1   **Effectiveness of an Online Cognitive Behavioral Therapy Program for Improving Sleep**

2   **Health and Productivity in the Workplace**

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10   **Abstract**

11   *Problem* Sleep disorders are highly prevalent among the adult working population. Employees

12   with significant sleep disorders have been found to be more likely to report difficulty with

13   concentration, problems with organization, interpersonal difficulty, decreased productivity,

14   absenteeism, and falling asleep at work.[1] Even modest sleep deprivation has a negative impact

15   on mood, cognitive performance, and motor function.[2] Cognitive behavioral therapy for

16   Insomnia (CBTi) is a multi-component, non-pharmacological approach to the treatment of

17   insomnia and other sleep disorders, that has been shown to have better long term

18   effectiveness than prescription sleeping pills.[3] Unfortunately, the access to qualified CBTi

19   solutions is limited.

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21   *Method* This was a retrospective, uncontrolled study of 2,138 employees, from five companies,

22   who were offered access to ProjectZ, an internet-based platform, designed to identify prevalent

23   sleep disorders in community dwelling employees and provide them with a personalized CBTi

24   program. Employees completed a brief online sleep health screener which included the

25   proprietary Abbreviated Insomnia Measurement Scale (AIMS), a modified STOP-Bang, the

26   Epworth Sleepiness Score (ESS) and the Work Limitations Questionnaire (WLQ). Perpetuating

27   insomnia factors were also identified. Based on the screening responses, ProjectZ's algorithms

28   offered each employee an individualized, self-paced, online CBTi program to address the sleep

29   issues identified. The program was presented as a group of strategy modules each of which

30   contained a series of differentially weighted challenges. The modules included the core

31   elements of CBTi such as stimulus control, sleep compression, relaxation, cognitive therapy, and

32   sleep hygiene. ProjectZ was gamified with a point system to enhance engagement. Once

33   employees completed all assigned challenges, a final assessment on the AIMS, ESS, WLQ, and

34   satisfaction indices was conducted.

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36   *Results* At baseline, 22% of employees were found to have significant symptoms of insomnia,

37   50% reported symptoms of sleep deprivation, 39% were at significant risk for sleep apnea, and

38   21% manifested excessive daytime sleepiness. Seventy-five percent of employees were found

39   to have at least one significant sleep health issue, 49% two or more, and 28% three or more.

40   The average WLQ score was 4.04%. A cohort of 322 employees completed all of their challenges

41   and completed a final assessment. Within this group, the prevalence of significant insomnia

42   dropped by 93% by program completion. The prevalence of sleep deprivation was reduced by

43   74%, and excessive daytime sleepiness was reduced 77%. Within the cohort that completed a

44   final assessment there was an average decrease of 1.54 percentage points on their WLQ score.

45   This cohort's baseline WLQ score was 3.56%, therefore the reduction represents a 43%

46   decrease in productivity limitation. The decrease in the WLQ score between baseline and final

47   assessment suggests that the productivity of 1.54 full-time employees per 100 was recovered as

48   a result of program participation. Additionally, 94% of employees felt the program was

49   personalized, 85% reported having improved sleep, and 81% reported having improved health.

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51   *Discussion* This study demonstrated the effectiveness of a personalized, self-paced on-line CBTi

52   platform in improving symptoms of insomnia and sleep deprivation, as well as increasing

53   productivity in a diverse workforce population. This is consistent with previous studies that

54   have shown on-line CBTi to be an effective tool.[4] The improvement of insomnia symptoms

55   obtained here was comparable to or exceeded those observed for in-person CBTi

56   interventions.[5] CBTi lends itself well to an Internet-based platform because the individual

57   treatment components can each be imparted to and implemented by the patient in an

58   individually-paced, step by step fashion. Our clinical experience in the treatment of insomnia

59   has revealed that, while each individual's history is unique, the factors actively perpetuating

60   insomnia are usually identifiable and reducible to a limited set. Computer algorithms can then

61   be developed to account for these perpetuating elements and to deliver tailored treatment

62   modules for the user to implement on their own.

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64   *Summary* Significant sleep disorders are highly prevalent in the workplace. There is a serious

65   shortage of resources available to address these issues which results in a significant economic

66   burden for employers. CBTi has been demonstrated to be highly effective and is the treatment

67   of choice for insomnia. ProjectZ successfully identified and assessed a wide range of employee

68   sleep health issues, and producing a personalized, self-paced, CBTi program. ProjectZ's CBTi

69   algorithms were not only effective at resolving insomnia but also had a positive impact on

70   reducing employee productivity limitation. The implementation of ProjectZ could therefore

71   represent a meaningful cost savings for an employer while improving the overall health, safety,

72   and productivity of the workforce.

73   **References**

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