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Article

The Impact of Telemonitoring and Health Coaching on Depression, Anxiety, and Stress Scales in Overweight and Obese Individuals

Noura MS Eid ^{1,2,*}, Ebtisam A. Al-ofi ^{2,3}, Sumia Enani ^{2,4}, Rana H. Mosli ¹, Raneem Saqr ^{5,6}, Karimah M Qutah ⁷ and Sara MS Eid ²

¹ Department of Clinical Nutrition, Faculty of Applied Medical Sciences, King Abdulaziz University, Jeddah, Saudi Arabia.

² King Fahd Medical Research Center, King Abdulaziz University, Jeddah, Saudi Arabia

³ Department of Physiology, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia

⁴ Department of Food and Nutrition, Faculty of Human Sciences and Design, King Abdulaziz University, Jeddah, Saudi Arabia

⁵ Department of Management Information System, Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Saudi Arabia

⁶ The Management of Digital Transformation and Innovation Systems in Organization Research Group, King Abdulaziz University, Jeddah 21589, Saudi Arabia

⁷ Quality and Patient Safety Administration, King Abdullah Medical City, Makkah, Saudi Arabia

* Correspondence: ooaeid2@kau.edu.sa

Abstract: (1) Background: The literature has demonstrated several pathways that link obesity with stress. Thus, new approaches to weight management programs must also integrate health coaching and telemonitoring for overall health and well-being. This study aimed to measure stress, anxiety, and depression scales (DASS-21) in overweight and obese participants who joined a pilot randomized controlled trial (RCT) and the association between changes in DASS-21 scores and changes in anthropometric measures. (2) Methods: Fifty participants were enrolled in a randomized controlled trial and divided into two groups: the intervention group, which received a hypocaloric diet remotely, weekly telemonitoring, and monthly health coaching, and the control group, which only followed a hypocaloric diet without any support. The Arabic version of the Depression Anxiety Stress Scales (DASS-21) was used. (3) Results: The data reveal that participants from the intervention group exhibited a significant decrease in the anxiety scale after 3 months compared with the control group. In addition, the correlations between depression, anxiety, stress, and all anthropometric measures in the intervention group showed a moderately significant positive correlation between changes in waist circumference and depression. (4) Conclusions: The findings confirm that integrating health coaching and telemonitoring can improve well-being and weight loss.

Keywords: obesity; depression anxiety stress scales (DASS-21); telenutrition; telemonitoring; health coaching

1. Introduction

Integrative nutrition combines the principles of traditional nutrition guidelines and functional nutrition to provide a more individualized approach to eating [1]. The Academy of Nutrition and Dietetics has recognized telenutrition as useful to implement in a dietitian's activity and defines it as "The interactive use by an RDN of electronic information and telecommunications technologies to implement the Nutrition Care Process with patients or clients at a remote location, within the provisions of the RDN's state license as applicable" [2]. Telenutrition has recently spread since the pandemic due to its convenience and accessibility to many populations. The literature has also revealed that monitoring physical activity and diet significantly improves weight loss and metabolic risks [3,4] and enhances patients' motivation. Thus, an integrated approach between nutrition, health

coaching and telemonitoring for weight management may have a stronger impact on changing behavior to a healthier approach. Previous research has shown that supporting healthcare with health coaching exhibits long-term and sustainable weight loss due to continuous follow-up, feedback, and guidance [5] to improve behavior and well-being [6], weight management and physical activity as well [7]. In fact, in the year 2022, lifestyle coaching delivered via digital channels showed significant long term weight loss [8]. In fact, primary outcomes from our pilot study have revealed that weight management programs when supported with telemonitoring and integrative nutrition health coaching, significant reductions in weight, BMI, fat%, visceral fat, and an increase in muscle. In addition to improvements in waist circumference measures and in blood lipids profile in comparison with the control group [9].

Remarkably, epidemiological studies on the prevalence of obesity in Saudi Arabia have been increasing in the past four decades [10], indicating that obesity still remains a burden among the population [11]. In addition, the WHO has indicated that 30% of deaths worldwide will be associated with lifestyle-related illnesses by the year 2030 and may be stopped by working on specific risk factors, including stress and depression [12]. In 2021 recent study was carried on Saudi adolescent in Abha city highlighted that obesity was a significant risk factor for and depression, which requires dietary and lifestyle intervention [13]. Stress has spread among the Saudi population, but little attention has been given to stress management during dietary consultations by integrative nutrition approaches [14]. Stress and depression have been proven to result from stressful circumstances during childhood and adolescence [15]. The strong link between obesity and stress was seen to be associated with overeating, unhealthy diets, and weight gain [16]. A study revealed that interpersonal stress may be more harmful to girls with overweight/obesity than boys due to body image sensitivities [17]. Moreover, stress is linked with overweight patients with binge-eating disorder (BED) [18]. A study examined the impact of integrating self-monitoring using self-monitoring apps and health coaching, where promising results were seen in both anthropometric measurements and lifestyle outcomes [7,19]. Thus, changes in lifestyle patterns and quality of life reduce stress, anxiety, and potential depressive episodes. In other words, applying integrative nutrition, or so-called holistic nutrition, via health coaching in dietary consultations can alter behaviors and overcome challenges and struggles to reduce stress and promote weight management [20,21]. Quality of life (QOL) is an additional measure that may be related to stress and the prevalence of obesity. A study has shown[22] that medical students suffer from both anxiety and stress and low quality of life, which may impact eating habits and weight management [20,23,24].

Recent studies have highlighted the impact of text-based mental health coaching in reducing symptoms of depression, anxiety, and stress in working individuals [25,26]. According to a systematic review, digital mental health interventions were effective in reducing symptoms of depression, anxiety, and psychological well-being among college students. Still, few studies have looked at the impact of telehealth or telehealth coaching on Depression, Anxiety, and Stress Scales. Hence, results suggest conducting intervention trials to assess the impact of telemedicine and telehealth coaching on depression, anxiety, and stress. An integrative approach that combines both clinical dietitians and health coaches to support clients in tackling factors associated with their stress during weight loss interventions. Therefore, the current study aim was to investigate the influence of a telenutrition weight loss program supported by telemonitoring and health coaching on Depression Anxiety Stress Scales (DASS-21) among overweight and obese adults living in Saudi Arabia. In addition, we aimed to study the correlation between Depression Anxiety Stress Scales (DASS-21) and anthropometric measures.

2. Materials and Methods

2.1. Study Design, Setting, and Participants

A 6-month two-arm pilot randomized controlled trial was conducted in 2022, starting in January 2022 to August 2023. A detailed study protocol is described previously [22]. This study was approved by the Research Ethics Committee (REC) at the Unit of Biomedical Ethics, the Faculty of Medicine, at

King Abdul-Aziz University (approval number: HA-02-j-008), and written informed consent was obtained from all the participants. The inclusion criteria included adults who were aged 20-50 years, female, or male, and obese or overweight. The exclusion criteria included participants who were not familiar with or did not have access to online applications and those who had a history of chronic diseases, such as diabetes, cardiovascular diseases, thyroid dysfunction, or any other endocrine abnormality. Moreover, all participants who joined any dietary interventions or used any type of medication or injections for weight loss in the past 3 months were excluded. Once the eligibility requirements were met, participants were randomly divided into two groups using a randomization website (<http://www.randomization.com>) and each participant had a specific code and got informed about which group they will be joining. Both the intervention group and the control group have received a hypocaloric tailored diet via telenutrition (remotely) by a registered dietitian (RD) and had several remote follow ups (10 to 14 consultations) until weight loss goals were achieved. Additionally, the intervention group have been provided with integrative nutrition support by an integrative nutrition health coach via Zoom platforms and smartphones (total of 6 sessions). Main aim of the telehealth coaching sessions is to address lifestyle factors associated with obesity and overweight status via a health history session, followed by a goal setting session and continuous guidance and recommendations to tackle specific lifestyle factors that may influence their commitment to the diet [27]. In alignment with telehealth coaching, participants in the intervention group were weekly telemonitored, to record their weights by end of each week (total of 36 weeks). During the 6-month duration of this study, participants from both groups were invited to a total of 3 physical visits at the Food, Nutrition, and Lifestyle unit at the King Fahd Medical Research Center, King Abdulaziz University, Jeddah, Saudi Arabia. Their anthropometric measurements and scores on the Depression Anxiety Stress Scales (DASS-21) were collected during each visit.

The sample size was calculated for our primary outcomes of the study, which is changes in weight and anthropometric measures that was shared recently in the Clinical Nutrition ESPEN congress in Milan, 2024 [9]. Sample size calculation was based on a published three-armed randomised controlled study that was carried to measure effectiveness of telemedical coaching on weight loss [5], which was similar to our primary outcome. The present study demonstrates secondary outcomes of the same participants enrolled in the study. Calculation used a power of 80%, significance level of 5%, and a dropout rate of 25%. Thus each group requires a minimum of 35 participant, to achieve significant differences between groups (3.7 kg (2.5 SD) in body weight in comparison with the control group [5]. Thus, we recruited 70 Participants via the university and research center's official social media platforms and then invited for an assessment visit to ensure they met the eligibility requirements via medical and anthropometric measures. Since the current study is a pilot study, we examined between 10% to 30% of the calculated sample size following evident recommendations on pilot study sample size [28]. The reason of conducting a pilot study is due to the nature of the study, which is the first study that conduct a telehealth intervention supported with a holistic approach in weight management, or so called "Integrative nutrition", to tackle stress in overweight and obese participants. Thus, a total of 50 participants were enrolled in the study to ensure we have a representable sample considering possible attrition rate in both groups. Therefore, a total number of 50 participants were enrolled (25 participants in each group). On Completion of the study, 18 and 12 participants were retained in the control and intervention groups, respectively. Showing that attrition rate was less in the intervention group than in the control group which will be discussed later in the discussion section However, number of participants have been varied in each time point, of which 29 participants have completed 3 months of the trial (18 in the intervention group and 12 in the control group) and 25 participants have completed 6 months of the trial (16 in the intervention group and 9 in the control group). The total of all time-point completers (baseline, 3 months and 6 months) were 15 participants in the intervention group and 8 participants in the control group.

2.2. Depression Anxiety Stress Scales (DASS-21)

This study used the translated Arabic version of the Depression Anxiety Stress Scales (DASS-21) [13] to assess symptoms related to depression, anxiety, and stress. The DASS-21 measured the rating of each symptom present in participants at different time points in this study: at baseline, 3-month, and 6-month visits, respectively. The DASS-21 comprises three subscales: depression, anxiety, and stress. Each subscale includes 7 items to be assessed using a Likert-type scale ranging from 0, which means "does not apply to me at all", and 3, which means "applies to me all the time". High scores on the DASS-21 scale are associated with clinical cases based on the DSM-V (*Diagnostic and Statistical Manual of Mental Disorders*). Depression is classified as normal (0-9), mild (10-13), moderate (14-20), severe (21-27), or extremely severe (≥ 28); anxiety is classified as normal (0-7), mild (8-9), moderate (10-14), severe (15-19), or extremely severe (≥ 20); and stress is classified as normal (0-14), mild (15-18), moderate (19-25), severe (26-33), and highly severe (≥ 34).

2.3. Statistical Analysis

Data were analyzed using the SPSS program, version 26.0. Continuous data are reported as means and SDs. Categorical variables are reported as frequencies and percentages (%). Independent t-test was used in the descriptive analysis of continuous variables and Chi-square test was used for categorical variables. Repeated measures analysis of variance (ANOVA) was conducted on all time-point completers as the primary analysis. The within-subjects factor was time (baseline, 3 months and 6 months). The between-subjects factor was intervention group (intervention and control) with pairwise comparisons between the time points (baseline vs. 3 months, baseline vs. 6 months). Bonferroni correction was used to adjust p-values for pairwise comparisons. Secondary analysis was done on completers at any time-point to maximize utilization of data. Between-group differences were examined at all time-points using independent t-test. The relationships between changes in the stress, anxiety, and depression scales and various anthropometric measurements were assessed using Spearman’s correlation coefficients. A value of <0.05 (two-sided test) was statistically significant.

3. Results

1. Participants' baseline characteristics

A total of 50 participants started this study, of which 29 completed 3 months of the trial (18 in the intervention group and 12 in the control group) and 25 completed 6 months of the trial (16 in the intervention group and 9 in the control group). **The total of all time-point completers (baseline, 3 months and 6 months) were 15 participants in the intervention group and 8 participants in the control group.**

Table 1. Participants' baseline characteristics.

	Any time-point completers		All time-point completers	
	Intervention (n = 18)	Control (n = 12)	Intervention (n = 15)	Control (n = 8)
Age (years) mean $\pm$ SD	33 $\pm$ 11	36 $\pm$ 10	33 $\pm$ 12	39 $\pm$ 9
Gender n (n%)				
Men	5 (28%)	6 (54.5%)	5 (33.3%)	5 (62.5%)
Women	13 (72%)	5 (45.5%)	10 (66.7%)	3 (37.5%)
Weight (kg) mean $\pm$ SD	90.1 $\pm$ 20.7	90.9 $\pm$ 21.9	90.5 $\pm$ 22.3	94.7 $\pm$ 23.9
BMI (kg/m ²) mean $\pm$ SD	33.2 $\pm$ 6.15	33.9 $\pm$ 5.58	33.6 $\pm$ 6.5	34.4 $\pm$ 5.7
BMI (kg/m ²) n (n%)				
<30	7 (39%)	3 (27%)	6 (40)%	2 (25%)
≥ 30	11 (61%)	8 (73%)	9 (60%)	6 (75%)

2. Weight, BMI, and WC at all time-points for all time-point completers

While the primary focus of this manuscript is on the psychological outcomes, a brief summary of the weight-related outcomes is provided here (Table 2). Briefly, participants in the intervention group only showed significant reductions in weight, BMI and WC at 3 months from baseline but not at 6 months [9]. The effect of intervention on weight loss and anthropometric measurements will be reported in detail in a separate manuscript [Eid et al., under review].

Table 2. Mean, SD and statistical significance for within and between-group differences in weight, BMI and WC at all time-points for all time-point completers.

	Baseline Mean (SD)	3 months Mean (SD)	6 months Mean (SD)	Within- group analysis Baseline vs. 3 months P-value	Within- group analysis Baseline vs. 6 months P-value	Between group analysis Intervention vs. control
Weight						
Intervention	91.5 (22.3)	87.3 (20.7)	88.5 (22.9)	0.015	0.227	0.620
Control	94.7 (23.9)	94.2 (25)	93.4 (24.5)	1	0.696	
BMI						
Intervention	33.6 (6.5)	32 (6.6)	32.4 (7.5)	0.012	0.253	0.624
Control	34.4 (5.7)	34.1 (6)	33.8 (5.7)	1	0.528	
WC						
Intervention	97 (18)	92 (16)	93 (16)	0.002	0.112	0.23
Control	106 (20)	103 (19)	101 (20)	0.081	0.217	

Data is expressed as mean (SD) for DASS-21 scores for completers of the study (n=15) in the intervention and (n=8) in the control group.
P-values were obtained through repeated measures analysis of variance (ANOVA) with pairwise comparisons between the time points. Bonferroni correction was used to adjust p-values for pairwise comparisons.

3. Stress, anxiety, and depression scales at all time-points for all time-point completers

The repeated measures ANOVA for stress, anxiety, and depression scores as measured by the DASS-21 for all time-point completers in the intervention (n=15) and the control groups (n=8) at baseline, 3 months, and 6 months showed that there no significant differences within groups over time for stress, anxiety, or depression (Table 3). In the intervention group, stress and anxiety scores decreased from baseline to 6 months, but these changes were not statistically significant. There was a significant between-group difference in anxiety (p = 0.037, Table 3), however, there were no significant time by intervention interactions for any of the variables.

Table 3. Mean, SD and statistical significance for within and between-group differences in stress, anxiety and depression scales at all time-points for all time-point completers.

	Baseline Mean (SD)	3 months Mean (SD)	6 months Mean (SD)	Within- group analysis Baseline vs. 3 months P-value	Within- group analysis Baseline vs. 6 months P-value	Between group analysis Intervention vs. control
Stress						
Intervention	12.93 (9.94)	12.93 (8.31)	9.33 (11.36)	1	0.621	0.09
Control	18.5 (9.37)	16.25 (13.41)	20.25 (10.55)	1	1	
Anxiety						
Intervention	8.93 (7.48)	6.53 (6.74)	6.53 (8.6)	0.415	0.51	0.037
Control	14 (8.07)	12 (7.56)	15.5 (8.93)	1	1	
Depression						
Intervention	8.8 (9.19)	8.67 (7.62)	7.2 (10.41)	1	1	0.129
Control	11.75 (8.17)	13.25 (10.08)	15 (10.03)	1	1	

Data is expressed as mean (SD) for DASS-21 scores for completers of the study (n=15) in the intervention and (n=8) in the control group.

P-values were obtained through repeated measures analysis of variance (ANOVA) with pairwise comparisons between the time points. Bonferroni correction was used to adjust p-values for pairwise comparisons.

4. Stress, anxiety, and depression scales at all time-points for completers at any time-point

The analysis of between-group differences in stress, anxiety, and depression scales (Table 1) revealed no significant differences between groups at baseline for any of stress, anxiety or depression. At the 3-month follow-up, the interventiongroup had significantly lower anxiety scores compared to the control group (6.3 ± 6.5 vs. 11.3 ± 6.4 , $P = 0.047$; Table 4), though differences in stress and depression remained non-significant. By the 6-month follow-up, differences in stress, anxiety, and depression between the groups were not statistically significant.

Table 4. Mean, SD, and statistical significance for between-group differences in stress, anxiety, and depression scales at all time points for completers at any time-point.

Variable/Time Point	Group	n	Mean	SD	P-Value
Stress					
Baseline	Intervention	18	13.1	10.1	0.327
	Control	12	17	11	
3 months	Intervention	18	12.6	7.9	0.691
	Control	12	14	11.9	
6 months	Intervention	16	11.3	13.4	0.222
	Control	9	18	12	
Anxiety					
Baseline	Intervention	18	8.4	7.1	0.157
	Control	12	12.7	8.8	
3 months	Intervention	18	6.3	6.5	0.047*
	Control	12	11.3	6.4	

6 months	Intervention	16	7.8	9.6	0.115
	Control	9	14.2	9.2	
Depression					
Baseline	Intervention	18	10.2	10.2	0.988
	Control	12	10.2	8.4	
3 months	Intervention	18	8.7	7.4	0.407
	Control	12	11.2	8.8	
6 months	Intervention	16	8.8	11.8	0.319
	Control	9	13.6	10.3	

- Data are expressed as means (SD) for DASS-21 scores.
- Significant differences in DASS-21 scores in each study arm at each time point are shown in bold (P-values: ^a P > 0.05, * P < 0.05, ** P < 0.01, and *** P < 0.001)

4. Changes in Stress, anxiety, and depression scales at all time points

The changes in the stress, anxiety, and depression scales did not significantly differ between the groups at either 3 or 6 months. The intervention group exhibited reduced stress and anxiety levels, and these changes were not significantly different from the changes observed in the control group. The depression scores showed minor changes over time, with no statistically significant differences between the groups at both follow-up points (Table 4).

Table 4. Mean, SD, and statistical significance for between-group differences in changes in stress, anxiety, and depression scales from baseline at 3 and 6 months.

Variable/Time Point	Group	n	Mean	SD	P-Value
Stress					
Δ at 3 months	Intervention	18	-0.56	10.31	0.533
	Control	12	-3	10.53	
Δ at 6 months	Intervention	16	-2.25	11.52	0.616
	Control	9	0.22	11.94	
Anxiety					
Δ at 3 months	Intervention	18	-2.11	5.51	0.746
	Control	12	-1.33	7.55	
Δ at 6 months	Intervention	16	-1.5	7.17	0.447
	Control	9	1.11	9.6	
Depression					
Δ at 3 months	Intervention	18	-1.56	8.91	0.449
	Control	12	1	8.97	
Δ at 6 months	Intervention	16	-0.25	11.31	0.587
	Control	9	2.22	9.72	

- Data are expressed as means (SD) for DASS-21 scores.
- Significant differences in DASS-21 scores changes in each study arm at 3 and 6 months are shown in bold (P-values: ^a P > 0.05, * P < 0.05, ** P < 0.01, and *** P < 0.001).

5. Correlations between changes in stress, anxiety, and depression scales and anthropometric measurements

The correlations between changes in the stress, anxiety, and depression scales and various anthropometric measurements were mostly weak and non-significant. Changes in weight, BMI, fat percentage, muscle percentage, and visceral fat percentage showed negligible correlations with changes in stress, anxiety, and depression. The only notable finding was the moderate and significant positive correlation between changes in waist circumference and depression (r = 0.455; P = 0.015; Table 5), suggesting that a decrease in waist circumference was associated with a decrease in depression.

Table 5. Correlations between changes in stress, anxiety, and depression scales and various anthropometric measurements.

	Δ Stress		Δ Anxiety		Δ Depression	
	r	P-Value	r	P-Value	r	P-Value
Δ Weight	-0.021	0.915	-0.061	0.759	0.253	0.194
Δ BMI	-0.07	0.724	-0.071	0.721	0.207	0.291
Δ Fat %	-0.218	0.266	0.057	0.774	0.065	0.743
Δ Muscle %	0.279	0.168	-0.074	0.719	0.103	0.618
Δ Visceral fat %	-0.152	0.459	-0.329	0.101	0.046	0.823
Δ WC	0.104	0.597	-0.202	0.302	0.455	0.015*

- n = 30
- Significant correlation analysis for the relationship between changes in stress, anxiety, and depression scores and various anthropometric measurements after 3 months of intervention
- Significant correlation analyses are shown in bold (P-values: ^a P > 0.05, * P < 0.05, ** P < 0.01, and *** P < 0.001).

4. Discussion

This study examined the effect of a telenutrition program supported by telemonitoring and health coaching on Depression Anxiety Stress Scales (DASS) among overweight and obese adults living in Saudi Arabia. The repeated measures analysis for participants who completed all study time-points revealed no significant differences within groups over time for stress, anxiety, or depression scores. While stress and anxiety scores decreased slightly in the intervention group, these changes were not statistically significant. A significant reduction in anxiety scores only at the 3-month visit in the intervention group compared with the control group in the any-time completers (6.3 ± 6.5 vs. 11.3 ± 6.4 ; $P = 0.047$; Table 3). Consistent with this study, a randomized controlled trial was conducted at the International Medical University of Malaysia among workers and students, showing a significant decrease in depression and anxiety scores in the intervention group, who had received text-based coaching from certified mental health professionals [25]. In another study, mobile applications for health coaching and telemonitoring showed significant weight loss and reductions in the Generalized Anxiety Disorder-2 Scale score, including improved sleep patterns after 12 months of intervention [29]. On the contrary, the Whole Health study that measured symptoms of depression among veterans indicates that interventions show more positive outcomes when participants have complex symptom presentations [30]. This explains why only anxiety scores were improved, because anxiety is a more commonly found symptom than depression [31]. The literature also confirms that even though both depression and anxiety are frequent among overweight and obese populations, anxiety is still considered more frequent among overweight/obese women [32]. This may be due to the larger number of women enrolled in our study that were retained in the intervention group ($n=13$ (72% of the total intervention group); Table 1). While significant improvement within the intervention group after 3 months was observed, the differences between the control and intervention groups were insignificant. This may be because the weight loss method is not necessarily the cause of reduced anxiety, depression, or stress; rather, the cause may be the weight loss itself. Recent research has explained the effect of weight loss and how it may alleviate depression and anxiety by improving metabolic and vascular dysfunction, reducing inflammation, and enhancing neuroimmune status, thereby positively influencing mood and emotional states. Researchers have studied different approaches to weight loss, which have successfully shown that significant weight loss is associated with a significant decrease in depression and anxiety (20). Our findings only show a moderate and significant positive correlation between changes in waist circumference and depression ($r = 0.455$; $P = 0.015$; Table 4) among the intervention group. In agreement with our findings, another study have also confirmed such findings A statistically significant association was found between BDI scores, BMI ($r=0.16$; $p=0.018$) and WC ($r=0.20$; $p=0.004$), which is due to the fact that WC is the anthropometric indicator of obesity and fat distribution in the body [33]. This was also evident in cross sectional

studies, such as the Gutenberg Health Study (GHS) were the association of depression and several anthropometric measure (BMI, WC, WHR, WHtR) have shown that the somatic-affective symptoms of depression were significantly associated to changes in anthropometric measures [34]. Indeed, obesity is a significant risk factor for anxiety and depression. Previous cross-sectional studies with larger sample sizes ($n=1624$) in Saudi Arabia have shown a significant relation between weight gain and depression, anxiety, and stress scale scores among adolescents and young adults [35]. Another study in Saudi Arabia also confirmed the correlation test carried out in this study, where obese male adolescents had high percentages of stress (44.4%), anxiety (73.2%), and depression (65.7%) compared with normal-weight participants [13]. In addition, researchers who studied different modalities of weight loss successfully showed that significant weight loss was associated with a significant decrease in depression and anxiety [36]. This is the first study conducted in Saudi Arabia that aimed to investigate the effect of remotely integrative nutrition (telenutrition, telemonitoring, and health coaching) on depression, anxiety, and stress scales among overweight and obese participants. Even though a positive attitude toward health-coaching practices by public health students in Saudi Arabia has been revealed, a lack of awareness and insufficient knowledge about health coaching remains [37].

This pilot study had several imitations, which may be considered when implementing the actual study to ensure reliable results. This study had two arms: control and intervention arms. The intervention arm has integrated a holistic strategy or so-called integrative nutrition approach for weight management, which may have impacted the outcomes' accuracy. Surprisingly, attrition rate was also revealed to be lower in the intervention group than the control group, which confirms the intervention positive impact. One of the common reasons to increase drop out rates from a weight loss study is difficulty to lose weight [38], young age, psychological and behavioural factors [39]. As mentioned previously in our primary outcomes that the intervention group had significant reduction in weight, BMI, fat%, visceral fat, and an increase in muscle % after 3 months when compared to the control group [9]. In addition most of our participants were adults and also getting holistic support from health coaches on both psychological and behaviour aspects of life, following the Institute for Integrative Nutrition [40], which focus on main aspects of life defined as "the circle of life", which include spirituality, creativity, finances, career, education, health, physical activity, home cooking, home environment, relationships, social life, and joy. This may be the reasons behind lower attrition rate in the intervention group, which resulted in committed participants. Thus, a three-arm study should be conducted, consisting of telenutrition, telemonitoring, and health coaching, separately, for more applicable conclusions. The sample size was not complete due to this being a pilot study. Hence, a larger number of participants and a longer trial duration (12 months) are suggested, alongside the use of existing telemedicine platforms and telemonitoring devices to empower this study with advanced technology. Furthermore, quality of life (QOL) is worth examining in future work to investigate the specific impact of health coaching on participants. Despite its limitations, this study represents a new and novel approach targeting depression, anxiety, and stress scales, which has never been implemented before. This study also supports previous studies' recommendations emphasizing the importance of introducing health professionals and health-related degrees to telemedicine and health coaching [37] to be aligned with the Health Sector Transformation Program of Vision 2030 [41].

5. Conclusions

In conclusion, this study's findings demonstrate that anxiety scores were significantly improved by integrating telemonitoring and health coaching into dietetic consultations. Additionally, a significant positive correlation was found between changes in waist circumference and depression, which suggests that a reduction in waist circumference results in a reduction in depression among participants who have been telemonitored and health coached. Thus, providing the intervention group with monthly personalized health coaching and weekly telemonitoring had a positive influence on the attrition rate which was lower when compared to the control group. This will help support participants joining weight loss programs to tackle factors associated with stress that may

impact weight loss struggles, in addition to improving the quality of dietetic consultations and enhancing awareness of integrative nutrition and health coaching for health professionals to have a stronger outcome on health and wellbeing of patients and clients. Future studies must investigate the effectiveness of telenutrition, health coaching, and telemonitoring for depression, anxiety, and stress scores in separate arms to obtain a more accurate and clear understanding of the integrative nutrition approach.

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