Online Report: Smartphone apps for weight loss and smoking cessation: Quality ranking of 120 apps (Full Methods and Results)

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Introduction

This online report provides more comprehensive *Methods* and *Results* details to that of a letter on this topic by Patel et al in the *New Zealand Medical Journal* (2015).

Methods

App selection

Lists for the four categories of apps (Android weight loss, Apple weight loss, Android smoking cessation and Apple smoking cessation) were collated using the 'xyo.net' app search engine. Search terms used were (weight loss/weight management/lose weight/calorie counting) or (stop smoking/quit smoking/smoking cessation/smoke free) for weight loss and smoking cessation apps respectively. Apps were ranked within the four categories (Android weight loss, Apple weight loss, Android smoking cessation and Apple smoking cessation) according to their download popularity as estimated by xyo.net. At this point inclusion criteria were applied to highest-ranking number of apps of each category until 40–45 apps that met the inclusion criteria were identified. To be included, apps had to: 1) be in English language; 2) be available in the NZ 'Google Play' or 'App Store'; 3) describe either smoking cessation or weight loss as a key feature/goal of the app within the app description; 4) target patients/consumers (as oppose to health professionals) and 5) cost less than NZ$4. The 30 highest-ranking apps within each category underwent full assessment. If the assessor deemed an app in this top 30 to not meet inclusion criteria once assessment began, it was replaced by the highest-ranking app outside the top 30. The selection processes for each group and shown in Figures 1-4.

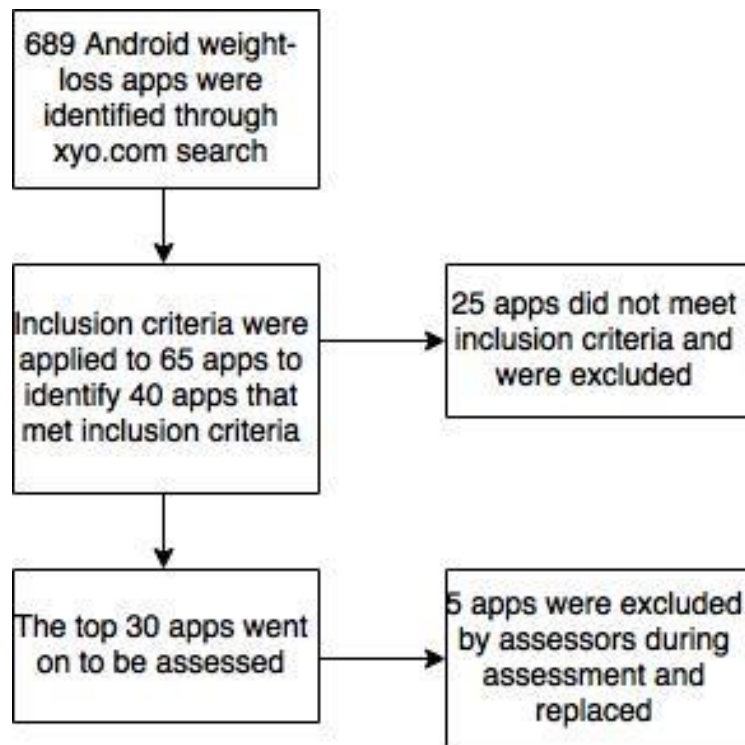**Figure 1: Selection process for Android weight loss apps**

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┌─────────────────────┐
│ 689 Android weight- │
│    loss apps were   │
│  identified through │
│    xyo.com search   │
└──────────┬──────────┘
           │
           ▼
┌─────────────────────┐         ┌─────────────────────┐
│ Inclusion criteria  │         │ 25 apps did not meet│
│ were applied to 65  │────────▶│ inclusion criteria  │
│ apps to identify 40 │         │ and were excluded   │
│ apps that met       │         │                     │
│ inclusion criteria  │         └─────────────────────┘
└──────────┬──────────┘
           │
           ▼
┌─────────────────────┐         ┌─────────────────────┐
│ The top 30 apps went│         │ 5 apps were excluded│
│  on to be assessed  │────────▶│ by assessors during │
│                     │         │ assessment and      │
│                     │         │ replaced            │
└─────────────────────┘         └─────────────────────┘
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Figure 2: Selection process for Apple weight loss apps

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┌─────────────────────┐
│ 590 Apple weight-   │
│ loss apps were      │
│ identified through  │
│ xyo.com search      │
└─────────────────────┘
          │
          ▼
┌─────────────────────┐        ┌─────────────────────┐
│ Inclusion criteria  │        │ 52 apps did not meet│
│ were applied to 97  │───────▶│ inclusion criteria  │
│ apps to identify 45 │        │ and were excluded   │
│ apps that met       │        │                     │
│ inclusion criteria  │        └─────────────────────┘
└─────────────────────┘
          │
          ▼
┌─────────────────────┐        ┌─────────────────────┐
│ The top 30 apps     │        │ 6 apps were excluded│
│ went on to be       │───────▶│ by assessors during │
│ assessed            │        │ assessment and      │
│                     │        │ replaced            │
└─────────────────────┘        └─────────────────────┘
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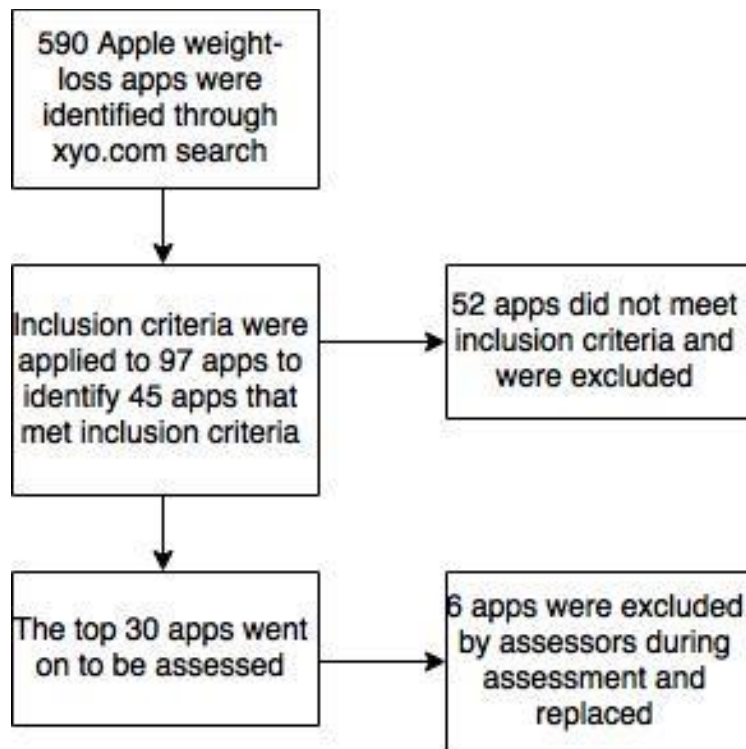
Figure 3: Selection process for Android smoking cessation apps

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┌─────────────────────┐
│ 327 Android smoking-│
│ cessation apps were │
│ identified through  │
│ xyo.com search      │
└─────────────────────┘
          │
          ▼
┌─────────────────────┐        ┌─────────────────────┐
│ Inclusion criteria  │        │ 61 apps did not meet│
│ were applied to 101 │───────▶│ inclusion criteria  │
│ apps to identify 40 │        │ and were excluded   │
│ apps that met       │        │                     │
│ inclusion criteria  │        └─────────────────────┘
└─────────────────────┘
          │
          ▼
┌─────────────────────┐        ┌─────────────────────┐
│ The top 30 apps     │        │ 1 app was excluded  │
│ went on to be       │───────▶│ by assessors during │
│ assessed            │        │ assessment and      │
│                     │        │ replaced            │
└─────────────────────┘        └─────────────────────┘
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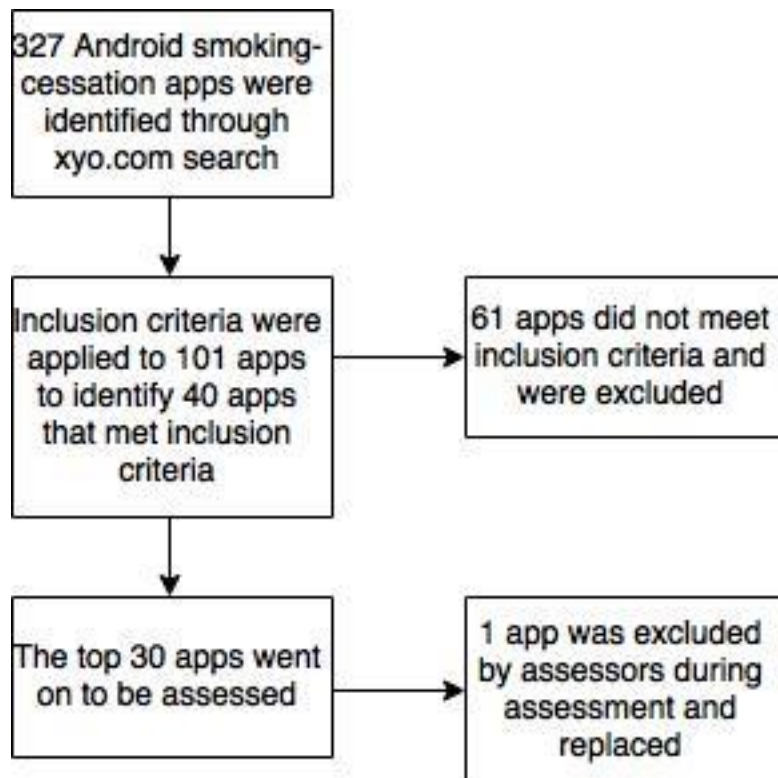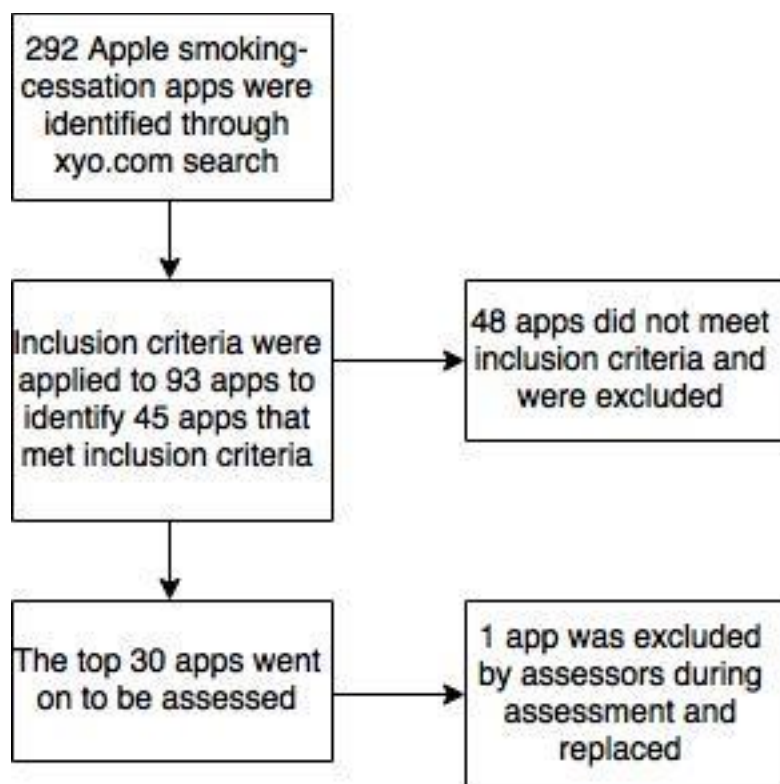
Figure 4: Selection process for Apple smoking cessation apps

Development of criteria

All apps were assessed using the 'Mobile Application Rating Scale' (MARS) as developed by Stoyanov et al.[1] The MARS assesses the apps for engagement, functionality, aesthetics, information and subjective quality. It was developed by researchers at Queensland University of Technology (Brisbane, Australia), following a comprehensive review of website and app assessment criteria within the published literature. The MARS was finalised by psychologists, interface designers and mHealth app developers with classification and refinement of previously published criteria, development of scale items and the addition of pertinent rating criteria. The MARS was applied here as an assessment of health app quality across broad domains, and final scores were calculated using the mean of the two assessors' scores.[1]

Each app was further assessed against either weight loss or smoking cessation criteria as appropriate. Smoking cessation specific criteria were established according to the methodology used by Abroms et al[2] in which assessment criteria were developed according to 'US Public Health Service's 2008 Clinical Practice Guideline for Treating Tobacco Use and Dependence'. Accordingly, smoking cessation criteria for this study were based on 'The New Zealand Guidelines for Helping People to Stop Smoking' and 'Background and Recommendations of the New Zealand Guidelines for Helping People to Stop Smoking' as published by the NZ Ministry of Health in 2014.[3][4] Table 1 shows the smoking cessation criteria.

Table 1: Smoking cessation criteria [3][4]

S1. Does the app assess smoking history?
S2. Does the app assess past experiences with quitting?
S3. Does the app assess previous use of smoking cessation medicines?
S4. Does the app give information about the withdrawal symptoms of smoking cessation?
S5. Does the app provide encouragement about the user's decision to quit?
S6. Does the app discuss ways to maintain the user's motivation e.g. goal setting, rewards, risks?
S7. Does the app explain the importance of complete abstinence?
S8. Does the app set a date to stop smoking (quit date)?
S9. Does the app give advice to every user to stop smoking?
S10. Does the app give personalised advice to stop smoking e.g. linking smoking to current medical conditions, dangers of second-hand smoke to friends and family?
S11. Does the app advise problem solving and coping mechanisms for identified barriers, triggers or cues?
S12. Does the app address relapses?
S13. Does the app encourage face-to-face support?
S14. Does the app encourage telephone support?
S15. Does the app suggest multiple support sessions?
S16. Does the app encourage social support?
S17. Does the app offer information about cessation services?
S18. Does the app offer contact details for cessation services?
S19. Are the offered services NZ appropriate?
S20. Are any of NZ's high-risk groups (eg, pregnant, Māori, PI peoples) offered information specific to them?
S21. Does the app encourage the use of smoking cessation medications (any nicotine replacement therapies (NRT), varenicline, bupropion, nortriptyline)?
S22. Does the app give advice on side effects of or gives any other additional information about smoking cessation medications?

S23. Does the app recommend smoking cessation medication use for at least 8 weeks?

Breton et al[5] similarly created weight loss specific criteria using US specific guidelines. Criteria for the assessment of weight loss apps in this study were thus developed predominantly according to the 'Clinical Guidelines for Weight Management in New Zealand Adults'.[6] Evidence-based information from Breton et al and other articles regarding weight loss apps specific features – was also incorporated into the criteria.[5,7,8,9,10,11,12,13] Table 2 shows all the weight loss criteria used.

Table 2: Weight loss Specific Criteria

W1. Does the app calculate body mass index (BMI)? [5,6]
W2. Does the app provide an interpretation of the user's BMI by providing information about health status and risks of related diseases? [5,6]
W3. Does the app create realistic weight loss goals that promote steady long-term weight loss (0.5-1kg per week)?[5,6,7]
W4. Does the app track changes in weight? [5,6]
W5. Does the app record and track foods eaten? [5,8]
W6. Does the app encourage intake of fruits and vegetables? [5,6]
W7. Does the app encourage intake of low-glycaemic-index, high-fibre foods? [6]
W8. Does the app encourage the substitution of sugar-sweetened beverages for water or low-fat milk? [5,6]
W9. Does the app encourage the reduction of saturated fats in the diet? [6]
W10. Does the app record and track physical activity? [5,6]
W11. Does the app encourage regular physical activity? [5,6]
W12. Does the app provide information and means to plan future meals?
W13. Does the app provide information on appropriate portion control for meals and snacks? [5,6]
W14. Does the app provide personalised positive reinforcement for regular use and/or accomplishments in the form of tips, points etc.? [7,9]
W15. Does the app encourage engagement with health services? [6,10]
W16. Does the app provide personalised feedback based on tracked information provided? [5,6]
W17. Does the app enable communication with other users of the app as a means to provide motivation and social support? [5,11]

W18. Does the app enable synchronisation with social-networking sites? [5][12]
W19. Does the app measure physical activity automatically by an in-app pedometer or accelerometer?[7]
W20. Does the app include the ability to identify foods by scanning the barcode with the camera?[13]
W21. Does the app use a food database that is applicable to the NZ food market?
W22. Does the app provide solutions to basic obstacles to physical activity and healthy eating? [6][7]

All apps were also assessed according to their level of Māori-specific cultural appropriateness. A literature search identified relevant publications.[14][15][16][17] Cultural guidelines detailed within these publications were summarised to develop criteria relevant to the assessment of smartphone apps. Table 3 shows the cultural appropriateness criteria.

Table 3: Cultural appropriateness Criteria (Specifically for Māori)

C1. Does the app contain Māori words or phrases?[14][15]
C2. Does the app emphasise family/whanāu involvement*?[14][15][16]
C3. Does the app include Māori forms of traditional medicine (rongoa)?[14][16]
C4. Does the app include elements of whakapono (trust, honesty, integrity)? [16]
C5. Does the app avoid use of graphic images? [16]
C6. Does the app include traditional Māori games or practices?[17]

*This includes an emphasis on motherhood, emphasis on being a role model in the family/whanāu

Assessment criteria specific to smoking cessation, weight loss and cultural appropriateness, were designed on a 'yes or no' (1 or 0) scale. Accordingly, the two assessors graded each app independently. If the two assessors disagreed about any of the criteria, they collaborated to discuss their reasoning, and came to a final consensus score for each criterion.

Assessors
Two assessors, taken from a pool of 12 medical students, independently assessed each app. Prior to data collection, as suggested by the authors of the MARS; app assessors were trained in application of assessment criteria.[1] Before assessing the apps selected for the study all assessors assessed the same two apps (one weight loss app and one smoking cessation app that were both excluded from due to low popularity) as a practice run. Assessors' scores of the weight loss, smoking cessation and cultural appropriateness specific criteria, along with their scores of the MARS were compared. Discrepancies were then discussed to maximise consistency between assessors, and ambiguities within the criteria were rephrased for clarity where the need arose.

Data analysis
All data were double entered and checked. Apps received a score across the MARS domains of functionality, aesthetics, engagement, information and subjective quality. Based on individual

items of the MARS, a total MARS score was calculated as a percentage. Where a criterion was rated not applicable (N/A), this was considered a 0 for the mean score calculations. Scores for each of weight loss, smoking cessation and cultural appropriateness criteria were also calculated as a total percentage adherence. The apps were ranked overall based on the scores of the three assessment criteria; MARS, smoking cessation/weight loss specific criteria, and cultural appropriateness criteria were weighted at: 45%, 45% and 10% respectively. Statistical analysis of inter-rater reliability was not possible in this study due to the low numbers of apps assessed by individual assessors.

Experiential Use

Following the assessment of apps against the above-mentioned criteria, the highest-scoring five weight loss apps from both the Android and iPhone domains were selected for a pilot study investigating experiential use. From ten assessors, each assessor used one of the apps over a 48-hour period to determine long-term functionality. Assessors focused on providing subjective feedback regarding the apps' ease of use – particularly with required time investment, effect on mobile battery life, ongoing engagement, and effects on pre-established behaviour/habits. The assessors were ten fourth-year medical students. Due to the nature of assessors (all non-smokers), experiential use of smoking cessation apps was not considered appropriate.

Results

App Assessment

Table 4 shows the results of all 30 apps assessed in each category. Criterion 2 of the weight loss criteria, concerned providing an interpretation of BMI and the health risks involved. It was only met by the app 'Tactio Health'. With regards to the smoking cessation criteria, only one app (not necessarily the same app for each criterion) met criteria 2, 3, 19 and 23. For example, 'Smoke Free - Quit smoking now and stop for good' was the only app that met criteria 19, regarding offering NZ-specific services. Many other criteria were only met by four or less apps out of the 60 that were assessed for smoking cessation. 'Noom Coach: Weight Loss Plan' (Android), 'Lifesum - Calorie Counter' (Android) and 'Calorie Counter, Dining Out, Food, and Exercise Tracker' (Apple) were the highest scoring weight loss apps, scoring 68%. 'Quit Now: My Quit Buddy' (Apple) was the highest scoring smoking cessation app, scoring 70%. Hence, even the highest scoring apps did not perform particularly well against our weight loss and smoking cessation specific criteria. All the assessed apps fared poorly against the cultural appropriateness criteria as a whole, with only two app out of the 120 ('You Can Quit Smoking' (Android) and 'LIVESTRONG: My Quit Coach - Dare to quit smoking' (Apple)) scoring 50%, with the apps scoring an average of 17%. Tables 5–8 detail how individual criteria from the weight loss, smoking cessation and cultural appropriateness specific criteria performed respectively.

Table 4: Scores and final ranking for smartphone apps in each of the four groupings (weight loss, smoking cessation, Android and Apple, n=30 per group, n=120 total)

App purpose and name (for all 30 apps in each of the 4 groups)	App developer	MARS score	Weight loss / smoking cessation criterion score	Cultural appropriate ness criterion score	Overall score* (ranked)
Weight loss, Android					
Noom Coach: Weight Loss Plan	Noom Inc	83%	68%	17%	70%
Lifesum - The Health Movement	Lifesum	79%	68%	17%	68%
Calorie Counter - MyFitnessPal	MyFitnessPal, Inc	86%	50%	17%	63%
Calorie Counter & Diet Tracker	SparkPeople	73%	59%	17%	61%
Lose weight without dieting	Harmonic Soft	77%	55%	17%	61%
Freeletics	Freeletics	74%	32%	33%	51%
Diet Assistant - Weight Loss ★	Alportela Labs	62%	46%	17%	50%
How to loose weight	Reliablesoft.Net	62%	41%	17%	48%
My Diet Coach - Weight Loss	InspiredApps (A.L) LTD	61%	41%	17%	47%
63 Simple Weight Loss Tips	Insplisity	57%	41%	33%	47%
Pedometer & Weight Loss Coach	Pacer Works	69%	32%	17%	47%
Calorie Counter	CalorieCount.com	57%	41%	17%	46%
RunKeeper - GPS Track Run Walk	FitnessKeeper, Inc	65%	32%	17%	45%
Diet and Weight Loss	NutriSoft Brazil	64%	32%	17%	45%
Effective Weight Loss Guide	naveeninfotech	54%	41%	17%	45%
My Diet Diary Calorie Counter	MedHelp, Inc - Top Health Apps	60%	32%	17%	43%
NexTrack: Making Exercise Fun	Nexercise Apps, Inc	59%	32%	17%	43%
Diet Point · Weight Loss	DietPoint Ltd	55%	32%	33%	42%
Workout Trainer	Skimble Inc	74%	18%	0%	42%
Weight Tracker weight loss app	cryofy.com	70%	18%	17%	41%
7 minute Workout	ABISHKKING	58%	27%	17%	40%
MyFitness Calculator BMI IIFYM	abhinav khanger	76%	9%	17%	40%
WalkLogger pedometer	Walklogger	56%	18%	17%	35%
Weight Loss Tracker - RecStyle	Recruit Holdings Co.,Ltd	58%	14%	17%	34%
Diet Plan- Weight Loss 7 Days	Gamebaby	49%	23%	17%	34%
Noom Walk Pedometer: Fitness	Noom Inc	52%	18%	17%	33%
Daily Yoga - Fitness On-the-Go	IMOBLIFE Co. Ltd	50%	14%	17%	30%
Monitor Your Weight	Husain Al-Bustan	54%	9%	17%	30%
Motivate Me to exercise	gray2rgb	37%	9%	17%	22%
Weight Loss Dance Workout	PocketFitness	41%	0%	17%	20%
Mean for all 30 apps studied	–	62%	32%	18%	44%
Range for all 30 apps studied	–	37% – 86%	0% – 68%	0% – 33%	20% – 70%
Weight loss, Apple					
Calorie Counter and Food Diary by MyNetDiary	MyNetDiary Inc	82%	64%	17%	67%
Calorie Counter, Dining Out, Food, and Exercise Tracker	Everyday Health, Inc	72%	68%	17%	65%
Calorie Counter & Diet Tracker by	MyFitnessPal.com	78%	59%	17%	64%

App purpose and name (for all 30 apps in each of the 4 groups)	App developer	MARS score	Weight loss / smoking cessation criterion score	Cultural appropriate ness criterion score	Overall score* (ranked)
MyFitnessPal					
5K Runner: 0 to 5K run training, Couch to 5K running, free	Clear Sky Apps LTD	80%	55%	17%	62%
Jillian Michaels Slim-Down: Weight Loss, Diet, Fitness, Workout & Exercise Solution	Everyday Health, Inc	76%	55%	17%	60%
Argus - Pedometer, Run, Cycle achieve your fitness and weight loss goals with the ultimate activity tracker by Azumio	Azumio Inc	76%	46%	17%	56%
Pacer - Pedometer plus Weight and BMI Management and Blood Pressure Tracker	Michael Caldwell	76%	46%	17%	56%
My Diet Diary Calorie Counter App	MedHelp	73%	46%	17%	55%
RunKeeper - GPS Running, Walk, Cycling, Workout and Weight Tracker	FitnessKeeper, Inc	80%	36%	17%	54%
Tactio Health	Tactio Health Group Inc	58%	55%	17%	52%
Weilos - Health and Wellness Community	Weilos, Inc	59%	41%	17%	47%
Nutrition Menu - Calorie, Exercise, Weight & Water Tracking	Shroomies	66%	32%	17%	46%
Noom Coach: Weight Loss	Noom, Inc	63%	32%	17%	44%
Running for Weight Loss: interval training plan, GPS, how-to-lose-weight tips by Red Rock Apps	GRINASYS CORP.	64%	27%	17%	43%
Walker - Pedometer Lite	Naoya Araki	67%	18%	17%	40%
My Diet Coach - Weight loss motivation for women & calorie counter - FREE	InspiredApps	64%	18%	17%	39%
Monitor your weight	Husain Al-Bustan	55%	18%	17%	35%
Workout Trainer	Skimble	63%	9%	17%	34%
Easy Weight Loss Tips! Best Diet Tracker & Mobile Diet Plan	Michael Quach	48%	23%	17%	34%
Happy Scale: Simple Weight Loss Tracker with Daily Moving Average Trend Line	Front Pocket Software LLC	62%	9%	17%	34%
Simple Weight Loss Tracker - RecStyle - Your Free Diet, Fitness & Beauty for Better Health	Recruit Holdings Co.,Ltd	62%	9%	17%	34%
WeightDrop – Weight Tracker and BMI Control Tool for Weight Loss - Get Fit & Lose Weight	Michael Szumielewski	51%	14%	17%	31%
Lose the Belly (Weight Loss for Women)	Pacific Spirit Media	45%	18%	17%	30%
Weight Loss for Men (Lose the Belly)	Pacific Spirit Media	44%	18%	17%	30%
SimpleWeight - Simple & Powerful Weight Control Tool	Takayoshi Kurachi	46%	14%	17%	28%
Visual Diet Diary -Record your weight and photo-	Zanmai Seikatsu Co., Ltd	50%	9%	17%	28%

App purpose and name (for all 30 apps in each of the 4 groups)	App developer	MARS score	Weight loss / smoking cessation criterion score	Cultural appropriate ness criterion score	Overall score* (ranked)
Best Diet Foods!	Michael Quach	41%	14%	17%	26%
True Weight Lite	made-up software	41%	9%	17%	24%
iBelieve - Weight loss tracker and BMI calculator	Tian Juntao	36%	9%	17%	22%
Virtual Weight Loss Model Lite	Pacific Spirit Media	27%	5%	17%	16%
Mean for all 30 apps studied	**–**	60%	29%	17%	42%
Range for all 30 apps studied	**–**	27% – 82%	5% – 68%	17% – 17%	16% – 67%
Smoking cessation, Android					
My Quit Smoking Coach	Andreas Jopp	83%	48%	33%	62%
You Can Quit Smoking	Insplisity	69%	52%	50%	59%
STOP Cigarettes - Quit smoking	academiacea	61%	44%	17%	49%
Quit Pro: stop smoking now	Muslim Pro Limited	76%	26%	17%	48%
SmokeLess!	Kroaqs	61%	30%	17%	43%
Get Rich or Die Smoking	Tobias Gruber	64%	22%	17%	40%
Quit smoking - QuitNow!	Fewlaps	62%	22%	17%	39%
Quit-Smoking Coach Free	Brainlag Studios	50%	30%	17%	38%
myQuitTime - Stop Smoking	Arete Appware	63%	17%	17%	38%
Smoke Free, stop smoking help	David Crane	67%	13%	17%	38%
Smoking Reducer Quit Smoking	Nochino Digital	63%	13%	17%	36%
QuitNow! PRO - Stop smoking	Fewlaps	54%	22%	17%	36%
aha!Smokefree	aha!dev	57%	17%	17%	35%
QUIT SMOKING	Mastersoft Ltd	59%	17%	0%	34%
Stop! Quit Smoking - LITE	CDdevelopment	52%	22%	0%	33%
Quit Smoking	Medicus Mundi	40%	30%	17%	33%
Stop Smoking	Team Geny	49%	17%	17%	31%
Quit Smoking	Azati	46%	13%	33%	30%
Quit Smoking	Luis Salcedo	48%	13%	17%	29%
Quick Quit	SELA Group	51%	4%	17%	27%
Easy Stop Smoking	GLOBUS	46%	9%	17%	26%
Free From Smoking - Hypnosis	theOBC	35%	17%	17%	25%
Smoke FREE Finally Non Smoking	sg-pages - Marus Steller	39%	13%	17%	25%
Kick the Habit: Quit Smoking	IcySpark	43%	9%	17%	25%
Quit smoking whith SOLOE	Full Thrust Ignition	47%	4%	17%	25%
Quit Smoking Log	Cory Charlton	41%	4%	17%	22%
Time To Quit Smoke	VantusMantus	37%	9%	17%	22%
Stop Smoking Hypnosis	On Beat Limited	41%	0%	17%	20%
I'm Quitting Smoking!	Developers with Balls Company	33%	9%	0%	19%
Mean for all 30 apps studied	**–**	52%	18%	17%	33%
Range for all 30 apps studied	**–**	33% – 83%	0% – 52%	0% – 50%	17% – 62%
Smoking cessation, Apple					
Quit Now: My QuitBuddy	Australian National Preventive Health	94%	70%	33%	77%

App purpose and name (for all 30 apps in each of the 4 groups)	App developer	MARS score	Weight loss / smoking cessation criterion score	Cultural appropriate ness criterion score	Overall score* (ranked)
	Agency				
LIVESTRONG MyQuit Coach - Dare to quit smoking	Demand Media, Inc	79%	61%	50%	68%
Stop-tobacco	Université de Genève	75%	65%	17%	65%
MyQuitSmokingCoach: Europe's No 1 Quit Smoking APP	Oliver Fuxen	68%	48%	17%	54%
Smoke Free - Quit smoking now and stop for good	David Crane	61%	52%	17%	53%
Quit Smoking - Cold Turkey (Lite Version)	Pinch Swipe Tap Pty. Ltd	50%	44%	0%	42%
Quit Pro: stop smoking now	Bitsmedia Pte Ltd	57%	26%	17%	39%
Quit smoking now - Quit smoking Buddy!	sander van der graaff	60%	22%	17%	39%
Kwit - quit smoking is a game	Geoffrey Kretz	50%	26%	17%	36%
Quit It - stop smoking today	digitalsirup GmbH	59%	17%	17%	36%
Quit Smoking - QuitNow!	Fewlaps, S.C	58%	22%	0%	36%
FREE Stop Smoking Cigarettes Now Quit Smokes Forever Tracker, Counter, & No Smoker Cigarette Quitter Coach App	Ellisapps Inc	54%	22%	17%	36%
My Last Cigarette - Stop Smoking Stay Quit	Mastersoft Ltd	47%	22%	17%	32%
Quit It Lite - stop smoking today	digitalsirup GmbH	55%	9%	17%	30%
NSMarathon	ls	49%	13%	17%	30%
CIGGY: The ill-fated terribly doomed love affair	RescueGirl	52%	4%	17%	27%
Stop Smoking Manager - SMOQUIT	Seallab	47%	9%	17%	27%
Smoke FREE - Finally Non Smoking	sg-pages	38%	13%	17%	25%
Cigarettes Lite	Thomas Kiesl	47%	4%	17%	25%
Stop Smoking!	On Beat Limited	42%	9%	17%	24%
Stop Smoking Instantly With Chinese Massage Point - FREE Acupressure Trainer	Dr. Jakob Bargak	50%	0%	17%	24%
Kick the Habit: Quit Smoking	IcySpark	44%	4%	17%	24%
Smoktivation: My motivation to quit smoking	JCD Software	40%	9%	17%	23%
Smoking Management	gacha	42%	4%	17%	22%
iQuit	JimmySquareBox	36%	9%	17%	22%
Cigarettes	Thomas Kiesl	37%	4%	17%	20%
The Joy of Quitting Smoking LITE	MUBIQUO	30%	9%	17%	19%
Hypnosis ~ Sleep Soundly	Hynotransformations	34%	0%	17%	17%
Quit Smoking Helper	Tae-han Kim	30%	0%	17%	15%
Gotta Smoke?	Prime73 Inc	30%	0%	17%	15%
Mean for all 30 apps studied	−	51%	20%	17%	33%
Range for all 30 apps studied	−	30% – 94%	0% – 70%	0% – 50%	15% – 77%

* Overall score based on the weightings of: 45% for the MARS criterion, 45% for the weight loss/smoking cessation criterion, and 10% for cultural appropriateness criterion.

Table 5: Weight loss specific criteria results

Weight loss criterion (criteria available in Table 1)	Android apps that met criterion (0-30)	Apple apps that met criterion (0-30)
1	8	8
2	0	1
3	11	8
4	13	21
5	8	10
6	9	12
7	8	8
8	4	4
9	13	6
10	15	16
11	12	11
12	11	10
13	14	4
14	11	11
15	2	1
16	14	14
17	15	9
18	18	14
19	4	4
20	6	7
21	7	5
22	6	8

Table 6: Smoking cessation specific criteria results

Smoking cessation criterion (criteria available in Table 2)	Android apps that met criterion (0-30)	Apple apps that met criterion (0-30)
1	21	20
2	0	1
3	0	1
4	3	5
5	22	16
6	19	10
7	3	5
8	17	17
9	7	10

Smoking cessation criterion (criteria available in Table 2)	Android apps that met criterion (0-30)	Apple apps that met criterion (0-30)
10	1	5
11	7	10
12	7	4
13	1	2
14	1	3
15	1	2
16	9	11
17	2	2
18	0	3
19	0	1
20	1	3
21	3	3
22	1	2
23	0	1

Table 7: Cultural appropriateness specific criteria results (weight loss apps)

Cultural appropriateness criterion (criteria available in Table 3)	Android apps that met criterion (0-30)	Apple apps that met criterion (0-30)
1	0	0
2	3	0
3	0	0
4	6	0
5	23	30
6	0	0

Table 8: Cultural appropriateness specific criteria results (smoking cessation apps)

Cultural appropriateness criterion (criteria available in Table 3)	Android apps that met criterion (0-30)	Apple apps that met criterion (0-30)
1	0	0
2	1	2
3	0	0
4	3	1
5	27	28
6	0	0

Experiential Use

Following a trial of experiential use over 48 hours, satisfaction in the use of weight loss apps was most readily achieved by apps that were "user-friendly" – that is, those considered aesthetically appealing and easy to navigate. Features noted to increase app functionality were: offline functionality, low battery usage, and memory functions that reduced the time required for meal/data input. Prompts to log meals/activity were also beneficial in maintaining consistent use of the app. Key requirements were that apps engaged users through interesting feedback or presentation of results as well as providing ongoing motivation/encouragement.

The need for internet access to log meals/search databases was reported to limit the usability of the app in a real life setting. Specific to the NZ context, few apps used databases that had a comprehensive coverage of food items available within the NZ market and consequently time required was significantly increased as such items needed to be entered manually. Alternatively where the "next-best fit" was selected, this raised concerns about the accuracy of caloric information. The assessors concluded that whilst functional, use of these apps could be time consuming or frustrating, particularly where meals had many components or where food-item weight was a required data point. Functionality of these apps would be increased by use of more comprehensive databases, and increased offline functionality.

Some assessors suggested that these apps were limited in the contribution they could make to long-term weight loss and management due to limited development of more holistic healthy habits. Rather than simply calorie counting – a task considered by some to encourage detrimental food behaviours – it was thought that dietary interventions should also include qualitative focus on sources of calories consumed rather than employing the concept that 'a calorie is a calorie' regardless of its source.[18] Table 9 provides more detail about how experiential users found the individual apps.

Table 9: Experiential Use of Weight loss Apps – Qualitative comments

App Provider & Name	Factors That Increased Functionality	Factors That Decreased Functionality
Android – Calorie Counter and Diet Tracker by Spark People	- Easy to use/navigate - Negligible effect on phone battery life - Many options for customisation including Prompts/reminders to log meals/physical activity - Points reward system increases motivation	- Not aesthetically pleasing, dated design - Requires internet access - Time consuming - Food/barcode scanner is not appropriate for the NZ market – requiring manual info entry and lacks cultural foods such as Asian cuisine and common food items such as "Sprite" soft drink
Android – Calorie Counter by MyFitnessPal	- Easy to use/navigate, intuitively designed - Negligible effect on phone battery life	Food/barcode scanner is not appropriate for the NZ market – requiring manual info entry

App Provider & Name	Factors That Increased Functionality	Factors That Decreased Functionality
	• Functions offline • Memory function retains previously logged meals/physical activity • Met all expectations	
Android – Lose weight without Dieting by Harmonic Soft	• Easy to use/navigate and operated well • Functions offline	• Interfaced appeared targeted at a younger user – not sophisticated • Significant battery use • Time consuming to use, especially in food/meal preparation with multiple components
Android – Noom Coach: Weight Loss Plan by Noom Inc	• Memory function retains previously logged meals • Prompts/reminders to log meals/physical activity • No advertisements within the app	• Food/barcode scanner is not appropriate for the NZ market • Significant (background) battery use • Requires internet access • Time consuming installation and set up
Android – Lifesum – Calorie Counter by ShapeUp Club AB	• Clean interface, simple to use, intuitive • Prompts/reminders to log meals/physical activity • Database comprehensive and appropriate to NZ	• Food/barcode scanner is not appropriate for the NZ market – requiring manual info entry • Barcode scanner/database requires internet access • Time consuming, especially when meals have multiple components
Apple – Calorie Counter, Dining Out, Food and Exercise Tracker	• Nice layout and good graphics • Functions offline • Easy to use • Clear overall goal seemed achievable with motivational tips and quotes	• Barcode scanner did not work in NZ and requires internet access • Lacks a pedometer which would be useful in measuring exercise • Weight units = pounds
Apple – Jillian Michaels Slim-Down: Weight Loss, Diet, Fitness and Workout & Exercise Solution	• Negligible effect on phone battery life	• Not aesthetically pleasing • Most features require internet access • Trouble loading instructional videos • Contents/function of this version of the app was limited with constant encouragement to upgrade to the pro version
Apple – Calorie Counter & Diet Tracker by MyFitnessPal	• Aesthetically pleasing: attractive layout, graphics, use of colour and visual information • Negligible effect on phone battery life • Functions offline • Memory function retains previously logged meals • Regularly updated with info/articles on healthy eating	• Some of the more sophisticated features of the app may require time for orientation
Apple – 5K Runner: 0 to 5K	• Very aesthetically pleasing • Easy to use/navigate	• Requires upgrade to pro version to complete programme

App Provider & Name	Factors That Increased Functionality	Factors That Decreased Functionality
Run Training, Couch to 5K Running	• Negligible effect on phone battery life • Enjoyable to use • Modifiable settings	• Training plans require the download of other associated apps • Little information on nutritional aspects of weight loss
Apple – Calorie Counter & Food Diary by MyNetDiary	• Aesthetically pleasing • Easy to use/navigate, buttons and links logical and worked well • Negligible effect on phone battery life • Functions offline, required internet access only for set up • Memory function retains previously logged meals • In app feedback is motivating/interesting • Interesting to use	• Food/barcode scanner is not appropriate for the NZ market, especially in food/meal preparation with multiple components • Time consuming to use

Discussion of study limitations

Due to time and resource constraints, individual assessors could not assess enough apps to allow useful inter-rater reliability calculations, to test the consistency of the criteria created for this trial, and to further validate the MARS.[1] Additionally each app was only assessed by two assessors, and across all apps, the large pool of assessors may have reduced the consistency of scores between apps. To minimise the disadvantages of these limitations, the created criteria were reasonably straightforward. The MARS was the best existing published tool that we could identify for assessing the broader quality of health apps available, and due to Stoyanov et al's[1] rigorous method in developing the criteria to be consistent and accurate, this was considered satisfactory for this study. Another limitation was the reliability of the website used to determine apps for assessment. It was decided that the website would be a better alternative to using search order as they appear on 'Google Play' or 'App Store' due to possible advertising deals influencing the order. Even if the website did not produce perfectly accurate lists, it is very likely that the most popular apps would still have remained amongst the top 30 apps, and thus would not have affected how these apps would be assessed in the integral part of the study.

Furthermore, the generalisability of experiential use finding was limited. The use of fourth-year medical students who were generally of healthy weight to test experiential use is not fully generalisable to the NZ adult population. Additionally, these assessors were more likely to have mobile-data plans. However, it should be noted that common problems and inconveniences experienced in this pilot with weight loss apps are likely similar for everyone, and development of new apps can try to minimise these.

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