

EFFECTIVENESS OF INTERNET-BASED AND MOBILE PHONE-BASED
INTERVENTIONS TO ACHIEVE SMOKING CESSATION FOR
ADOLESCENT AND ADULT SMOKERS:
A META-ANALYSIS

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Master of Health Science

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Table of Contents

Acknowledgements.....	7-10
Abstract of the Thesis	10-11
Glossary of Terms.....	13-15
Abbreviations	15-16
Outline of this Thesis	17
Chapter 1. Introduction	18
1.1 Overview	18
1.2 The importance of tobacco smoking as an issue	18-19
1.2.1 Exposure to second-hand smoke as a result of tobacco smoking as an issue	18-21
1.2.2 Conditions affecting health attributable to tobacco smoking	21-24
1.3 Prevalence of smoking among adolescents and adults.....	24
1.3.1 Prevalence of smoking among the New Zealand population	25-29
1.3.2 Exposure to second-hand smoke among New Zealanders	29-32
1.3.3 Declines in smoking rates among the New Zealand population .	32-36
1.4 Smoking cessation	36
1.4.1 Benefits of smoking cessation interventions.....	36-37
1.4.2 Review of smoking outcome measures.....	37-43
1.4.3 Communication used in interventions to change health behaviour	43-44
1.4.4 Theories guiding interventions for smoking cessation	44-45
1.4.5 Non-Internet and Non-Mobile phone-based interventions used in smoking cessation programmes.....	45-46
1.4.6 Internet-and Mobile phone-based interventions used in Health..	46-47
1.4.7 Tobacco Smoking Cessation support available in New Zealand	47-50
1.5 The aim of this Analysis	50
1.6 Purpose, Research Question and Hypotheses	50-53

Chapter 2. Review of the Literature.....	54
2.1 Overview	54
2.2 Smoking among adolescents and adults.....	54
2.2.1 Smoking among adolescents	54-58
2.2.2 Effective smoking cessation support for young adults	58
2.2.3 Young adults' use of tobacco cessation support.....	58-59
2.3 Discussion of how Internet-and Mobile phone components are included in Smoking Cessation Programmes.....	59
2.3.1 Internet-and Mobile phone-based interventions used in health care	59-60
2.3.2 The use of Internet and Mobile phones for healthy behaviour change	61-62
2.3.3 The use of the Internet	62-63
2.3.4 The use of Mobile phone.....	63-64
2.3.5 The use of the Internet and Mobile phone to deliver Smoking Cessation	65
2.3.6 Potential benefits of Internet-and Mobile phone-based interventions for Smoking Cessation.....	65-66
2.3.7 Possible limitations of Internet-and Mobile phone-based interventionsfor Smoking Cessation	66-67
2.4 Internet-and Mobile phone-based interventions-previous research ...	67
2.4.1 Studies which included adolescents	68-69
2.4.2 Studies which included adults	69-74
2.4.3 Summary of previous research	75-76
Chapter 3. Methods	77
3.1 Overview	77
3.2 Steps of this Meta-Analysis.....	77
3.2.1 Protocol	77
3.2.2 Eligibility criteria: Inclusion & Exclusion criteria for studies ...	77-79
3.3 Search of Literature	79
3.3.1 Search Terms & Databases searched	79-81
3.4 Appraisal of the Studies Based on their Titles and Abstracts.....	81
3.4.1 Search for fugitive literature.....	81-82
3.4.2 Hand searches from the lists of references from the literature	82
3.4.3 Critical Appraisal of the studies included in the full text assessment	82-83
3.5 Risk of Bias Assessment	83
3.6 Summary of the Results of the study: Random-Effects vs. Fixed-Effects Meta-Analysis.....	84-85
3.7 Assessment of heterogeneity of studies.....	86
3.8 Summary of the studies: Odds Ratio and Forest Plots	86-87
3.9 Testing for Publication Bias: Visual Inspection.....	87

3.10 Subgroup Analyses	87-88
Chapter 4. Results of the Meta-Analysis.....	89
4.1 Overview	89
4.2 Results of the search	89-90
4.3 Randomized Controlled Trials included in this Meta-Analysis.....	90
4.3.1 Recruitment and Participants.....	90-91
4.3.2 Interventions	91
4.3.3 Outcomes	91-92
4.3.4 Comparisons	92-98
4.4 Risk of Bias in included studies.....	98
4.4.1 Randomization	99
4.4.2 Allocation Concealment	99
4.4.3 Blinding.....	99
4.4.4 Incomplete Outcome Data.....	100
4.5 Forest Plot of all included studies	115
4.5.1 Fixed-Effects Analysis	116
4.5.2 Random-Effects Analysis.....	116
4.6 Forest Plots of Subgroup Analyses	116-118
4.7 Funnel Plots of Fixed-Effects and Random-Effects Analyses to examine Publication Bias	118-119
4.8 Descriptions of the Results.....	119
4.8.1 Effects of Interventions	119-125
Chapter 5. Discussion and Conclusion.....	126
5.1 Overview	126
5.2 Summary of main findings	126-128
5.3 Quality of Evidence.....	128-130
5.4 Agreements and Disagreements with other trials and reviews..	130-131
5.5 Implication for practice.....	131-132
5.6 Strengths and limitations of this Analysis.....	132-133
5.7 Implications for future research	133
5.8 Conclusion.....	133-134
References	134-139
Appendices	140
Appendix A. Agency websites and other websites accessed for unpublished literature	140
Appendix B. Included and excluded studies.....	140-148

List of Tables

Table.1: Current smoking population by ethnic group among people aged 15 years and over

Table.2: Smoking rates in youth aged 15-19 years by ethnicity

Table.3: Adjusted risk rate ratios for current smoking among the total population

Table.4: Adjusted risk rate ratios for current smoking among 15-19 years olds

Table.5: Exposure to Second-hand smoke (SHS) at home and in the car among ethnicity

Table.6: Adjusted risk rate ratios for non-smoking adults' Second-hand smoke (SHS) exposure at home and in car

Table.7: Exposure to Second-hand smoke (SHS) at home and in the car for children aged 14 years and under

Table.8: Adjusted risk rate ratios for non-smoking children aged 14 years and under-Second-hand exposure at home and in the car

Table.9: Changes in current smoking prevalence by ethnicity 'between 2006-2012'

Table.10: Changes in current smoking prevalence by gender 'between 2006-2012'

Table.11: Adjusted risk rate ratios for non-smoking children- SHS exposure by ethnicity and deprived neighbourhoods

- Table.12: Mean age for smoking initiation and mean age of smoking uptake among current smokers over the age of 20 years by ethnicity
- Table.13: Mean age of smoking initiation of year 10 students from 2006-2012
- Table.14: Search History of PubMed Database search
- Table.15: Cochrane Collaboration Risk of Bias Tool
- Table.16: Search Term Results from PubMed Database search
- Table.17: Characteristics of all studies included in this review
- Table.18: Summary of Findings of all included studies in this review
- Table.19: Assessment of Bias in included studies
- Table.20: Characteristics of excluded studies with reasons for exclusion
- Table.21: Fixed-Effects Analysis of all studies included in this review
- Table.22: Random-Effects Analysis of all studies included in this review
- Table.23: Analysis for Subgroup 1. Internet-& Mobile phone-based interventions, outcome: 7 days point prevalence, self-reported abstinence
- Table.24: Analysis for Subgroup 2. Internet-& Mobile phone-based interventions, outcome: 7 days point prevalence, self-reported abstinence, Salivary Cotinine & Carbon Monoxide Testing
- Table.25: Analysis for Subgroup 3. Internet-& Mobile phone-based interventions; outcome: 7 days point prevalence, self-reported abstinence, additional Nicotine Replacement Therapy or Telephone Calls
- Table.26: Analysis for Subgroup 4. Internet-& Mobile phone-based interventions, outcome: 7 days & 30 days point prevalence, self-reported abstinence

Table.27: Analysis for Subgroup 5. Internet-& Mobile phone-based interventions, outcome: Comparison group also received Internet-& Mobile phone-based interventions at lower frequency

List of Figures

Figure.1: Current smoking among the total population in New Zealand by age group and gender

Figure.2: Current smoking among young people aged 15-19 years by gender

Figure.3: Current smoking among total population by neighbourhood deprivation

Figure.4: Exposure to Second-hand smoke at home and in car by age group

Figure.5: Exposure to Second-hand smoke (SHS) at home and in the car for children aged 14 years and under, by neighbourhood deprivation (age-standardized)

Figure.6: Changes in current smoking among young people aged 15-19 years by gender

Figure.7: Decline in current & daily smoking rates among the population in New Zealand 1996/97-2012/13

Figure.8: Quorum Chart

Figure.9: Forest Plot of Fixed- Effects Analysis of all included studies

Figure.10: Forest Plot of Random-Effects Analysis of all included studies

Figure.11: Forest Plot of Analysis for Subgroup 1. Internet-& Mobile

phone-based interventions, outcome: 7 days point prevalence, self-reported abstinence

Figure.12: Forest Plot of Analysis for Subgroup 2. Internet-& Mobile phone-based interventions, outcome: 7 days point prevalence, self-reported abstinence, Salivary Cotinine & Carbon Monoxide Testing

Figure.13: Forest Plot of Analysis for Subgroup 3. Internet-& Mobile phone-based interventions, outcome: 7 days point prevalence, self-reported abstinence, additional Nicotine Replacement Therapy or Telephone Calls

Figure.14: Forest Plot of Analysis for Subgroup 4. Internet-& Mobile phone-based interventions; outcome: 7 days & 30 days point prevalence, self-reported abstinence

Figure.15: Forest Plot of Analysis for Subgroup 5. Internet-& Mobile phone-based interventions; outcome: Comparison group also received Internet-& Mobile phone-based interventions at lower frequency

Figure.16: Funnel Plot of Fixed-Effects Analysis of all studies included

Figure.17: Funnel Plot of Random-Effects Analysis of all studies included

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Abstract of the Thesis

Smoking is a leading cause of preventable diseases and death world-wide and within New Zealand. Despite overall declines, particularly young adults and Maori (the indigenous population of New Zealand) continue to have high rates of smoking. Research suggests that Internet- and Mobile phone-based interventions are effective to achieve cessation of smoking however the effects are short-term. The purpose of this Meta-Analysis was to pool together evidence regarding the effectiveness of Internet-and Mobile phone-based interventions to achieve longer-term cessation of smoking among adolescent and adult smokers. The analysis was based on the assessment and pooling of Randomized Controlled Trials and reported outcomes at six months or longer. This analysis was based on English Language articles published in the previous ten years (2004-2014) whose comparison group received either any other intervention or an intervention inclusive of but not limited to Internet-and Mobile phone-based interventions delivered at a lower frequency. Both a Fixed-Effects and a Random-Effects Meta-Analysis between all studies were conducted to assess the length of abstinence. Moreover the individual studies were grouped using an outcome theme and five subgroup analyses were conducted.

Findings from both, the Fixed-Effects and Random-Effects Meta-Analysis suggest great heterogeneity among the studies. Overall findings suggest that Internet-and Mobile phone-based interventions used in smoking cessation are effective in achieving longer-term cessation of smoking (pooled OR= 1.13, 95% CI: 1.07, 1.20). Findings from the subgroup analyses suggest that both Internet-and Mobile phone-based interventions combined with an additional intervention inclusive of Nicotine Replacement Therapy are most effective in achieving longer-term cessation of smoking among adolescent and adult smokers. These findings suggest that Internet-and Mobile phone-based interventions alone are not sufficient to achieve longer-term smoking cessation among chronic smokers and that additional interventions are needed to achieve longer-term smoking cessation.

Glossary of Terms

Mobile phone: An electronic telecommunications device which connects to a wireless communications network through radio wave or satellite transmission- a small portable telephone, also referred to as a Cell phone or Cellular Phone.

Mobile phone-based interventions: Interventions which use the Mobile phone as a main component and include text messages, applications, phone calls

Cigarette: dried leaves of a tobacco plant rolled in rice paper to create a small round cylinder (cigarette)

Co-verified 4-week quitter: A self-reported quitter who's air CO was assessed and found at less than 10ppm.

Current Smokers: Adults who have smoked 100 cigarettes in their life time and currently smoke cigarettes every day (daily) or on some days (non-daily)

Daily Smoker: someone who has smoked more than 100 cigarettes in their lifetime and smokes at least 1 cigarette daily.

Electronic cigarette: an electronic vaporisation system used to produce an aerosol vapour rather than burning tobacco to produce smoke/ battery-operated device that typically contains nicotine and propylene glycol and

may include other substances including flavour (for example tobacco flavour, menthol)

Former Smokers: Adults who have smoked at least 100 cigarettes in their life time but say they currently do not smoke

Internet: A global system of interconnected computer networks that serve billions of people world-wide

Internet- based interventions: Interventions which use the Internet as a main component and include emails, accessing websites, online discussion forums, private chat online

Never Smokers: Adults who have never smoked a cigarette or who smoked fewer than 100 cigarettes in their entire life time

Non-Smokers: Adults who currently do not smoke cigarettes, including both former smokers and never smokers

Recent quitter: someone who has made a quit attempt in the past 12 months

Self-help booklets: Books or manuals inclusive of information written with the intention to instruct its readers on solving personal problems

Self-help treatment: Treatment of the self without any supervision of a health professional

Self-reported 4-week quitter: A treated smoker, assessed after 4 weeks after designated quit date who declares has not smoked a single puff

Smoking: The practice in which a substance (cigarette) is burned and the resulting smoke is breathed in to be tasted and absorbed into the blood stream

Smoking Cessation: The process of discontinuing tobacco smoking

Smoking Initiation: the time when an individual smoked their first cigarette (may have been just a few puffs)

Smoking Uptake: when an individual starts smoking daily

Socio-economic status: parental income, education, occupational status

Successful quitting: an individual that has quit within the last 1-12 months and has remained abstinent since

Treated smoker: A smoker who undergoes at least one treatment session on or prior to quit date

Abbreviations

CO- Carbon Monoxide

COPD- Chronic obstructive pulmonary disease

CVD- Cardio-vascular disease

ITT- Intention-to-treat

LFU- Lost to follow up

MMS- Multi-media Message Service

MOH- Ministry of Health

NRT- Nicotine Replacement Therapy

NZHS- New Zealand Health Survey

RCT- Randomized Controlled Trial

SES- Socio-economic status

SHS- Second-hand smoke

SMS- Short Message Service

SR- Self-reported

SRNT- Society of Research on Nicotine & Tobacco

SOS: An urgent appeal for help, in smoking cessation programmes referred to participants needing urgent advice on how to cope with craving and withdrawal symptoms

TS- Treated smoker

TTM- Trans-theoretical Model of Behaviour Change

WHO- World Health Organization

Outline of this thesis

This thesis consists of five chapters. Chapter 1 provides background information relevant to this research about smoking and Internet-and Mobile phone-based smoking cessation programmes and an understanding as to why this Meta-Analysis was undertaken. Chapter 2 describes background information about previous research and literature reviews. The existing literature suggests that Internet-and Mobile phone-based interventions have the potential to achieve short-term cessation of smoking. In this chapter, the key studies on the effectiveness of the Internet-and Mobile phone-based interventions for achieving smoking cessation are provided.

The details of the research methodology are provided in the Chapter 3. The results of this analysis are presented in Chapter 4, and Chapter 5 provides a discussion of the major findings, the implications and recommendations for future research.

Chapter 1 Introduction

1.1 Overview

This chapter provides background information about tobacco smoking in New Zealand and world-wide, an explanation of the different diseases and illnesses that are attributable to tobacco smoking and the prevalence of tobacco smoking among different ethnic and age groups inclusive of deprived and less deprived neighbourhoods in New Zealand.

Furthermore, this chapter explains smoking cessation interventions and benefits, current cessation support services that are available in New Zealand and information about declines in prevalence of smoking among the population of New Zealand. The aim and relevance of this Analysis is presented in the latest part of this chapter.

1.2 The Importance of Tobacco Smoking as an issue

Cigarette Smoking is a leading public health concern world-wide and within New Zealand. Smoking is an addictive behaviour and it harms nearly every organ and system in the body. Not only does it increase the heart rate and blood pressure, it slows down the blood flow, narrows down the blood vessels and reduces the oxygen to different parts of the body and it is linked to increased risk of developing cancerous and non-cancerous diseases and illnesses. Cancerous diseases and illnesses attributable to tobacco smoking include lung cancer, cancer of the larynx (voice box), oral cavity (mouth, tongue, lip), nose and sinuses,

pharynx (throat), oesophagus, stomach, pancreas, cervix, kidney, bladder, ovary, colon and rectum, and leukaemia whereas non-cancerous diseases and illnesses are inclusive of cardiovascular disease (CVD) and chronic obstructive pulmonary disease (COPD). Not only smokers are at risk of developing diseases and illnesses attributable to tobacco smoking, non-smokers and particularly young children are at high risk as they are exposed to second-hand smoke in their home and in the car they travel in.

In the year 2000, 4.83 million premature deaths (estimate range: 3.94-5.93 million) globally were estimated to be due to tobacco smoking and these occurred almost equally in developed countries (2.43 million) and in developing countries (2.41 million) (Ezzati, 2003). The leading causes of death were cardiovascular diseases (1.69 million deaths, 35% of all smoking attributable deaths), chronic obstructive pulmonary disease (COPD, 0.97 million deaths) and lung cancer (0.85 million deaths). Twenty-two per cent of all deaths from cancer in adults and 11% of all cardiovascular disease deaths world-wide were considered to be attributable to tobacco smoking (Ezzati, 2003) and a large proportion of tobacco-related deaths occurred in developed countries (Ezzati, 2003). Statistics from the year 2013 reported that the life of six million people world-wide is claimed by smoking each year and that more than five million of these are a result of direct tobacco use, while more than 600,000 are non-smokers being exposed to second-hand smoke (WHO, 2015).

1.2.1 Exposure to Second-hand Smoke (SHS) as a result of tobacco smoking as an issue

Second-hand smoke (SHS) is the smoke from burning tobacco products inclusive of cigarettes, cigars or pipes also known as environmental tobacco smoking (ETS) or passive

smoking (CDC, 2014). Containing a lethal mix of more than 4,000 chemicals inclusive of arsenic, hydrogen cyanide, ammonia and carbon monoxide second-hand smoke harms people of all ages, however particularly young children are at risk as they are mostly exposed to it at home and in the car they travel. There are several health effects associated with the exposure to second-hand smoke among young children inclusive of ear infections, more frequent asthma attacks, respiratory symptoms (coughing, sneezing, short of breath), respiratory infections (bronchitis, pneumonia) and a greater risk of sudden infant death syndrome (SIDS) (USDHHS, 2015). For adults the same risk factors as for smokers apply.

In New Zealand, about one in six adults (18%) have been identified as a chronic smoker and smoking is associated with 5,000 deaths per year in New Zealand's mortality and 9.1% loss of DALY (MOH, 2013). DALY (disability-adjusted life years) measures how far the population falls short of 'ideal' health (MOH, 2013).

The New Zealand population consists of several large ethnicity groups which includes New Zealand Europeans (65%), Maori-the indigenous population (14%), people from the Pacific Islands including Samoa, Cook Islands, Tonga, Nuie, Fiji, Tokelan (7%) and Asian people including these from countries predominantly from China, India, Korea, Philippines, Japan, Sri Lanka, Cambodia (9%) (Statistics NZ, 2013) and life expectancy rates differ among the above mentioned population groups. The life expectancy for Maori females at birth is 76.5 years and for Maori males 72.8 years compared to non-Maori females 83 years and non-Maori males 79.3 years (MOH, 2013). And as mentioned before, as a result of high smoking rates the life of approximately 5000 New Zealanders is claimed every year (MOH, 2014) and an average New Zealand smoker is estimated to lose 5.2 years of their life due to tobacco smoking (MOH, 2014).

The economic burden of tobacco-induced diseases is huge. The costs of smoking to New Zealand in 2005 were \$1.7 billion and this includes costs incurred because of lost production due to early death, lost production due to smoking-caused illness and smoking-related health care costs (MOH, 2007).

There are nearly 350 deaths (which refer to approximately three people per day) per year including a number of diseases and illness as mentioned above to be from past exposure to second-hand smoke (MOH, 2014). Also children are at high risk-15,000 asthma attacks in children under the age of 16 years are caused by second-hand smoke yearly. Additionally second-hand smoke puts children at high risk of sudden infant death and causes more than 600,000 premature deaths per year (WHO, 2015).

The Ministry of Health New Zealand (MOH) conducts a yearly Health Survey and Tobacco Use Survey which count as valuable sources of information about health behaviours of people residing in New Zealand and their health status. Findings from this New Zealand Health Survey (NZHS) from the year 2012/2013 indicate that 18% were smokers (this represents around 626,000 smokers) compared to 25% of the adult population, who were reported as being smokers in the year 2006/2007. Risk differences among different cultures were identified. The Statistics among the Maori culture still remain high, 39% were smokers in the year 2012/2013 compared to 40% who were reported smoking in the year 2006/2007. Almost 4% of non-smokers were exposed to second-hand smoke (SHS) at home or in the car they travelled.

1.2.2 Conditions affecting health attributable to tobacco-smoking *Cancerous and non-cancerous conditions*

Cancerous diseases and illnesses attributable to tobacco smoking include lung cancer, cancer of the larynx (voice box), oral cavity (mouth, tongue, lips), nose and sinuses, pharynx

(throat), oesophagus, stomach, pancreas, cervix, kidney, bladder, ovary, colon and rectum, and leukaemia (American Cancer Society, 2014).

Furthermore, tobacco smoking increases the risk of developing non-cancerous diseases and illnesses inclusive of cardiovascular disease (CVD) and chronic obstructive pulmonary disease (COPD). Tobacco acts in a number of ways to cause CVD. It temporarily raises the blood pressure and decreases the amount of oxygen that the blood can carry and increases the tendency for the blood to clot. Blood clots can form in arteries causing a range of heart diseases that ultimately result in a stroke or sudden death. Cardiovascular disease (CVD) comprises a group of diseases that involve the heart or the blood vessels including coronary artery diseases (CAD) inclusive of angina pectoris and myocardial infarction (commonly known as heart attack). Stroke, atrial fibrillation, congenital heart disease, aortic aneurysms, peripheral artery disease and venous thrombosis also belong to the group of cardiovascular disease (Mendis, 2011). Coronary artery disease, stroke, and peripheral artery disease all involve atherosclerosis (known as arteriosclerotic vascular disease (ASVD) - a specific form of arteriosclerosis in which an artery wall thickens as a result of invasion and accumulation of white blood cells and proliferation of smooth muscle creating a fibro-fatty plaque (Ross, 1999). Angina pectoris is classified by sensation of chest pain, pressure or squeezing pain often due to ischemia of the heart muscle from obstruction or spasm of the coronary arteries. Myocardial infarction (commonly known as heart attack) occurs when blood flow stops to a part of the heart causing damage to the heart muscle. Stroke (also known as cerebrovascular accident CVA or brain attack) is classified as poor blood flow to the brain resulting in cell death. There are two types, one is ischemic and due to lack of blood flow and the other one is haemorrhagic due to bleeding (Donnan, 2008). Atrial fibrillation is an abnormal heart rhythm characterized by rapid and irregular beating of the heart (Munger, 2014). Aortic aneurysm is the enlargement of the aorta to greater than 1.5 times the normal size and this can cause aortic

rupture and internal bleeding. Peripheral artery disease (PAD) also known as peripheral vascular disease (PVD) is the narrowing of the arteries other than these that supply the brain and heart (Cole, 1993). Buerger's disease is the narrowing of peripheral blood vessels that leads to dry gangrene of fingers and toes and leads to amputation. Venous thrombosis is a blood clot that forms within a vein: a deep vein thrombosis (DVT) in which a blood clot is formed in the deep veins of the leg. This blood clot can embolize and flow towards the lungs leading to pulmonary embolism (PE) a blood clot in the lungs which is life-threatening (Turpie, 2008).

Furthermore tobacco smoking is associated with hazardous alcohol use and poor mental health. This is explained further in the next paragraph.

Smoking associated with hazardous alcohol consumption

Smoking is not only attributing to higher risk of developing cancerous and non-cancerous diseases and illnesses, there is also a well-established relationship between smoking and alcohol consumption and furthermore between smoking and mental health.

Research has reported that higher levels of alcohol use are also associated with higher levels of smoking (Sorlie et al, 1990; Falk et al, 2006) and lower rates of quitting (Dollar et al, 2009) and four of ten smokers (40%) have a potential hazardous drinking problem compared with 14% of non-smokers (NZHS, 2013). Hazardous drinking rates are higher in smokers than non-smokers across all age groups and hazardous drinking patterns are higher in smokers than non-smokers of all deprivation levels.

Smoking associated with poor mental health

Strong evidence also exists between smoking and poor mental health. Smoking is known to increase stress, anxiety and the chances of developing depression, anxiety disorders or other

mental illnesses as well as increasing the risk of suicidal intentions and suicide-related acts (Fergusson et al, 2003; Breslau et al, 2005). Findings from the New Zealand Health Survey 2012/13 reported almost a quarter (24%) of smokers indicated that they were diagnosed with a mental condition compared with 15% of non-smokers and more increased among aged 35-44 years and aged 45-55 years groups (MOH, 2013).

1.3 Prevalence of smoking among adolescents and adults

As mentioned above smoking among adolescents and adult smokers is a significant health problem. 80% of adult smokers became regular smokers before the age of 20 years therefore teenage smoking is a precursor to nicotine addiction among adult smokers (MOH, 2013). ‘In the absence of intervention, adolescent smokers will most likely become adult smokers’ (WHO, 2010).

An estimated 50% of males and females who start smoking as adolescents will continue to smoke for at least 16-20 years (Pierce, 1996) and the younger they start smoking the more likely they are to develop higher levels of nicotine dependence than are those who start smoking at a later stage, leading to more difficulty quitting (Mermelstein, 2003). On average it takes 2-3 years to become a regular smoker and addicted to smoking (Colby, 2000).

Young people tend to underestimate the addictive nature of nicotine and therefore adolescent smokers are very likely to think that they can quit at any time (Al-Delaimy, 2006). However only about 4% of smokers aged 12-19 years successfully quit smoking each year (USDHHS, 2014). The majority of quit attempts are unsuccessful, in fact most individuals tend to relapse within a few days of quitting (Lane, 2011). Meanwhile, many adolescents attempt to quit

smoking each year. Internationally 65-85% of young adults are likely to have made at least one quit attempt and failed (Sussman, 2009).

1.3.1 Prevalence of smoking among the New Zealand population

Smoking rates are declining however this decline is not happening across all population groups therefore smoking rates still remain high among some groups. As it has been the case for many years, Maori continue to have the highest current and daily smoking rates among all other population groups (Table.1). Around four in ten (39%) of Maori adults are a current smoker, 42% of them are female smokers and 36% of them are male smokers (Table.1). Compared to other non-Maori ethnic groups among people aged 15 years and over Maori are 2.5 times more likely to be smokers (Table.3). The risk among Pacific adults remains high compared to non-pacific adults. One in four (25%) of Pacific adults is a current smoker (Table.1) with 27% male smokers and 23% female smokers. Pacific adults are therefore 1.3 times more likely to be smokers compared to non-Pacific adults (Table.3). Smoking rates among New Zealand Europeans/Others and Asian adults are a lot lower compared to those of Maori and Pacific adults. 16% of male and 14% of female New Zealand Europeans/Others are smokers (Table.1). Asian adults show the lowest smoking rates among all other ethnic groups. One in ten (10%) of Asian adults is a smoker, 16% of them are male smokers and 4.3% are female smokers (Table.1). Asian adults are half as likely to be smokers compared to non-Asian adults and this makes them the population who is at the lowest risk for developing smoking-attributable diseases and illnesses (Table.3).

Smoking was most common among the population aged between 20-34 years whereas the highest rates of smoking occurred in the 20-24 years age group for females and 25-34 years age group for males while the lowest rates were observed in those aged 75 years and over (Figure.1). Current smoking prevalence increased with age for males until they reached the ages of 25-34. From the age 35, a steady decline was observed and from age 55 both male and female smoking rates declined at similar rates (MOH, 2013).

Table.1: Current smoking population by ethnic group among people aged 15 years & over

Ethnicity	Males		Females		Total	
	<i>Prevalence</i>	<i>Estimates</i>	<i>Prevalence</i>	<i>Estimates</i>	<i>Prevalence</i>	<i>Estimates</i>
Maori	36.	79,000	42	98,000	39	177,000
Pacific	27	26,000	23	25,000	25	50,000
Asian	16	33,000	4.3	8,000	10	41,000
European/Other	16	217,000	14	8,000	15	418,000

Source: MOH 2012/13 NZHS

Comparisons among different age groups and gender differences show that smoking is more common in those aged between 20-34 years among females and in those aged 25-34 years among males. The lowest smoking rates are among those adults aged 75 years or over with very little gender differences (Figure.1). Among youth aged 15-19 years and over one in ten (10%) is a smoker (Table.4).

Figure. 1: Current smoking among the total population in NZ by age group and gender

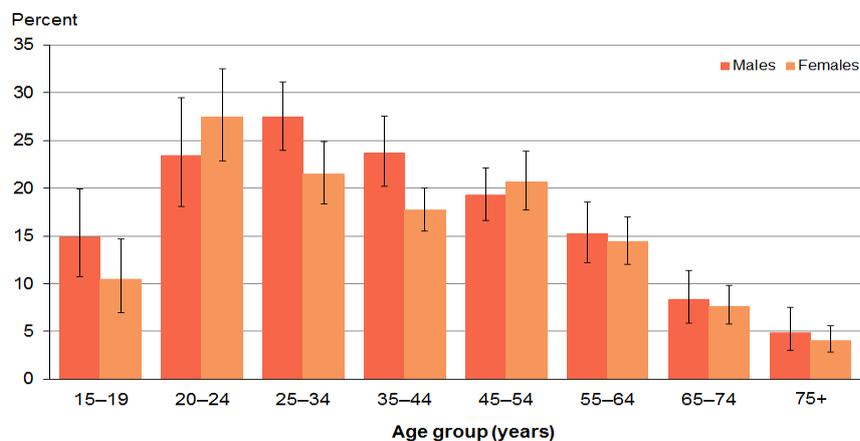
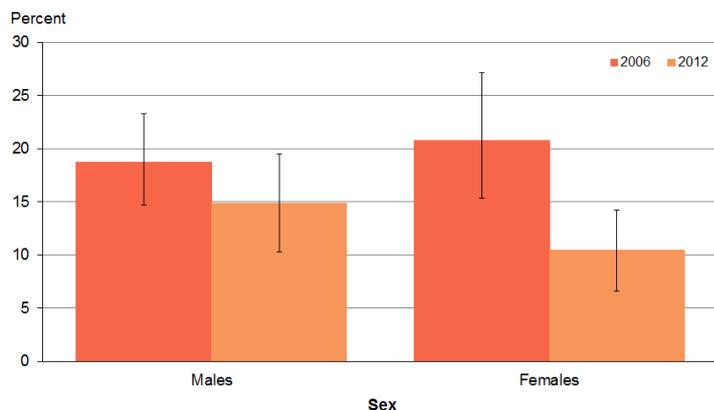


Table.2: Smoking rates in youth aged 15-19 years by ethnicity

Ethnicity	Prevalence	Estimates
Maori	25	15,000
Pacific	11	3,000
Asian	6	3,000
European/Other	12	26,000

Source: MOH 2012/13 NZHS

Figure 2: Current smoking among young people aged 15-19 years by gender



Higher smoking rates have also been reported among those who live in deprived neighbourhoods. Three in ten people living in the most deprived neighbourhoods are smokers compared to one in ten people living in the least deprived areas (Fig.3). Smoking is more common in deprived neighbourhoods. People who live in the most deprived areas are almost three times more likely to be smokers than people who live in least deprived areas.

Figure 3: Current smoking among total population by neighbourhood deprivation

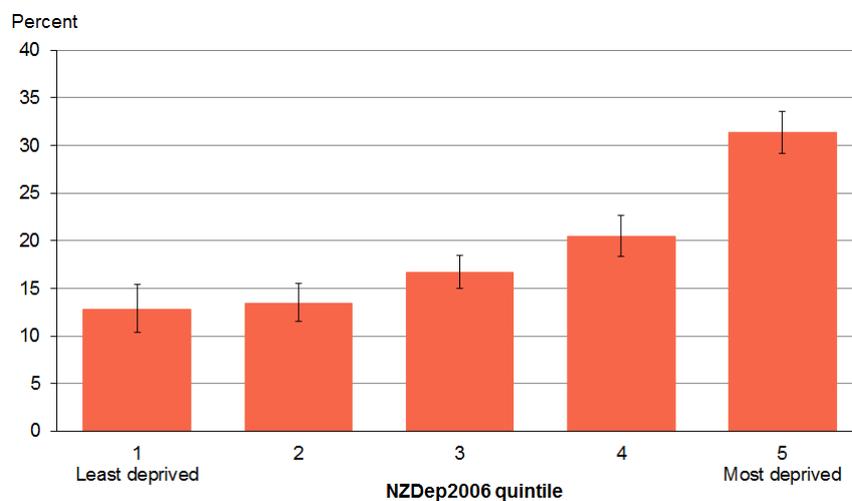


Table 3: Adjusted risk rate ratios for current smoking among the total population

Men versus women	1.1
Maori versus non-Maori	2.5
Pacific versus non-Pacific	1.3
Asian versus non-Asian	0.5
Most deprived versus least deprived	2.8

Source: MOH 2012/13 NZHS

Table 4: Adjusted risk rate ratios for current smoking among 15-19 years olds

Men versus women	1.4
Maori versus non-Maori	2.5
Pacific versus non-Pacific	0.8
Asian versus non-Asian	0.5
Most deprived versus least deprived	6.1

1.3.2 Exposure to Second-hand Smoke among New Zealanders

As mentioned previously, second-hand smoke harms people at all ages however particularly children are at high risk. Findings from the New Zealand Tobacco Use Survey found that second-hand smoke (SHS) exposure in the home and in the car is higher among non-smokers of younger age groups (9% among 15-19 year olds and 6.8% among 20-24 year olds) compared with non-smokers aged 25-75 years (2.2-3.2%). Results also show Maori non-smokers are more likely to be exposed to second-hand smoke compared with other non-smoking ethnic groups. Around one in ten (9%) non-smoking Maori is exposed to second-hand smoke at home (Table.5) and Maori non-smoking adults are therefore 2.6 times more likely to be exposed to SHS when compared with other non-smokers (Table.6). Maori and Pacific non-smokers (8% each) have a higher exposure to second-hand smoke in the car they travel in compared to non-Maori and non-Pacific. Maori non-smokers are over twice as likely to be exposed to second-hand smoke in the car they travel in compared to non-Maori (Table.6) and Pacific non-smokers are twice as likely to be exposed to second-hand smoke compared to non-Pacific non-smokers (MOH, 2013).

Non-smokers living in the most deprived areas are also highly exposed to Second-hand smoke at home or in the car they travel and are 3.2 times more likely to be exposed compared with non-smokers living in the least deprived areas (Table.6). Exposure to second-hand smoke in the car they travel in doubled among younger children and those aged 14 years and under who are living in the most deprived areas (6%) compared to those living in the least deprived areas (2.4%). Maori children are almost three times more likely to be exposed to SHS smoke in the home (9%) or in the car (11%) (Table.7). Children living in the most deprived neighbourhoods are almost eight times more likely to be exposed to SHS in the

home and four times more likely to be exposed in the car they travel in compared to children living in the least deprived neighbourhood. (Table.9). Younger non-smokers aged between 15-19 years and between 20-24 years (6.8%) are more likely to be exposed compared to older non-smokers aged between 25-75 years and older (2.2-3.2%).

Table 5: Exposure to Second-hand Smoke (SHS) at home and in the car among ethnicity

Ethnicity	Exposure at home (%)	Estimates	Exposure in car (%)	Estimates
Maori	9	25,000	8	21,000
Pacific	6	8,000	8	11,000
Asian	2.4	9,000	2.4	8,000
European/Other	3.4	76,000	2.9	65,000

Source: MOH 2012/13 NZHS

Table 6. Adjusted rate ratios for non-smoking adult's- Second-hand Smoke (SHS) exposure at home and in car

Population group	Home	Car
Men versus women	1.4	1.2
Maori versus non-Maori	2.6	2.2
Pacific versus non-Pacific	2.0	1.3
Asian versus non-Asia	0.5	0.5
Most deprived versus least deprived	3.2	2.4

Source: MOH 2012/13 NZHS

Younger non-smokers are more likely to be exposed to SHS. Non-smokers in the younger age groups (15-19 years, 20-24 years) (10% and 6.8% compared with older non-smokers (25-75 years and over: 2.2-3.2%) (Figure.4).

Non-smoker’s exposure to SHS in the car was also higher in the younger age group (15-24 year olds) compared to the older age groups (25-75 year olds and over).

Figure 4: Exposure to SHS at home and in car by age group

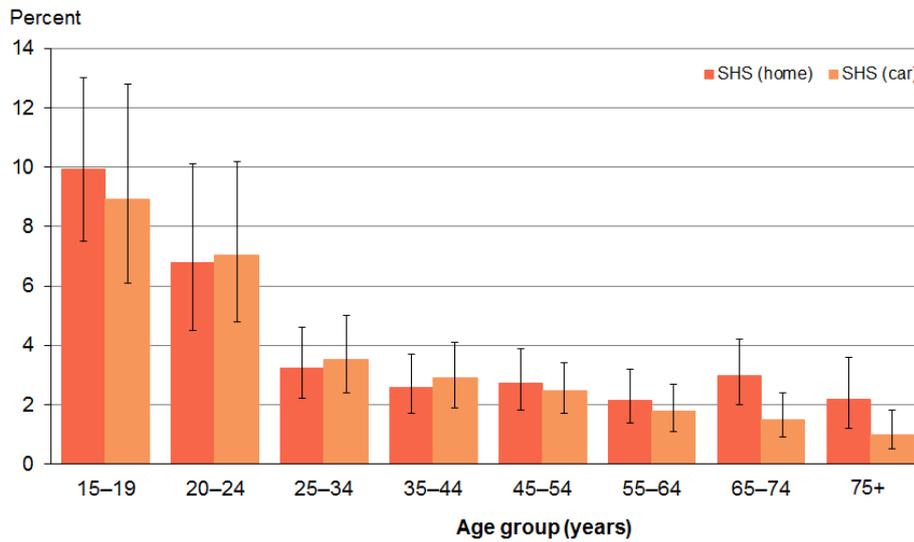
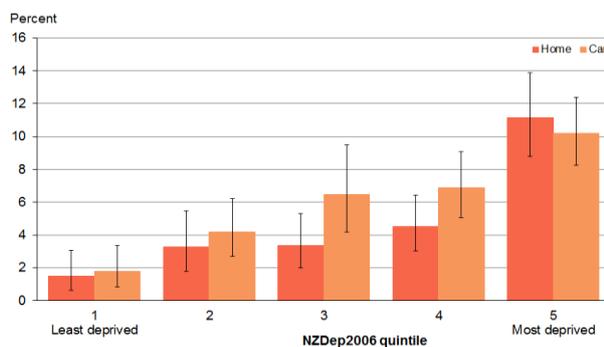


Table 7: Exposure to SHS at home and in the car for children aged 14 years & under

Ethnicity	Exposure at home	Estimates	Exposure in car	Estimates
Maori	9	21,000	11	26,000
Pacific	6	8,000	5	6,000
Asian	2.3	2,000	1.4	1,000
European/Other	4.1	26,000	6	35,000

Source: MOH 2012/13 NZHS

Figure 5: Exposure to SHS at home and in the car for children aged 14 years and under, by neighbourhood deprivation (age-standardised)



Children in the most deprived areas have the highest exposure to SHS. Similar to the pattern observed to adults, a gradient observed with more children being exposed to SHS in the home and in the car with increasing neighbourhood deprivation. Adjustments for age, gender and ethnic group revealed that children who live in the most deprived areas were eight times more likely to be exposed to SHS in the home or car compared to children who live in the least deprived areas (Table.11).

Non-smokers in the most deprived areas had the highest prevalence to SHS. Exposure to SHS among non-smokers in the home showed gradient with neighbourhood deprivation and increasing from least deprived to most deprived (Fig.5). SHS exposure at home in the most deprived areas is the highest 3.2 times that of the exposure at home in least deprived areas (Table.6). Exposure in the car was similar for non-smokers that lived in the least deprived areas (2.2% and 2.4%) but more than doubled in the most deprived areas (Fig.5).

Table.8: Adjusted rate ratios for non-smoking children -SHS exposure at home and in car

Population group	Home	Car
Maori versus non-Maori	2.6	2.6
Pacific versus non-Pacific	1.4	0.9
Asian versus non-Asian	0.4	0.2
Most deprived versus least deprived	7.8	3.9

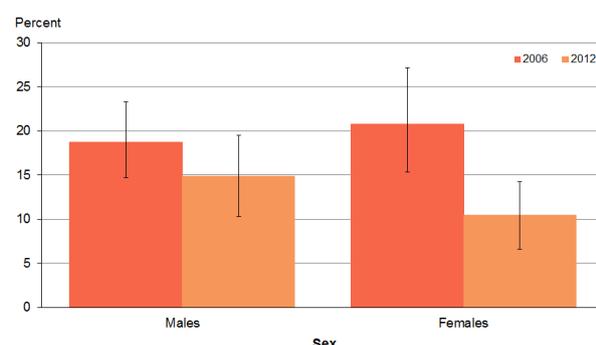
Source: MOH 2012/13 NZHS

1.3.3 Declines in smoking rates among the New Zealand population

Since 1996 smoking prevalence rates show a continuous decrease. Findings from the Tobacco Use Survey 2012/2013 conducted by the Ministry of Health showed a decline in the

percentage for females (13% decline) and males (12% decline) of the total population between the years 2006 and 2012 (Table.10). The proportion of female smokers in 2012 (16%) was significantly lower than the proportion of male smokers (19%). Significant decreases were also found in both current and daily smoking rates. In 1996/97 a quarter (just over 25%) of the adult population were smokers and by 2012/13 this rate had dropped to around one in six (18%) adults. Around 16% of these are classified as daily smokers, equating to 554,000 adult smokers daily. Slightly smaller declines were found among Maori people, Pacific people and Asian people. Maori people show a decline (-7%) with 39% being current smokers compared to 42% being smokers in 2006. 25% of Pacific people (decrease -7) are smokers compared to 27% who were smokers in 2006. Furthermore smoking rates among Asian people declined (-7) reporting 10% of smokers compared to 11% in 2006. Still the greatest and most significant decline (-18) is among New Zealand Europeans/Others with 15% of being smokers with one in ten (10%) being daily smokers compared to 19% in 2006 (Table.9). Additionally the overall smoking rate among Youth has decreased. Since 2006 there has been a significant decline in current smoking rates among young people aged 15-19 years old where 13% are current smokers compared to 20% who were smokers in 2006. A significant decline in smoking rates was reported among young females from 21% in 2006 to 10% in 2012, however only a small decrease from 19% in 2006 to 15% in 2012 were reported among their male peers (Figure.6).

Fig. 6 Changes in current smoking among young people aged 15-19 years by gender



These declines are likely to be driven by decline in delay in smoking initiation and an increase in smoking cessation (MOH, 2014). Smoking prevalence rates have been declining steadily since the 1996's and this has continued to decline further in the years 'between 2006-2012', however declines of smoking rates are not happening across all ethnic groups at the same rate. Some show greater decline than others. Smoking rates among Maori adults and Maori Youth remain high therefore more action needs to be taken to lower the risks of smoking-attributable diseases and illnesses and to reach New Zealand's aspirational goal of becoming a smoke free nation by the year 2025.

Fig.7: Decline in Daily Smoking rates 1996/97 – 2012/13

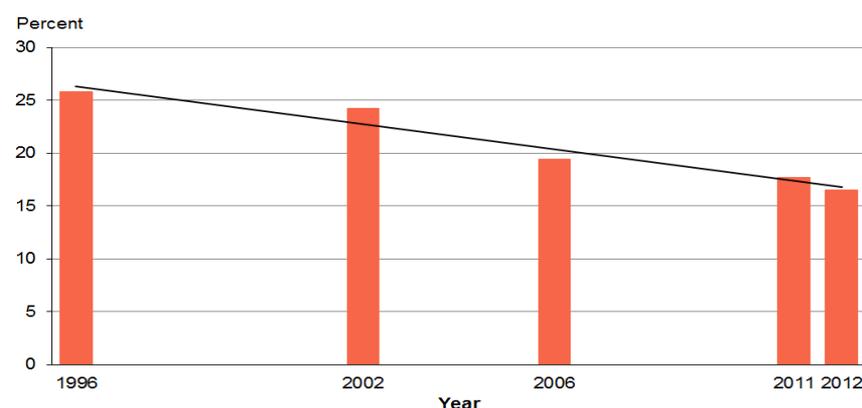


Table.9: Changes in current smoking prevalence by ethnicity between 2006 and 2012

Ethnicity	2006 (%)	2012 (%)	Relative Change (%)
Maori	42	39	-7
Pacific	27	25	-9
Asian	11	10	-10
European/Other	19	15	-18

Prevalence Estimates

Source: MOH 2012/13 NZHS

Table.10: Changes in current smoking prevalence by gender between 2006 and 2012

Gender	2006 (%)	2012 (%)	Relative Change (%)
Male	21	19	-12
Female	19	16	-13

Source: MOH 2012/13 NZHS

Younger non-smokers in New Zealand were more likely to be exposed to SHS. SHS exposure in the home was higher among non-smokers in younger age groups (15-19 & 20-24) 9% and 6.8% compared with non-smokers (25-75+: 2.2-3.2%). Results showed Maori non-smokers are more likely to be exposed to SHS. Around one in ten (9%) non-smoking Maori are exposed to SHS at home (Table.7). Maori non-smoking adults are 2.6 times more likely to be exposed to SHS at home compared to non-Maori non-smokers (Table.6). Maori and Pacific non-smokers (8%) reported most exposure to SHS in the car they travelled in. Maori non-smokers were over twice as likely to be exposed to SHS in the car they travelled in than non- Maori non-smokers. Pacific non-smokers are twice as likely to experience SHS compared to non-Pacific non-smokers. Also deprived areas show to have the highest SHS exposure at home and in the car, 3.2 times more likely to be exposed to SHS at home than people of least deprived areas (Table.6). Exposure in the car more than doubled in deprived areas (6%) than in less deprived areas (2.4%) (NZHS, 2013). Maori children were almost three times more likely to be exposed to SHS, one in ten (9%) at home and in the car (11%) (Table.7). Children living in most deprived areas were almost eight times more likely to be exposed to SHS at home and in the car four times more likely than those in least deprived areas (Table11.)

Table.11: Adjusted rate ratios for non-smoking children -SHS exposure by Ethnicity and deprived neighbourhood

Population group	Home	Car
Maori versus non-Maori	2.6	2.6

Pacific versus non-Pacific	1.4	0.9
Asian versus non-Asian	0.4	0.2
Most deprived versus least deprived	7.8	3.9

1.4 Smoking Cessation

The risks for smoking-related diseases and illnesses increase the earlier in life a person starts to smoke (WHO, 2014).

Billions of dollars are spent every year on treating smoking-related diseases these costs can decrease once smoking rates decrease (WHO, 2014). The risks are not reversible, however quitting smoking reduces the risk of lung cancer and other cancers and chronic lung disease, heart conditions, stroke. Former smokers also referred to ‘adults who have smoked at least 100 cigarettes in their life time but say they currently do not smoke’ live longer than people who continue to smoke (WHO, 2013).

Prevention and Cessation are the two principal strategies in the battle against tobacco smoking. Many smokers would like to stop smoking however find it difficult to do so on their own and therefore require advice as well as support from a qualified health professional.

Research has shown that advice from a qualified health professional increases quit attempts and increases the use of effective medications that can nearly double to triple rates of successful cessation (Fiore, 2008).

1.4.1 Benefits of Smoking Cessation Interventions

Cessation also has immediate and major health benefits to smokers of any age, including decreased blood pressure, diminished coughing and increased lung capacity. Additionally at all ages, smoking cessation reduces the risk of all these mentioned above diseases and reduces the risk of premature death (MOH, 2013).

The benefits are well known. Doll's Research (Doll, 2005) on British doctors showed that those who stopped smoking before the age of 35 years returned to almost the same risk of tobacco-related diseases as non-smokers however stopping smoking at any age reduces the risk compared to current smokers (Doll, 2005). Some health benefits of quitting smoking are more immediate than others (Quit Group UK, 2015). After only 20 minutes of quitting blood pressure and pulse of an individual return to normal and after 8 hours oxygen levels in the blood return to normal. Carbon monoxide is eliminated from the body and the lungs start to clear mucus and other smoking debris within 24 hours. 48 hours after quitting the ability to taste and smell may be greatly improved and after 72 hours breathing becomes easier as the bronchial tubes begin to relax and energy levels increase. It takes between 2-12 weeks for the circulation throughout the whole body to improve. After approximately 3-9 months the lung function increases by up to 10% and breathing difficulties decrease along with coughing and wheezing symptoms. From one year onwards after quitting the risk of a heart attack drops to half of that of a smoker and after 10 years the risk of lung cancer falls to half that of a smoker. The risks of a heart attack fall to the same as someone who has never smoked following 15 years of quitting smoking (Quit Group UK, 2015).

1.4.2 Review of smoking cessation outcome measures

Interventions for smoking cessation have been developed by researchers in a number of distinct disciplines. As a result, a variety of different outcome measures have been developed and employed. These measures can be broadly classified as self-report and biochemical (Velicer et al, 1997; cited in Velicer, 2004). The self-report measures can be classified into one of three broad classes of measures: point prevalence abstinence, continuous abstinence and prolonged abstinence. Each measure characterizes former smokers using a different

perspective and has different potential strengths, weaknesses and uses of the measures. There are also biochemical measures which are used inclusive of Carbon Monoxide (CO) and Cotinine. The Russell Standard which was proposed by West (2009) provides further outcome measures to define smoking status and outlines six criteria. Further details are explained below.

Self-report outcome measures

- point prevalence abstinence. – refers to the proportion of people not smoking at any given point in time,
- continuous abstinence. – refers to the proportion of people not smoking at all since the onset of the intervention,
- prolonged abstinence. – refers to the proportion of people abstinent for some interval.

The minimum time intervals for point prevalence abstinence are 24 hours, 7-days, and 30-days. The advantages of point prevalence abstinence is that non-smoking may be biochemically validated. Self-reported smoking status helps to identify a significant percentage of smokers. However data suggests that a percentage of patients ranging from 1.4% in broadly based epidemiologic studies to as high as 35% in populations where smoking is a known risk factor inclusive of patients with respiratory disease, cancer patients and pregnant women will self-report inaccurately due to a variety of reasons including misunderstanding, intentional deception, embarrassment, denial, shame. Therefore it is advantageous to use additional biochemical outcome measures to validate self-report.

Biochemical outcome measures

Measurement of cotinine which is a primary metabolite of nicotine that has a half-life of 16 to 18 hours and that can be detected in urine, saliva, plasma or serum provides a reliable means of determining smoking status and other tobacco product use or exposure over a period of 2 to 3 days. Carbon Monoxide (CO) a by-product of cigarette smoke can be measured in expired air. CO has a shorter half-life of 2 to 4 hours and is rapidly eliminated whereas cotinine may be detected for several days after tobacco use. Biochemical verification provides added precision to participants self-reports (Society for Research on Nicotine and Tobacco Committee, 2002). A smoker depending on the brand and number of cigarettes smoked acquires a Carboxyhemoglobin (COHb) level of 2 to 15% (10-80ppm CO). Carboxyhemoglobin (COHb) is a stable complex of Carbon monoxide and haemoglobin that forms in red blood cells upon contact with carbon monoxide. For instance, '20 cigarettes per day smokers' may have a 3-6% COHb level (15-34ppm CO) which increases to 6-16% (15-60ppm CO) for '40 cigarettes per day smokers'. Smoking over 40 cigarettes per day results however in a COHb level of up to 20%. These levels depend on the brand of the cigarettes, the number of cigarettes smoked and the time elapsed since the last cigarette was smoked. The most immediate benefit to smoking cessation is a rapid decline in the CO level in the blood within 12 hours. As if the ratio exceeds a value of 10ppm this is compatible with the diagnosis smoker. Regular smokers often get readings between 20 and 30ppm while heavy smokers can get up to 30, 40 or up to 50ppm or over. COHb levels can be assessed using an exhaled CO monitor. The subject holds their breath for 20 seconds and then blows into the monitor. The amount of CO in end-expired air is after 20 seconds in approximate equilibrium with the concentration of COHb in the blood. Within a few seconds, the digital readout shows the level of CO in the subject's blood at the time. Recordings in the afternoon are best for consistency as CO levels fall overnight so therefore

morning readings may give misleading low results. However a high reading in the morning indicates strong evidence of heavy inhalation and high nicotine dependence. The half-life of COHb during sleep is approximately 5 hours. The standard cut off point for determining a person's smoking status on a given day is 10ppm. Readings below 10ppm indicate a non-smoking status and readings above 10ppm indicate that smoking has probably taken place in the preceding 12-24 hours. Measure of cotinine exposure: Cotinine is an alkaloid found in tobacco and is also the predominant metabolite of nicotine. It has a half-life of approximately 20 hours and is typically detectable for several days (up to one week) after the use of tobacco. The level in blood, saliva and urine is proportionate to the amount of exposure to tobacco smoke so it's a valuable indicator of tobacco smoke exposure including secondary smoke (passive smoke). Cotinine levels under 10ng/ml are considered to be consistent with no active smoking whereas in the urine 10ng/ml to 100ng/ml associated with light or moderate exposure and levels above 300ng/ml are seen as heavy smokers with more than 20 cigarettes smoked per day. There are differences in saliva between 1ng/ml to 30ng/ml may associated with light exposures, levels of active smoking reach 100ng/ml. However, point prevalence may overestimate the number of quitters as people may start smoking again at a later time and smokers who quit within the common point prevalence time frames of 24 hours, one week or one month may only experience the immediate health benefits of cessation.

Continuous abstinence is more stable over time because for longer periods of abstinence also the likelihood of relapse reduces and it allows for the evaluation of longer-term health effects of smoking cessation. However, continuous abstinence includes only a small number of smokers who quit without relapses also this only decreases as more quitters relapse and it cannot be validated biochemically.

Prolonged abstinence refers to that smokers have been abstinent for a long time period inclusive of 6-12 months. This is more stable than point prevalence, it allows smokers who take delayed action to quit to be counted and it can assess long-term health benefits, however this requires a long follow up period and cannot be validated biochemically (Velicer, 2004).

The level of nicotine dependence can also be determined by questions from the Fagerstrom Test of Nicotine Dependence (FTND) is a commonly used measure of the level of dependence on nicotine in smoking cessation and the baseline levels of dependence have been correlated with the likelihood of success at quitting (Heatherton, 2001).

The Russell Standard

Robert West (2009) proposes The Russell Standard, which defines the smoking status in clinical research for monitoring the throughout success rates of stop smoking services, allowing meaningful direct comparisons between the services. The Russell Standard was named after Psychiatrist Michael Russell, who was an early advocate of nicotine's role in cigarette addiction and developed smoking cessation therapies. Russell was born in March 1932 in Cape Town South Africa and died in July 2009 of a heart attack. He first described the role in nicotine addiction in 1971 when most researchers still thought of smoking as a ritual and a habit. 'We named the gold standard for assessing success rates of the National Health Service (NHS,2014) stop smoking services after Russell (The Russell Standard) in recognition that without him there would be no NHS services' said Robert West, who joined the Russell Group in 1982 as a postdoctoral researcher. Russell became convinced that nicotine was the key to smoking's addictiveness and decided to find ways of how to measure smoking intakes. After taking a trip to visit a smoking cessation clinic which used gum he decided to undertake his own studies of using nicotine gum. Realizing that non-pharmacological intervention would also be an essential part of any smoking cessation effort,

Russell undertook trials that showed the benefits of brief advice to stop smoking given by general practitioners. Through his work covering the pharmacological side as well as the behavioral psychology side Russell was invited to the UK's Medical research Council (MRC) in 1978. His goal was to find a way for people who wanted to give themselves nicotine to do so without harming themselves. This Russell Standard outlines six criteria as follows:

- 'treated smoker'. – A 'treated smoker (TS)' is a smoker who undergoes at least one treatment session on or prior to the quit date. Smokers who attended an assessment session but fail to attend thereafter will not be counted. Neither are smokers who have already stopped smoking at the time they first came to the attention of the services;
- 'self-reported 4-week quitter (SR4WQ)'. – A smoker is counted as a 'self-reported 4-week quitter (SR4WQ)' if he/she is a 'treated smoker', is assessed (face-to-face, by postal questionnaire or by telephone) 4 weeks after the designated quit date (minus 3 days or plus 14 days) and declares that he/she has not smoked even a single puff on a cigarette in the past 2 weeks,
- 'Co-verified 4-week Quitter (4WQ)'. – A smoker is described as a 'Co-verified 4-week quitter (4WQ)' if he/she is a 'self-reported 4-week quitter' and his/her expired air CO is assessed 4 weeks after the designated quit date (minus 3 days or plus 14 days) and found to be less than 10ppm;
- 'Lost to follow up at 4 weeks (LFU4W)'. – A smoker is counted as 'lost to follow up at 4 weeks (LFU4W)' if on attempting to determine the 4-week quitter status, he/she cannot be contacted;

- '52-week Quitter (52WQ)'. – A smoker is counted as a '52-weeks quitter (52WQ)' if he/she is a 'treated smoker', is assessed (Face-to face, by postal questionnaire or telephone) 52 weeks after the designated quit date (plus or minus 30days) and declares that he/she has not smoked more than five cigarettes in the past 50 weeks.
- 'Lost to Follow Up at 52 Weeks (LFU52W)'. – A 'treated smoker' is counted as a 'lost to follow up at 52 weeks (LFU52W)' if on attempting to determine the 52-week quitter status, he/she cannot be contacted.

1.4.3 Communication used in interventions to change health behaviour

There are several ways of different communication used in health, some seem successful whereas others not.

Kreuter et al (2000) describe different ways of communication used in health ranging from messages that are not all individualized to those messages which are individualized. Health Communication ranges from generic communication to personalised generic communication to targeted and tailored communication.

Generic communication defines as communication that is not individualized or based on any kind of individual assessment. An example of generic communication includes a booklet on risks of smoking that an individual may read at a doctor's office while waiting. A very similar communication method to general communication defines as personalized generic communication. This is almost the same as generic communication however uses a characteristic to more personalise a health message. Health professionals from general practices or health agencies tend to use this by including the clients name when sending emails and letters. A more widely applied form in health communication and education is

targeted communication. Targeted communication refers to messages that are developed with a certain segment of the population in mind inclusive used in group therapies to reach a group with similar goals. As mentioned, target communication messages are widely applied however a further form identified as tailored communication has been explored for many years and seems to be successful (Kreuter, 2000).

Tailoring messages- Tailored communication

An individual can only perceive a health message relevant to them in order to pay attention to the message and be influenced by this message. One form of health communication referred as tailored communication makes this possible (Kreuter, 2000). Tailored messages are defined as ‘messages of any combination of strategies and information intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest and is derived from an individual assessment’. Therefore tailored messages are perceived as more relevant by individuals, are more likely to be read and re-called by individuals and are more effective at changing health behaviours among individuals compared to other types of communication offered in health interventions. Tailored messages are important for any change of health behaviour intervention including smoking cessation programmes.

1.4.4 Theories guiding interventions for Smoking Cessation

There are different theories and models which guide the messages and strategies for Smoking Cessation which use self-efficacy and social support. A commonly used model Trans-theoretical model was put to rest (West, 2007). There are several different models and stages when trying to reach a goal and a number of different ways to effectively help people to change their behavior. Human behavior plays a central role in the maintenance of health and prevention of disease. With interest in lowering morbidity and mortality associated with

health-related behaviours, health professionals turn to models of behavior change to guide the development of strategies that foster self-protective action, reduce behaviour that increases health risks, effective adaption to and coping with illness. Models include Learning and Conditioning (Skinner, 1938), Cognitive Social Learning (Bandura, 1986), Health Belief Model (Hochbaum, 1958), Theory of Reasoned Action (Ajzon & Fishbein, 1980), Trans-theoretical Model of Behaviour Change (Prochaska & DiClemente, 1983), Social Action Model (Edwart, 1991). The Trans-theoretical Model was put to rest according to West (2007) because it did not draw arbitrary dividing lines in order to differentiate between the different stages, however not everyone agrees.

1.4.5 Non-Internet and Non-Mobile phone-based interventions used in Smoking Cessation programmes

There is good evidence for the effectiveness of brief, therapist-delivered interventions inclusive of advice from a physician in helping people to quit smoking (Stead, 2013). Furthermore interventions inclusive of brief advice to quit from a health professional (Stead, 2008), group therapy (Stead, 2005), individual counselling (Lancaster, 2005) and telephone counselling (Rabius, 2004), effective pharmacological support includes Nicotine Replacement Therapy (Strecher, 2005), varenicline (Cahill, 2009), nortriptyline and bupropion (Hughes, 2009).

All of these have shown benefits in helping people to quit smoking. However, these interventions mentioned above are usually dependent on a qualified health professional to deliver or guide the intervention and can be expensive and time-consuming. Furthermore they only reach a small proportion of people who smoke and can be very inconvenient for clients as they require having to take time off work and are not accessible at anytime and anywhere. However, these interventions tend to not reach adolescents (Curry, 2007).

1.4.6 Internet-and Mobile phone-based interventions used in Health

Internet and Mobile phone use among the World's population especially among adolescents and young adults has grown extensively and they are well integrated into the daily lives of many people. Health services have started to recognize the benefits of Internet-and Mobile phone components to improve communication with their clients and patients and thereby increase the efficiency and effectiveness of their services. The Internet and Mobile phone are used to send text message-and email-based reminders for health service appointments, medication adherence, reporting test results, monitoring of glucose in diabetes and moreover to deliver interventions to change health-related behaviours inclusive of promotion of physical activity and weight loss programmes, reduction of problem drinking and smoking cessation support (Cole-Lewis, 2010; Hurling 2007).

The Internet- and Mobile phone have become increasingly useful in the delivery of health care including smoking cessation programmes world-wide and within New Zealand.

Internet- and Mobile phone-based interventions are described as interventions in which the Internet and Mobile phone are a main part of the smoking cessation programme. These mentioned interventions are inclusive of but not limited to access to websites containing information about dangers of smoking, quitting, prevention of relapse, questionnaires, online discussion forums, access to private chat messages and online peer support, online smoking cessation diary, informative and motivational emails and text messages including advice and suggestions about strategies how to cope with craving situations, interactive voice response and video clips containing information about smoking and presentations from medical professionals.

Initially Mobile phones and the Internet were mainly used as another form of communication with patients to improve the efficiency and effectiveness of existing health care services.

They have been used to collect data and monitor long-term conditions. Gradually over the years they started to be used to deliver interventions either alone or in combination with other modes of delivery inclusive of the Internet and pharmacological methods. Some of these are explained below.

They promise a powerful role in behaviour change interventions as well as influencing youth culture and are also becoming increasingly useful in the delivery of smoking cessation programmes around the world and within New Zealand (Etter, 2005; Woodruff, 2007).

Internet- and Mobile phone-based interventions have shown to be effective for delivering smoking cessation interventions as stand-alone interventions and as an adjunct to pharmacotherapy (Strecher, 2005; Swartz 2006). They are promising in helping to reduce cravings since cravings are known as one of the main factors why people relapse (Mermelstein, 2003). Cravings are defined as a way of thinking about a feeling that impacts/impels the individual to take whatever steps are necessary and feasible to achieve the object of the addiction. However, it is a motivational state that goes beyond feelings it overwhelms the individual in totality, dominating thoughts, feelings and actions of the individual to the exclusion of all else.

1.4.7 Tobacco smoking cessation support available in New Zealand

National initiatives of organisations inclusive of Quitlines, Cancer Societies, projects including Smoke free 2025 and furthermore Internet- and Mobile phone-based interventions

used in smoking cessation programmes have been developed to decrease smoking rates. Reducing smoking prevalence and reducing health disparities are priority of the NZ Health strategy, the cancer control strategy and the Ministry of Health's 5 year plan for tobacco smoking 'clearing the smoke 2004-2009' (MOH, 2004) since at least one third of the socio-economic deprivation gradient in life expectancy and approximately one quarter of the ethnic disparity in life expectancy is accounted for by tobacco smoking (MOH, 2014), New Zealand legislation change, and Smoke free by 2025. In March 2011 the NZ government committed to a goal of NZ becoming smoke free by the year 2025. It means our children and grandchildren will be free from exposure to tobacco and the prevalence of tobacco across all population will be less than 5% however the goal is not a ban on smoking. Tobacco will be 'difficult to sell and supply' (MOH, 2015).

Interventions to address smoking have been in place in New Zealand since the 1940's (MOH, 2014). However, combined efforts to reduce harm only were gained from momentum during the 1960's after the release of several international reports linking smoking to cancer and other illnesses and diseases (WHO, 2012). Over the past decade tobacco control interventions have also focused on reducing exposure to second-hand smoke (for instance amendments to smoke free Environments Act and other campaigns) and supporting smokers to quit (through services inclusive of Quitline, mass media campaigns, graphic warnings on cigarette packets and tobacco tax increases).

New Zealand guidelines recommend that all health professionals undertake the 'ABC' of smoking cessation: A- ask about and document every person's smoking status, B- give brief advice to stop to every person who smokes, C- strongly encourage every person who smokes to use cessation support (a combination of behavioural support and stop-smoking medicine

works best) and offer to help them access it (MOH, 2014). National cessation services are provided by a charitable trust organisation (the Quit Group) in the form of a free-phone counselling service (Quitline), subsidised Nicotine Replacement Therapy (NRT), online ordering of Nicotine Replacement Therapy, online blogs and text message service (txt2quit). Primary care practices offer opportunistic brief advice and referral. Individual cessation counselling services are available in most hospitals, in some primary care practices, from private counsellors and by a network of Maori smoking cessation services (Aukati kaipaipa). Several pharmacological options are available in New Zealand: Nicotine Replacement patches, gum lozenges, inhalers and these are all subsidised and available from a quit card provide (pharmacy), Quitline or a prescription from a doctor. Nortriptyline and bupropion are also subsidised but are only available on prescription from a doctor. Varenicline also requires a prescription from the doctor but is not subsidised.

Quitline offers phone service (available in 44 languages) and provides free advice and non-judgemental support to quit smoking. A quitline advisor helps to create a quit smoking plan for each individual, helps the individual to understand the smoking addiction and how to identify the reasons why they smoke. Once this has been established they then provide support with new ways to cope and how to beat cravings, also provide booklet and helpful information; provide a quitcard which can be redeemed at pharmacies to get subsidised Nicotine patches, gum and lozenges. They also started offering text messages as support (txt2quit).

Despite all the different methods of smoking cessation programmes smoking rates still remain high. As mentioned, the decline of smoking rates is not occurring among all population groups and some ethnic groups and young adults are at higher risk of smoking as well as smoking initiation/uptake. A proportion of young adults say they would rather not smoke however where effective interventions exist they tend to underutilize them. This may

be partly because interventions have not been tailored for use in their age group. Therefore it is important to tailor messages, which was explained earlier.

1.5 The aim of this Analysis

Internet- and Mobile phone-based interventions used in smoking cessation programmes are good and effective for short-term cessation (less than six months) however these may or may not be effective for longer-term smoking cessation (cessation of smoking for at least six months or longer). Therefore this analysis adds to the previous research by investigating whether or not Internet-and Mobile phone-based interventions are effective in achieving longer-term cessation of smoking (at least six months or longer).

1.6 Purpose, Research Question and Hypotheses

While Internet- and Mobile phone- based interventions used in smoking cessation programmes are good and effective for short-term smoking cessation, it is uncertain to whether they can be effective for longer-term smoking cessation. A large Meta-Analysis conducted by Civljak et al. (2010) provides evidence of short-term effects using Internet-based interventions in smoking cessation programmes. They included twenty randomized controlled trials which included participants of all age groups, all gender, of all ethnicity groups, of all health statuses and no matter what language they spoke. Any type of Internet-based intervention that could be compared to a no intervention control or a different Internet programme control was eligible for inclusion. Interventions ranged from a very low intensity intervention, providing a list of smoking cessation to highly intensive interventions which included tailoring. Furthermore, these studies assessed short-term smoking cessation

outcomes of less than six months and reported study effects as a risk ratio with 95% confidence intervals. Sample sizes of included trials ranged from less than 150 (Mermelstein, 2006) to nearly 12,000 (Etter, 2005). As previously mentioned, findings from Civljak et al. (2010) research suggest that Internet-based interventions are effective to achieve abstinence of smoking however their effects are short-term (RR=2.46, 95% CI: 1.16,5.21). Furthermore, their research suggests that there is a need for research which assesses longer-term effects of smoking cessation (six months and longer) therefore this Meta-Analysis was conducted to investigate the role of Internet- and Mobile phone-based interventions ‘delivered over emails, accessing websites and text messages’ and others in achieving longer-term smoking cessation. It is important to achieve longer-term smoking cessation as smoking rates still remain high and smoking is a leading public health concern that also imposes a huge economic burden on society and current health care costs world-wide and within New Zealand. Furthermore, this Meta-Analysis was conducted to add value to the investigation of the effectiveness of Internet- and Mobile phone-based interventions and for the reason as Meta-Analyses have some advantages over primary studies: A Meta-Analysis can achieve and is useful for the following reasons: (1) using meta analyses, it is useful to achieve an increase in power by pooling together small studies; (2) improve accuracy known as the estimation of intervention effect which can be improved if it is based on more information, to assist in answering questions which are not presented by individual primary studies due to them involving a specific type of participants and specifically defined interventions, this way a selection of studies in which these specific characteristics differ can allow investigation of the consistency of effect and reasons for the difference in effect estimates, to settle controversies arising from apparently conflicting studies and to generate new hypotheses. For this reason this statistical analysis of findings allows the degree of conflict to be formally assessed and reasons for different results to be explored and quantified.

Research Question

The following research question was addressed:

What is the effectiveness of Internet-and Mobile phone-based interventions for achieving longer-term cessation of smoking among adolescents and adult smokers aged 15-64 when compared with non-Internet- and non- Mobile phone-based interventions or interventions that include the Internet or Mobile phone at a lower frequency?

Hypotheses

This Meta-Analysis tested the following hypotheses:

Hypothesis 1:

Internet- and Mobile phone components as a main part of their intervention will achieve longer-term abstinence rates from smoking among adolescent and adult smokers compared with interventions which did not include the Internet- and Mobile phone or interventions which included the Internet and Mobile phone but at a lower frequency.

Hypothesis 2:

Internet-and Mobile phone components as a main part of their intervention with additional interventions inclusive of Nicotine Replacement Therapy (NRT) or Telephone Calls will achieve longer-term abstinence rates from smoking among adolescent and adult smokers compared with interventions which did not include the Internet and Mobile phone or interventions which did include the Internet and Mobile phone but at a lower frequency.

The following outcomes were investigated and compared and an analysis for five different subgroups was conducted:

Outcome 1:

Internet- and Mobile phone-based interventions, self-reported abstinence, 7 days point prevalence compared with all other interventions

Outcome 2:

Internet- and Mobile phone-based interventions, self-reported and biochemically verified abstinence, 7 days point prevalence compared with all other interventions

Outcome 3:

Internet- and Mobile phone-based interventions combined with additional interventions inclusive of Nicotine Replacement Therapy (NRT) or Telephone Calls, self-reported, 7 days point prevalence compared with all other interventions

Outcome 4:

Internet- and Mobile phone-based interventions, self-reported abstinence, 7 days and 30 days point prevalence compared with all other interventions

Outcome 5:

Internet- and Mobile phone-based interventions, self-reported abstinence, 7 days point prevalence compared with interventions that included the Internet and Mobile phone but at a lower frequency.

Chapter 2. Review of the Literature

2.1 Overview

This chapter provides a review of the literature related to adolescent and adult smoking, smoking cessation and Internet- and Mobile phone-based interventions. The first section provides information about adolescent smoking, smoking initiation, risk factors for smoking, stages of smoking, nicotine addiction and nicotine withdrawal. Furthermore it provides information of benefits and possible limitations of Internet- and Mobile phone-based interventions and information about existing literature which suggests that Internet-and Mobile phone-based interventions have the potential to achieve short-term cessation of smoking.

2.2 Smoking among adolescents and adults

2.2.1 Smoking among adolescents

Smoking often starts in adolescence. The USDHHS warns that ‘In abstinence of intervention, adolescent smokers will most likely become adult smokers’ (USDHHS, 2014). After the age of twenty, the risk of smoking uptake on a regular basis decreases and this suggests that if adolescents can be kept tobacco free, then most of them will never become established smokers dependent on nicotine. The risk is particularly among those aged between 15 and 19 years, middle (15-17) to late (18-19) adolescence as this is considered a critical phase of experimentation and development of regular smoking behavior.

Young adults compared to older adults have different smoking patterns, tending to smoke fewer cigarettes and less often (Curry, 2007; Hammond, 2005). They are more likely to say that they want to quit smoking and are also more likely to report recent quit attempts (CDC, 2006; Curry, 2007).

There have been many factors identified that can influence tobacco use among youth and subsequent success in quitting and these include: gender, age and development stage, socio-economic status, education level, ethnicity, cultural background, history of tobacco use, risk-taking behaviour and psychological aspects (those who smoke and drink are more likely to marijuana or cocaine use placing themselves in more harm) , personal acceptability of tobacco use and commitment to cessation, tobacco use among peers and family, external support for cessation, time availability, knowledge, attitudes and beliefs about tobacco, self-esteem and self-perception, sense of control and behavioural skills (Milton, 2004). Smoking rates are also influenced by additional factors- density of tobacco retailers around schools as well as social and environmental influences-those in the media, marketing and the modeling of tobacco products through popular role models (Lane, 2012).

Smoking initiation

Significant differences in smoking initiation (first cigarette) and when a person starts smoking daily have been found among different ethnic groups and Maori had the earliest average age of smoking initiation (NZHS, 2013).

The average age current smokers aged 20 years plus smoked their first puff or their first cigarette (smoking initiation) was 14.8 years. There were significant differences in smoking initiation across different ethnic groups with Maori having the earliest average age of initiation at 14.1 years, Asian smokers having the latest onset of initiation at 18 years (Table.12).

Asian smokers were the slowest to take up daily smoking. The average age when smokers started smoking daily was 17.7 years, but this varied across ethnic groups. Pacific smokers had a later onset of initiation but had the shortest time period between initiation and uptake

compared with smokers of other ethnic groups (2.7 years). Not only did Asian smokers delay initiation longer than other ethnic groups, they also had the longest delay in progressing to daily smoking (3.7 years).

Table. 12: Mean age for smoking initiation and mean age of smoking uptake of current smokers over the age of 20 years by ethnicity

Ethnicity	Mean Age (years)	Initiation (years)	Difference (years)
Maori	14.1	17	3.0
Pacific	16.6	19.3	2.7
Asian	18.4	22.1	3.7
European/Other	14.5	17.5	3.0

Source: MOH 2012/13 NZHS

Table.13: Mean Age of smoking initiation of year 10 students from 2006-2012

Year	Mean Age (years)
2006	11.3
2008	11.4
2010	11.6
2012	11.6

Source: Youth Insights Survey 2012

Stages of adolescent smoking

There are five stages that people transition through in the process of taking up smoking: ‘non-smoking stage’ through to ‘preparatory stage’, then through to ‘trying stage’, next

through to 'experimenter stage', then through to 'regular use stage' and through to the 'established and dependent smoker stage'. When transitioning through to the 'preparatory stage' from 'non-smoking', adolescents develop attitudes and beliefs about smoking. From the 'preparatory stage' they then move through to the 'Trying stage'. This stage involves adolescents smoking a few cigarettes and often happens as a result of peer pressure and influence. After this, in the 'experimenter stage' they continue to smoke but do it irregular (once a month). From this stage on cigarette smoking gradually increases in frequency and also occurs across different situations. After this, in the 'regular use stage' they begin to smoke on a routine basis but they may not smoke every day or at high rates however smoking occurs more often. Following this stage, they progress through to the final stage in which they smoke daily or almost daily and by now developed a physiological need for the substance and they are then described as having become an established smoker dependent on nicotine.

Nicotine addiction

Nicotine addiction is one of the most common forms of drug addiction (USDHHS, 2003). The primary indicator of drug dependence is compulsive use, psychoactive effects of the drug and the drug reinforcing behaviour. The American Psychiatric Association (APA, 2013) recognises two conditions related to nicotine addiction: nicotine dependence and nicotine withdrawal. Nicotine dependence is characterized by a person's having lack of control of nicotine which is a psychoactive substance and continuation of its use despite negative consequences. Use of nicotine may be through smoking cigarettes (the most common source), smokeless tobacco and nicotine gum.

Nicotine withdrawal

Nicotine withdrawal results after the abrupt cessation or reduction of use of substances containing nicotine. The symptoms of withdrawal may include craving nicotine, anger, irritability, anxiety, restlessness, increased appetite or weight gain (APA, 2014).

2.2.2 Effective smoking cessation support for young adults

Even if young adults do want to quit there is little evidence of effective cessation interventions developed specifically for young adults. Two reviews of smoking cessation intervention trials for these under 20 years of age found that many studies were statistically underpowered (Grimshaw, 2006; Sussman, 2009). They concluded that interventions that tended to have more positive outcomes were complex and designed around issues for young people and their smoking. These interventions included some motivational enhancement (clarifying desire for change and reducing ambivalence towards change, motivational interviewing, increasing willingness to change, and response-contingent re-enforcement, extrinsic rewards inclusive of money or prizes and stages of change techniques). The effects were also seen for programmes that used social influences (media peer social influences), cognitive-behavioural techniques (reasons for smoking and quitting, self-monitoring and how to cope with stress, seeking out social support, waiting out urges for cigarettes, self-management and problem solving).

2.2.3 Young adults' use of tobacco cessation support

Where there is evidence for effectiveness of smoking cessation support in adults, inclusive of counselling and Nicotine Replacement Therapy (NRT), these tend to be underused by young adults (CDC, 2006). In comparison with older adults, younger adults are less likely to use pharmacotherapy or evidence-based behavioural support (Curry, 2007;

Hughes, 2009). This may be partly because only few interventions have been tailored for use in their age group.

2.3 Discussion of how Internet- and Mobile phone components are included in smoking cessation programmes

2.3.1 Internet-and Mobile phone-based interventions used in health care

More health care providers are now including Internet and Mobile phone components inclusive of text messaging, emails, accessing websites, accessing video clips online, access to online discussion forums and information within their smoking cessation programmes. The Internet and Mobile phone allow people to receive information and treatment at any time, wherever they are and they also provide anonymity.

As mentioned in Chapter 1, initially Mobile phones and the Internet were mainly used as other forms of communication with patients to improve the efficiency and effectiveness of existing health care services. They have been used to collect data and monitor long-term conditions. Gradually over the years they started to be used to deliver interventions either alone or in combination with other modes of delivery inclusive of the Internet and pharmacological methods. Some of these are explained below.

Some studies describe Mobile phone and Internet use in sending text messages from health service providers to their clients as reminders to either increase attendance rates at appointments (Downer, 2006; Leong, 2006), or to improve adherence to treatment (Puccio, 2006; Barclay, 2009). Text messages have also been sent in this way to report test results to

clients (Menon-Johansson, 2007; Dhar 2006). Some interventions have been using text messages to improve communication with patients in primary care settings (Leong, 2006; Haller, 2009). A survey done by Chhanabhai (2010) found that young adults were happy to communicate with primary care providers using text messages and also found that young adults were already communicating about health issues by text messaging with their family and friends.

A study described the use of Mobile phones for data collection where questionnaires were downloaded onto Mobile phones to collect physical activity data (Bexelius, 2010), alcohol-related behaviours in adolescents (Kauer, 2009) and mood in adolescents (Reid, 2009).

Growing literature has been found around Mobile phone- and Internet interventions for the management of long-term conditions between clinic visits. These include the variety of functions inclusive of patients communicating results of home monitoring to health care providers and providers responding with advice and updated care plans and instructions for medication. Much of this research has been done in people with diabetes mellitus-sending results of glucose monitoring and advice on alterations to medications (Tasker, 2007; Ferrer-Roca, 2004; Kim 2006) and there are also broader interventions around cardiovascular disease 'tele-monitoring' which tend to use the Internet- and fixed telephone lines (Nembeck, 2009; Scherr, 2009; Giordano 2009). Furthermore, Mobile phones and the Internet have been used to deliver interventions in health behaviour change (explained below).

'Smart phones' are adding a new dimension to the use of Mobile phone and the Internet in health. Smart phones are Mobile phones that run on an operating system (OS) that allows the downloading of applications onto the phone (Sarasohn-Kahn, 2010). The benefits of this are almost full computer functions including Internet access on the Mobile phone.

2.3.2 The use of the Internet and Mobile phone for healthy behaviour change

Further use of Mobile phones and the Internet is to deliver interventions designed to support individuals in making a healthy behaviour change. Behaviour modification is an important part of many public health programmes to aim to prevent some of the major global disease burdens inclusive of cardiovascular disease, diabetes and cancer and many more. These programmes often attempt to motivate and support people to alter lifestyles that pose significant risks to individuals and population health inclusive of smoking tobacco, alcohol and substance misuse, diets and sedentary lifestyles (Cole-Lewis, 2010), to support weight loss (Raab, 2009; Manzoni, 2011), increase physical activity (Hurling, 2009), manage diet for people with diabetes (Franklin, 2006) and smoking cessation (these are explained in this Chapter). A systematic review done by Stephens (2013) assessed seven studies closely using Mobile phones to increase physical activity and promote weight loss. Multiple studies have reported the benefits of using this type of technology to enhance interventions for weight loss. Most of the trials demonstrated a beneficial impact of text messaging or smart phone applications in interventions for the risk factors reduction for cardiovascular disease including physical inactivity and overweight and obesity. A text messaging intervention was implemented in five of these seven studies (Gerber et al, 2009; Haapala et al, 2009; Joo and Kim, 2007; Patrick et al, 2009; Shapiro et al, 2008) with remaining two studies implementing a Smart phone application (Gasser et al, 2006; Lee et al, 2010). Three of the studies examined text messaging as the primary intervention but were supported by education, in person weigh-ins or telephone calls (Haapala, 2009; Patrick, 2009; Shapiro, 2008). Two studies that examined the effects of text messaging that were part of a larger intervention and supportive to a specific weight management programme (Gerber, 2009; Joo, 2007). The most frequently measured outcome was the change in weight (57%), followed by physical activity (43%),

change in body mass index (29%), change in waist circumference (29%), nutrition or diet adherence (29%), change in fat mass (14%), sugar-sweetened beverage intake (14%) and screen time (14%). Five reported statistical results in at least one outcome. There are also broader interventions around cardiovascular disease ‘tele monitoring’ that may or may not include the Mobile phone however these tend to use the Internet and fixed telephone lines (Nembeck, 2009; Scherr, 2009; Giordano, 2009).

2.3.3 The use of the Internet

The Internet is a global system of interconnected computer networks that was preceded by the DARPA experiments (The US Defense Advanced Research Projects Agency) and following the experiments initially confined to the scientific community. The Internet serves billions of people world-wide and its different networks consist of millions of private, public, academic, government networks of local and to global scope that are linked by a broad array of electronic, wireless and optical networking technologies. The Internet carries an extensive range of online information resources which are referred to as helpful databases that exist online (Internet Society, 2013). It can be used to access the world- wide web through using a mobile phone, personal computer or laptop. Over the years the world-wide web has grown to be a unique space and has become one of the major channels of information and communication. The history of the Internet begins with the development of electronic computers in the 1950’s. The initial concepts of packet networking (known as formatted units of data) originated in several computer science laboratories in the US, France and then Great Britain. The Internet was introduced to the wider society in the late 1990’s and early 2000’s and has been widely used for mailing lists, emails, e-commerce, online shopping (Amazon and Ebay), online forums, bulletin boards and personal websites including blogs. It

has grown rapidly since and turned into a key part of global society. 6.9 billion Internet users were reported world-wide by the end of the year 2010, 67% in developed countries and 21% in developing countries. Additionally 24% of fixed broadband subscriptions in developed countries and 4% in developing countries were reported world-wide. Email started in 1965 as a way for multiple users of timeframe computers which are computers used by large organisations for bulk data processing inclusive of census, industry and consumer statistics to communicate with each other. The first email was sent by Raymond Tomlinson in 1971. Raymond Tomlinson, a US programmer born in 1941 in New York implemented an email system in 1971 on the ARPANET (Advanced Research Projects Agency Network) while working for a technology company now called BBN technologies which he joined in 1967. It was the first system able to send mail between users on different hosts connected to the ARPANET. Prior to this mail could be sent only to others who used the same computer.

2.3.4 The use of Mobile phone

A Mobile phone also known as a 'Cellular Phone' or 'Cell Phone' is an electronic telecommunications device which connects to a wireless communications network through radio wave or satellite transmissions. It provides voice communications, short message service 'SMS' and multi-media message service 'MMS'. Mobile phones are also defined as small telephones that people can take with them outside their homes (Oxford Dictionary 2010). The history of the Mobile phone begins with the development in the 1970's. Martin Cooper, born in 1928 in Chicago, also known as 'the father of the Mobile phone' led the team at Motorola and invented the first handheld Cellular Mobile phone in 1973. Cooper made the world's first Cellular Mobile phone call and brought it on the market in 1983. Since the introduction of Mobile phone networks the use has grown exponentially. By the end of 2008

4.1 billion Cellular Mobile subscriptions world-wide were reported, Mobile phone and ownership of Mobile phones, 61% in developed countries and also an increase in Mobile phone subscriptions was reported in developing countries. By the end of 2008 this reached 49.5% from close to 0% ten years previously (ICT, 2009). Mobile phone subscriptions overtook telephone lines globally in 2002. Since then fixed telephone lines have remained under 20% for some years with decreases in developed countries and only a small growth in developing countries (ICT, 2009). Moreover the Commerce Commission reported more active Mobile phone connections than people, 4.9 million Mobile phones for 4.3 million people or 114 Mobile phones per 100 of the population. These statistics include business and private Mobile phones (Commerce Commission Telecommunications, 2009). There has also been a rapid expansion in the use of text messaging (SMS) since the first commercial text message was sent in 1992 by employees of logica CMG (CTIA Wireless Association, 2009). At the end of 2006, 72% of Mobile phone users were reported to be using text messaging. Globally mobile broadband connections where people were able to access multi-media services defined as data services inclusive of Mobile phone, email or browsing mobile websites reached 14% in developed countries by the end of 2008 but less than 1% in developing countries (ICT, 2009). Smartphones are the newer mobile phones and have added a new dimension to the use of mobile phones in health. Smartphones 'Cell phones with built-in computer-operating systems' provide functions inclusive of taking pictures using a built-in camera , sending and receiving pictures, videos, accessing the Internet via the mobile phone network or a mobile phone broadband connection and this covers almost full computer functions additionally to text messaging and phone calls. There were 5805 health, medical and fitness apps available for one brand of smartphone (The Apple I phone) by early 2010 (Sarasohn-Kahn, 2010).

2.3.5 The use of Internet-and Mobile phone to deliver smoking cessation

Previous research suggests that the Internet and Mobile phone have the potential to deliver behaviour change interventions and that they can be effective in achieving cessation of smoking, however the effects are short-term (Civljak, 2012; Riley 2008). Smoking cessation services are using the Internet and Mobile phones for the delivery of support and motivational messages, education and information about the dangers of smoking and the delivery of techniques on how to cope with craving situations in smoking cessation programmes. In most cases these interventions have been used in adjunction with other interventions inclusive of but not limited to Nicotine Replacement Therapy (NRT) and Telephone counselling.

2.3.6 Potential benefits of Internet- and Mobile phone-based interventions for smoking cessation

Individual level population health programmes can be very difficult to implement to individuals, require several resources inclusive of health professional face-to face counseling and are at high cost. Internet- and Mobile phone interventions both attempt providing individual level programmes which are tailored in intensity and messages but which can also be delivered to very large and disparate populations. The ensuing benefits are reaching a large proportion of target audience regardless of their location with far fewer health resources (particularly people) needed and therefore at much lower cost and improved cost-effectiveness. Online treatment programmes are convenient because their content can be accessed at anytime and anywhere which means participants do not need to attend a clinic and they are very easy to use. Smoking messages and websites including online forums have

the provision of content that can distract the user from cravings and additionally have the ability to link the user with others for social support. These can be delivered directly to the individual, sent for instance at the usual smoking times or saved and viewed at the most convenient time of the participant's day. They offer a great level of anonymity compared to treatments in person or phone-based counselling and have the ability to tailor messages to suit individual characteristics (age, gender, Ethnicity) and set up in advance to be then sent automatically. This way the programmes are personalized to the individuals characteristics however require little input from professionals. Moreover this makes it possible to deliver health care services to those people who have difficulty attending a centre due to issues inclusive of transport, costs, family care, time off work and distance from available services. Furthermore they have the potential to reach audience who might not otherwise seek support because possible stigmatisation. Therefore they seem a perfect fit to reach a target population of young adults who seem to smoke more.

2.3.7 Possible limitations of Internet- and Mobile phone-based interventions for smoking cessation

While Internet-and Mobile phone interventions seem to be a useful way of delivering interventions among adolescents and adults, there are some limitations in the use of them. One of the limitations that can affect the use of Mobile phones compared to the use of the Internet is that the amount of information that can be sent using text messaging is limited because text messaging is limited in the number of characters. Looking up websites using the Internet via a computer or modernized Mobile phone also brings limitations inclusive of that the Internet is not a 100% secure place for data information and information is not always reliable and accurate (Bremer, 2005). Another aspect it is difficult to know and measure to which extent participants engage in an intervention, and if they do so if it is enough engagement to obtain adherence to the intervention programme. There have also been some

concerns over the possibility of addiction to Internet and Mobile Phone use particularly with text messaging among young adults. A survey conducted by Walsh (2007) assessed 946 adolescents and adults aged between 15-24 years and found excessive use of Mobile phones among this age group. Participants also showed 'withdrawal' or a 'feeling of loss' without their mobile phones and this may lead to future behavioural problems in educational achievements in the future (Walsh, 2007). Negative impact on personal life has also been indicated through research done by Raab (2009). The stereotype depicts an adolescent at the dinner table, completely distracted in family time, instead being completely occupied with text messages and also distracted at school. Mobile phones may dehumanize the dynamics of human contact. Some people may not know how to interact in real life anymore preferring the safety and comfort of text messaging or email (Mason, 2014). Another aspect of limitations, while these interventions seem very useful among adolescents and young adults they may not work well with older age groups as they may not be familiar with these modern technologies and prefer fixed telephone networks over Mobile phone and email.

2.4 Internet-and Mobile phone-based interventions-previous research

Previous research suggests that Internet-based and Mobile phone-based interventions have the potential to achieve cessation of smoking among adult smokers, however results are short-term and it is uncertain whether these above mentioned interventions can help achieve longer-term cessation of smoking. Internet- and Mobile phone-based interventions are inclusive of access to websites containing information about the dangers of smoking, quitting, relapse prevention, questionnaires, online discussion forums, access to private chat messages and online peer support, online smoking cessation diary, informative and

motivational emails and text messages including advice and suggestions about strategies how to cope with cravings situations and interactive voice response.

2.4.1 Studies which also included adolescents

Internet-based interventions

Mermelstein (2006) assessed the effectiveness of Internet-and Telephone-based interventions for smoking cessation and outcome was 30 days point prevalence self- reported abstinence at 3 months. Three-hundred and fifty-one students from private and public schools aged 16 years plus took part in this. The following interventions were assessed: the Not Plus condition which includes proactive facilitator-initiated telephone calls to students with one phone call during week 5 and booster phone calls in between. Participants also had access to a website which was specifically designed for adolescents to help them quit smoking and furthermore had access to a Quitline website. The Control group received a group-based programme called the Standard Not programme.

Patten (2006) assessed the effectiveness of an Internet-based intervention compared to a brief office intervention programme. Participants for this research included one hundred and thirty-nine adolescents aged 11-18 years. The Stomp Out Smoke programme (STOMP) includes access to a website inclusive of basic information about smoking and strategies about quitting and furthermore participants were sent emails which were tailored to participants individual characteristics. The Control group received a brief office intervention (BOI) which includes weekly meetings with a counsellor. Outcome studied 30 days point prevalence self-reported and biochemical verified abstinence at 3 months.

Woodruff (2007) assessed the effectiveness of Internet components in a smoking cessation programme. Participants included were 136 adolescents aged 15-18 years. The Intervention

group was involved in an Internet-based virtual reality world combined with motivational interviewing which was conducted in real-time by a smoking cessation counsellor and included seven sessions over a timeframe of 7 weeks and included 4 online surveys in addition. The control group completed 4 online surveys but received no support through a counsellor. Outcome studied was 7 days point prevalence self-reported abstinence at 3 months.

Mobile phone-based interventions

Bramley et al. (2005) assessed the effectiveness of using mobile phone text messaging interventions among Maori and non-Maori to achieve cessation of smoking. Findings suggest short-term effectiveness of Mobile phone-based intervention self-reported abstinence rates. 26% of intervention group compared with 11.2% of the control group reported abstinence at 6 weeks. 1705 participants (Maori and non-Maori) aged 16 years plus were included in this study. The STOMP- Stop Smoking by Mobile Phone intervention included regular, personalized text -messages providing smoking cessation advice, support and distraction. Participants self-identifying as Maori received in addition to text messages in English also text-messages in Maori. There were 140 texts specifically developed. Five text messages daily for 4 weeks were sent after participant's quit day. 6 weeks after quit date text-messages were reduced from five text messages daily to three text messages per week until follow up at 26 weeks. The control group received no smoking-related information and only received one text message a fortnight. There were no differences found between Maori and non-Maori.

2.4.2 Studies which included adults

Internet-based interventions

Etter et al. (2005) assessed two computer-tailored interventions for smoking cessation. 'Stop-Tabac' is a French language website inclusive of fact sheets, online booklets, answers to frequently asked questions, access to personal stories written by current and former smokers, games, forums and chat room; and 11969 participants aged 18 years plus took part in this. Findings of this research suggest personalized messages via emails can be effective short-term and 25.2% versus 15.7% had quit smoking at the 2.5 months follow up. Participants were asked to complete a 62-item questionnaire providing the following information: their smoking history, their smoking status, the stage of change they are in, if they had quit before, their level of tobacco dependence, their attitudes towards smoking and their coping methods. Participants received personalized counselling in form of a letter, illustrated with cartoons and graphs specific to match their answers from the questionnaire. The other programme used a shorter 38-item questionnaire however their counselling letter was based on information about Nicotine replacement (NRT) and with not much information about health risks of smoking and how to deal with craving situations.

Stoddard (2008) assessed two Internet-based intervention programmes. The outcome studied was 7 days point prevalence self-reported abstinence at 3 months. Participants included were 1375 adults aged 18 years plus. The programme for the intervention group consisted access to a website called smokefree.govt which included an asynchronous bulletin board (BB condition) and online quit guides. The BB condition offered a forum where participants could respond to categories posted on the bulletin board or start their own message. The Control group was offered access to the website to online quit guides for self-help and was provided with links on how to reach a counsellor if needed.

Strecher et al. (2005) assessed the efficacy of a web-based computer-tailored smoking cessation programme as a supplement to nicotine patch therapy. Results demonstrate effectiveness of web-based interventions in conjunction with Nicotine Replacement Therapy. 29% of the web & Nicotine Group had quit compared to 23.9% in the web-only group at 6 weeks. At 12 weeks 28% of the web and Nicotine Replacement Group compared to 18% in web-only group. This included 3971 participants aged 18 years plus and who used NiQuitin (CQ) 21mg patch. The following interventions were compared: the active CQ plan and a non-tailored web-based smoking cessation programme. Participants were asked to complete a questionnaire and provide the following information: demographics, their smoking history, their motives for quitting, their expectations about more challenging situations during the quit process. Based on information included in the questionnaires, participants received three tailored newsletters delivered via email and behavioural support messages also delivered via email over a period of 10 weeks which were tailored to participants individual characteristics. Emails included a cessation guide inclusive of suggestions about how to stay quit and overcoming craving situations and were also encouraging compliance with Nicotine Replacement Therapy (NRT) since all participants were using NiQuitin (CQ). Additionally participants were allowed to identify a supportive person that would receive an email with advice how to support the participant. The control group received the newsletters and emails including advice and no Nicotine Replacement Therapy (NRT).

Swartz et al. (2006) assessed short-term efficacy (90 days) of an automated behavioural intervention for smoking cessation which was delivered via an Internet website. 351 participants were included and the majority of them (86%) were aged between 26 and 55 years. It was expected that participants quit within the next 30 days. Results from this research indicate that web-based interventions can have a positive impact on changing health

behaviours. 24.1% presented abstinence at 90 days post quit date. The 1-2-3 Smoke free programme included a website which was designed to be an automated approximation of the experience a smoker would receive when working with a live smoking cessation counsellor. This intervention was inclusive of five major content modules: benefits of stopping smoking, overcoming common barriers to cessation, strategies for avoiding situations that prompt cravings, strategies for dealing with cravings and setting a quit date. The last included creating a personalized quit plan calendar with individual advice and a list of options for social support. The intervention included video segments which included a physician presenting a message about the health importance of stopping smoking. There was no personal email or telephone component included therefore participants only interacted with the website. The control group received nothing for 90 days.

Te Poel (2009) assessed Internet-based interventions in smoking cessation programmes. Four hundred and fifty-eight adults aged 18 years plus took part in this. The Intervention group received a 7-9 page computer-tailored email letter which was generated from responses to an online questionnaire. The control group received a 7-page generic non-tailored email letter after completing the same questionnaire. Emails addressed generic information about attitudes, social influences, self-efficacy, skills and action planning. Outcome studied was 7 days point prevalence self-reported abstinence at 6 months.

Mobile phone-based interventions

Research conducted by Obermayer et al. (2004) assessed Mobile phone components in smoking cessation programmes among college students. Findings from this study present 28% had quit and 43% had made at least one 24 hour quit attempt. Forty-six college students aged between 18-25 years participated in this study. The interventions were inclusive of text messages and access to a website. Firstly a questionnaire including the following

information: participant's smoking habit and smoking pattern, basic history of their smoking, information about their high-risk cravings situations, their motivation and self-efficacy to quit was completed by participants. Participants had access to a website using a log-in and were encouraged to visit the website daily. The programme also offered text-messages inclusive of motivational messages and several educational components on topics including information on how to handle withdrawal symptoms of smoking, information how to handle high-risk situations sent using a Mobile phone. Participants were able to alert everyone by sending a 'SOS-messages' (in urge for help messages) at the time they found themselves in a high-risk situation in which they craved a cigarette. This intervention also offered peer-support, allowed selected others inclusive of family and close friends of participants to follow the smokers' progress on the website and send additional text messages encouraging the smoker in their quitting.

Research done by Ybarra et al. (2012) assessed cessation rates in a text-messaging based smoking cessation programme. 45% of the intervention group and 36% of the control group reported abstinence at 12 weeks and this result was confirmed by carbon monoxide testing (CO). 151 Participants were included in this study and they were aged 18 years plus. This programme was based on motivational and supportive text-messages. Participants were asked to answer the following questions: to describe their feelings about smoking how they would rate their craving for a cigarette on a scale from 1-3, if they wanted to quit, the reasons why they wanted to quit and what they would do if someone offered them a cigarette. A informative brochure including understanding quitting, strategies on how to cope with craving situations and how to stay committed to quitting and information about smoking behaviour and dangers, finding out their smoking patterns and the reason why they smoke, learn how to start up a smoking diary, advice on how to involve their family and

friends in supporting them but also learn to become a self-supporter was provided to all participants including the ones in the control group. The intervention group received text messages in addition to the informative brochure. Five text messages inclusive motivational and supportive advice was sent out to participants on a daily base. Abstinence was measured using self-reported as well as carbon monoxide (CO) testing

Internet- and Mobile phone-based interventions

Research done by Riley et al. (2008) assessed Internet- and Mobile phone-based interventions among college students. At 6 weeks 45% achieved abstinence (self-reported) and 42% were based on cotinine verification. These results indicate that Internet- and Mobile phone-based interventions are potentially efficacious and an easily disseminated method for providing cessation interventions to young adult smokers. This study included 31 college students aged between 18 and 24 years. The web-based component of this intervention provided the participants with educational modules including information about smoking and smoking dangers, progress-monitoring tools including quit calendar and email alerts to user-selected significant others who would provide social support at critical times during the programme. Text messages were personalised and on the basis of participants individual quit date. Participants received between one and three text messages daily. These included personal advice about how to stay quit, strategies how to cope with craving situations and how to stay abstinent. Most participants received two text messages daily. Additionally participants could sent an 'emergency message' when the needed additional support.

2.4.3 Summary of previous research

Overall findings of the above mentioned trials suggest that Internet-and Mobile phone-based interventions are effective for achieving abstinence of smoking, however their effects are short-term.

Results of short-term effectiveness of Internet-based interventions:

Three studies assessed Internet-based interventions compared with Internet components delivered at lower frequency in the control group (Etter, 2005; Stoddard, 2008; Woodruff, 2007). Etter (2005) found that 25.2% of the intervention group compared to 15.7% of the control group quit smoking at the 2.5 months follow up, whereas Woodruff (2007) reports 22% of the intervention group compared with 15% of the control group had quit at the 3 months follow-up. Furthermore results from Stoddard (2008) present effectiveness of short-term abstinence of smoking (RR=0.95, 95% CI: 0.64, 1.40).

Three studies assessed Internet-based interventions compared with usual care or self-help (Patten, 2006; Swartz, 2006; Te Poel, 2009). Patten (2006) reports that 12% of the intervention group compared with 6% of the control group had quit at the 24 weeks follow up while Swartz's (2006) findings are 24.1% of the participants had reported to be abstinent of smoking at the 90 days follow up. Moreover, Te Poel (2009) suggests Internet-based interventions work short-term as 28% of the participants had quit at the 6 months follow up.

One trial assessed an Internet-based intervention which included additional Nicotine Replacement Therapy (Strecher, 2005) and found 28% of the participants of the intervention group compared to 18% of the control group had quit at the 12 weeks follow-up. And one trial assessed Internet-based intervention with included additional telephone calls

(Mermelstein, 2006) and suggests the combination of both works to achieve abstinence of smoking (RR=1.96, 95% CI: 1.02, 3.77).

Results of short-term effectiveness of Mobile phone-based interventions

One trial assessed a Mobile phone intervention compared with Mobile phone components in the control group (Bramley, 2005) and the findings of this research reported that 26% of participants of the intervention group compared to 11.2% of the control group had quit smoking at the 6 weeks follow up.

Findings of one trial which assessed a Mobile phone-based intervention compared with no intervention for the control group (Obermayer, 2004) reported 43% had made a quit attempt for at least 24 hours.

One trial compared a Mobile phone-based intervention with usual care (Ybarra, 2012) and found 45% of the participants of the intervention group compared to 36% of the control group had quit smoking at 12 weeks and these findings were confirmed with carbon monoxide testing (CO).

Results of short-term effectiveness of Internet-and Mobile phone-based interventions combined

One trial assessed an Internet- and Mobile phone-based intervention combined compared to no intervention for the control group (Riley, 2008). Results from this research reported that 45% of the participants had quit smoking at 6 weeks and that 42% of these were confirmed with cotinine verification.

Chapter 3: Methods

3.1 Overview

A Meta-Analysis was conducted to measure the effectiveness of Internet- and Mobile phone- based interventions for the quitting and prevention of longer term relapse of smoking. This chapter provides all information about the individual steps of this Meta-Analysis.

3.2 Steps of the Meta-Analysis

3.2.1 Protocol

We did not write a formal protocol for this Meta-Analysis and therefore we did not register the protocol. We developed this Meta-Analysis without a protocol. As this was part of a Master degree thesis, we used the thesis proposal as a protocol to guide us conducting this research. The University of Canterbury has no system of archiving thesis proposals, hence a protocol is not available.

3.2.2 Eligibility Criteria: Inclusion and Exclusion criteria for Studies

Studies were included in this research if they met the following criteria:

1. Participants- the study included adolescents and adult population aged between 15 and 64 years residing anywhere in the world, both gender and all ethnicity.

2. Intervention- The study assessed Internet- and Mobile phone-based interventions. This would include access provided to the participants to websites containing information about the dangers of smoking, quitting, relapse prevention, questionnaires, discussion forums, private chat messages, quitting diary, informative & motivational emails and text messages including advice and suggestions about strategies on how to cope with craving situations and interactive voice response.
3. Comparison- studies that compared Internet-and Mobile phone-based interventions with a) interventions which did not include any Internet-or Mobile phone components, b) self-treatment, phone or face to face counseling, herbal remedies, e-cigarette, hypnosis and c) those which included Internet or Mobile phone components but at a lower frequency (for instance, the intervention group received 3-5 text messages per week and the control group received the same intervention however only received 1-2 text messages per fortnight)
4. Outcome- Abstinence of smoking for at least 6 months after the start of the intervention or 12 months wherever data was available. The research measured self-reported abstinence and included the ones inclusive of biochemical validation.
5. Types of studies- As this was a Meta-Analysis of intervention trials, we therefore considered only those that were Randomized Controlled Trials (RCT).
6. English Language- The research was conducted in English Language or where a written translation was available. We did not have the resources to translate studies ourselves.

7. Time constraint- The research was published ‘between the 1st January 2004 to 1st April 2014’. We considered this time interval to include all studies published in the past ten years to maintain currency.

A study was excluded from this research if:

1. This research did not assess Internet- and Mobile phone-based interventions.
2. Research was not an RCT.
3. Research did not include adolescents and adults aged between 15 and 64 years.
4. Research did not have the correct comparison group (one that did not receive the intervention and or not at the same frequency or another comparable intervention)
5. Research did not assess the appropriate outcome of at least 6 months abstinence.
6. Study was not reported in English language or a translated version was not available.
7. Research was not published between 1st January 2004 and 1st April 2014.

3.3 Search of Literature

Eleven searches were conducted which are outlined in detail in Table.14.

3.3.1 Search Terms and Databases searched

Information sources- A search of PubMed, Medline, Google Scholar, Psyc Literature, CINAHL (Cumulative Index of Nursing & Allied Health Literature Database, Web of Science, Collected Health Literature Related Databases which are maintained at UC and the Cochrane Database of Systematic Reviews or CDSR was conducted. A librarian was contacted where ever access to articles was required.

The advanced search method was used to search the above mentioned databases and the search keywords mentioned in Table.14 were entered into the Mesh heading/subheading column. Boolean expressions inclusive of “AND” and “OR” were added. “AND” was used to narrow down the search to only specific terms and “OR” was used to expand the searches to include all terms.

Table.14 Search History of the PubMed Database Search

Search ID#	Search Terms	Search Options
S1	DE “Smoking Cessation” OR “ DE “Nicotine Withdrawal” OR DE “Tobacco Smoking”	Search modes-Boolean /Phrase
S2	(smok* or tobacco or cigarette* or nicotine) AND (cessation or ceas* or quit*)	Search modes-Boolean /Phrase
S3	S1 or S2	Search modes-Boolean /Phrase
S4	DE “Online Therapy” OR DE “Computer-Mediated Communication” OR DE “Internet” OR DE “Telecommunications Media” OR DE “Telephone Systems”	Search modes-Boolean /Phrase
S5	DE “Social Media” OR DE “Electronic Communication” OR DE “Online Social Networks” OR DE ‘websites”	Search modes-Boolean/Phrase
S6	DE “Cellular Phones”	Search modes-Boolean/Phrase
S7	Internet or phone or blog* or cell* phone or facebook or social media or twitter or world wide web or text messag* or e-therap* or teletherap*	Search modes-Boolean/Phrase
S8	S4 or S5 or S6 or S7	Search modes-Boolean/Phrase
S9	S3 and S8	Search modes-Boolean/Phrase
S10	S3 and S8	Limiters-Publication Year from: 2004-2014

		Search modes-Boolean/Phrase
S11	S3 and S8	Limiters- Publication Year from: 2004-2014; English; Age Groups: Adolescence (15-18 yrs), Adulthood (18yrs & older), Young Adulthood (18-29yrs), Thirties (30-39yrs), Middle Age (40-64yrs) Search modes-Boolean/Phrase

3.4 Appraisal of the Studies Based on their Titles and Abstracts

In the first pass of this Meta-Analysis studies were selected based on their titles and abstract whether they met the Inclusion or Exclusion criteria. Those studies which met the Inclusion criteria based on the appraisal of their title and abstract were retained and were stored in Endnote under a folder named ‘so far included studies based on the appraisal of their title and abstract’ awaiting follow up for obtaining their full texts from the relevant databases. Meanwhile the studies which did not meet the inclusion criteria based on the appraisal of their titles and abstracts were excluded and removed from the further consideration and stored in a folder named ‘Excluded studies based on appraisal of their title and abstract’ and therefore no full texts of these studies were obtained.

3.4.1 Search for fugitive literature

Most unpublished literature was accessed via the Internet through of relevant organization’s websites and two additional websites. These websites were identified from well- established organizations involved in tobacco control inclusive of the New Zealand Ministry of Health,

The World Health Organization and the following database was explored NZ Research and an Internet search using the google platform inclusive terms “tobacco control” and “tobacco research”. Website directories were searched for links to any relevant pages on Internet- or Mobile phone components used in smoking cessation programmes. In addition, basic search terms “Internet”, ‘Mobile Phones’, and ‘Smoking Cessation’ were used where website search functions were available. New Zealand universities catalogues and the University of Canterbury library catalogue were also searched for dissertations and theses of relevance to this research.

3.4.2 Hand searches from the lists of references from the literature reviewed

A comprehensive search of the reference lists of all included studies has been conducted to find further studies. Moreover, a search through the University of Canterbury library catalogue and archives has been conducted, looking through relevant, e-books, e-journals including journals and paper books which are kept on the shelves at the Library of the University of Canterbury.

3.4.3 Critical Appraisal of the studies included in the full text

In the second pass of this Meta-Analysis, full texts of the ‘so far included studies based on the appraisal of their title and abstract’ were obtained from the relevant databases and read through. These studies were excluded from further assessment if their full text did not match the Inclusion criteria. The studies which met the Inclusion criteria based on their full text were stored in a folder named ‘included studies based on the appraisal of their full text’ within Endnote and awaiting follow up for further assessment inclusive of Risk of Bias. Furthermore, reference lists of all included studies were looked through to find more possible studies. As mentioned above, Endnote was used to store all search results and

individual folders were created within Endnote to manage data. The individual folders within Endnote comprised of an ‘so far included studies based on the appraisal of their title and abstract’ folder, an ‘included studies based on the appraisal of their full texts’ folder and an ‘excluded studies based on their title, abstract and full text’.

3.5 Risk of Bias Assessment

An Assessment of Risk of Bias was conducted among all included studies which met the Inclusion criteria based on the appraisal of their full text. The following criteria were assessed using the ‘Cochrane Collaboration Risk of Bias Tool’ (Higgins 2011a, Higgins 2011b) which is a domain- based evaluation and includes the following parts: Random sequence generation (selection bias), Allocation concealment (selection bias), Blinding (performance bias and detection bias, blinding of participants), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other bias (publication bias). The Risk of Bias criteria was judged as ‘low risk’, ‘high risk’ or ‘unclear risk’ (lack of information or uncertainty over the potential bias). The following table is the guide with the specific questions of the ‘Cochrane Collaboration Risk of Bias Tool’.

Table.15 ‘Cochrane Collaboration Risk of Bias Tool’

BIAS	QUESTIONS
Random Sequence Generation (Selection Bias)	Was the allocation adequately generated?
Allocation Concealment (Selection Bias)	Was the allocation adequately concealed?
Blinding	Was knowledge of the allocated interventions adequately prevented

(Performance & Detection Bias)	during the study?
Incomplete Outcome data (Attrition Bias)	Was incomplete outcome data adequate addressed?
Other Bias (Publication Bias, Reporting Bias)	Was the study apparently free of other problems that could put it at high risk of bias? Were reports of the study free of suggestion of selective outcome reporting?

3.6 Summary of the Results of the Study: Random-effects versus Fixed-effects Meta- Analysis

A Meta-Analysis uses two models, one is the Fixed-Effects Method and the other one is the Random-Effects Method.

Fixed-Effects Method:

In a Fixed-Effects Analysis is assumed that all the included studies share a common true effect size μ . The observed effects are distributed about μ with a variance σ^2 that depends primarily on the sample size of each study. There is only one level of sampling since all studies are sampled from a population with effect size μ and therefore only one source of sampling error exists within the studies. Since the goal of this approach is to assign more weight to the studies that carry more information, researchers may propose to weight each study by its sample size. So that for instance a study with one thousand subjects would get 10 times the weight of a study with one hundred subjects. Assignments of the weights are based on the inverse of the variance rather than the sample size. The inverse variance is

roughly proportional to the sample size but is a more nuanced measure and serves to minimize the variance of combined effect.

Random-Effects Method:

The Fixed-Effects Method discussed above starts with the assumption that the true effect is the same in all included studies however the assumption may be implausible in some reviews. When a decision is made to incorporate a group of studies in a Meta-Analysis it is assumed that the studies have enough in common that it makes sense to synthesize the information rather than assume that there is one true effect. Rather than the assumption that there is one true effect, a distribution of true effect sizes is tolerated. The combined effect therefore cannot represent the common effect but instead represents the effect sizes and the mean of the population true effects. The Random- Effects Method consists of two level sampling and two sources of error. Firstly the true effect sizes θ are distributed about μ with variance τ which reflects the actual distribution of the true effects about their mean; second the observed effect T for any given θ is distributed about θ with variance σ^2 that depends primarily on the sample size for each study. When assigning weights to estimate μ there are two sources of sampling error, one within the studies and one between the studies to deal with. In the Fixed-Effects Analysis as comparison each study is weight by the inverse of its variance. In the Random-Effects Analysis too, each study is weight by the inverse of its variance. However the difference is that the variance now includes the original (within-studies) variance plus the between-studies variance.

3.7 Assessment of the heterogeneity of studies

An assessment of heterogeneity using I-squared statistics was conducted. I- squared statistics describes the percentage of variation across the different studies and it expresses the inconsistency of the results of the studies.

This formula was used to calculate I -square calculate I-square $I^2 = \frac{(Q-df)}{Q} * 100$

If the studies were found to be statistically homogeneous based on the I-statistic cut off value ($p= 0.1$) then the results from these studies were combined. If on the other hand, the studies demonstrated a lack of homogeneity on the basis of statistical tests then the studies were further investigated to identify the causes of their heterogeneity. A significance level of 0.1 was used as an indication and the following interpretation guide was used: 0-40% indicates might not be important; 30-60% indicates ‘may represent moderate heterogeneity’; 50-70% ‘may represent substantial heterogeneity’ and 75% or more indicates a ‘considerable level of inconsistency’ (Higgins 2011a).

3.8 Summary of the Studies: Odds Ratio and Forest Plot

The results of the studies were combined and the following formula was used to calculate the Odds Ratio:

$$OR = \frac{\text{odds of event in experimental group}}{\text{odds of event in control group}} = \frac{S_E/F_E}{S_C/F_C} = \frac{S_E F_C}{F_E S_C}$$

The findings are presented in a Forest Plot created using the Review Manager Software (RevMan). The Forest Plot illustrates the effect size and precision for each study (95% CI) and for the combined effect. It shows whether the combined effect is based on a few studies or many and whether the effect size is consistent or if it varies (OR 95% CI). Data entry is

presented in two columns. The left-hand column includes the list the names of the studies (Randomized Controlled Trials). The right-hand column presents the plot of the measure of the effect (OR) for each of the studies which is illustrated as a square. The overall meta-analyzed measure of the effect is presented on the plot as a dashed vertical line. The meta-analyzed measure of effect is plotted as a diamond. Other points are used to indicate the confidence interval (CI) for the estimate. Then a vertical line which represents no effect was plotted. If the confidence intervals of the individual studies overlapped with the line it demonstrates that at given level of confidence their effect sizes do not differ from no effect for each individual study. If the points of the diamond overlapped the line of the no effect the overall meta-analyzed result meant it did not differ from no effect at the given level of confidence.

3.9 Testing for Publication Bias: visual inspection

Publication Bias was tested by setting up a Funnel Plot. The Funnel Plot is graphically presented and was created using the Review Manager Software (RevMan). This shows the assumptions that the largest studies are near the average and the small studies are spread on both sides of the average. If there are any variations shown from this assumption there is a likelihood that publication bias exists. A symmetric inverted funnel shape indicates well-presented data in which publication bias is very unlikely. And an asymmetric funnel shape indicates the relationship between the treatment effect and the study size.

3.10 Subgroup Analysis

Subgroup analyses were conducted following the analysis of the entire data set. Studies with the same outcome criteria were grouped together and assessed. Studies included in Subgroup 1 assessed all Internet- and Mobile phone-based interventions and measured 7 days point

prevalence and self-reported abstinence. These were compared with all other interventions which did not include Internet- and Mobile phone components or no intervention. The following trials were included in the analyses of Subgroup 1: Haug (2011), Haug (2013), Seidman (2010) and Skov-Ettrup (2014). Subgroup 2 included the following trials Elfeddali (2012), Free (2009) and Free (2011) and assessed all which included Internet- and Mobile phone-based interventions which measured 7 days point prevalence and self-reported abstinence and additionally included salivary cotinine and carbon monoxide testing. These were then compared with other interventions which did not include any Internet- and Mobile phone components or no intervention. Next Brendryen (2008) and Zbikowski (2011) were assessed as part of the analysis for Subgroup 3. These included Internet- and Mobile phone-based interventions which included additional interventions inclusive of Nicotine Replacement Therapy (NRT) or additional telephone calls. Furthermore a fourth subgroup including the following trials Seidman (2010) and Skov-Ettrup (2014) which assessed Internet- and Mobile phone-based interventions that measured 7 days point prevalence as well as 30 days point prevalence self-reported abstinence compared with all other interventions or no intervention. Towards the end a further subgroup was analyzed, Subgroup 5 which included the following trials Borland (2013), Free (2011), McKay (2008), Rodgers (2005) and Wangberg (2011). The mentioned randomized controlled trials assessed Internet- and Mobile phone-based interventions and measured 7 days point prevalence self-reported abstinence compared with the same interventions Internet-and Mobile phone-based interventions however these were delivered at lower frequency to comparison group.

Chapter 4: Results of the Meta-Analysis

4.1 Overview

The results of this research, a Meta-Analysis are presented in this chapter. The aim of this Meta-Analysis was to investigate the effectiveness of Internet- and Mobile phone-based interventions used in smoking cessation to achieve longer-term abstinence among adolescent and adult smokers. This was achieved by comparing the intervention groups of randomized controlled trials with other interventions which did not include any Internet or Mobile phone components and pooling their findings.

4.2. Results of the search

One hundred twelve articles were retrieved from the main database search and seven additional articles were identified through other sources. After duplicates were removed, the title and abstract of 96 articles was studied and four articles were gained and discovered using the reference research method. Full text was obtained of 25 articles and seven articles were obtained from a previous search of the literature. The seven articles which were obtained from a previous search of the literature were used to demonstrate evidence of previous research conducted in smoking cessation. After all fourteen studies (Borland, 2013; Brendryen, 2008; Brendryen , 2008/2; Elfeddali, 2012; Free, 2009; Free, 2011; Haug, 2011; Haug, 2013; McKay, 2008; Rodgers, 2005; Seidman, 2010; Skov-Ettrup, 2014; Wangberg, 2011; Zbikowski, 2011) met the inclusion criteria after their full texts have been assessed and were further investigated in this Meta-Analysis. A full list of all excluded studies along with reasons for exclusion can be found in Table 'Characteristics of excluded

studies' whereas Table 'Characteristics of studies included in this review' provides further details of all included studies.

4.3 Randomized controlled trials included in this Meta-Analysis

4.3.1 Recruitment & Participants

Recruitment was very similar among the studies. Borland (2013), Brendryen (2008), Brendryen (2008), Skov-Ettrup (2014) and Zbikowski (2011) recruited their participants through quit websites and advertisements in online newspapers whereas Rodgers (2005), Skov-Ettrup (2014) and Zbikowski (2011) received their participants from quitline and cancer societies. Free (2011), Free (2009) used the radio, leaflets and posters for their recruitment while Rogers (2005) put posters up at tertiary institutions within the region. Haug (2013) and Haug (2011) recruited their participants from a rehabilitation centre and Zbikowski (2011) received their participants through referrals from General Practitioners.

Trials which only included adult participants aged 18 years & over:

Nine studies Borland (2013), Brendryen (2008), Brendryen (2008/2), Elfeddali (2012), Haug (2011), Haug (2013), McKay (2008), Seidman (2010) and Zbikowski (2011) included participants aged 18 years plus, three studies Free (2009), Free (2011).

Trials which included adolescent & adult participants aged 15 years & over:

Three studies included adolescents in their research. Wangberg (2011) included adolescents aged 16 years plus and Rodgers (2005) and Skov-Ettrup (2014) included participants aged 15 years and over.

Sample sizes among all included trials ranged from 200 participants (Free 2009) to 5800 participants (Free 2011) and in two trials (Elfeddali, 2012; Wangberg, 2011) participants could enter a draw to win prizes.

4.3.2 Interventions

A range of different interventions were included in this review. Three of them assessed both Internet- and Mobile phone-based interventions (Borland, 2013; Brendryen, 2008; Brendryen, 2008/2) whereas six of them evaluated Internet-based interventions (Elfeddali, 2012; Haug, 2011; McKay, 2008; Seidman, 2010; Wangberg, 2011; Zbikowski, 2011). Additionally five studies investigated Mobile phone-based interventions (Free, 2009; Free, 2011; Haug, 2013; Rodgers, 2005; Skov-Ettrup, 2014). Furthermore one study included Nicotine Replacement Therapy in addition to Internet and Mobile phone components (Brendryen, 2008) and one study added telephone calls to Internet components (Zbikowski, 2011). More details about the comparisons are given in the comparison section below and descriptions of main features of each study intervention are provided in the ‘Characteristics of studies included in this review’ table.

4.3.3 Outcomes

All fourteen studies reported smoking status of at least six months or more after the start of the intervention (Borland, 2013; Brendryen, 2008; Brendryen, 2008/2; Elfeddali, 2012; Free, 2009; Free, 2011; Haug, 2011; Haug, 2013; McKay, 2008; Rodgers, 2005; Seidman, 2010; Skov-Ettrup, 2014; Wangberg, 2011; Zbikowski, 2011). For most studies a 7-days point prevalence self-reported abstinence of smoking was the main outcome however two of

these studies reported a 30-days point prevalence self-reported abstinence of smoking additionally (Seidman, 2010; Skov-Ettrup, 2014). Due to limited face-to face contact and due to data collection through Internet- and Telephone interviewing, biochemical validation (inclusive of salivary cotinine and Carbon monoxide measured in expired air) was conducted to confirm self-reported abstinence of smoking among three of the above mentioned studies (Elfeddali, 2012; Free, 2009; Free, 2011).

4.3.4 Comparisons

Overall analysis of Internet-and Mobile phone-based interventions inclusive of additional nicotine replacement therapy or telephone calls compared with all other interventions including Internet-and Mobile phone-based interventions delivered at a lower frequency, outcome: 7 days & 30 point days point prevalence, self-reported & biochemically validated abstinence of smoking:

Firstly, a comparison of all fourteen included studies was conducted however it was agreed if gross heterogeneity among all trials was found, further analyses would be conducted to further explore the reasons of heterogeneity. Five subgroup analyses have been conducted.

Subgroup Analyses

Trials were grouped together according to whether they had studied the same outcome.

Description of Subgroup 1. Internet-and Mobile phone-based interventions compared with all other interventions; Outcome: 7 days point t prevalence self-reported abstinence of smoking:

Five studies were included in this comparison: Brendryen (2008/2) assessed Internet- and Mobile phone interventions and the outcome studied was self-reported abstinence at 6 and 12 months. 290 adults (144 in the intervention group and 146 in the control group) 18 years plus, who owned a Mobile phone and had access to the Internet were included. Participants

did not receive any Nicotine Replacement Therapy. The intervention included emails, access to webpages and text messages including strategies on how to stay abstinent. The Control group had access to general resources including books and magazines about self-treatment. Haug (2011) assessed Internet-based interventions and the outcome was self-reported abstinence at 6 months. Participants included in this research were 477 adults (242 in the intervention group and 235 in the control group) aged 18 years plus, who had access to emails and the Internet and wanted to quit. Rauchberatung.de is a smoking cessation programme that is delivered via the Internet and it consists of information and advice available on message boards online, websites, questionnaires, and emails. Buddy support was available and emails included motivational messages and advice on how to stay abstinent. The control group received information and advice. Haug (2013) assessed Mobile phone-based interventions and the outcome was self-reported abstinence at 6 months. Participants included were 755 adults (372 in the intervention group and 383 in the control group) aged 18 years plus and who owned a Mobile phone and wanted to quit. SMS Quit Coach is a smoking cessation programme that includes text messages at least three times per week, motivational messages, two text messages per week for 3 months and group and 1159 in the control group) aged 18 years plus and who had access to the Internet. QSN (Quit Smoking Network) users were directed through websites and the programme provided strategies on how to stay non-smoking, how to overcome cravings and a web-forum was provided. The control group received online resources (factsheets) articles. Seidman (2010) assessed the effectiveness of internet interventions and the outcome was self-reported abstinence at 6 months and 13 months. 2153 Adults (1106 in the intervention group and 1047 in the control group) aged 18 years plus and who had access to the Internet. Participants were provided with a link to access an interactive website for information and to complete a series of exercises to help reinforce the motivation to quit and stay abstinent.

Emails included advice and strategies how to cope with triggers for a cigarette. The control group had access to a non- interactive website containing downloadable self-help booklets (designed by American Cancer Society). Skov-Ettrup (2014) assessed Mobile phone interventions and the outcome was self-reported abstinence at 12 months. 2030 adolescents and adults (1055 in the intervention group and 975 in the control group) aged 15 years plus who owned a cell phone were included. Xhalke.dk is a smoking cessation program which includes Internet- and Mobile phone components. Two personalized daily text messages including advice on how to cope with specific situations were delivered to participants. The control group received weekly text messages.

Description of Subgroup 2. Internet-and Mobile phone-based interventions compared with all other interventions, Outcome: 7 days point prevalence, self-reported & biochemically validated abstinence of smoking

Three studies were included in this comparison: Elfeddali (2012) assessed Internet-based interventions in smoking cessation programmes. The outcomes studied were self-reported and biochemically verified abstinence at 12 months. Participants were 2031 adults (1395 in the intervention group and 636 in the control group) aged 18 years plus. Stay quit for you study (SQ4U) includes online assignments and questionnaires, including information about dangers of smoking, the benefits of not smoking and motivational messages. The Control group only filled out questionnaires and did not receive emails and interventions. Free (2009) assessed Mobile phone-based interventions and the outcome studied was self-reported and biochemically verified abstinence at 6 months. Participants were 200 adolescents and adults (102 in the intervention group and 98 in the control group) aged 16 years plus, who owned a Mobile phone. STOMP- Stop Smoking with Mobile Phone is a six months cessation programme delivered via Mobile phone. Participants received regular

personal text messaging with advice and support to help messages including information on strategies how to cope with withdrawal symptoms. The control group received no text messages. Free (2011) assessed Mobile phone-based interventions and the outcome was 6 months self-reported and biochemically verified abstinence at 6 months. This research included 5800 adolescents and adults (2915 in the intervention group and 2885 in the control group) aged 16 years plus and who owned a Mobile phone. This six months smoking cessation programme was delivered via Mobile phone. Participants received five text messages for the first 3 weeks, then three per week for 26 weeks. A total of 156 messages were sent and messages included motivational and support messages to help participants stay abstinent. They could text 'lapse' to receive urgent advice and to receive peer support. The control group received simple short text messages on a fortnightly basis. Self-reported and biochemically verified abstinence was assessed using postal salivary cotinine testing and carbon monoxide testing in person.

Description of Subgroup 3. Internet-and Mobile phone-based interventions inclusive of additional Nicotine Replacement Therapy & Telephone Calls, Outcome: 7 days point prevalence, self-reported abstinence of smoking:

Two studies were included in this comparison: Brendryen (2008) assessed Internet-and Mobile phone interventions. The outcome studied was self-reported abstinence at 6 and 12 months. Participants were 396 adults (197 in the Internet and owned a Mobile phone. Happy Ending is a one year smoking cessation programme delivered via the Internet and Mobile phone. It consists of emails, access to webpages, interactive voice response, text messages, access to a craving helpline, strategies on how to cope with cravings situations. All participants were given free Nicotine Replacement Therapy (NRT). The control group received self-help booklets including 44 pages containing general information, a quit diary and telephone numbers from the National Quitline. Research conducted by Brendryen (2008)

assessed Internet-and Mobile phone interventions. The outcome studied was self-reported abstinence at 6 and 12 months. Participants were 396 adults (197 in the Internet and owned a Mobile phone. Happy Ending is a one year smoking cessation programme delivered via the Internet and Mobile phone. It consists of emails, access to webpages, interactive voice response, text messages, access to a craving helpline, strategies on how to cope with cravings situations. All participants were given free Nicotine Replacement Therapy (NRT). The control group received self-help booklets including 44 pages containing general information, a quit diary and telephone numbers from the National Quitline. Zbikowski (2011) assessed the Internet and included additional telephone calls. The outcome studied was self-reported abstinence at 6 months. 1198 adults (797 in the intervention group and 401 in the control group) aged 18 years plus were included. The website included interactive tools, a discussion forum, personalized emails, five one-on one telephone calls for 7 days and 21 days while the control group only received telephone calls but no access to the website.

Description of Subgroup 4. Internet-and Mobile phone-based interventions compared with all other interventions, Outcome: 7 days point prevalence & 30 days Prevalence, self-reported abstinence

This comparison included two trials: Seidman (2010) assessed the effectiveness of internet interventions and the outcome was self-reported abstinence at 6 months and 13 months. 2153 Adults (1106 in the intervention group and 1047 in the control group) aged 18 years plus and who had access to the Internet. Participants were provided with a link to access an interactive website for information and to complete a series of exercises to help reinforce the motivation to quit and stay abstinent. Emails included advice and strategies how to cope with triggers for a cigarette. The control group had access to a non- interactive website containing downloadable self-help booklets (designed by American Cancer Society). Skov-Ettrup (2014) assessed Mobile phone interventions and the outcome was self-reported abstinence at

12 months. 2030 adolescents and adults (1055 in the intervention group and 975 in the control group) aged 15 years plus who owned a Mobile phone were included. Xhalke.dk is a smoking cessation program which includes Internet- and Mobile phone components. Two personalized daily text messages including advice on how to cope with specific situations were delivered to participants. The control group received weekly text messages.

Description of Subgroup 5. Internet- and Mobile phone-based interventions compared with Internet -and Mobile phone-based interventions at lower frequency, Outcome: 7 days point prevalence, self-reported abstinence of smoking

Five trials were included in this comparison: Borland et al. (2013) assessed Internet- and Mobile phone-based interventions in smoking cessation programmes. The main outcome of this research was self-reported abstinence at 6 months. Participants included in this study were 3530 adults (2195 in the intervention group and 1335 in the control group) aged 18 years plus, owned a Mobile phone and had access to the Internet. Quit Coach is a personalized smoking cessation programme delivered over the Internet and Mobile phone. These interventions included letters of advice, suggestions about strategies on how to cope with cravings and motivational messages. The control group received brief information on web- and phone-based interventions. Free (2011) assessed Mobile phone-based interventions and the outcome was 6 months self-reported and biochemically verified abstinence at 6 months. This research included 5800 adolescents and adults (2915 in the intervention group and 2885 in the control group) aged 16 years plus and who owned a Mobile phone. This six months smoking cessation programme was delivered via Mobile phone. Participants received five text messages for the first 3 weeks, then three per week for 26 weeks. A total of 156 messages were sent and messages included motivational and support messages to help participants stay abstinent. They could text 'lapse' to receive urgent advice and to receive peer support. The control group received simple short text messages on a fortnightly basis.

Self-reported and biochemically verified abstinence was assessed using postal salivary cotinine testing and carbon monoxide testing in person. McKay (2008) assessed Internet-based interventions and the outcome was self-reported abstinence at 6 months. Participants included were 2318 adults (1159 in the intervention distract from cravings and withdrawal symptoms. Five to six messages per day were sent for 4 weeks and the maintenance stage included one message every fortnight. Quit Buddy and messages on demand were available. The Control group received one message per fortnight. Rodgers (2005) assessed Mobile phone-based interventions and 1705 adolescents and adults (852 in the intervention group and 853 in the control group) aged 18 years plus took part in this. This six months smoking cessation programme delivered via Mobile phone included regular personalized text messages with information and advice to help distract participants from cravings for a cigarette. Messages on demand were available. The control group received one text message per fortnight.. Wangberg (2011) assessed Internet based interventions and the outcome studied was self-reported abstinence at 12 months. Included were 2298 adolescents and adults (1171 in the intervention group and 1127 in the control group) aged 16 years plus. This smoking cessation programme based on general advice included dangers of smoking, motivational messages, discussion forum and a personalized online cessation diary was delivered for 12 months. Buddy support and private chat messages were available. The control group received also an Internet-based intervention but had no email contact.

4.4 Risk of Bias in included studies

The factors considered important in smoking cessation studies by the Cochrane Tobacco Addition Group are randomization (selection bias) allocation concealment (selection bias)

blinding (performing and detection bias), treatment of missing outcome data (attrition bias) and other bias inclusive of publication bias.

4.4.1 Randomization

Randomization was considered adequate in most trials and computerized randomization was used in the majority of trials and one study used the telephone for randomization. (Free, 2011). Thirteen of these were judged 'low risk' for Randomization (Borland, 2013; Brendryen, 2008; Brendryen, 2008/2; Elfeddali, 2012; Free, 2009; Haug, 2013; McKay, 2008; Rodgers, 2005; Seidman, 2010; Skov-Ettrup, 2014; Wangberg, 2011; Zbikowski, 2011). However one study was judged as 'unclear risk' as this trial did not provide sufficient information other than that randomization was done by week of attendance (Haug, 2011).

4.4.2 Allocation Concealment

Allocation Concealment was considered adequate among thirteen studies and these were judged 'low risk'. However one study was judged 'high risk' as recruiting staff were aware of the condition to which participants were allocated to (Free, 2011). Wherever little information about allocation concealment was provided but investigators used computerized randomization and had less interaction with their participants, this research judged 'low risk'. Another study did not describe the details of allocation concealment but still was judged 'low risk' as randomization was automated so it was assumed to be 'low risk' (McKay, 2008).

4.4.3 Blinding

Blinding was an issue in two trials (Free, 2009; Rodgers, 2005). In both studies participants were aware whether they were receiving the intervention or not although research staff were blind to the allocation.

4.4.4 Incomplete Outcome Data

All studies included in this review used intention-to treat analyses for smoking status, reporting analyses based on total numbers randomized, with drop-outs and participants lost to follow up classified as smoking. Wherever possible the number of participants who completed the trials were noted.

Four studies were judged 'high risk of bias'. In one study (Rodgers, 2005) incentives for providing final follow up data differed between groups (one month of free texting was received by the control group on the completion of follow up, whereas the intervention group had already received their month of free text messaging from quit day and did not receive a further incentive follow up). However Authors suggest this is likely to have caused the difference in loss to follow up at six months in the intervention group (69%) compared to (79%) in the control group. It was suggested that some participants in the control group may have thought their free month of text messaging depended on reporting quitting. The other studies judged as high risk of incomplete outcome data were Elfeddali (2012), McKay (2008) and Wangberg (2011). Only 27% of participants in each trial provided assessment data at 6 months follow up.

An overall Analysis inclusive of a Fixed-effect and a Random-effect Analysis of all fourteen studies using the 'DerSimonian Laird Method' and 'Mantel-Haenszel Method' was conducted. Previously was decided that if heterogeneity was found among studies, individual subgroup analyses would be conducted to further investigate these results. The details of this are described in the Methods section.

Figure 8: Quorum Chart

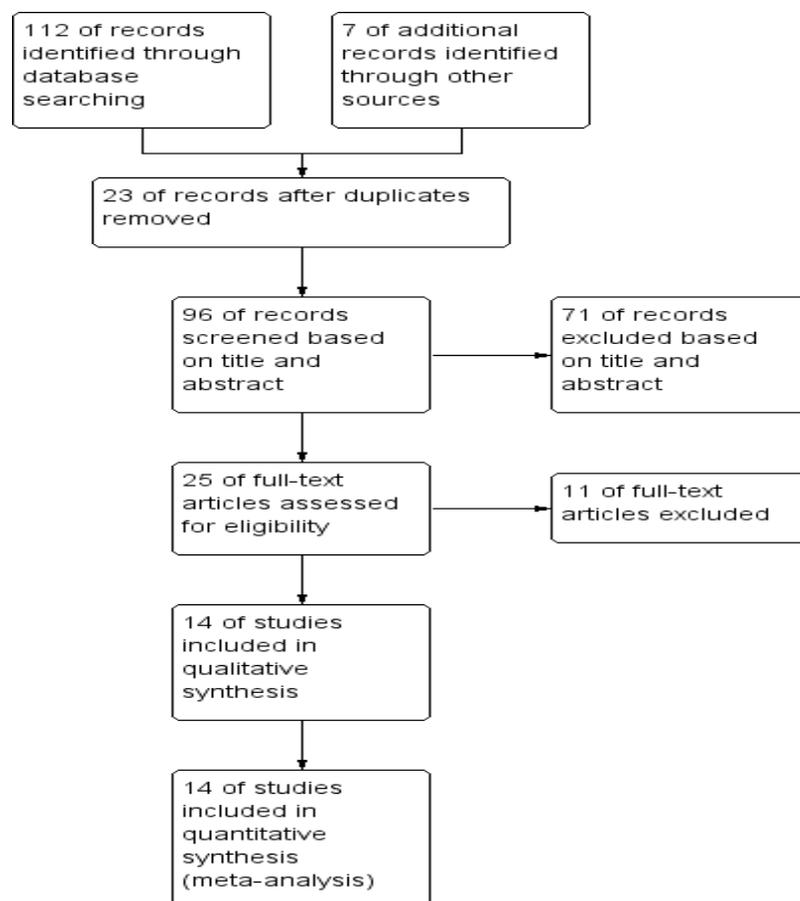


Figure 8; Results of the search

Table.16 Search term results from PubMed Database search

Search Term	Results
DE “Smoking Cessation” OR “ DE “Nicotine Withdrawal” OR DE “Tobacco Smoking”	22 669
(smok* or tobacco or cigarette* or nicotine) AND (cessation or ceas* or quit*)	11 272
DE “Online Therapy” OR DE	23 370

“Computer-Mediated Communication” OR DE “Internet” OR DE “Telecommunications Media” OR DE “Telephone Systems”	
DE “Social Media” OR DE “Electronic Communication” OR DE “Online Social Networks” OR DE ‘websites’	5599
DE “Cellular Phones”	1120
Internet or phone or blog* or cell* phone or facebook or social media or twitter or world wide web or text messag* or e-therap* or teletherap*	35 636
Limiters- Publication Year from: 2004- 2014; English; Age Groups: Adolescence (15-18 yrs), Adulthood (18yrs & older), Young Adulthood (18-29yrs), Thirties (30-39yrs), Middle Age (40-64yrs) Search modes-Boolean/Phrase	112

Table.17 Characteristics of all studies included in this review

Borland (2013)	
Methods	Recruitment through quit websites and advertisements in online newspapers
Participants	3530 adults aged 18 years plus, 2195 in the intervention group and 1335 in the control group, willing to quit smoking, have access to the Internet and own a Mobile phone
Intervention	Internet- and Mobile phone-based intervention for smoking cessation Quit Coach is a personalized smoking cessation programme delivered over the Internet and Mobile phone and includes letters of advice, suggestions about strategies on how to cope with craving situations and motivational emails and text messages to help participants to quit and stay abstinent
Outcomes	Control group received brief information on Web- and Mobile phone-based interventions self-reported abstinence at 6 months
Notes	OR= 1.51, 95% CI= 0.94, 2.41

Brendryen (2008)	
Methods	Recruitment through quit websites and advertisements in online newspapers
Participants	396 participants aged 18 years plus, 197 in the intervention group and 199 in the control group, smokers willing to quit smoking, having daily access to the Internet and email and own a Mobile phone
Interventions	<p>Internet- and Mobile phone-based intervention in smoking cessation</p> <p>Happy Ending is a smoking cessation programme that is one year long and consists of emails, access to webpages, interactive voice response, text messages, access to a cravings helpline and all of these included information about quitting smoking, dangers of smoking and strategies on how to stay abstinent. Participants were given free Nicotine Replacement Therapy to use as an additional intervention.</p> <p>Control group received self-help booklets containing general cessation information, a quit calendar and phone number from the national quitline</p>
Outcomes	self-reported abstinence at 6 and 12 months
Notes	OR= 1.86, 95% CI= 1.27, 2.92
Brendryen (2008/2)	
Methods	Recruitment through quit websites and advertisements in online newspapers
Participants	290 participants aged 18 years plus, 144 in the intervention group and 146 in the control group, willing to quit smoking, have access to the Internet and own a Mobile phone
Interventions	<p>Internet- and Mobile phone-based intervention in smoking cessation without Nicotine Replacement Therapy.</p> <p>Happy Ending is a smoking cessation programme and its duration is one year long. It consists of emails, access to webpages, interactive voice response, text messages and access to a craving helpline. All of these included information and strategies about how to quit and how to cope with cravings situations. Participants did not receive Nicotine Replacement Therapy additionally.</p> <p>Control group received self-help booklets 44 pages, containing general cessation information, a quit diary and the phone number from the national quitline</p>

Outcomes	self-reported abstinence at 6 and 12 months
Notes	OR= 1.66, 95% CI=0.99, 2.79
Elfeddali (2012)	
Methods	Recruitment through flyers, advertisements in local newspapers, online advertisements on website of national funds, advertisements on a national news page and the Dutch foundation for a Smoke free future
Participants	2031 participants aged 18 years plus, 1395 in the intervention group and 636 in the control group, motivated to quit smoking, willing to set a quit date, having access to the Internet and Emails
Interventions	Internet-based intervention for smoking cessation Stay quit for you (SQ4U) is a smoking cessation programme delivered using the Internet. It includes online assignments, questionnaires and information about dangers of smoking, the benefits of not smoking and motivational messages delivered via emails. Control group only filled out questionnaires and did not receive emails and intervention
Outcomes	self-reported abstinence at 12 months
Notes	OR= 1.95, 95% CI= 1.0, 2.6
Free (2009)	
Methods	Recruitment through radio, leaflets and poster advertisements
Participants	200 participants, aged 16 years plus, 102 in the intervention group and 98 in the control group, willing to quit smoking, own a Mobile phone
Interventions	Mobile phone-based intervention for smoking cessation Stop smoking with a Mobile phone (STOMP) is a six months long smoking cessation programme and consists of personal text messages including advice and support to help distract from craving and withdrawal symptoms. Five to six text messages per day sent for 4 weeks and in the maintenance stage reduced to one text message every fortnight. Quit Buddy and messages on demand were available. Control group received one text message per fortnight
Outcomes	self- reported and biochemically verified abstinence at 6 months
Notes	OR= 1.28, 95% CI= 0.46, 3.56

Free (2011)	
Methods	Recruitment through radio, leaflets and poster advertisements
Participants	5800 participants, aged 16 years plus, 2915 in the intervention group and 2885 in the control group, willing to quit smoking and own a Mobile phone
Interventions	Mobile phone-based intervention for smoking cessation Six months smoking cessation programme in which participants received five text messages for the first 3 weeks, then three text messages per week for 26 weeks. A total of 156 text messages were sent including information, motivational support and advice to help participants stay abstinent. Participants could text lapse for urgent advice and peer support.
Outcomes	Control group received simple short messages on a fortnightly basis self-reported and biochemically verified abstinence at 6 months
Notes	OR= 2.20, 95% CI= 1.8, 2.68
Haug (2011)	
Methods	Recruitment patients from Rehabilitation centres
Participants	477 participants aged 18 years plus, 242 in the intervention group and 235 in the control group, willing to quit smoking and having access to the Internet and Emails
Interventions	Internet-based intervention for smoking cessation Rauchberatung de. is a smoking cessation programme that is delivered through the Internet and consists of information and advice available on message boards online, websites, questionnaires and emails. Buddy support was available. Emails included motivational messages and advice on how to stay abstinent.
Outcomes	Control group received information and advice on background information Self-reported abstinence at 6 months
Notes	OR =2.20, 95% CI=1.1, 3.8
Haug (2013)	
Methods	Recruitment through Rehabilitation Centres
Participants	755 participants aged 18 years plus, 372 in the intervention group and 383 in the control

Interventions	<p>group, willing to quit smoking and own a Mobile phone</p> <p>Mobile phone-based intervention for smoking cessation</p> <p>SMS Quit Coach is a smoking cessation programme that includes text messages at least three times a week, two text messages per week for 3 months and messages include motivational support, information about dangers of smoking, benefits of staying abstinent and strategies on how to cope with cravings.</p>
Outcomes	Control group received no text messages
Notes	self-reported abstinence at 6 months
Notes	OR= 1.18, 95% CI= 0.81, 1.72
McKay (2008)	
Methods	Recruitment through the Internet including advertisements on Google and Yahoo search engines and links to relevant sites
Participants	2318 participants aged 18 years plus, 1159 in the intervention group and 1159 in the control group, interested in quitting and have access to the Internet and Emails
Interventions	<p>Internet-based intervention for smoking cessation</p> <p>Quit Smoking Network (QSN) is a smoking cessation programme that consists of motivational emails, access to a website that provides advice and strategies on how to cope with cravings and how to stay abstinent and includes a web forum for advice and buddy support.</p>
Outcomes	Control group received factsheets about dangers of smoking and how to quit but no buddy support and emails
Notes	self-reported abstinence at 6 months
Notes	OR= 1.08, 95% CI=0.84, 1.42
Rodgers (2005)	
Methods	Recruitment through advertisements at tertiary institutions, from quitlines and cancer societies
Participants	1705 participants aged 15 years plus, 852 in the intervention group and 853 in the control group, willing to quit smoking and own a Mobile phone
Interventions	<p>Mobile phone-based intervention for smoking cessation</p> <p>Do you smoke after text intervention consists</p>

<p>Outcomes</p> <p>Notes</p>	<p>of regular personalized text messages three times per week which include information and advice about smoking, support and motivational messages to help participants stay abstinent and distract them from cravings for a cigarette. Messages on demand were available additionally.</p> <p>Control group received one text message per fortnight</p> <p>self-reported abstinence a 6 months</p> <p>OR= 1.50, 95% CI= 0.92, 2.44</p>
<p>Seidman (2010)</p>	
<p>Methods</p> <p>Participants</p> <p>Interventions</p> <p>Outcomes</p> <p>Notes</p>	<p>Recruitment through quitlines and cancer societies</p> <p>2153 participants aged 18 years plus, 1106 in the intervention group and 1047 in the control group who had access to the Internet and Emails</p> <p>Internet-based intervention for smoking cessation</p> <p>Participants were provided with a link to access an interactive website for information and to complete a series of exercises to help reinforce the motivation to quit and stay abstinent. Emails included advice and strategies how to cope with triggers for a cigarette.</p> <p>Control group had access to a non-interactive website containing downloadable self-help booklets</p> <p>self-reported abstinence at 6 and 13 months</p> <p>OR= 1.44, 95% CI= 1.06, 1.96</p>
<p>Skov-Ettrup (2014)</p>	
<p>Methods</p> <p>Participants</p> <p>Interventions</p>	<p>Recruitment through quitlines and cancer societies</p> <p>2030 participants aged 15 years plus, 1055 in the intervention group and 975 in the control group who owned a Mobile phone</p> <p>Mobile phone-based intervention for smoking cessation</p> <p>Xhalke.dk is a smoking cessation programme which includes Mobile phone-based components. Participants received two daily text messages including advice on how to cope with specific situations</p> <p>Control group received weekly text messages</p>

Outcomes	self-reported abstinence at 12 months
Notes	OR= 1.28, 95% CI= 0.91, 2.08
Wangberg (2011)	
Methods	Recruitment through quit websites
Participants	2298 participants aged 16 years plus, 1171 in the intervention group and 1127 in the control group, willing to quit and access to the Internet and Emails
Interventions	Internet-based intervention for smoking cessation This smoking cessation programme is based on general advice including dangers of smoking, benefits of non smoking, a discussion forum with information and advice, an personalized online cessation diary and motivational messages delivered through email. Buddy support and private chat was available. Control group received Internet intervention but no email contact
Outcomes	self-reported abstinence at 6 and 12 months
Notes	RR= 0.96, 95% CI= 0.66, 1.40
Zbikowski (2011)	
Methods	Recruitment through quit websites, advertisements in online newspapers, quitline, cancer society advertisements and referrals from the GP
Participants	1198 participants aged 18 years plus, 797 in the intervention group and 401 in the control group, willing to quit, own a telephone and have access to the Internet
Interventions	Internet-based intervention with additional telephone calls for smoking cessation This smoking cessation programme includes a website consisting of interactive tools, a discussion forum, personalized emails containing advice and motivational messages, five one on one telephone calls for 7 days and 21 days. Control group received only telephone calls but had no access to the website
Outcomes	self-reported abstinence at 6 months
Notes	OR= 1.19, 95% CI= 1.08, 1.31

Table.18 Summary of Findings Table of all studies included

Internet and Cell phone-based interventions compared to all other interventions and those including Internet and Cell phone for smoking cessation						
Patient or population: patients with smoking cessation						
Settings:						
Intervention: Internet and Cell phone-based interventions						
Comparison: all other interventions and those including Internet and Cell phone						
Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No. of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk All other interventions and those including Internet and Cell phone	Corresponding risk Internet and Cell phone-based interventions				
Internet & Cell phone: 7 days point prevalence self-report Follow-up: 6-12 months	Study population					
	465 per 1000	465 per 1000 (442 to 493)	RR 1.00 (0.95 to 1.06)	5705 (5 studies)	⊕⊕⊕⊕ low ¹	
	Moderate					
Internet & Cell phone: 7 days point prevalence self-report & biochemically verified Follow-up: 6-12 months	Study population					
	901 per 1000	955 per 1000 (937 to 973)	RR 1.06 (1.04 to 1.08)	8031 (3 studies)	⊕⊕⊕⊕ moderate ^{1,2}	
	Moderate					
Internet ,Cell phone, NRT & Telephone Calls: 7 days point prevalence self-report Follow-up: 6-12 months	Study population					
	367 per 1000	285 per 1000 (249 to 326)	RR 0.78 (0.68 to 0.89)	1594 (2 studies)	⊕⊕⊕⊕ high	
	Moderate					
Internet & Cell phone: 7 days & 30 days point prevalence self-report Follow-up: 6-12 months	Study population					
	382 per 1000	371 per 1000 (344 to 401)	RR 0.97 (0.90 to 1.05)	4183 (2 studies)	⊕⊕⊕⊕ high	
	Moderate					
Internet & Cell phone vs. Internet & Cell phone (lower frequency) self-report Follow-up: 6-12 months	Study population					
	573 per 1000	580 per 1000 (566 to 593)	RR 1.01 (0.99 to 1.03)	15851 (5 studies)	⊕⊕⊕⊕ moderate ^{2,3,4,5}	
	Moderate					

*The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

CI: Confidence interval; RR: Risk ratio;

GRADE Working Group grades of evidence

High quality: Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low quality: We are very uncertain about the estimate.

¹ Allocation Concealment Bias

² Incomplete Outcome Data Bias

³ Incomplete Outcome Data Bias

⁴ Incomplete Outcome Data Bias

⁵ Incomplete Outcome Data Bias

Table.19 Assessment of Bias in studies included

TRIAL	RANDOM SEQUENCE GENERATION	ALLOCATION CONCEALMENT	INCOMPLETE OUTCOME DATA	BLINDING
Borland (2013)	Computerized number generator within baseline survey	Participants were told what study is about, then randomized to conditions	Loss to follow up: n=475 (13% total) at 7 months	Participants were told what study is about, then randomized to conditions
Brendryen (2008)	Computerized Randomization	Names & identities of participants were concealed until after assignment to condition	Loss to follow up: n= 9 (n=6 control, n=3 intervention) at 4 weeks, n=55 (n=31 control, n=24 intervention) at 6 months	Double Blind
Brendryen (2008/2)	Computerized randomization	Names & identities of participants were concealed until after assignment to conditions	Loss to follow up: n=24 (n=19 control, n=5 intervention) at 4 weeks, n=64 (n=38 control, n=26 intervention) at 6 months	Double Blind

Elfeddali (2012)	Computer-generated randomization	Computerized assignment	Lost to follow up: high losses n=202 control, n=364 intervention	
Free (2009)	Computerized randomization	Concealed until after assignment	Lost to follow up: n=5 at 4 weeks, 98% follow-up, n=16 (n=8 control, n=8 intervention) at 6 months	Single blind
Free (2011)	Telephone-randomization	Concealed until after assignment	Lost to follow up: less than 5%. n=92 control, n=176 intervention	Single Blind
Haug (2011)	Randomized by week of attendance based on randomization list	Recruiting staff was aware of condition participants were allocated to	Follow up assessments: n=217 (92%) control, n=214 (85%)intervention	
Haug (2013)	Computer-generated randomization	Randomization list to ensure equal assignment to conditions	Lost to follow up: n=111 control, n=85 intervention	Single Blind
McKay (2008)	Computerized randomization	Not described however recruitment is automated	Follow up: 27% provided data at 3 and 6 months	
Rodgers (2005)	Computerized	Concealed until after	Lost to follow up: n=35 control, n=46 intervention at	Single Blind

	randomization	assignment	6 weeks, 95.9% and 94.6%, 79% control vs 69% intervention at 6 months OTHER BIAS explained in Risk of Bias Assessment Description	
Seidman (2010)	Computerized randomization	Assignment done via Quitlink	Lost to follow up: n=30 at 4 months, n=98 at 6 months, n=13 months, response rate: 38.4% in control, 37.7% in intervention.	
Skov-Ettrup (2014)	Computerized randomization	Concealed until after assignment	Response rate at 12 months: 36.3%, control, 38.1% intervention	Single Blind
Wangberg (2011)	Computerized randomization	Computerized allocation	High losses to follow up n=116 of 419, response rate 27.7% in intervention, n=128 of 428, response rate 29.9% at 12 months	
Zbikowski (2011)	Computerized randomization	Computerized allocation	Response rate: 74.2% at 6 months,	

Table.20 Characteristics of excluded studies with reasons for exclusion

Author	Reason for Exclusion
Abroms, L. (2008).	A formative evaluation
Akers, L. (2007).	Assessed cost-effectiveness of self-help smokeless tobacco cessation programmes
An, Lawrence, C. (2008)	Assessed & identified strategies for improving outcomes for web-assisted cessation
Aveyard, P. (2007).	Assessed behavioural support in smoking cessation
Balmford, J. (2009).	Not a Randomized Controlled Trial
Bancej, C. (2007).	Review
Bialous, S. (2009).	Description of relationships among demographic & smoking characteristics
Bock, B. (2008).	Review
Boudreaux, E. (2012).	Development & evaluation of computer-assisted cessation
Bramley, D. (2005).	assessed 6 weeks abstinence
Burri, M. (2006).	Analysis
Carmody (2008)	Assessed Hypnosis
Chen, H. (2006).	Assessed 6 weeks abstinence
Civljak, M. (2010)	Meta-Analysis
Diaz-Gete, L. (2013)	Study Protocol
Elfeddali, T. (2012)	Assessed 6 weeks abstinence
Etter, J.F (2005)	Assessed at 2.5 months
Etter, J.F (2006)	Identifies most popular websites
Etter, J.F (2006/2)	Review
Frazer, T. (2010)	Not a Randomized Controlled Trial
Gordon, J. (2013)	Assessed 3 months abstinence
Graham,A. (2007)	Not a Randomized Controlled Trial
Harrington, K. (2012)	Study Protocol
Haug, S. (2009)	Study Protocol
Haug, S. (2012)	Study Protocol
Hotta, K. (2007)	Not a Randomized Controlled Trial
Houston, T.K. (2008)	Compared email reminders
Houston, T.K. (2010)	Evaluates intervention to increase implementation of brief provider advice
Houston, T. (2013)	assessed quality improvements of email reminders
Hutton, H. (2011)	Review
Japuntich, S. (2006)	Wrong comparison

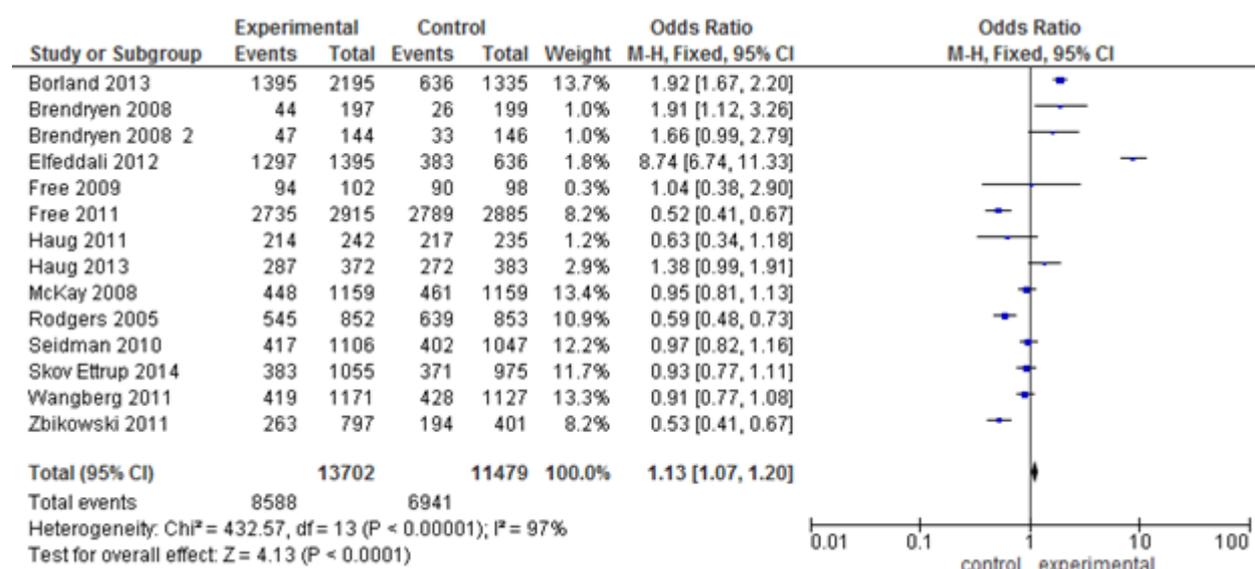
Klatt, C. (2008)	Not a Randomized Controlled Trial
Kramer, J. (2009)	Study Protocol
Laan, (2012)	Study Protocol and assessed health risks
McClure, J. (2013)	Assessed 3 months abstinence
McDonnell, D. (2011)	Assessed 1 month abstinence
Meredith, S. (2011)	Not a Randomized Controlled Trial
Mermelstein, R. (2006)	Assessed 3 months abstinence
Miguez, M. (2006)	Assessed self-help programmes, no Internet
Munoz, R. (2006)	Assessed 3 months abstinence
Myung, S. (2009)	Meta-Analysis
Nagler, R. (2012)	Did not assess abstinence in smoking
Naughton, F. (2012)	Assessed 3 months abstinence
Norman, C. (2008)	Wrong comparison
Obermayer, J. (2004)	Assessed 6 weeks abstinence
Oenema, A. (2008)	Assessed 1 month abstinence
Ota, A. (2005)	Assessed 1 month abstinence
Patten, C. (2006)	Incomplete Data
Pike, K. (2007)	Follow up at 3 months
Rabius, (2008)	Incomplete Data
Ramo (2012)	Survey
Riley, (2008)	Assessed 6 weeks abstinence
Rooke (2010)	Meta-Analysis
Sadasivam, (2011)	Assessed barriers and facilitators of e-referral system
Sarna (2009)	Not a Randomized Controlled Trial
Saul (2007)	Not a Randomized Controlled Trail
Schmelz (2010)	Evaluates impact of semester long course to promote tobacco counseling
Schumann (2008)	Assessed Computer-tailored intervention but no internet
Severi (2011)	Evaluated the effect of written information regarding participation to society
Severson (2008)	Incomplete Data
Shabab (2009)	Review
Smit (2012)	Assessed abstinence at 5 months
Smolkowski (2010)	Examined methods to impute missing outcome from tobacco intervention
Stanczyk (2011)	Assessed description and design of intervention
Stoddard, J.(2005)	Not an Randomized Controlled Trial
Stoddard, J. (2006)	Assessed smoking cessation

	programmes and resources for better design of one
Stoddard, J. (2006/2)	Not an Randomized Controlled Trial
Stroops, W. (2009)	Wrong comparison
Strecher, V. (2005)	Assessed abstinence at 12 weeks
Strecher, V. (2006)	Assessed abstinence at 12 weeks
Strecher, V. (2008)	Identified psychosocial and communication components
Sutton, S. (2007)	Assessed telephone interventions
Te Poel,F. (2009)	Not a Randomized Controlled Trial
Terry (2011)	Telephone-based intervention
Unrod, M. (2007)	Assessed computer programmes but no internet or Cell phone
Ussher, M. (2011)	Assessed self-help interventions
Vajer, P. (2011)	Assessed psychometric properties and validity of smoking dependence
Valdivieso-Lopez, E. (2013)	Study Protocol
Walters, S. (2006)	Review
Whittaker, R. (2011)	Incomplete Data
Woodruff, S. (2007)	Assessed abstinence at 6 weeks
Ybarra, M. (2012)	Assessed 3 months abstinence

4.5 Forest Plot of All Included Studies

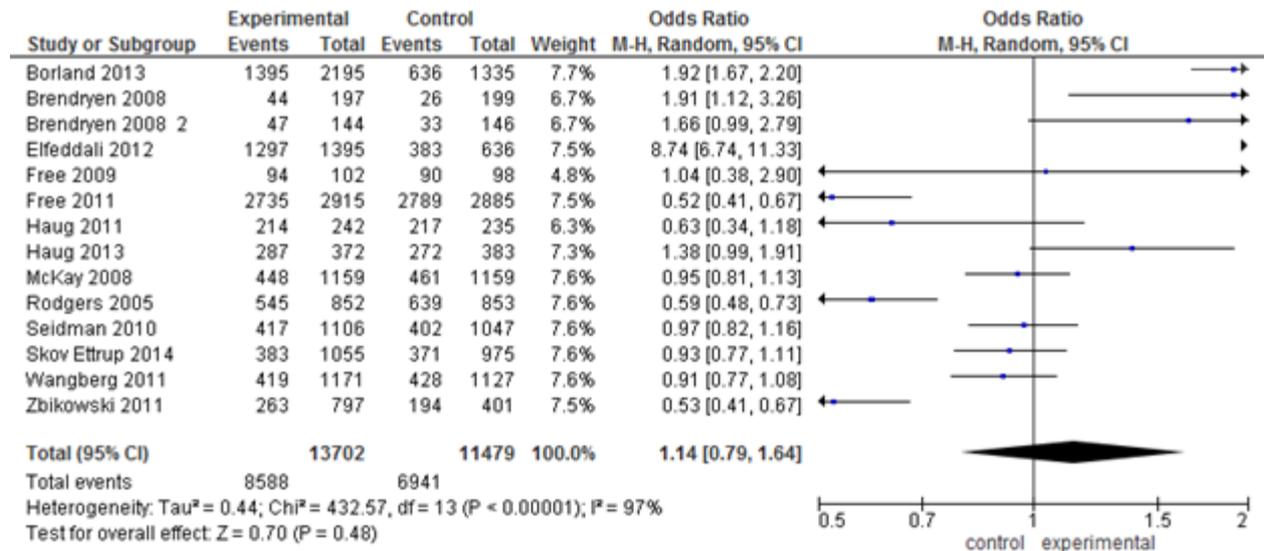
4.5.1 Fixed Effects-Analysis of all included studies

Table.21/ Fig.9 Forest plot of Comparison 1. of all included studies: Internet- and Mobile phone-based interventions for smoking cessation, outcome: 7 days and 30 days point prevalence, self-reported abstinence.



4.5.2 Random- Effects Analysis of all included studies

Table.22/ Fig.10. Forest plot of Comparison 2. of all included studies: Internet- and Mobile phone-based interventions for smoking cessation, outcome: 7 days and 30 days point prevalence, self-reported abstinence.



4.6 Forest Plots of Subgroup Analyses

Table.23/ Fig.11 Forest plot of Comparison for Subgroup 1: Internet- and Mobile phone-based interventions for smoking cessation, outcome: 7 days point prevalence, self-reported abstinence.

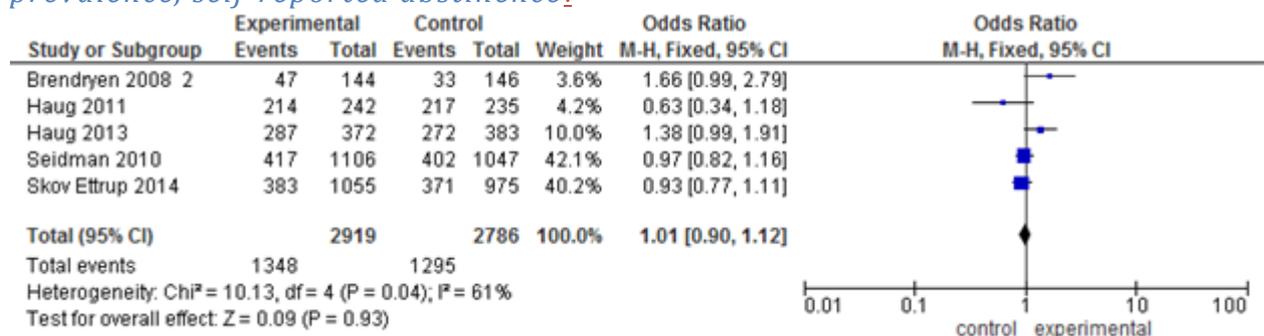


Table.24 / Fig.12 Forest plot of Comparison for Subgroup 2: Internet-and Mobile phone-based interventions for smoking cessation, outcome: 7 days point prevalence, self-reported abstinence, salivary cotinine and carbon monoxide testing.

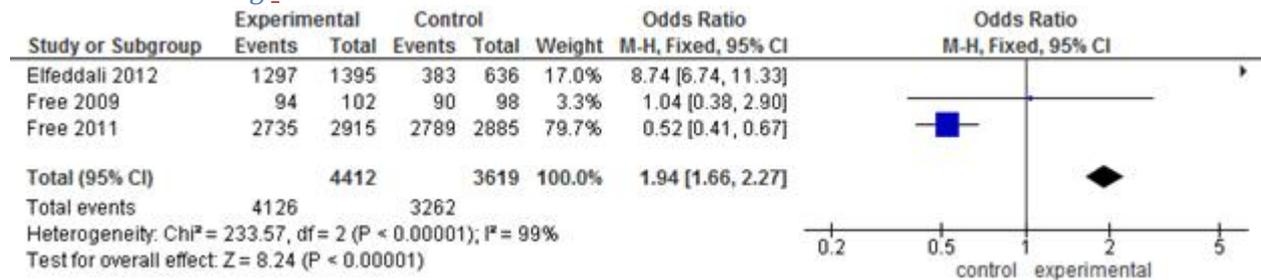


Table.25 / Fig.13 Forest plot of Comparison for Subgroup 3: Internet-and Mobile phone-based interventions for smoking cessation, outcome: 7 days point prevalence, self-reported abstinence, additional Nicotine Replacement Therapy or Telephone Calls.

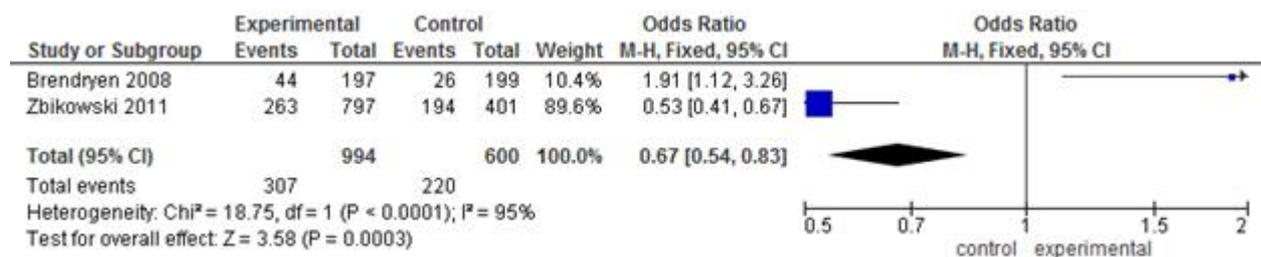


Table.26 / Fig.14 Forest plot of Comparison for Subgroup 4: Internet-and Mobile phone-based interventions in smoking cessation, outcome: 7 days and 30 days point prevalence, self-reported abstinence.

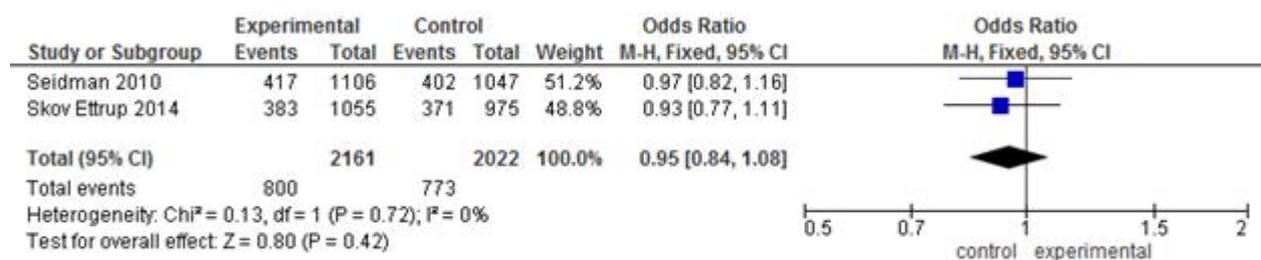
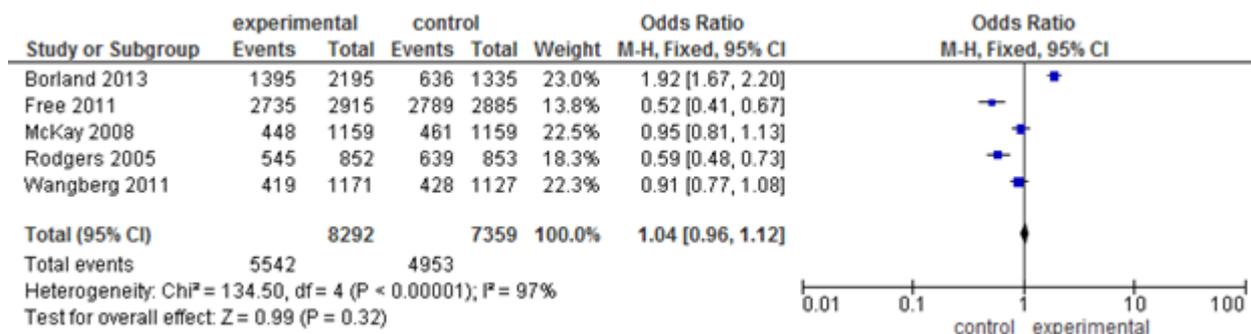


Table.27/ Fig.15 Forest plot of comparison for Subgroup 5: Internet-and Mobile phone-based interventions in smoking cessation, outcome: Comparison group also received Internet-and Mobile phone-based interventions at lower frequency.



4.7 Funnel Plots of Fixed-Effects & Random-Effects Analysis to examine Publication Bias

Fig.16 Funnel plot of Comparison 1.of all included studies: Internet-and Mobile phone-based interventions for smoking cessation, outcome: 7 days and 30 days point prevalence, self-reported abstinence. (Fixed-effects-Method)

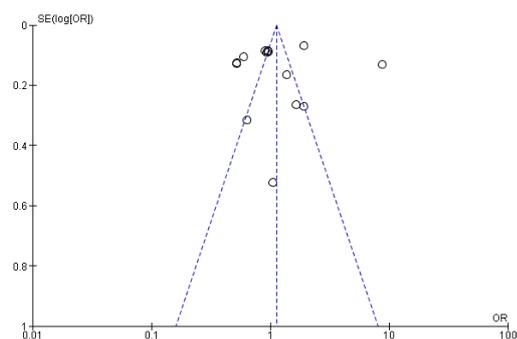
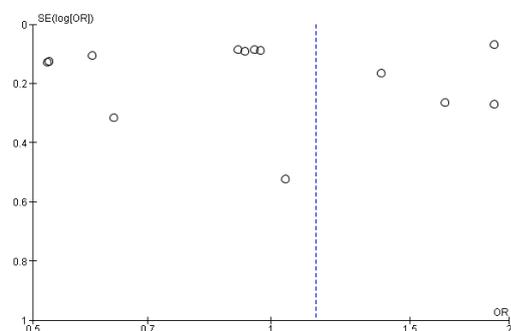


Fig.17 Funnel plot of Comparison 2.of all included studies: Internet-and Mobile phone-based interventions for smoking cessation, outcome: 7 days and 30 days point prevalence, self-reported abstinence. (Random-effects Method)



4.8 Description of the Results

4.8.1 Effects of Interventions

Comparison 1. overall analysis of Internet-and Mobile phone-based interventions inclusive of additional Nicotine Replacement Therapy or Telephone calls compared with all other interventions including Internet-and Mobile phone-based interventions delivered at a lower frequency, outcome: 7 days & 30 point days point prevalence, self-reported & biochemically validated abstinence of smoking:

Gross heterogeneity was found among the studies and due to this further subgroup analyses were conducted to further investigate these results. Findings from the Mantel-Haenszel Fixed-Effects Method as well as the Random-Effects Method suggest gross heterogeneity exists among the included studies ($I^2 = 97\%$). Whereas findings from the Fixed-Effect Method Analysis suggest that interventions which include the Internet or Mobile phone may achieve longer-term abstinence of smoking among adolescent and adult smokers (Table.21)

Five studies suggest that Internet- and Mobile phone-based interventions can be effective to help people stay abstinent longer-term: Borland (2013) [OR=1.92, 95% CI: 1.67, 2.20], Brendryen (2008) [OR=1.91, 95% CI: 1.12, 3.26], Brendryen (2008/2) [OR=1.66, 95% CI: 0.99, 2.79], Elfeddali (2012) [OR=8.74, 95% CI: 6.74, 11.3] and Haug (2013) [OR=1.38, 95% CI: 0.99, 1.91]. Five studies suggest there is a tendency that interventions, which include the Internet or Mobile phone may work however it is uncertain: Free (2009) [OR=1.04, 95% CI: 0.38, 2.90], McKay (2008) [OR=0.95, 95% CI: 0.81, 1.13], Seidman (2010) [OR=0.97, 95% CI: 0.82, 1.16], Skov-Ettrup (2014) [OR=0.93, 95% CI: 0.77, 1.11] and Wangberg (2011) [OR=0.91, 95% CI: 0.77, 1.08].

However, Free (2011) [OR=0.52, 95% CI: 0.41, 0.67], Haug (2011) [OR=0.63, 95% CI: 0.34, 1.18], Rodgers (2005) [OR=0.59, 95% CI: 0.48, 0.73] and Zbikowski (2011) [OR=0.53, 95% CI: 0.41, 0.67] suggest that other interventions work better than Internet and Mobile phone-based interventions (Table.21; Table.22).

The findings from both the Fixed-Effects Method Analysis (OR=1.13, 95% CI: 1.07, 1.20) and Random-Effects Method Analysis (OR=1.14, 95% CI: 0.79, 1.64) of all fourteen included studies showed gross heterogeneity among studies exists and therefore it is unclear whether these interventions work ($I^2=97\%$). Borland (2013) presents the biggest weight with 13.7% towards the total result of this Analysis and suggests that Internet-and Mobile phone interventions can be effective longer-term, however McKay (2008) with 13.4%, Wangberg (2011) with 13.3%, Seidman (2010) with 12.2% and Skov-Ettrup (2014) with 11.7% add very similar weight towards the total effect (OR=1.14; 95% CI: 0.79, 1.64; $p=0.48$) of this Analysis and these suggest that Internet- and Mobile phone-based interventions may work or may not work but it is uncertain (Fig.9; Fig.10).

However five different subgroups were created and for each group an analysis has been conducted to further investigate this heterogeneity and to gain satisfactory evidence about whether Internet- and Mobile phone-based interventions work.

Subgroups

Comparison of Subgroup 1. Internet-and Mobile phone-based interventions compared with all other interventions; Outcome: 7 days point prevalence, self-reported abstinence of smoking:

Five trials Brendryen (2008/2), Haug (2011), Haug (2013), Seidman (2010) and Skov-Ettrup (2014) were combined for the Analysis of Subgroup 1. Brendryen (2008/2) assessed Internet- and Mobile phone-based interventions compared with general care and self-help whereas

Haug (2013) and Skov-Ettrup (2014) both assessed Cell phone-based intervention as standalone intervention although Haug (2013) included general care and self-help as comparison while Skov-Ettrup (2014) used Mobile phone-based interventions which were delivered at lower frequency as comparison. Moreover Seidman (2010) and Haug (2011) both assessed Internet-based intervention as standalone intervention however Seidman (2010) included the Internet at a lower frequency in its control group, on the other hand Haug (2011) used general care and self-help as comparison.

Findings from this analysis suggest that the use of emails, access to webpages and the use of text messages used in smoking cessation programmes can be effective in achieving longer term abstinence of smoking when compared to general care and self-help interventions – Brendryen (2008/2) [OR=1.66, 95% CI: 0.99, 2.79]. Furthermore an Mobile phone-based intervention used as a standalone intervention compared to general care and self-help can also be effective to achieve longer term abstinence of smoking- Haug (2013) [OR=1.38, 95% CI: 0.99,1.91]. Other findings from this analysis propose that Internet- or Mobile phone-based interventions used as standalone interventions may be effective if compared with Internet- or Mobile phone-based interventions delivered at a lower frequency, however to which extent they can be effective to achieve longer term abstinence of smoking is unclear- Seidman (2010) [OR=0.97, 95% CI: 0.82, 1.16], Skov-Ettrup (2014) [OR=0.93, 95% CI: 0.77, 1.11]. Although this analysis included one study which suggests that if an Internet –based intervention is used as a standalone intervention and compared with general care and advice of a smoking cessation intervention it is not effective-Haug (2011) [OR=0.63, 95% CI: 0.34,1.18].

Overall findings from this comparison suggest that Internet- and Mobile phone-based interventions combined can be the most effective in achieving longer term (6 months or

more) abstinence of smoking, however it needs to be considered that moderate heterogeneity was found among these trials ($I^2= 61\%$) as shown in Table.23.Seidman (2010) with 42.1% adds the biggest weight to the overall result (OR=1.01; 95% CI: 0.90, 1.12; $p=0.93$) of this Analysis very closely followed by Skov-Ettrup (2014) with 40.2% and both suggest that it is unclear whether Internet-and Mobile phone interventions can work longer-term (Fig.11).

Comparison of Subgroup 2. Internet-and Mobile phone-based interventions compared with all other interventions, Outcome: 7 days point prevalence, self-reported & biochemically validated abstinence of smoking

Three trials Elfeddali (2012), Free (2009) and Free (2011) were included for this Analysis of Subgroup 2. Elfeddali (2012) assessed an Internet-based intervention used as a standalone intervention compared with general care and self-help. Free (2009) as an alternative assessed a Cell phone-based intervention used as a standalone intervention however compared with an Cell phone-based intervention delivered at a lower frequency.

Furthermore, Free (2011) assessed an Cell phone-based intervention and also compared this one to another Cell phone-based intervention which was delivered at a lower frequency.

Findings from this analysis suggest that motivational messages delivered through email and access to online questionnaires and webpages when compared to general care and self-help can be effective in achieving longer term abstinence of smoking-Elfeddali 2012 (OR=8.74, 95% CI: 6.74, 11.33). Additional findings indicate that an Cell phone-based intervention used as a standalone intervention and compared with another Cell phone-based intervention that is similar to the main intervention but delivered at a lower frequency can be effective in achieving longer-term abstinence of smoking.-Free 2009 (OR=1.04, 95% CI: 0.38, 2.90).

However, some other findings suggest that when an Cell phone-based intervention is compared to another Cell phone-based intervention but the second one differs from the first one then it is not effective.-Free 2011 (OR=0.52, 95% CI: 0.41, 0.67).

Overall findings from this comparison suggest that Internet-based interventions used as a standalone intervention when compared to general care or self-help can be effective in achieving longer term abstinence of smoking, however these results need to be considered critical as high heterogeneity was found among these studies ($I^2=99\%$). Free (2011) with 79.7% adds the biggest weight to the overall result (OR=1.94; 95% CI: 1.66, 2.27; $p<0.00001$) (Fig.12).

Comparison of Subgroup 3. Internet-and Mobile phone-based interventions inclusive of additional Nicotine Replacement Therapy & Telephone Calls, Outcome: 7 days point prevalence, self-reported abstinence of smoking:

Two trials Brendryen (2008) and Zbikowski (2011) were included for this Analysis of Subgroup 3. Brendryen (2008) assessed an Internet-and Mobile phone-based intervention in which participants were offered Nicotine Replacement Therapy in addition to the Internet-and Mobile phone-based intervention compared with general care and self-help. While Zbikowski (2011) assessed an Internet-based intervention in which participants received additional telephone calls compared to an intervention where participants only received the telephone calls and had no access to the Internet.

Findings of this analysis suggest that Internet-and Mobile phone-based interventions with Nicotine Replacement Therapy offered in addition to the intervention compared with general care and self-help can be effective in achieving longer term abstinence of smoking.-

Brendryen (2008) [OR= 1.91, 95% CI: 1.12, 3.26]. However, Internet-based interventions with telephone calls offered in addition to the intervention compared to an telephone calls only intervention suggest not to be effective as telephone calls only in this case seems to work better.-Zbikowski 2011 (OR=0.53, 95% CI: 0.41, 0.67).

Overall findings from this comparison suggest that Internet-and Mobile phone-based interventions with Nicotine Replacement Therapy added in addition to the intervention compared to general care and self-help can be more effective in achieving longer-term abstinence of smoking. However, there has been high heterogeneity found among these studies ($I^2= 95\%$). Zbikowski (2011) with 89.6% presents the biggest weight towards the overall effect (OR=0.67; 95% CI: 0.54, 0.83; $p=0.0003$) and suggests that interventions offered to control group work better (Fig.13).

Comparison of Subgroup 4. Internet-and Mobile phone-based interventions compared with all other interventions, Outcome: 7 days point prevalence & 30 days Prevalence, self-reported abstinence

Two trials Seidman (2010) and Skov-Ettrup (2014) were included for this Analysis of Subgroup 4. Seidman (2010) assessed an Internet-based intervention used as a standalone intervention compared with another Internet-based intervention which was delivered at a lower frequency. Skov-Ettrup (2014) assessed an Mobile phone-based intervention as a standalone intervention compared to another Mobile phone-based intervention which was delivered at a lower frequency.

Findings from both trials of this analysis are similar. However both trials suggest that their control groups with lower frequency interventions were more effective at achieving abstinence of smoking- Seidman 2010 (OR=0.97, 95% CI: 0.82, 1.16), Skov-Ettrup 2014 (OR= 0.93, 95% CI: 0.77, 1.11). There was no heterogeneity found among these trials ($I^2= 0\%$). Seidman (2010) with 51.2% adds the biggest weight, closely followed by Skov-Ettrup (2014) with 48.8% towards the overall result of this Analysis (OR=0.95; 95% CI: 0.84, 1.08; $p=0.42$) and these suggest that it is uncertain whether Internet-and Mobile phone interventions work longer-term (Fig.14).

Comparison of Subgroup 5. Internet-and Mobile phone-based interventions compared with Internet -and Mobile phone-based interventions at lower frequency, Outcome: 7 days point prevalence, self-reported abstinence of smoking

Five trials Borland (2013), Free (2011), McKay (2008), Rodgers (2005) and Wangberg (2011) were included for this Analysis of Subgroup 5. Borland (2013) assessed an Internet-and Mobile phone-based intervention compared with an Internet-based intervention which was delivered at a lower frequency. Free (2011) assessed and Mobile phone-based intervention compared with another Mobile phone-based intervention which was delivered at a lower frequency. Whereas McKay (2008) assessed an Internet-based intervention compared to another Internet-based intervention. Rodgers (2005) assessed Mobile phone-based interventions compared to Mobile phone-based interventions. Wangberg (2011) assessed Internet-based interventions compared to Internet interventions without email.

Findings from this analysis suggest that Internet-and Mobile phone-based interventions are most effective when combined-Borland 2013 (OR=1.92, 95% CI: 1.67, 2.20). Internet-based interventions compared with other internet intervention they may work –McKay 2008 (OR=0.95, 95% CI: 0.81, 1.13), Wangberg 2011 (OR=0.91, 95% CI: 0.77, 1.08). less frequency text messages in control work better-Rodgers 2005 (OR=0.59, 95% CI: 0.48, 0.73), Free 2011 (OR=0.52, 95%CI: 0.41, 0.67). Heterogeneity ($I^2=97%$) was found among these studies and Borland (2013) with 23% adds the biggest weight towards the total effect (OR=1.04; 95% CI: 0.96, 1.12; $p=0.32$) and suggests Internet-and Mobile phone interventions work longer-term, however McKay (2008) with 22.5% and Wangberg (2011) with 22.3% followed closely and suggest uncertainty exists (Fig.15).

A summary of findings table was created for all these findings (Table.18)

Chapter 5: Discussion and Conclusion

5.1. Overview

This chapter presents a summary of the main findings of this Meta-Analysis, the strengths and limitations of this research, Agreements and Disagreements compared to other trials and reviews, information about Implication of Practice and recommendations for future research.

5.2 Summary of main findings

Fourteen randomized controlled trials were included in this Meta-Analysis of which the earliest was published in 2005 (Rodgers, 2005) and the latest in 2014 (Skov-Ettrup, 2014). Samples sizes among included studies varied between 200 participants (Free, 2009) and 5800 participants (Free, 2011). Interventions included in this research were a variety of different Internet- and Mobile phone-based interventions. One trial (Brendryen, 2008/2) investigated the effectiveness of an intervention which combined Internet- and Mobile phone-based interventions and included additional Nicotine Replacement Therapy compared with usual care or self-help; another trial (Brendryen, 2008) assessed interventions which combined Internet- and Mobile phone-based components compared to usual care and self-help; moreover another study (Borland, 2013) investigated Internet- and Mobile phone-based components combined compared with Internet-intervention delivered at lower frequency. Zbikowski (2011) assessed an Internet-based intervention with additional telephone calls compared to only telephone calls intervention and furthermore Haug (2011) investigated the Internet as a standalone intervention when compared with usual care or self-help, whereas Haug (2013) assessed a Mobile phone-based standalone intervention compared with usual care and self-help. Eight interventions investigated the effects of Internet or Mobile phone-based interventions when compared with same interventions however delivered at lower

frequency: Four of these trials assessed an Internet-based intervention compared with an Internet-based intervention which was delivered at lower frequency (Elfeddali, 2012; McKay, 2008; Seidman, 2010; Wangberg, 2011), whereas four trials investigated an Mobile phone-based intervention compared to another Mobile phone-based intervention delivered at lower frequency (Free, 2009; Free, 2011; Rodgers, 2005; Skov-Ettrup, 2014).

Overall findings from this Meta-Analysis suggest that Internet- and Mobile phone-based interventions can be effective. Five studies (Borland, 2013; Brendryen, 2008; Brendryen, 2008/2; Elfeddali, 2012; Haug, 2013) suggest that Internet- and Mobile phone-based interventions can be effective to help people stay abstinent of smoking longer-term (6 months or longer), whereas five studies (Free, 2009; McKay, 2008; Seidman, 2010; Skov-Ettrup, 2014; Wangberg, 2011) indicate that there is a chance that Internet-and Mobile phone-based interventions may work to achieve longer-term abstinence of smoking, however these results are uncertain to which extent. There are four studies (Free, 2011; Haug, 2011; Rodgers, 2005; Zbikowski, 2011) which reported that other interventions which either included Internet- or Mobile phone but delivered at lower frequency and other interventions inclusive of telephone only interventions had greater effects on abstinence.

Gross heterogeneity was found in both overall analyses which included all 14 trials ($I^2=97\%$) therefore five subgroups were conducted to further investigate this heterogeneity. Findings from the subgroup analyses suggest that Internet-and Mobile phone-based interventions are effective to achieve longer-term abstinence of smoking among chronic smokers (Borland, 2013) however findings also suggest that to achieve longer-term abstinence of smoking (6 months or more and close to 12 months) Internet- and Mobile phone-based interventions alone are not sufficient and additional interventions inclusive of Nicotine Replacement Therapy are needed (Brendryen, 2008).

Findings support our hypotheses however gross heterogeneity was found among most analyses and there were a few issues with trials included so therefore results do have to be viewed with caution.

5.3 Quality of Evidence

Most trials included in this review relied on self-reported data from participants. Biochemical validation was attempted in only three trials (Elfeddali, 2012; Free, 2009; Free, 2011).

However, the Society for Research on Nicotine & Tobacco subcommittee on biochemical verification in clinical trials considers that verification is not necessary when a trial includes a large community-based population with limited face-to face contact and where optimal data collection methods are conducted through mail, telephone or the Internet. The Society however does recommend that biochemical verification be used in trials of smoking cessation programmes which include a special population inclusive of adolescents (SRNT, 2002).

There were some other issues discovered when conducting this Meta-Analysis and these are explained below.

Conducting research via the Internet or Mobile phone provides opportunities to generate very large sample sizes but it is also methodologically challenging because of threats to internal and external validity inclusive of selection bias (Feil, 2003). There were limited details about the procedure for sequence generation and allocation concealment among studies included in our Meta-analysis and although we judged the likelihood of selection bias was small in those trials which recruited participants online, however we couldn't detect all issues of bias.

Most trials (twelve of fourteen trials: Borland, 2013; Brendryen, 2008; Brendryen, 2008/2; Elfeddali, 2012; Free, 2009; Haug, 2013; McKay, 2008; Rodgers, 2005; Seidman, 2010; Skov-Ettrup, 2014; Wangberg, 2011; Zbikowski, 2011). However one trial (Haug, 2011) was

judged with 'unclear risk' bias as this trial did not provide sufficient information other than randomization was done by week of attendance.

Thirteen studies were judged with 'low risk' bias for allocation concealment however one trial (Free, 2011) was judged as 'high risk' bias as recruiting staff was aware of the condition to which participants were allocated to. Furthermore one trial (McKay, 2008) did not describe sufficient details of allocation concealment but was still judged as 'low risk' bias as randomization was automated so therefore it was assumed to be 'low risk'.

Blinding was an issue in two trials included in our Meta-Analysis. In both trials Free (2009) and Rodgers (2005) participants were aware whether they were receiving the intervention or not although the research staff were blind to the allocation.

Furthermore four trials were judged 'high risk' bias for incomplete outcome data caused by over-reporting of quitting. In one study Rodgers (2005) incentives were given to participants for providing final follow up data. There were differences in loss of follow up found among the intervention and control group of this trial. One month of free texting was received by the control group on the completion of the final follow up, whereas the intervention group had already received their free text messaging month from quit day and did not receive a further incentive follow up. However, authors suggest this is likely to have caused the difference in loss to follow up at six months which was 69% in the intervention group and 79% in the control group. This trial included one of the youngest population groups (15 years and over) among all the studies included in this Meta-Analysis and it was suggested that some participants in the control group may have thought their free months of text messaging depended on reporting quitting. The Society for Research on Nicotine & Tobacco subcommittee indicates that adolescents may be a special population among which over-reporting of quitting is more likely compared among other population groups (SRNT, 2002).

However newer technology interventions inclusive of the Internet and Mobile phone are expected to have high proportions of young people (SRNT, 2002).

5.4 Agreements & Disagreements with other trials and reviews

Some findings cannot match with what other researchers have found as there has been no similar Meta-Analysis which investigated the effectiveness of Internet-and Mobile phone-based interventions to achieve longer-term effects of smoking cessation published. Therefore this Meta-Analysis was the first to investigate the effectiveness of Internet- and Mobile phone-based interventions to achieve longer-term abstinence of smoking (6 months or longer).

Some findings of this analysis however align to some extent with findings from a Meta-Analysis conducted by Civljak et al. (2010) which assessed the effectiveness of Internet-based interventions compared with no Internet-based interventions or Internet-based interventions delivered at lower frequency. However effects are shorter lived compared to results of this Meta-Analysis. One of the trials (Strecher, 2005) included in the research by Civljak et al. (2010) assessed the efficacy of web-based computer-tailored smoking cessation programmes as a supplement to Nicotine Replacement Therapy (NRT). Findings of this study suggest that Internet-based interventions are more successful achieving abstinence of smoking when combined with additional interventions inclusive of Nicotine Replacement Therapy. However effects are short-lived (12 weeks, OR= 1.26, 95% CI: 1.10, 1.44) compared to findings of this Meta-Analysis therefore these findings align only to some extent with our hypothesis and findings.

Some findings of our Meta-Analysis were surprising compared to findings what other research had investigated. A study (Mermelstein, 2006) which was included in research conducted by Civljak et al (2010) and assessed the effectiveness of Internet-based interventions offered with additional telephone calls compared to telephone calls as a standalone intervention suggests that the combination of Internet-based interventions with additional telephone calls work best to achieve abstinence of smoking (RR=1.96, 95% CI: 1.02, 3.77) although their effects were short-term (3months). Conversely one of the trials (Zbikowski 2011) which assessed the same interventions compared to Mermelstein (2006) and was included in our Meta-Analysis however found that abstinence was more likely among the control group who only received telephone calls compared to the combination of Internet and telephone (OR=0.53, 95% CI: 0.41, 0.67). These findings are surprising since our Meta-Analysis overall findings suggest that Internet- and Mobile phone-based interventions are not as effective as standalone interventions and need additional interventions for greater achievement of effectiveness however based on our research this does only apply to including Nicotine Replacement Therapy however not to telephone calls.

5.5 Implication for practice

This research is the first Meta-Analysis that investigated the effectiveness of Internet- and Mobile phone-based interventions to achieve longer-term cessation of smoking among adolescent and adult smokers aged between 15 years and 64 years and therefore it fills a gap in the cessation literature. The purpose of this research was to assess interventions used in smoking cessation which included Internet and Mobile phone components compared to other interventions which did not include the Internet and Mobile phone or compared with interventions which did include Internet and Mobile phone components but were delivered at

a lower frequency. The results revealed significant differences between groups on these outcome measures. Findings demonstrate that interventions which included Internet and Mobile phone components have an effect. Increased quit attempts. The range of quit attempts was wider with the 6 months follow up. A possible reason for this increase in quitting is the webpages, text messages and emails inclusive of quitting and motivational messages as part of the interventions served as cues to action or reminders for smokers to consider quitting and therefore they made quit attempts more frequently. Web-based and Mobile phone-based interventions therefore offer an effective medium to promote and achieve quitting among adolescent and adult smokers.

5.6 Strengths and Limitations

A Meta-Analysis was conducted to add value to the investigation of the effectiveness of Internet- and Mobile phone-based interventions and for the reason as Meta-analyses have some advantages over primary studies: It can achieve an increase in power and evidence by pooling together different randomized controlled trials and improve the accuracy known as the estimation to help answer research questions not presented by individual primary studies. This also allows the degree of conflict to be formally assessed and reasons for different results to be explored and quantified. Meta-Analyses also help to settle controversies arising from conflicting studies or can be used to generate new hypotheses. However this research had also limitations which are explained below.

Some limitations of the randomized controlled trials included in this Meta-Analysis should be taken into consideration in interpreting the results. Some trials relied on self-reported data on smoking status from participants and did not assess smoking status with a biochemical

test because of that it is not possible to correctly determine the validity of the results. On the other hand it needs to be considered that there is a debate in the research literature on whether biochemical validation is applicable to adolescents because their bodies may metabolize nicotine in a different manner than adults (SRNT, 2002). Another limitation was the variety of large and small trial groups between the studies. Most of the collected data came from Randomized Controlled Trials accessed through PubMed. Nevertheless, one of the key strengths of this research is that it is the first Meta-Analysis that assessed the effectiveness of Internet- and Mobile phone-based interventions to achieve longer term cessation (at least 6 months and beyond 6 months) of smoking among adolescent and adult smokers aged between 15 years and 64 years, residing anywhere in the world. A lot of previous research has focused on short-time abstinence of smoking inclusive of 6 weeks, 12 weeks and some 6 months.

5.7 Implications for future research

More research on this topic is required to expand the finding established in this Meta-Analysis and previous research. Assessing different individual Smart phone applications and their different effects, different demographic groups (low income countries compared to the rest of the world, difference in quitting rates between males and females, and some cost-effectiveness research for these longer term smoking cessation group.

5.8 Conclusion

The Internet and Mobile phone with their richness of options and opportunities for communication and sharing information have become a regular part of daily life for the majority of people in many countries. It is therefore appropriate to consider using them as

tools to increase the choice and access to smoking cessation support. Internet-and Mobile phone-based interventions also have some advantages over most current treatment services: they are convenient in that they can be accessed anywhere and at any time and they offer the option of anonymity. For health care providers they have the potential of being very cost-effective as interventions can be directly delivered to the participant with minimal direct contact and lower resource requirements. Internet-and Mobile phone-based interventions also offer a variety of different options how they can be delivered to the individual: they can be provided each as a standalone intervention, both combined as an intervention or individually or combined in conjunction with other cessation support inclusive of but not limited to individual support groups, counselling, Nicotine Replacement Therapy and Telephone Calls.

Previous research suggests that Internet-and Mobile phone-based interventions are effective to achieve abstinence of smoking, however their effects were short lived. This Meta-Analysis contributed to narrowing the gap by reviewing relevant literature and helped to identify the previously unknown effects of longer-term cessation. Overall findings of this Meta-Analysis suggest that Internet-and Mobile phone-based interventions are very effective in achieving longer-term abstinence of smoking however for them to be more efficient for longer-term cessation additional interventions are needed inclusive of Nicotine Replacement Therapy.

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Appendix A. Agency websites and other websites accessed for unpublished literature

New Zealand

Cancer Society of New Zealand: <http://www.cancernz.org.nz>

Heart Foundation of New Zealand: <http://www.nhf.org.nz>

Ministry of Health: <http://www.health.govt.nz>

Public Health Units/ District Health Boards

Canterbury: <http://www.cpublichealth.co.nz>

Te Reo Marama: <http://www.tereomarama.co.nz>

International

Cochrane: <http://www.cochrane.org>

National Health Services UK: <http://www.nhs.uk>

World Health Organisation: <http://www.who.int/topics/tobacco/en>

Centre for Disease Control: <http://www.cdc.gov>

Open Grey: <http://www.opengrey.eu>

Appendix B. Included & Excluded Studies

Included studies

1. Borland, R. (2013). Population-level effects of automated smoking cessation help programs: a randomized controlled trial. *Addiction*, 108 (3): 618-628.
2. Brendryen, H. (2008). A digital smoking cessation program delivered through Internet & cell phone without nicotine replacement (happy ending): randomized controlled trial. *Journal of Medical Research*, 10 (5):e51.

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13. Wangberg, S., Nilsen, O., Antypas, K., Gram, I.T. (2011). Effect of tailoring in an Internet-based intervention for smoking cessation; randomized controlled trial. *Journal of Medical Internet Research*, 13 (4): e121.

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Excluded studies

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