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The effectiveness of telemedicine in the prevention of type 2 diabetes: a systematic review and meta-analysis of interventions

Laura Suhlrie, Raga Ayyagari, Camille Mba, Kjell Olsson, Harold Torres-Aparcana, Steven James, Elpida Vounzoulaki, Daniel B. Ibsen

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Nota: Algunas diapositivas son cortesía de Daniel B. Ibsen

Global Diabetes Journal Club

Contents

Welcome to the Global Diabetes Journal Club (GDJC) website! We aim to sustain a collegial, accessible platform for diabetes researchers, health care providers and the public to connect and learn about recent research across nutritional, clinical and genetic epidemiology as they apply to diabetes. We are committed to supporting early-career researchers interested in diabetes epidemiology. Our members have joined GDJC meetings from 6 continents.

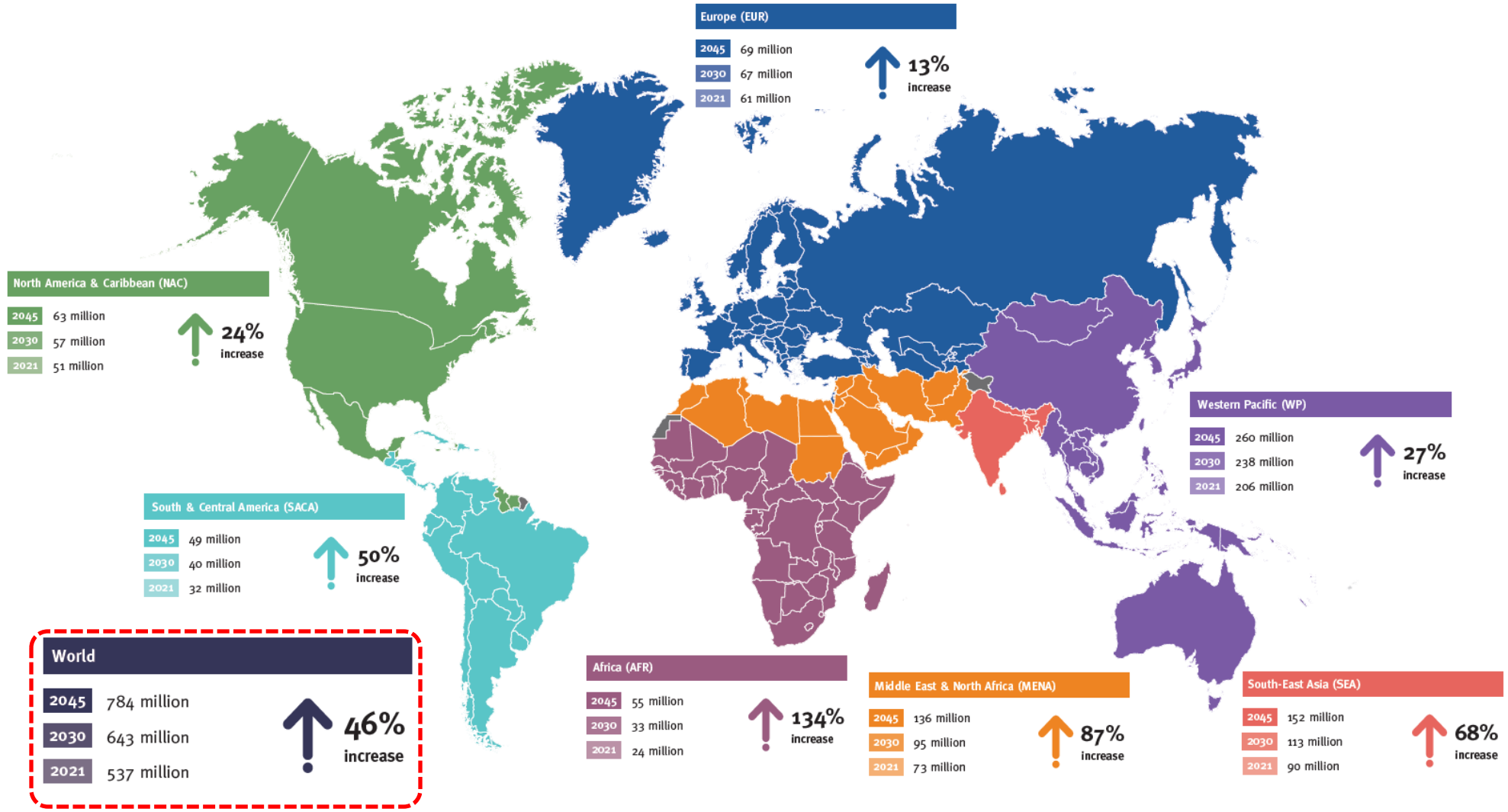
We run two main programs:

- **GDJC Talks** Monthly hour-long Zoom meetings that include an article/project presentation and discussion.
- **Ad hoc working groups** In Summer 2020, we created two research teams, each of which is preparing a systematic review on an aspect of prevention of type 2 diabetes.

If you want stay updated, please join our mailing list here, where we send announcements and reminders for our upcoming talks and other relevant events.

Follow us on Twitter @GDiabetesJC and view our previous GDJC Talks on our YouTube channel.

Cantidad de adultos (20 a 79 años) con diabetes a nivel mundial. Atlas IDF 2021



Open Access Research

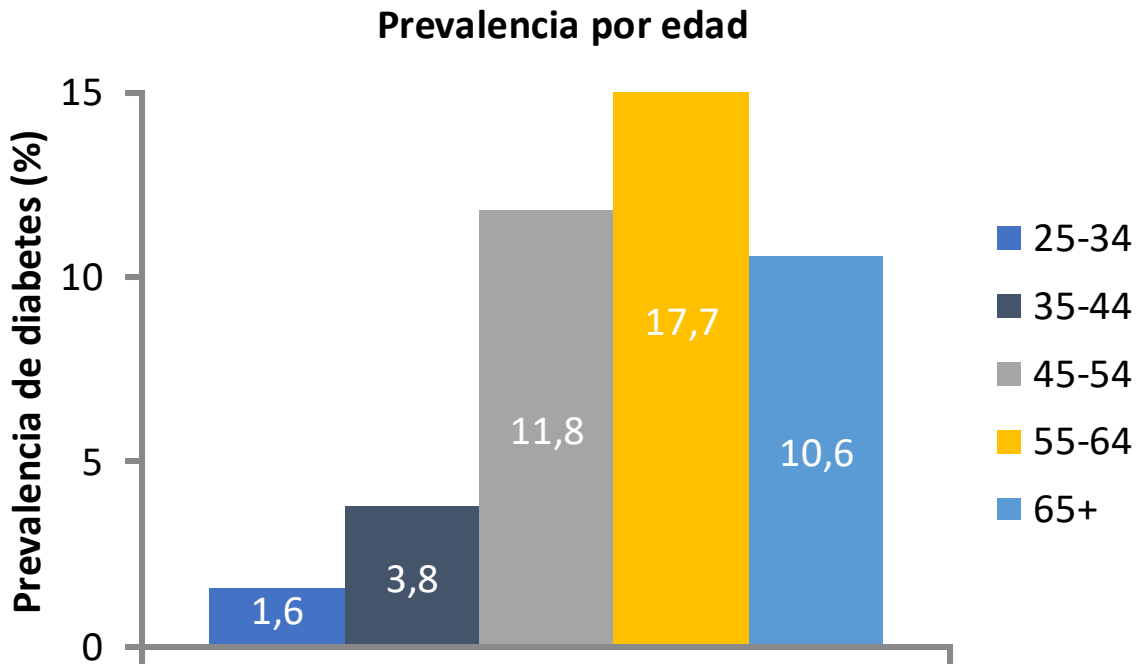
BMJ Open Diabetes Research & Care

Prevalence of diabetes and impaired fasting glucose in Peru: report from PERUDIAB, a national urban population-based longitudinal study

Segundo N Seclen,[1] Moises E Rosas,[2] Arturo J Arias,[3] Ernesto Huayta,[4] Cecilia A Medina[4]

Estudio longitudinal, poblacional urbano y nacional de 1677 adultos ≥25 años entre 2010 y 2012

Prevalencia nacional estimada de diabetes: 7,0 %



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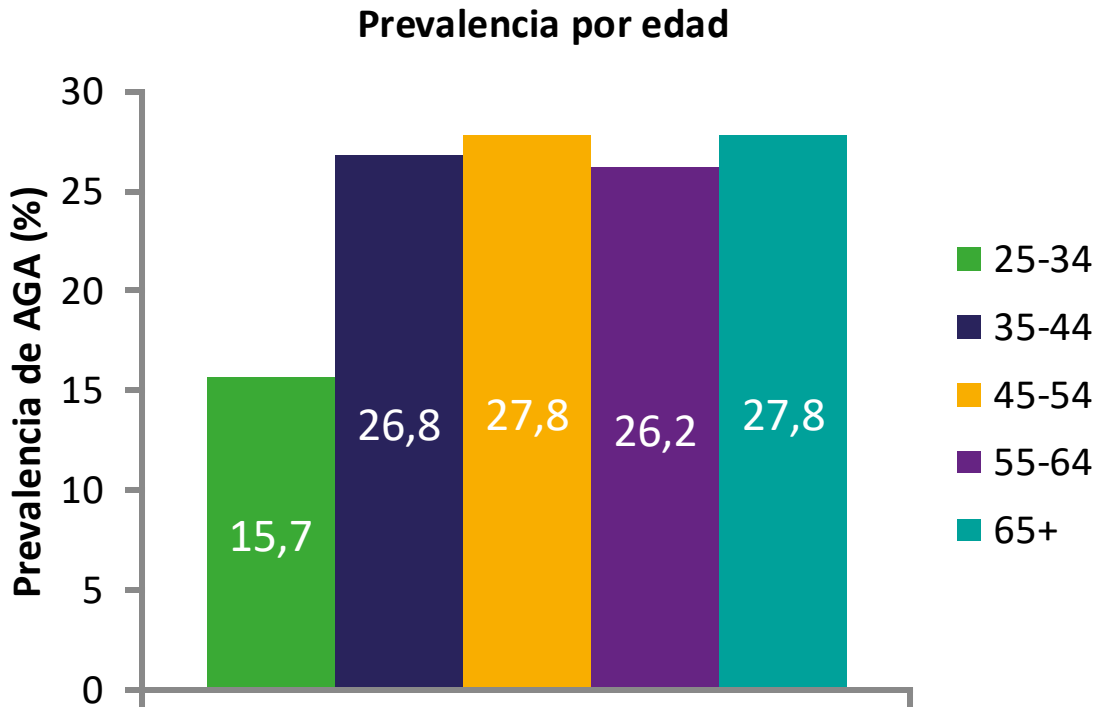
- **Prevalencia estimada de alteración de la glucosa en ayunas (100-125 mg/dl): 22,4 %**

- **Prevalencia DM + GAA ≈ 30%**



NIHR | National Institute for Health and Care Research

PROSPERO
International prospective register of systematic reviews

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Effectiveness of telemedicine in prevention of type 2 diabetes: a systematic review and meta-analysis of interventions relevant for primary care settings

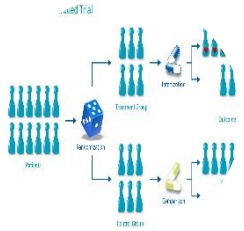
Daniel Ibsen, Camille Mba, Elpida Vounzoulaki, Enzo Cerullo, Harold Torres, Kjell Olsson, Steven James, Raga Ayyagari, Laura Suhlrie

Citation

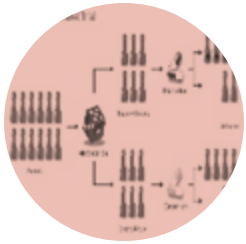
Daniel Ibsen, Camille Mba, Elpida Vounzoulaki, Enzo Cerullo, Harold Torres, Kjell Olsson, Steven James, Raga Ayyagari, Laura Suhlrie. Effectiveness of telemedicine in prevention of type 2 diabetes: a systematic review and meta-analysis of interventions relevant for primary care settings. PROSPERO 2020 CRD42020210829 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020210829

To evaluate the effectiveness of **telemedicine-delivered** diet and/or physical activity **interventions** to prevent type 2 diabetes **in people at risk**

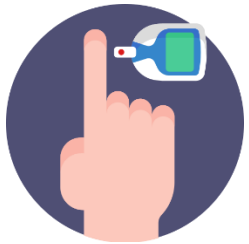
Population: adult populations at high risk of developing T2D (diagnosis of pre-diabetes confirmed by clinical parameters or screening tools, metabolic syndrome and overweight/obesity)



Intervention: diet and physical activity intervention with any technologically assisted primary prevention strategies such as telemedicine-based lifestyle interventions, including video conferencing, text messages, e-mail, internet, smartphone applications, phone calls



Comparator: No restrictions were made regarding the control group



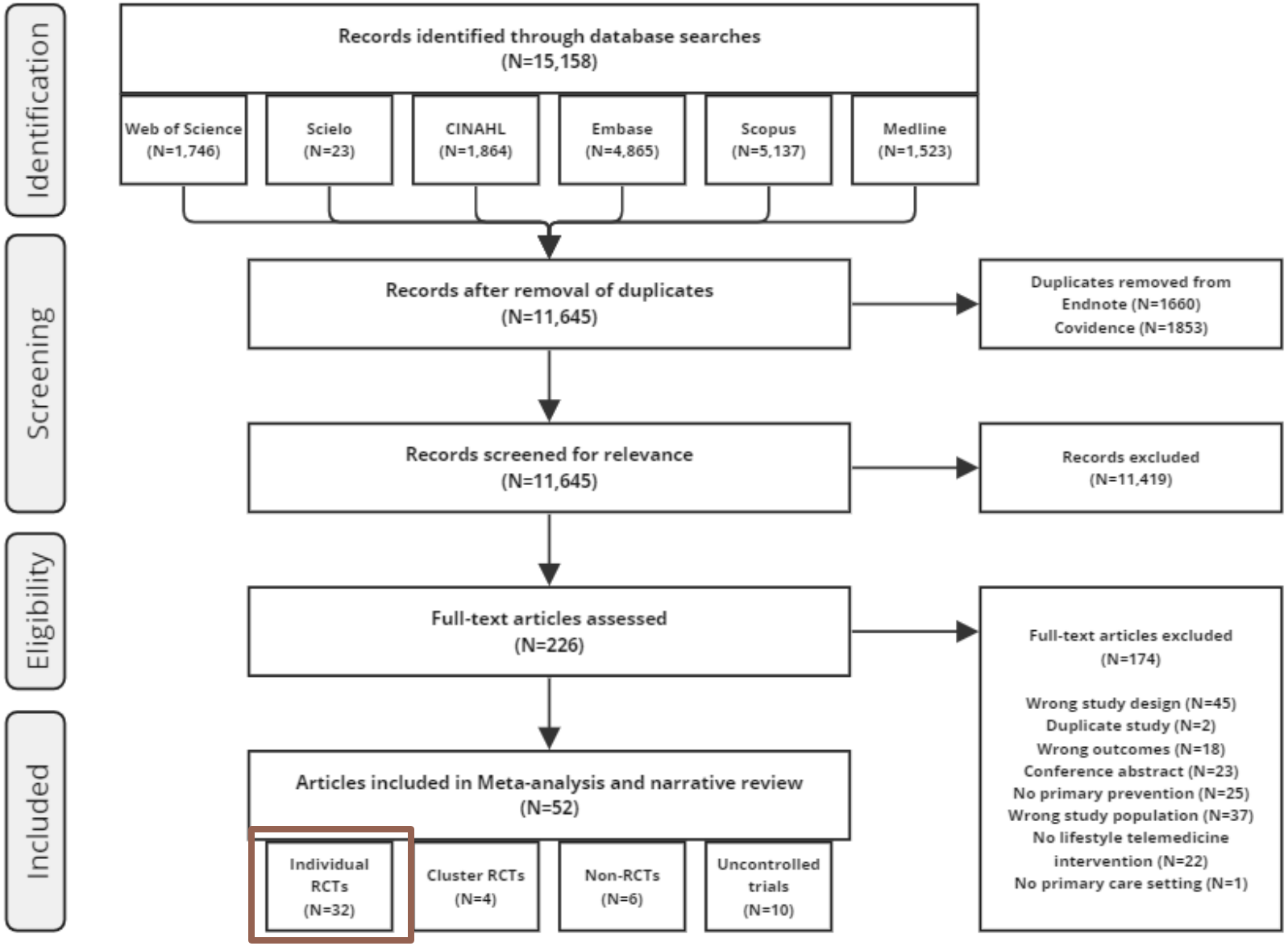
Outcome: Any clinically relevant outcomes related to metabolic syndrome and incidence of T2D (adiposity, blood glucose, lipids, blood pressure)

Hipótesis

Telemedicine interventions **relevant to primary care settings** in preventing T2D in people at high risk improve T2D risk factors compared to control or less intensive interventions.

Metodologia

- The primary outcome was a change in body weight.
- For the meta-analysis, only randomised controlled trials (RCTs) were included.
- We included non-randomized designs in the narrative review.
- No limitations were made regarding the language of the study and country where the intervention took place as long as the intervention setting was primary care or was relevant to primary care



CINAHL (Cumulative Index to Nursing and Allied Health Literature)

Table 1. Characteristics of individually randomised intervention studies included in the meta-analysis investigating effectiveness of telemedicine intervention on prevention of type 2 diabetes mellitus.

Study, year (ref)	Criteria for high-risk	Setting	Region	Intervention focus	Telemedicine	Support	Control group	Intervention duration, months	N participants	Risk of bias assessment
Aguiar 2016 (56)	Overweight/obesity	Home	Australia	Diet and exercise	Tele-education, Telemonitoring	No support	Wait list control	6	101	Low
Allman-Farinelli 2016 (57)	Overweight/obesity	Home	Australia	Diet and exercise	Tele-education, Telemonitoring	Supported by remote contact	Usual care + minimal telemedicine only	3	250	High
Apinaniz 2019 (58)	Overweight/obesity	Combination	Europe	Diet and exercise	Tele-education	Supported by remote contact	Intervention without telemedicine	6	110	Some
Bender 2018 (59)	Prediabetes & overweight	Combination	North America	Diet and exercise	Tele-education, Telemonitoring, Telementoring	Supported by remote	Wait list control	3	67	Some
Block 2015 (60)	Prediabetes & overweight	Home	North America	Diet and exercise	Tele-education, Telemonitoring	No support	Wait list control	6	339	Low
Bosak 2010 (61)	Metabolic syndrome	Combination	North America	Exercise	Tele-education, Telemonitoring	Supported by remote contact	Usual care	1.5	22	High

Carnie 2013 (62)	Overweight/obesity	Pharmacy	North America	Diet and exercise	Tele-education	Supported by remote and face-to-face contact	Usual care + minimal telemedicine only	6	199	Low
Chen 2020 (63)	Prediabetes	Combination	Asia	Diet	Combination	Supported by remote and face-to-face contact	Usual care	3	138	Some
Cho 2020 (64)	Metabolic syndrome	Home	Asia	Diet and exercise	Telementoring, Telemonitoring	Supported by remote contact	Usual care	6	129	Low
Cicolini 2014 (65)	Hypertension	Clinic	Europe	Diet, exercise and medication	Tele-education	Supported by remote contact	Usual care	6	203	Low
Fischer 2015 (66)	Prediabetes & overweight	Combination	North America	Diet and exercise	Tele-education	Supported by remote contact	Usual care	12	163	High
Fukuoka 2015 (67)	Prediabetes & overweight	Combination	North America	Diet and exercise	Tele-education, Telemonitoring	Supported by face-to-face contact	Usual care	5	61	High
Green 2014 (68)	Overweight/obesity	Clinic	North America	Diet	Tele-education, Telemonitoring	Supported by remote contact	Usual care	6	101	Some

Hebden 2014 (69)	Overweight/obesity	Home	Australia	Diet and exercise	Tele-education, Telemonitoring	No support	Usual care	3	51	Some
Hurkmans 2018 (70)	Overweight/obesity	Home	Europe	Diet and exercise	Other	Supported by face-to-face contact	Wait list control	3	102	High
Jahangiry 2015 (71)	Metabolic syndrome	Home	Asia	Diet and exercise	Tele-education, Telemonitoring	Supported by remote contact	Wait list control	6	160	High
Johnson 2019 (72)	Overweight/obesity	Home	North America	Diet and exercise	Telemonitoring, Telementoring	Supported by remote contact	Usual care + minimal telemedicine only	3	30	Low
Kempf 2018 (73)	Overweight/obesity	Other	Europe	Diet and exercise	Tele-education, Telemonitoring, Telementoring	Supported by remote contact	Usual care	3	180	Low
Lison 2020 (74)	Overweight/obesity	Hospital	Europe	Diet and exercise	Tele-education, Telemonitoring	No support	Wait list control	3	105	Low
Ma 2013 (75)	Prediabetes & overweight	Clinic	North America	Diet and exercise	Tele-education, Telemonitoring	Supported by remote contact	Usual care	15	241	Low
McLeod 2020 (76)	Prediabetes	Combination	Australia	Overall behaviour	Tele-education, Telemonitoring, Telementoring	Supported by remote contact	Usual care	12	225	Low

Patel 2019 (77)	Overweight/obesity	Home	North America	Diet	Tele-education, Telemonitoring	Supported by remote contact	Intervention + minimal telemedicine only	6	105	High
Pérez Ewert 2016 (78)	Prediabetes & overweight	Home	South America	Diet and exercise	Tele-education, Telemonitoring	Supported by remote contact	Usual care	9	70	Low
Peyer 2017 (79)	Overweight/obesity	Combination	North America	Diet and exercise	Telemonitoring	Supported by face-to-face contact	Intervention without telemedicine	2	89	Some
Rogers 2016 (80)	Overweight/obesity	Combination	North America	Diet and exercise	Tele-education, Telemonitoring	Supported by remote contact	Intervention without telemedicine	6	39	High
Silina 2017	Overweight/obesity	Home	Europe	Diet and exercise	Tele-education	No support	Intervention without telemedicine	12	129	Some
Staite 2020 (81)	Prediabetes & overweight	Home	Europe	Diet and exercise	Tele-education, Telemonitoring	No support	Usual care + minimal telemedicine only	12	200	High
Tanaka 2018 (82)	Prediabetes & overweight	Home	Asia	Diet	Tele-management,Telemonitoring	Supported by remote contact	Usual care	3	112	Low

Pérez Ewert JC, Bustamante C, Alcayaga C, Medina M, Sánchez H, Campos S, et al. Evaluación del Modelo Multi-componente de Telecuidado de apoyo a Personas con Pre-diabetes en Chile. Actualidades en Psicología. 2016;30(121)

Table 2. Characteristics of cluster-randomised, non-randomised and non-controlled intervention studies excluded from the meta-analysis investigating effectiveness of telemedicine intervention on prevention of type 2 diabetes mellitus.

Study, year (ref)	Design	Criteria for high-risk	Setting	Region	Intervention focus	Telemedicine	Support	Control group	Duration, months	N	Results summary
Chee 2014 (30)	Cluster randomised parallel group design	Metabolic syndrome	Home	Asia	Exercise	Tele-education	Supported by face-to-face contact	Intervention without telemedicine	4	147	Within-group analyses revealed that the intervention group significantly increased the step number per day with a stronger increase between baseline and two months compared to between two months follow up and four months,
Davies 2016 (28)	Cluster randomised parallel group design	Prediabetes	Clinic	Europe	Diet and exercise	Tele-education	Supported by remote and face-to-face contact	Usual care	36	880	A 6-hour intervention followed by yearly 3-hour refreshers showed a non-significant 26% reduced risk of developing T2D and statistically significant improvements in HbA1c (−0.06%, CI[−0.11, −0.01]), LDL cholesterol (−0.08 mmol/mol CI[−0.15, −0.01]), sedentary time (−26.29 min, CI[−45.26, −7.32]) and step count (498.15, CI[162.10, 834.20]).
Rusali 2018 (29)	Cluster randomised parallel group design	Overweight/obesity	Workplace	Asia	Diet and exercise	Tele-education	No support	Usual care group and face-to-face group	4	108	The online intervention group showed lower reductions in body weight (-1.12 kg) compared to the face-to-face intervention group (-5.80 kg) and

Resultados

Telemedicine interventions reduced:
Body weight (mean difference (MD): -1.66 kg, 95% confidence interval (CI) -2.48,-0.90, I2=81%, n studies=17)
Body mass index (MD -0.71 kg/m2, 95% CI -1.06,-0.37, I2 =70%, n studies=11)
Waist circumference (MD -2.82 cm, 95% CI -5.16,-2.35, I2=84%, n studies=8)
HbA1c (MD -0.07%, 95% CI -0.14,0.00, I2 =71%, nstudies=11).
No significant effects were found for other clinical outcomes.
The narrative synthesis supported the results

Effect on cardiometabolic risk factors

Risk factor	N RCTs	N	MD (95% CI)	95% prediction interval	Tau (95% CI)	I^2
Measures of anthropometry						
Body weight, kg	17	2484	-1.66 (-2.48, -0.90)	-4.60, 1.21	1.27 (0.60, 2.11)	81%
Body mass index, kg/m^2	11	1546	-0.71 (-1.06, -0.37)	-1.77, 0.34	0.42 (0.12, 0.83)	70%
Waist circumference, cm	7	1010	-2.82 (-5.16, -2.35)	-9.17, 3.61	2.30 (0.64, 5.21)	84%
Measures of blood glucose						
FPG, mmol/L	9	1127	-0.05 (-0.19, 0.11)	-0.40, 0.33	0.12 (0.01, 0.30)	46%
HbA1c, %	11	1480	-0.07 (-0.14, 0.00)	-0.29, 0.15	0.09 (0.03, 0.17)	71%
Measures of blood lipids						
LDL cholesterol, mmol/L	8	1142	-0.04 (-0.17, 0.09)	-0.35, 0.27	0.10 (0.00, 0.26)	40%
HDL cholesterol, mmol/L	9	1271	0.02 (-0.02, 0.07)	-0.12, 0.18	0.04 (0.00, 0.13)	65%
TG, mmol/L	8	1170	0.00 (-0.24, 0.26)	-0.67, 0.68	0.25 (0.01, 0.57)	92%
Measures of blood pressure						
Systolic blood pressure, mmHg	10	1378	-2.06 (-4.38, 0.15)	-8.43, 4.16	2.25 (0.23, 5.06)	58%
Diastolic blood pressure, mmHg	8	1105	-1.82 (-4.05, 0.18)	-7.58, 3.65	1.94 (0.15, 4.54)	64%

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Effect on body weight in subgroups

Subgroup	N RCTs	MD (95% CI)	I^2
Overall	17	-1.66 (-2.48, -0.90)	81%
Type of control group			
Intervention without telemedicine	3	-2.48 (-4.48, -0.47)	0%
Usual care	8	-1.26 (-2.18, -0.34)	32%
Minimal telemedicine	3	-1.09 (-2.81, 0.63)	73%
Wait list control	3	-2.74 (-4.29, -1.19)	92%
Degree of behavioral support			
No support	4	-2.07 (-3.60, -0.54)	89%
Supported by remote contact	12	-1.58 (-2.46, -0.70)	44%
Supported by remote and face-to-face contact	1	-1.40 (-4.06, 1.26)	-

Subgroup	N RCTs	MD (95% CI)	I^2
Overall	17	-1.66 (-2.48, -0.90)	81%
High-risk population			
Overweight/obese	7	-2.64 (-3.81, -1.47)	75%
Prediabetes	3	-1.19 (-2.59, 0.20)	24%
Prediabetes and overweight/obese	4	-0.90 (-2.16, 0.35)	18%
Metabolic syndrome	3	-1.57 (-2.99, -0.15)	55%
Risk of bias			
Low	5	-1.84 (-3.12, -0.56)	83%
Some	7	-1.57 (-2.74, -0.40)	53%
High	5	-1.65 (-3.05, -0.25)	67%
Duration of intervention			
Short (<6 months)	5	-1.34 (-2.45, -0.19)	45%
Medium (6 to <12 months)	5	-2.47 (-3.70, -1.24)	79%
Long (>= 12 months)	6	-1.31 (-2.41, -0.20)	54%

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Diet and exercise delivered using telemedicine reduced body weight, BMI, waist circumference and Hba1c. No changes were seen in FPG, blood lipids or blood pressure. Subgroup analysis found larger effects for people with overweight/obesity.

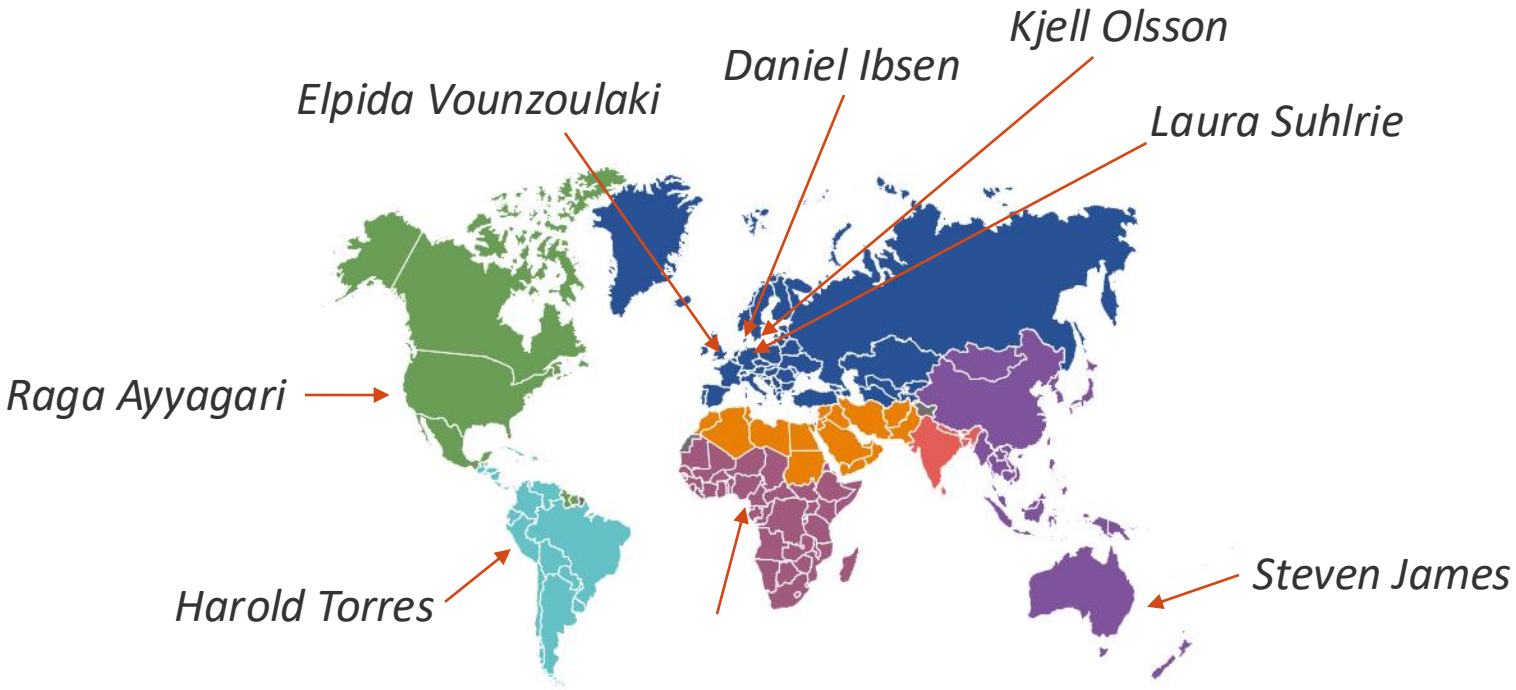
- Comprehensive search and multiple outcomes
- Bayesian meta-analysis approach, which has been suggested to be better when there is between-study heterogeneity and when the number of studies is small

There is potential but more knowledge is needed

- Search covers 2010 – 2020 => fast technological development; will new technology improve outcomes?
- Broad definition of the intervention => what intervention is best? We cannot say for sure

Conclusiones

Our study highlights the potential for telemedicine-delivered interventions in preventing T2D in people at risk.



Muchas gracias

GDJC co-organizers
Omar Silverman
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Camille Mba