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ORIGINAL RESEARCH

A Digital Lifestyle Program for Psychological Distress, Wellbeing and Return-to-Work: A Proof-of-Concept Study

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Abstract

Objective: To demonstrate proof-of-concept for a chatbot-led digital lifestyle medicine program in aiding rehabilitation for return-to-work.

Design: Retrospective cohort study with pre-post measures.

Setting: Community setting, Australia.

Participants: 78 adult participants (mean age 46 years, 32% female) with an active workers' compensation claim (N=78).

Interventions: A 6-week digital lifestyle medicine program led by an artificially intelligent virtual health coach and weekly telehealth calls with a health coach.

Main Outcome Measures: Adherence (% program completions) and engagement (% of daily and weekly sessions completed), changes in depression, anxiety and distress (K10), psychological wellbeing (WHO-5), return-to-work confidence and anxiety and change in work status.

Results: Sixty participants completed the program (72%), with improvements in psychological distress ($P \leq .001$, $r=.47$), depression ($P<.001$, $r=.55$), anxiety ($P<.001$, $r=.46$) and wellbeing ($P<.001$, $r=.62$) were noted, as well as increased confidence about returning to work ($P \leq .001$, $r=.51$) and improved work status ($P \leq .001$). Anxiety about returning to work remained unchanged. Participants completed an average of 73% of daily virtual coach sessions and 95% of telehealth coaching sessions.

Conclusions: Artificial intelligence technology may be able to provide a practical, supportive, and low-cost intervention to improve psychosocial outcomes among individuals on an active workers' compensation claim. Further, controlled research is needed to confirm these findings.

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Work disability is a major public health burden.[1] Worldwide, musculoskeletal injuries are the most common work-related injury and are among the most expensive health conditions affecting the working-age population.[2-4] In addition, mental disorders (both mental illness and conditions such as distress and burnout) affect 1 in 5 adults each year and are among the leading causes of disability and absence from the workplace. An estimated 12 billion workdays are lost yearly, equating to $1 trillion USD in lost productivity worldwide.[5-7]

The duration of absence from work is associated with an increased risk of never returning to work, poor long-term health, and higher financial costs.[8-10] Furthermore, being out of work for any reason is associated with increased morbidity, increased mortality, and negative physical, psychological, social and economic effects on the affected individual, their family, and the wider community.[11-13] A lack of care after a workplace injury is associated with increased risk of psychosocial difficulties in returning to work.[14,15] Therefore, improving return-to-work outcomes is critical. This is of particular interest in Australia, where 89% of serious workers' compensation claims are related to physical injury and musculoskeletal disorders, while the second most common reason is mental health.[16] The estimated total economic cost of workplace injury and illness in Australia was over $60 billion between 2008 and 2009.[8]

Treatments for comorbid musculoskeletal injuries and mental disorders often include referrals to health services for physical or

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psychological services.[17-21] While these treatments represent an important component of treatment, prior evidence indicates that these treatments result in only modest improvements in work disability.[20-24] A previous systematic review of return-to-work interventions concluded there's insufficient evidence for current interventions to address return to work outcomes among workers with musculoskeletal or mental health conditions.[25] Technology-based interventions may provide an opportunity to address this gap, with advances in artificial intelligence (AI) offering opportunities to deliver accessible, personalized, and cost-efficient interventions.[26]

Chatbots are conversational agents that mimic human interaction through written, oral, and visual forms of communication.[27] With the increased access to smartphones, computers and internet, chatbots offer the potential to provide accessible, autonomous, and interactive health-related services. Chatbots have the potential to increase the accessibility and efficacy of lifestyle modification programs.[26,28] Previous systematic reviews and meta-analyses suggest that chatbots are effective for improving medication adherence, stress, anxiety, and depression.[28-31] However, the application of a chatbot-based intervention within a return-to-work context has yet to be evaluated. Therefore, the purpose of this retrospective analysis was to assess the engagement, adherence and preliminary effectiveness of an AI virtual health coach-led lifestyle medicine and psycho-education intervention for people on an active workers' compensation claim.

Methods

Study design and ethics

This pre-post study used data collected in the process of service delivery from October 2021 to June 2022. As a retrospective analysis of deidentified existing data and data collected for quality assurance purposes, this study was deemed as being exempt from requiring ethical review by the University of South Australia Human Research Ethics Committee (application ID 205146). Participants' responses were provided voluntarily, and participants were advised that their data may be used for quality assurance purposes. Upon signing up to receive the LeapForward program, participants consented for their data to be used for future research purposes and were informed that providing consent for this is voluntary. This article was prepared following STROBE guidelines,[32] and the LeapForward program is described in accordance with the template for intervention description and replication checklist.[33]

Description of the LeapForward Program

The "LeapForward Program" is a 6-week online program that integrates evidence-based strategies from the Lifestyle Medicine and Positive Psychology literature.[34,35] Underpinning the intervention is numerous behavior change techniques to target determinants of lifestyle behaviors, including goal-setting, problem-solving, goal-review, self-monitoring, feedback, social support and education with credible sources.[36]

List of abbreviations:

AI	**Artificial Intelligence**
ITT	**Intention to treat**
K10	**Kessler-10**
M	**Mean**
Mdn	**Median**
WHO-5	**World Health Organization Wellbeing Index**

Components

Participants accessed the program via a smart device which consisted of the following components: 'Lucy' (an AI health coach), the LeapForward website (including daily educational video content), a weekly telehealth call with an allied health coach, and a workbook.

Virtual health assistant 'Lucy'

Lucy is a rules-based virtual health coach, created and hosted using Clevertar's AI chatbot software.[a] Lucy performs 3 key roles: (1) guiding participants through an introductory session involving baseline measures and program overview; (2) guiding users through a daily check-in regarding their mood and goal progress; and (3) prompting the daily educational video and engaging in a brief discussion to ensure comprehension of video concepts, then prompting goal setting based on the daily content. Participants were required to create a user account to access the program.

Content

An overview of the program structure and content delivered is shown in figure 1. Participants receive a daily text or email prompting them to log in and complete the daily content.

Participants and recruitment

Participants were referred into the program by case managers at EML insurance (a major Australian personal injury insurer providing workers' compensation and self-insurance services) if they met the following eligibility criteria: (1) an active personal injury claim; (2) their primary condition was either physical or psychological in nature; (3) a reduced capacity to engage in work or life; (4) psychosocial difficulties (eg, relating to resiliency, self-efficacy and/or motivation); (5) poor engagement with recovery self-management or return-to-work; (6) no complex trauma or known significant factors preventing long-term return-to-work and life; and (7) the ability to read and write in English. Participants who were referred into the program received an email notifying them and were required to create an account to begin the program. Because of the ecological nature of this intervention, participants were able to engage in treatment as usual.

Outcomes and measures

Sociodemographic, injury information and disability status

At baseline, all participants completed a sociodemographic questionnaire. Injury information was provided by the insurance company. Participants completed a survey (the General Health Questionnaire for psychological claims or the Orebro Musculoskeletal Pain Screening Questionnaire for physical claims) to determine their risk for future work disability.

The following outcomes were collected at baseline and end of program (6 weeks):

Psychological distress

The Kessler-10 (K10) questionnaire was used to assess levels of psychological distress.[37] It consists of 10 items scored on a 5-point Likert scale with total scores ranging from 10-50. Scores were

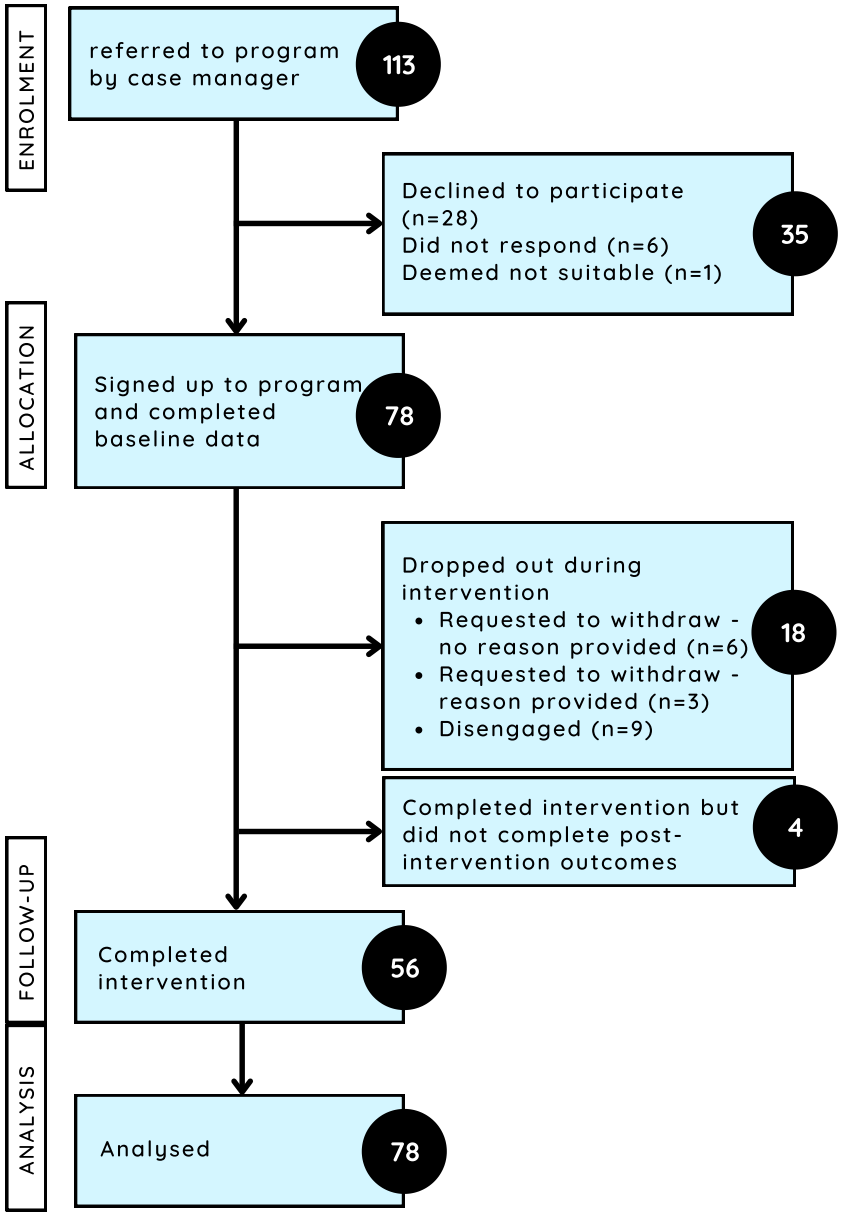


Fig 1 Participant flow through the study.

grouped into 4 levels of psychological distress; a score of 10-15 indicated low, 16-21 moderate, 22-29 high and 30-50 very high.[38] The K10 has excellent psychometric properties,[39] including high internal consistency (a=0.93)[37] and discriminant validity.[40]

Emotional wellbeing

The World Health Organization Wellbeing Index (WHO-5) was used to assess subjective psychological wellbeing.[41] It consists of 5 items scored on a 6-point Likert scale with total raw scores ranging from 0 (absence of wellbeing) to 25 (maximum wellbeing). Scores are converted into a percentage.[42] The WHO-5 has high clinimetric validity and is a sensitive screening tool for depression (scores ≤50).[42]

Return to work confidence and anxiety

Confidence and anxiety about returning to work was captured with two, purpose-designed single items "How confident do you feel that you will ever return to paid work?" and "How anxious would you say you feel about the thought of returning to work?", each scored on a 10-point Likert scale.

Work status

Return to work status at baseline and program completion was provided by the insurance company in 5 categories: not working (no current work capacity), not working (has current work capacity), working—partial work capacity (same employer), working—partial work capacity (different employer), and working—full work capacity (same employer).

Satisfaction with program

Upon completion of the program participants were sent a link to complete a 7-item satisfaction survey (supplemental appendix, available online only at http://www.archives-pmr.org/).

Engagement and adherence

Engagement with the LeapForward program was assessed based on virtual health coach usage data and telehealth coaching session completion (out of a maximum of 6). For the virtual health coach usage criteria, a participant was required to interact with Lucy, provide mood and goal check-in data and view the daily video content to be considered as having completed the daily check-in (out of a maximum of 30).

Bias

The data were collected in an ecological (ie, real-world) setting, therefore, no attempts were made to address bias (eg, no attempts to balance the sex or socioeconomic status of participants). Participants' program usage and outcomes reflect those achieved under real-world conditions.

Power and statistical analyses

Participants' sociodemographic characteristics were analyzed descriptively, using means and SDs, frequencies and percentages. Descriptive variables between completers and non-completers were compared using 2-tailed *t* tests for continuous measures and chi-square tests for categorical measures. Preliminary effectiveness was assessed using Wilcoxin signed rank test for related samples. Wilcoxon effect sizes (*r*) were calculated by dividing the z value by the square root of N, with 0.1-<0.3 interpreted as a small effect, 0.3-<0.5 interpreted as a medium effect, and 0.5+ interpreted as a large effect.[38] Baseline measures were carried forward for missing follow-up data. Sensitivity analyses using complete case data were conducted. All analyses were performed using SPSS version 28[b] with an alpha of .05 denoting statistical significance. Post-hoc power calculations suggested that with a total sample size of N=78 and an alpha of 0.05, the study had 98% power to detect a large (*r*=0.5) effect size, and 68% power to detect a medium (*r*=0.3) effect size.

Results

Recruitment and retention

A total of 78 participants commenced the program. Eighteen dropped out, 4 completed the intervention but did not complete the Week 6 outcome measures, and 56 participants completed the 6-week program and assessments (figure 2).

Participant characteristics

Participants' baseline demographic and clinical characteristics are provided in table 1. On average, participants were aged 46 years (SD=14 years), and one-third were women. Four out of 5 participants had a physical injury, and almost none were working (3%). Orebro scores indicated almost all participants had a moderate or high-risk of long-term disability and failure to return to work. There were no differences in sex, education level, marital status, primary injury or work status between completers and noncompleters, however, completers tended to be older than noncompleters.

Adverse events

No adverse events related to program participation were reported.

Engagement and retention

Overall, 72% of participants completed the program. Out of a maximum of 30 days, participants completed 22 days on average (ie, completed daily check in with Lucy and watched educational video) and 5.7 out of a maximum of 6 telehealth coaching sessions. In total, 18 participants dropped out. Four participants completed the program but did not complete postintervention outcome measures. Engagement and retention data are displayed in figure 3.

Satisfaction with program

Nine participants completed the postintervention satisfaction survey. Participants reported they were on average 8 out of 10 likely to recommend the program to a friend or colleague with similar issues. Participants rated the program 3.8 out of 5 (good to very good). Of the 9 respondents, 7 felt that they were coping a little better or much better than before the program, while 2 felt about the same as at the start of the program.

The aspects of the program respondents liked the most were talking with the coach (n=8), watching the videos (n=5), talking to Lucy (n=2), working on goals (n=2) or all aspects of the program (n=2). The least liked parts of the program were the workbook (n=5), talking to Lucy (n=3) and watching the videos (n=2). From the open-ended questions, participants expressed the changes they have noticed since doing the program as 'improved ability to manage stress', 'improved patience', 'less cranky', 'increased awareness of thoughts and feelings and why these might be occurring', 'more exercise', and 'confidence in setting boundaries.' One participant noted nothing had changed. The most common change suggested was more ability to respond to Lucy (n=3), though 1 participant suggested ongoing follow-up with the coach would be beneficial.

Preliminary effectiveness

Psychological outcomes

The intention-to-treat preliminary effectiveness results are shown in table 2. From baseline to end of intervention (week 6), median distress scores reduced by 4 points, reducing from an average of 'very high' psychological distress category to 'high'. A Wilcoxon signed rank test indicated that distress scores were statistically significantly lower after the intervention (Median (*Mdn*)=31.5, n=78) compared to before (*Mdn*=27.5, n=76), *T* 146, *z*=-5.042, *P*≤.001, with a medium-to-large effect size, *r*=.47. Anxiety and depression scores demonstrated a 2- and 3-point reduction (ie, improvement), respectively. Wilcoxin signed-rank test indicated that both reductions were statistically significant, depression: *T* 116.5, *z*=-4.848, *P*<.001, with a large effect size, *r*=.55; anxiety: *T* 159.5, *z*=-4.061, *P*<.001, with a medium effect size, *r*=.46.

Wellbeing scores improved by a median of 18 points. A Wilcoxin signed-rank test indicated that this difference was statistically significant, *T* 1333, *z*=-5.473, *P*<.001, with a large effect size, *r*=.62.



Fig 2 Content and structure of the LeapForward intervention.

Table 1 Participant sociodemographic characteristics

	Whole Sample (n=78)	Completers (n= 56)	Non-completers (n=22)	*P*
Age (y), mean ± SD	46 (14)	48.7 (13.4)	41.8 (13.6)	.045
Sex (% female)	32%	24%	8%	.788
Marital status				.432
Single (never married)	15 (19.2%)	10	5	
In a domestic partnership	19 (24.4%)	11	8	
Married	28 (35.9%)	23	5	
Married but separated	4 (5.1%)	2	2	
Divorced and not remarried	7 (9%)	6	1	
Widowed and not remarried	2 (2.6%)	2	-	
Prefer not to say	3 (3.8%)	2	1	
Living alone				.327
Yes	14 (17.9%)	12	2	
No	64 (82.1%)	44	20	
Education level				.944
Some of high school	20 (26.3%)	15	5	
Completed high school	24 (31.6%)	17	7	
Trade school	21 (27.6%)	14	7	
Bachelor's degree	10 (13.2%)	7	3	
Prefer not to say	1 (1.3%)	1	-	
Most used device				.580
Smartphone	44 (57.1%)	32	12	
Tablet	7 (9.1%)	4	3	
Computer	26 (33.8%)	20	6	
Workplace industry				.802
Agriculture	1 (1.3%)	1	-	
Manufacturing	5 (6.4%)	3	2	
Electricity, gas, water and waste	1 (1.3%)	1	-	
Construction	9 (11.5%)	6	3	
Wholesale trade	10 (12.8%)	7	3	
Retail trade	7 (9%)	6	1	
Accommodation and food	1 (1.3%)	1	-	
Transport, postal and warehouse	21 (26.9%)	14	7	
Financial and insurance	1 (1.3%)	1	-	
Professional, scientific, and technical	4 (5.1%)	4	-	
Administrative and support	3 (3.8%)	3	-	
Education and training	2 (2.6%)	2	-	
Health care and social assistance	11 (14.1%)	6	5	
Other (automotive repair)	2 (2.6%)	1	1	
Primary injury				.432
Psychological	15 (19.2%)	12	3	
GHQ Risk Low	1 (1.3%)	-	1	
GHQ Risk Med	4 (5.1%)	4	-	
GHQ Risk High	10 (12.8%)	8	2	
Physical	63 (80.8%)	44	19	
Orebro Risk Low	1 (1.3%)	1	-	
Orebro Risk Med	45 (57.7%)	31	14	
Orebro Risk High	17 (21.8%)	12	5	
Work status				.355
Not working: no current work capacity	52 (66.7%)	39	13	
Not working: current work capacity	24 (30.8%)	15	9	
Working: current work capacity	2 (2.6%)	2	-	

Return to work confidence and anxiety

Confidence about returning to work increased from before the intervention (Mean (*M*)=2.55, *Mdn*=3) to after (*M*=3.06, *Mdn*=3). Wilcoxin signed-rank test indicated that the change was statistically significant, *T*=368, *z*=-4.493, *P*≤.001, with a large effect size, *r*=.51.

Anxiety about returning to work decreased slightly from before (*M*=2.47, *Mdn*=2) to after (*M*=2.42, *Mdn*=2) the intervention, though Wilcoxin signed rank test indicated this change was not statistically significant (*T*=375, *z*=-.481, *P*=.631).

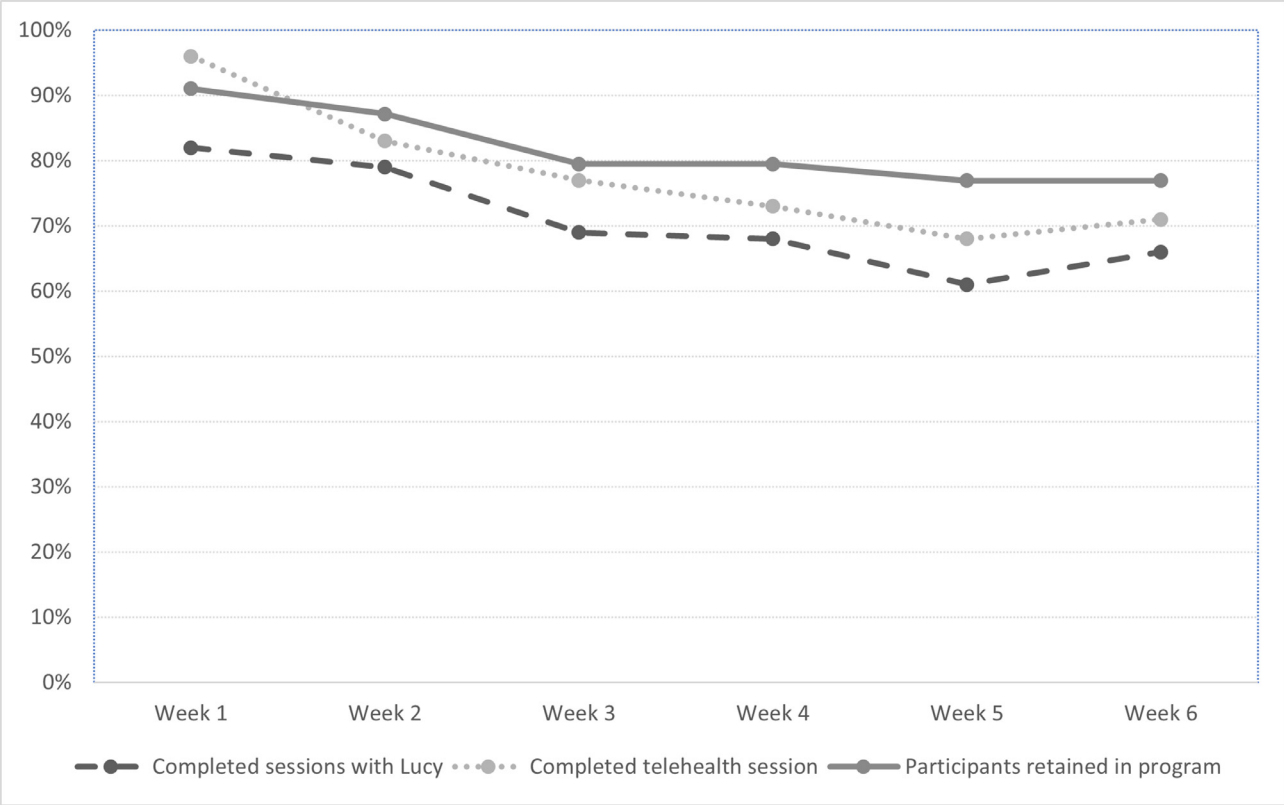


Fig 3 Participant engagement and drop out by week.

Return-to-work status

Changes in return-to-work status from baseline to end of intervention are presented in table 3. At baseline, only 2 participants were working in any capacity, while, at follow-up, 20 were working in some capacity. A chi-square test revealed a significant reduction in participants who were not working (pre = 76 to post = 58) and a subsequent increase in return to work (pre = 2 to post = 20), chi-square (4, N=78)=19.267, $P \leq .001$.

Sensitivity analyses

Sensitivity analyses were conducted using complete case data (n=56). Results were consistent with the ITT analyses, though improvements appeared to be slightly larger in magnitude. For example, distress scores decreased 10 points and wellbeing scores improved by 26 points (vs 4 points and 18 points, respectively, in the ITT analyses). Return-to-work confidence improved by 0.51 (vs 0.83 in the ITT analyses) while return to work anxiety remained unchanged for both (see supplemental table, available online only at http://www.archives-pmr.org/).

Discussion

This study assessed the engagement, adherence and preliminary effectiveness of an AI virtual health coach-led lifestyle medicine and psycho-education intervention for people on an active workers' compensation claim. Findings indicated high engagement and adherence over the 6-week program. Preliminary analyses

Table 2 Psychological outcomes pre- and post-intervention

	Median (IQR)				
Outcome	Baseline (N=78)	Post-intervention (ITT) (N=78)	Z	*P* Value	*r*
K10 total	31.5 (22 – 39)	27.5 (18 – 35)	-5.042	<.001	.47
K10 depression	14 (9 – 17)	11 (7 – 14)	-4.848	<.001	.55
K10 anxiety	12 (9 – 15)	10 (7 – 14)	-4.061	<.001	.46
WHO-5	22 (12 – 40)	40 (24 – 60)	-5.473	<.001	.62
	Mean ± SD				
RTW Confidence	2.55 (1.59)	3.06 (1.66)	-4.493	<.001	.51
RTW Anxiety	2.47 (1.61)	2.42 (1.42)	-.481	.631	-

NOTE. Missing post-intervention data (N=22) imputed using baseline carried forward method.
Abbreviations: IQR, Interquartile range; RTW, return-to-work

Table 3 Return to work status before and after intervention (N = 78).

	Not Working (No Current Work Capacity)	Not Working (HasCurrent Work Capacity)	Working — Partial Work Capacity (Same Employer)	Working — Partial Work Capacity (Different Employer)	Working — Full Work Capacity (Same Employer)
Pre	52	24	2	0	0
Post	33	25	14	2	4

suggested that the intervention was associated with improvements in psychological distress, depression, anxiety, wellbeing and return to work confidence, and an increase in the proportion of participants working at the end of the 6-week intervention.

This is the first evaluation of an online lifestyle program led by an AI health coach for active workers' compensation claimants. It found high completion and engagement rates. As there are no studies directly comparable to the current study, we have considered our findings in the context of previous AI virtual health coach interventions,[43,44] online mental health interventions[45-47] and return-to-work interventions.[48-50] Engagement with the chatbot-led intervention in our study were comparable to previous chatbot interventions designed to improve mental health symptoms.[43,44] For example, a previous trial of cognitive behavior therapy—based chatbot interventions for depression and anxiety reported that participants checked-in with the chatbot an average of 12 times over a 2-week period.[43] The attrition rate in our study was favorable compared with attrition reported in previous studies of smartphone[51] or web-based[49] return-to-work interventions.[49,51] This may be because the LeapForward program integrated numerous behavior change techniques with weekly support from a health coach. These techniques included goal setting, education, and healthy habit formation for physical activity, diet, sleep, stress reduction, and mindfulness. Return-to-work outcomes in the current study were similar to those reported in a previous evaluation of a smartphone app that achieved significant improvements in depression, anxiety, and days of sick leave in the past month.[51] Thus, our findings align with previous studies and contribute to the limited evidence on digitally delivered programs for workers' compensation populations.

Key strengths of this work are its novelty and potential for scalability, providing a personalized program remotely and via mostly automated technology. Psychological outcomes were evaluated using validated health measures, and sensitivity analysis was used, ensuring that the intervention effects are not overestimated compared with a per-protocol analysis. Another key strength of this work is the collaboration between academia and industry. Many academic-initiated research programs are unsuccessful in gaining uptake and implementation in real-world settings and are not sustained beyond their evaluation in research settings. Therefore, working with industry is an important way to achieve sustainability and real-world implementation. In addition, this study examined a real-world sample of users, whose data reflected "real" usage, enhancing the ecological validity of findings. The present findings indicate there is considerable potential and interest in this virtual health coach intervention as a supplement to usual care, to improve return to work outcomes among individuals on an active workers' compensation claim. A larger, prospective trial to confirm the preliminary findings of this study appear warranted. Ideally, a randomized controlled trial design would be used, to allow the program effects to be disentangled from natural recovery. In addition, future research could capture process outcomes in greater detail, to inform future improvements to program elements, such as the virtual health coach's language style, variety of language, specific intervention content, and alternative modes of output (eg, speech, images).

Study limitations

Limitations must also be acknowledged. A key limitation is the lack of a control group. Without a control group, it is impossible to disentangle the true effects of the LeapForward program vs natural recovery. In addition, we used retrospective data, and the sample size for the satisfaction data were small. Our analyses examine group data and do not reflect the variability of effectiveness that occurred at an individual level. Accordingly, this study should be viewed as a first step toward evaluating this AI virtual health coach-led lifestyle medicine and psycho-education intervention.

Conclusion

Findings from this study provide preliminary evidence indicating high engagement and high adherence with an AI virtual health coach-led lifestyle medicine and psycho-education intervention for people on an active workers' compensation claim. Preliminary analyses indicate the intervention was associated with improvements in psychological distress, depression, anxiety, wellbeing, return to work confidence and anxiety, and work status. These findings suggest that AI technology may provide a practical, supportive and low-cost interventions to improve psychosocial outcomes among individuals on an active workers' compensation claim. However, future research using a more rigorous study design (eg, prospective data collection, with a randomized comparator), is required to confirm these findings.

Suppliers

a. Device; Clevertar Services Pty Ltd.
b. IBM SPSS Statistics for Windows, version 28.0; IBM Corp.

Keywords

Artificial intelligence; Lifestyle; Mental health; Online intervention; Return-to-work; Telemedicine

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