st ed.). Routledge. doi: org/10.4324/9781315385907

Lindström, J., Louheranta, A., Mannelin, M., Rastas, M., Salminen, V., Eriksson, J., Uusitupa, M. & Tuomilehto J.2021. Finnish Diabetes Prevention Study Group. The Finnish Diabetes Prevention Study (DPS): Lifestyle intervention and 3-year results on diet and physical activity. Diabetes Care. 2021 Dec;26(12):3230-6. doi: 10.2337/diacare.26.12.3230

Losiouk, E., Lanzola, G., Del Favero, S., Boscari, F., Messori, M., Rabbone, I., Bonfanti, R., Sabbion, A., Iafusco, D., Schiaffini, R., Visentin, R., Galasso, S., Di Palma, F., Chernavvsky, D., Magni, L., Cobelli, C., Bruttomesso, D. & Quaglini, S. 2018. Parental evaluation of a telemonitoring service for children with Type 1 Diabetes. J Telemed Telecare. 2018 Apr;24(3):230-237. doi: 10.1177/1357633X17695172.

Martín-Peláez, S., Fito, M. & Castaner, O. 2020. Mediterranean Diet Effects on Type 2 Diabetes Prevention, Disease Progression, and Related Mechanisms. A Review. Nutrients. Jul 27;12(8):2236. doi: 10.3390/nu12082236.

Martos-Cabrera, M.B., Gómez-Urquiza, J.L., Cañadas-González, G., Romero-Bejar, J.L., Suleiman-Martos, N., Cañadas-De la Fuente, G.A. & Albendín-García, L. 2021. Nursing-Intense Health Education Intervention for Persons with Type 2 Diabetes: A Quasi-Experimental Study. Healthcare (Basel). Jul 1;9(7):832. doi: 10.3390/healthcare9070832

Masri, D.E., Koscielniak, N., Piatt, G., Zazzo-Miller, R., Arnetz, R. & Jaber, L. 2020. Barriers and facilitators to perceived diabetes self-management in Arab American patients with diabetes. ORIGINAL RESEARCH| VOLUME 14, ISSUE 3, 232-238, accessed on 03 November 2022. https://www.primary-care-diabetes.com/article/S1751-9918(19)30081-6/fulltext

McKinstry, B., Hanley, J., Wild, S., Pagliari, C., Paterson, M. & Lewis S. 2013. Telemonitoring based service redesign for the management of uncontrolled hypertension: multicentre randomised controlled trial BMJ; 346 :f3030. doi:10.1136/bmj.f3030

Miller, W.R. & Rollnick, S. 2013. Motivational Interviewing: Helping people to change (3rd Edition). Guilford Press.

Miyamoto, S., Dharmar, M., Fazio, S., Tang-Feldman, Y. & Young, H. M. 2018. mHealth Technology and Nurse Health Coaching to Improve Health in Diabetes: Protocol for a Randomized Controlled Trial. JMIR Res Protoc. Feb 15;7(2):e45. doi: 10.2196/resprot.9168.

NEJM Catalyst, 2017. What Is Patient-Centered Care? Accessed on 02 November 2022. https://catalyst.nejm.org/doi/full/10.1056/CAT.17.0559

Nelson, L., Mayberry, L., Wallston, K., Kripalani, S., Bergner, E. & Osborn, C.2016. Development and Usability of REACH: A Tailored Theory-Based Text Messaging Intervention for Disadvantaged Adults With Type 2 Diabetes. JMIR Hum Factors 2016;3(2). doi: 10.2196/humanfactors.6029

Noar, S.M. & Harrington,N.G. 2012. eHealth Applications: Promising Strategies for Behavior Change. Routledge.

Norris, S.L., Lau, J., Smith, S.J., Schmid, C.H.& Engelgau, M.M. 2002. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. Diabetes Care. Jul;25(7):1159-71. doi: 10.2337/diacare.25.7.1159

Nseir, W., Nassar, F. & Assy, N. 2010. Soft drinks consumption and nonalcoholic fatty liver disease. World J Gastroenterol. 2010 Jun 7;16(21):2579-88. doi: 10.3748/wjg.v16.i21.2579

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., et al. 2020. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

Pal, K., Eastwood, S.V., Michie, S., Farmer, A.J., Barnard, M.L., Peacock, R., Wood, B., Inniss, J.D. & Murray, E. 2013. Computer-based diabetes self-management interventions for adults with type 2 diabetes mellitus. Cochrane Database Syst Rev. 2013 Mar 28;2013(3):CD008776. doi: 10.1002/14651858.CD008776.pub2

Panagiotakos, D.B., Tzima, N., Pitsavos, C., Chrysohoou, C., Papakonstantinou, E., Zampelas, A. & Stefanadis, C.2005. The relationship between dietary habits, blood glucose and insulin levels among people without cardiovascular disease and type 2 diabetes; the ATTICA study. Rev Diabet Stud. 2005 Winter;2(4):208-15. doi: 10.1900/RDS.2005.2.208

Paré, G. & Kitsiou, S. 2017. Methods for Literature Reviews. In: Lau F, Kuziemsky C, editors. Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]. Accessed on 13 October 2022. https://www.ncbi.nlm.nih.gov/books/NBK481583/

Park, J. & Peters, P. A. 2014. Mortality from diabetes mellitus, 2004–2008: a multiple-cause of-death analysis. Health Rep. 25; 3:12-16.

Powers, M.A., Bardsley, J., Cypress, M., Duker, P., Funnell, M.M., Fischl, A.H., Maryniuk, M.D., Siminerio, L. & Vivian, E. 2016. Diabetes Self-management Education and Support in Type 2 Diabetes: A Joint Position Statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. Clin Diabetes. Apr;34(2):70-80. doi: 10.2337/diaclin.34.2.70

Ramadas, A., Quek, K.F., Chan, C.K. & Oldenburg, B. 2011. Web-based interventions for the management of type 2 diabetes mellitus: a systematic review of recent evidence. Int J Med Inform. 2011 Jun;80(6):389-405. doi: 10.1016/j.ijmedinf.2011.02.002

Reynolds, A.N., Akerman, A.P., Mann, J. 2020. Dietary fibre and whole grains in diabetes management: Systematic review and meta-analyses. PLoS Med. Mar 6;17(3):e1003053. doi: 10.1371/journal.pmed.1003053

Richards, D.A. & Hallberg, R I. (Eds.). 2015. Complex Interventions in Health: An overview of research methods (1st ed.). Routledge. doi: org/10.4324/9780203794982

Rombouts, M., Raaijmakers, L.G.M., Kuunders, T.J.M. et al. 2022. The Acceptance and Use of the e-Health Instrument 'The Personal Health Check' in Four Dutch Municipalities: Lessons Learned. J Primary Prevent 43, 25–48. https://doi.org/10.1007/s10935-021-00651-2.

Rosland, A., Heisler, M., Choi, H., Silveira, M.J. & Piette, J.D. 2010. Family influences on self-management among functionally independent adults with diabetes or heart failure: do family members hinder as much as they help? Chronic Illn. 2010;6(1):22–33. doi: 10.1177/1742395309354608.

Ryan, R. M. & Deci, E.L. 2000. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. Contemporary Educational Psychology. Volume 25, Issue 1, January 2000. 54-67. Doi: https://doi.org/10.1006/ceps.1999.1020

Sanchez-Villegas, A., Schlatter, J., Ortuno, F. Lahortiga, F., Pla, G., Benito, S. & Martinez-Gonzalez, A. 2008. Validity of a self-reported diagnosis of depression among participants in a cohort study using the Structured Clinical Interview for DSM-IV (SCID-I). BMC Psychiatry 8, 43. https://doi.org/10.1186/1471-244X-8-43

Santos, A. & Silva, M.S. 2014. How people with diabetes evaluate participation of their family in their health care. Invest Educ Enferm.32(2):260–269

Sherman, R.O. & Cohn, T. M. 2016. Improving your coaching skills. Accessed on 04 November 2022. https://www.myamericannurse.com/wp-content/uploads/2016/05/ant5-Coaching-425b.pdf

Sin, D.Y.E., Guo, X., Yong, D.W.W. et al. 2020. Assessment of willingness to Tele-monitoring interventions in patients with type 2 diabetes and/or hypertension in the public primary healthcare setting. BMC Med Inform Decis Mak. https://doi.org/10.1186/s12911-020-1024-4

Sin, D.Y.E., Guo, X., Yong, D.W.W. et al. 2020. Assessment of willingness to Tele-monitoring interventions in patients with type 2 diabetes and/or hypertension in the public primary healthcare setting. BMC Med Inform Decis Mak 20, 11. https://doi.org/10.1186/s12911-020-1024-4

Skär, L. & Söderberg, S. 2017. The importance of ethical aspects when implementing eHealth services in healthcare: A discussion paper. J Adv Nurs. 2018 May;74(5):1043-1050. doi: 10.1111/jan.13493. Epub 2017 Nov 29.

Smoking Cessation: A Report of the Surgeon General. 2020. Accessed on 10 September 2022. https://www.hhs.gov/sites/default/files/2020-cessation-sgr-full-report.pdf

Solomon, R. C. (2008). The philosophy of emotions. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), Handbook of emotions (pp. 3–16). The Guilford Press.

Suseelal, T. & John, K.L. 2018. A Study to Assess the Impact of Home Based Education on Life Style Modification among Adults with Diabetes Mellitius at Selected Villages in Kancheepuram District, tamil Nadu, India. doi: 10.5958/0974-9357.2018.00122.8

Suseelal, T. & John, K.R. 2018. A Study to Assess the Impact of Home Based Education on Life Style Modification among Adults with Diabetes Mellitius at Selected Villages in Kancheepuram District, tamil Nadu, India. Doi: 10.5958/0974-9357.2018.00122.8

Swobodaa, C. M., Miller, C.K., & Wills, C.E. 2017. Impact of a goal setting and decision support telephone coaching intervention on diet, psychosocial, and decision outcomes among people with type 2 diabetes. Patient Education and Counseling. Volume 100, Issue 7,1367-1373. https://doi.org/10.1016/j.pec.2017.02.007

Sydanmerkki. 2022. Heart Symbol. Accessed on 27 November 2022. https://www.sydanmerkki.fi/en/

Templier, M. & Paré, G. 2015. A Framework for Guiding and Evaluating Literature Reviews. ISSN: 1529-3181. Accessed on 13 October 2022. https://www.iwi.uni-

hannover.de/fileadmin/iwi/Lehre/Wissenschaftliches_Arbeiten_fuer_Studierende/Templier_Pare_2015_A_Framework_for_Guiding_and_Evaluating_Literature_Reviews.pdf

Thomas, D. R. 2006. A General Inductive Approach for Analyzing Qualitative Evaluation Data. American Journal of Evaluation, 27(2), 237–246. Accessed on 18 October 2022. https://doi.org/10.1177/1098214005283748

Thomson, H., Oliver, N., Godsland, I.F., Darzi, A., Srivanichakorn, W., Majeed, A., Johnston, D.G., et al. 2018. Protocol for a clinical trial of text messaging in addition to standard care versus standard care alone in prevention of type 2 diabetes through lifestyle modification in India and the UK. BMC Endocr Disord. 2018 Sep 10;18(1):63. doi: 10.1186/s12902-018-0293-8.

Turnbull, F.M., Abraira, C., Anderson, R.J., Byington, R.P., Chalmers, J,P., Duckworth, W.C., Evans, G.W., Gerstein, H.C., Holman, R.R., Moritz, T.E., Neal, B.C., Ninomiya, T., Patel, A.A., Paul, S.K., Travert, F. & Woodward, M. 2009. Intensive glucose control and macrovascular outcomes in type 2 diabetes. Diabetologia. 2009 Nov;52(11):2288-98. doi: 10.1007/s00125-009-1470-0

Unhealthy diet and lack of physical activity are leading global risks to health. (who 2020)

van Buul, A.R, Kasteleyn, M.J., Arends, J.M. et al. 2020. eHealth only interventions and blended interventions to support self-management in adolescents with asthma: A systematic review. Clinical eHealth. PP. 49-62.

van Vugt, M., de Wit, M., Cleijne, W.H. & Snoek, F.J. 2013. Use of behavioral change techniques in web-based self-management programs for type 2 diabetes patients: systematic review. J Med Internet Res. 2013 Dec 13;15(12):e279. doi: 10.2196/jmir.2800. PMID: 24334230; PMCID: PMC3869055.

Varnai, P., Nausedaite, R., Beckers, D. et al. 2019. eHealth – Future Digital Health in the EU. Accessed on 10 October 2022. https://www.espon.eu/sites/default/files/attachments/Final%20report.%202019%2003%2025_final%20version_0.pdf

Webb, J., Peerbux, S., Smittenaar, P., et al. 2020. Preliminary Outcomes of a Digital Therapeutic Intervention for Smoking Cessation in Adult Smokers: Randomized Controlled Trial. JMIR Ment Health. Oct 6;7(10):e22833. doi: 10.2196/22833.

Welzel, F.D., Bär, J., Stein, J. et al. 2021. Using a brief web-based 5A intervention to improve weight management in primary care: results of a cluster-randomized controlled trial. BMC Fam Pract 22, 61. https://doi.org/10.1186/s12875-021-01404-0

Welzel, F.D., Bär, J., Stein, J. et al. 2021. Using a brief web-based 5A intervention to improve weight management in primary care: results of a cluster-randomized controlled trial. BMC Fam Pract 22, 61. https://doi.org/10.1186/s12875-021-01404-0

Whitehead, L. & Seaton P. 2016. The Effectiveness of Self-Management Mobile Phone and Tablet Apps in Long-term Condition Management: A Systematic Review. J Med Internet Res. 2016 May 16;18(5):e97. doi: 10.2196/jmir.4883.

WHO. 2020. Healthy diet. Accessed on 03 November 2022. https://www.who.int/news-room/fact-sheets/detail/healthy-diet

WHO. 2022. Physical activity. Accessed on 03 November 2022. https://www.who.int/news-room/fact-sheets/detail/physical-activity

Wondmkun, Y.T. 2020. Obesity, Insulin Resistance, and Type 2 Diabetes: Associations and Therapeutic Implications. Diabetes Metab Syndr Obes. 2020 Oct 9;13:3611-3616. doi: 10.2147/DMSO.S275898.

World Health Organization. 2022. Diabetes. Accessed on 14 October 2022. https://www.who.int/news-room/fact-sheets/detail/diabetes

Xie, X.T., Liu, Q., Wu, J. & Wakui, M. 2009. Impact of cigarette smoking in type 2 diabetes development. Acta Pharmacol Sin. 2009 Jun;30(6):784-7. doi: 10.1038/aps.2009.49

Yang, X. & Kovarik, C.L. 2021. A systematic review of mobile health interventions in China:Identifying gaps in care. Accessed on 1 November 2022. https://journals.sagepub.com/doi/pdf/10.1177/1357633X19856746

Yasmin, F., Nahar, N., Banu, B. et al. 2020. The influence of mobile phone-based health reminders on patient adherence to medications and healthy lifestyle recommendations for effective management of diabetes type 2: a randomized control trial in Dhaka, Bangladesh. BMC Health Serv Res 20, 520. https://doi.org/10.1186/s12913-020-05387-z

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List of abbreviations

CDC: American Centers for Disease Control and Prevention
IDF: International Diabetes Federation
mhealth: mobile health
eHealth: electronic health
WHO: World Health Organization
THL: Finnish Institute for Health and Welfare
DM2: diabetes mellitus 2 or type 2 diabetes mellitus
BMI: body mass index