





Comparing the Effect of Digital Health Interventions on Anxiety and Depression of Individuals Facing Cancer

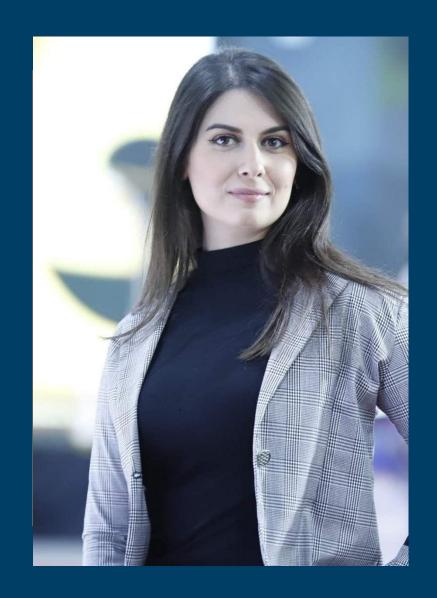
SYSTEMATIC REVIEW AND META-ANALYSIS

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Resume

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BACKGROUND

The impact of cancer on patient quality of life (QoL) [1]

Anxiety (35.2%), pain (44.5%) and fatigue (96%) among cancer patients
[2,3,4]

- Current standard care [5,6]
- Adoption of **technology** is widespread among adolescents [7]
- Covid-19 pandemic accelerated the development and implementation of digital health [8]
- WHO Recommendations on Digital Interventions for Health System Strengthening (2019) [9]



• **Digital health** is expected to improve **QoL** [10]









CLINICAL QUESTION



Clinical question: Does eHealth and mHealth change the mental and

physical health outcomes of Cancer Patients?

- P Cancer Patients during therapy
- Digital health interventions: eHealth (e.g. Virtual reality and games), mHealth (e.g. mobile apps)
- C Conventional interventions
- O Mental and Physical health outcomes:

Pain (Wong-Baker FACES Pain Rating Scale, PCS-C)

Anxiety (CAM-S, VAS, CASI)

Fear (CFS)

QoL (PedsQL, HRQoL, SF-36, PROMIS, EORTC QLQ-C30, etc.)

Satisfaction (PSQ-18, Likert-format surveys)

PedsQL: Pediatric Quality of Live Inventory

SF-36: 36-item Short-Form Survey **PROMIS**: Patient-reported Outcome Measurement Information System

EORTC QLQ-C30: Euroepan Organisation for Research and Treatment of Cancer Core Quality of Life Questionnaire

PSQ-18: Patient Satisfactory

Questionnaire

PCS-C: Pain Catastrophizing Scale

for Children

CAM-S: The Children's Anxiety Meter-

State

VAS: visual analogue scale

CASI: Childhood Anxiety Sensitivity Index

CSF: The Child Fear Scale

Hypothesis: Digital health interventions will improve the mental and physical health outcomes of cancer patients

SEARCH KEY, FLOWCHART SELECTION



N⁰ of

texts

eligible full-

207

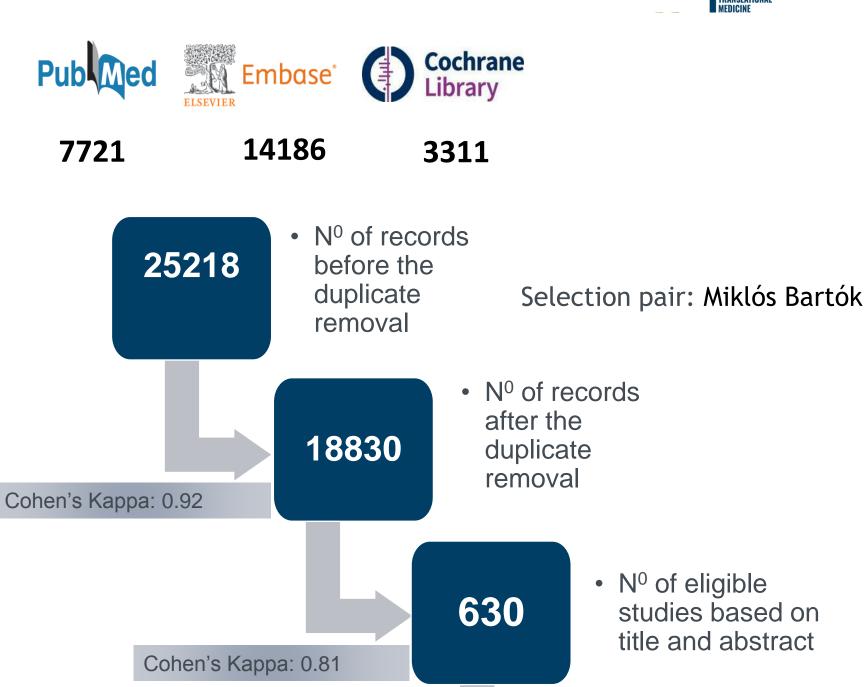
("cancer" OR carcinom* OR tumo* OR malignan* OR oncolog* OR neoplas* OR metasta*)

AND

("digital health" OR "electronic health" OR "telemedicine" OR ehealth OR "mobile health" OR mhealth OR ("web-based" AND "intervention") OR ("web-based" AND "interventions") OR ("computer-based" AND "interventions") OR ("internet-based" AND "interventions") OR ("internet-based" AND "interventions") OR "Virtual reality" OR VR OR "virtual reality exposure therapy" OR ("active" AND "video game") OR ("active" AND "video games") OR exergam* OR videogame* OR ("mobile" AND "application") OR ("mobile" AND "applications") OR ("smartphone" AND "applications") OR ("smartphone" AND "applications") OR ("smartphone" AND "apps") OR ("smartphone" AND "games") OR ("mobile" AND "games") OR ("smartphone" AND "games") OR "text messag*" OR "social media" OR "wearable*")

AND

("quality of life" OR "HRQoL" OR "compliance" OR "satisfaction" OR ("mental" AND "outcome") OR ("mental" AND "outcomes") OR ("physical" AND "outcomes") OR ("emotional" AND "distress") OR ("health" AND "behavior") OR ("health" AND "behaviors") OR "self efficacy" OR "depression" OR "anxiety" OR ("physical" AND "activity") OR "fear" OR "pain" OR ("symptoms" AND "management") OR "distraction")





Anxiety

Anxiety change differences between Virtual Reality (VR) interventions and control groups

Study	Age	Scale	Duration		Experir Mean	nental SD	N	Co Mean	ontrol SD	SMD of differences	SMD	95%-0	Cl We	ight
Sharifpour et al. 2020	14-18*	PASS	2 months	15					1.8042 *	: 1		-24.68; -1		
Chirico et al. 2019	18-70*	STAI	immediately after	28	-6.85	0.7239	34	-1.47	1.2190	-	-5.18 [-6.24; -4	1.11] 12	2.8%
García et al. 2023	30-82**	HADS	immediately after	71	-2.00	0.2581	62	-0.92	0.4642	+	-2.90	-3.39; -2	2.41] 12	2.9%
Uslu et al. 2023	18-65*	STAI	1st chemo cycle	33	-13.15	5.7486	33	-0.03	7.1724	+		-2.59; -1		
Fabi et al. 2022	NA	STAI-S	1st chemo cýcle	22	-12.50	5.4463	22	-2.00	7.2378	+		-2.30; -0		
Wong et al. 2022	6-12*	CSAS-C	1st chemo cycle	9	-5.78	3.2816	10	-1.40	3.7483	-		-2.18; -0	-	
Jeayareka et al. 2020	10-18*	RCMAS (total)	2-3 chemo cycles at	least 6	-1.50	1.4176	6	0.34	2.4036			-2.07; (
Zhang et al. 2023	18-57**	STÀI	14 days	30	7.33	4.3200	30	3.77	8.0200	+	0.55		1.06] 12	
Random effects mode Heterogeneity: /2 = 96% [94%;		9.5137 , p < 0.01		214		2	212		Γ			-8.66;	1.28] 100	0.0%
									-20	-15 -10 -5 0 5	10			
Study	Age	Scale	Duration		(perim ean	ental SD	N	Con Mean	trol SD	SMD of difference	s SM	D 95%	G-CI W	/eight

Study	Age	Scale	Duration	Expe NMea	erimental n SD		ntrol SD	SMD of differences	SMD	95%-CI	Weight	
Gao et al. 2020 Shin et al. 2023 Jimenez et al. 2018	18-75** 20-65* 35-74**	STAI-S STAI STAI-S	after intervention immediately after after intervention	97 -1.7	9 6.0289	30 -0.97 99 -0.99 18 -5.50	2.1617	+	-0.18 [·	0.46; 0.1	39] 31.0% 0] 42.7% 9] 26.3%	
Random effects mo		.1207. n = 0.05		146		147	1		-0.40[-1.46; 0.6	6]100.0%	

Study	Age	Scale	Duration		xperin Mean	nental SD	N	Co Mean	ontrol SD	SMD of differences	SMD	95%-CI	Weight
Menekli et al. 2022 Wong et al. 2020 Gerçeker et al. 2021	20-63** 6-17* 6-17*	STAI STAIC CAM-S	4 hours after immediately after immediately after	54	-5.56		54	-2.06	4.2593	+	-0.85 [·14.25; -11. -1.24; -0.4 -1.19; 0.0	5] 33.5%
Random effects mode Heterogeneity: /2 = 99% [99%;	144		1	145				-4.67[-	21.85; 12.	50]100.0%			
Tieterogeneity. I 9970 (9970,						-2	20 -15 -10 -5 0 5	10					

Anxiety change differences between webbased interventions and control groups



			Experimental			Control											
Study	Age	Scale	Duration	N	Mean	SD	NI	Mean	SD	SM	D of di	fference	s SMI	95%	₀-CI	Weight	[
Chang et al. 2020	≥20*	DASS-21	6 weeks	41	-2.00	3.9187	26	-0.35	4.1284			÷	-0.4	1 [-0.90	; 0.09] 8.6%)
Ryhänen et al. 2013	NA	STAI	after radiotherapy	47	-0.65	0.5475	43	-0.49	0.5264			Ė	-0.3	0 [-0.71	; 0.12	12.2%)
Akard et al. 2021	7-17*	PedsQL-CM	after 7-176 days	33	-3.20	6.9659	57	0.00	13.6778			Ė.	-0.2	7 [-0.70	0.16	11.4%	j
David et al. 2012	≥18*	MAC	4 weeks	56	-1.10	3.3628	55	-1.03	3.9638			•	-0.0	2 [-0.39	0.35	15.2%	j
Hauffman et al. 2020	NA	STAI-S	10 months	124	1.00	5.3666	121	1.00	5.3666			+	0.0	0 [-0.25	0.25] 33.7%	j
Winzelberg et al. 2003	30-69**	STAI-S	12 weeks	36	1.00	10.7723	36	0.40	10.5603			ļ.	0.0	6 [-0.41	0.52	9.9%)
Danielle et al. 2022	NA	EORTC OG-25	12 weeks	33	-11.10	22.2720	33 -	-13.00	21.5035			<u>+</u>		-	-	j 9.1%	
Random effects model Heterogeneity: /2 = 0% [0%; 71%],	τ ² = 0 n = 0.5	8		370)	;	371				T		-0.0	9 [-0.25	; 0.07]100.0	%
	, , , , , , , , , , , , , , , , , , , ,	•								-20	-10	0	10				

Anxiety change differences between mobile app interventions and control groups



				Experin	nental	С	ontrol					
Study	Age	Scale	Duration	N Mean	SD	NMean	SD	SN	ID of differences	SMD	95%-CI	Weight
Ham et al. 2019 Ghanbari et al. 2021 Zheng et al. 2024	16-65* 20-60* ≥18*	STAI-S	10 weeks 1 week 6 months	38 -6.71	7.5907	39 0.07	3.3162		+	-1.15[-2.80; -1.2 -1.64; -0.6 -0.94; -0.1	7] 34.6%
Random effects mode Heterogeneity: /2 = 84% [53%;		5.14, p < 0.01		109	1	10		-20	-10 0 10	-1.19	-3.04; 0.6	5] 100.0%



Depression

Depression change differences between Virtual Reality (VR) interventions and control groups



Study	Age	Scale	Duration	Experim N Mean		N	Contro Mean S		SMD of differences	SMD	95%-CI	Weight
Chirico et al. 2019 Zhang et al. 2023 Fabi et al. 2022 García et al. 2023	18-70* \$ 18-57** NA 30-82**	CES-D HADS	immediately after 14 days 1 st chemo cycle ⁺⁺ immediately after	30 -3.10 4	.4700 .1219	30 22	0.07 3.69 1.30 1.63	00 62		-0.76 [] 0.00	-10.73; -7.3 -1.29; -0.2 -0.59; 0.5 -0.33; 0.3	4] 25.2% 9] 25.2%
Random effects m Heterogeneity: /2 = 97% [9 ++: within 48 hours after 1	95%; 98%], t			151	•	148		-10 -8	3 -6 -4 -2 0 2	-2.38 4	[-9.32; 4	.56] 100.0%

Depression change differences between webbased interventions and control groups



					erime	ental		Contr	rol				
Study	Age	Scale	Duration	N N	/lean	SD	N	Mean	SD	SMD of differences	SMD	95%-CI	Weight
Winzelberg et al. 2003 Fann et al. 2016 Hauffman et al. 2020 Chang et al. 2020 Bektas et al. 2022	30-69** ≥18* NA ≥20* ≥18*	CES-D PHQ-9 HADS DASS-21 BDI	12 weeks 5-12 weeks 4 months 6 weeks 12 weeks	285 (124 -1 41 -1	0.05 1.20 .51	8.8363 3.4250 3.2112 3.8508 7.7441	289 121 26	0.62 -0.90 -1.50		+	-0.16 [- -0.09 [- -0.00 [-	1.09; -0.14 0.33; 0.00 0.34; 0.16 0.49; 0.49	0] 56.7% 6] 24.3% 9] 6.3%
Random effects mode Heterogeneity: /2 = 16% [0%; 82		01, p = 0.32		516			502		-10 -	8 -6 -4 -2 0 2	- <mark>-0.15</mark> [-	0.34; 0.04	4]100.0%

DISCUSSION



- ☐ Negative SMD values = symptom reduction vs. standard care
- ☐ VR shows a clinically relevant effect on anxiety
- ☐ Pooled effects of VR, mobile apps, and web-based interventions:
 - promising reductions in anxiety
- lacktriangle Depression results less conclusive o small samples, need larger trials
- ☐ Considerable heterogeneity observed across studies



STRENGTHS

- 1. Several high quality reports (RCTs)
- 2. Several measurement tools developed in this field

LIMITATIONS

- 1.Interviews and semiinterviews
- 2. Difficulties in comparison
- 3.Small sample size



CONCLUSION

VR intervention has the potential to reduce the anxiety among cancer patients

IMPLICATION FOR PRACTICE

Age-specific digital health interventions should be introduced to oncological care

IMPLICATION FOR RESEARCH

- 1. RCTs with high patient number should focus on more homogenous (age, cancer type) target populations
- 2. New age-, and diseasetargeted digital health interventions should be developed



"Somewhere, something incredible is waiting to be known"

Carl Sagan