

## **Effects of Shinrin-yoku Retreat on Mental Health: A Pilot Study in Fukushima, Japan**

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### **Abstract**

Shinrin-yoku (forest bathing) is a cost-effective healing practice that has recently attracted the interest of social scientists who have attributed it, in part, to mental health benefits. Japanese university students suffer from high rates of mental health problems, and the number of suicides remain high despite the total number of suicides in Japan decreasing. Effective mental health approaches which increase mental wellbeing and self-compassion, and reduce associated deficits, such as loneliness, are sought after for Japanese students, however healthful treatment has not been identified to date. Accordingly, this pre-post pilot study evaluated the levels of mental wellbeing, self-compassion, and loneliness among 25 Japanese undergraduate students who participated in a three-day shinrin-yoku retreat in Fukushima. Measurements were taken prior, straight after, and two weeks-post intervention. One-way ANOVA with Tukey post hoc analysis revealed that the mean scores of self-compassion, common humanity, and mindfulness increased statistically significantly from pre-retreat to follow-up. The mean scores of mental wellbeing and loneliness did not statistically significantly change. The positive effects on self-compassion indicate that shinrin-yoku retreat should be evaluated within a larger sample and in a shorter time frame to establish optimal shinrin-yoku parameters in this arena.

*Keywords: shinrin-yoku; mental health; mental wellbeing; self-compassion; loneliness;*

*Fukushima*

## Introduction

The use of nature to increase or maintain key facets of physical and mental wellbeing is a well-established movement in psychological investigation and has informed the basis of governmental policy in the West (Department for Environment, Food and Rural Affairs (DEFRA), 2018). Specifically, nature has been implicated in improved levels of anxiety, happiness, life satisfaction, and resilience (Kotera et al., 2021a; Martyn & Brymer, 2016; Pritchard, Richardson, Sheffield, & McEwan, 2019; Ryan et al., 2010), and is considered beneficial for cognitive functioning (Cacioppo & Hawkley, 2009) and empathy towards others (Fido & Richardson, 2019).

In Japanese culture, the relationship between nature and wellbeing has also been embedded in clinical practice, with one such example being *shinrin-yoku* (‘森林浴’); a term created in 1982 by the Japanese Ministry of Agriculture, Forestry, and Fisheries, and which roughly maps onto the concept of *forest bathing* in English literature. At its core, *shinrin-yoku* is the process of relaxing, taking long deep breaths, and observing (through sight, sound, smell, and touch) ones’ nature-based surroundings (Miyazaki, 2018). Although a relatively new concept in most countries (Rajoo et al., 2019), the physical benefits of *shinrin-yoku* are well documented. Being surrounded by nature for sustained periods of time has been associated with improvement in one’s immune system, as well as cardiovascular and respiratory functioning (Jung, Woo, & Ryu, 2015; Williams, 2016). As such, *shinrin-yoku* has proven popular in the East (Yu & Hsieh, 2020), potentially as a function of its ease in implementation, and cost- and resource-efficient nature (Kotera & Rhodes, 2020).

What’s more, converging evidence suggests that engagement in *shinrin-yoku* benefits psychological wellbeing as well. *Shinrin-yoku* has been shown to effectively reduce a host of psychologically-relevant indices, including depression, anxiety, anger, selfishness, and stress (Kotera, Richardson, & Sheffield, 2020; McEwan et al., 2021; Park, Tsunetsugu, Lee,

Kagawa, & Miyazaki, 2012; Pritchard et al., 2019). Moreover, a three-day shinrin-yoku intervention reportedly led to significantly reduced scores on dimensions of tension–anxiety, anger–hostility, depression–dejection, as well as confusion–bewilderment within a Profile of Mood States (Yu & Hsieh, 2020). Given that poor mental health (and the presence of mental health disorders) represents a global issue (thought to affect around 1.1 billion people (Ritchie & Roser, 2018), and contribute to economic output losses of \$2.5–8.5 trillion (Patel et al., 2018), finding resource- and cost-efficient means of alleviating related symptoms holds importance.

Mental health is currently one of the top national agendas in Japan (Miyake & Okamoto, 2015) with rates of depressive and anxiety disorders positioned as the second highest in the world, totalling five million and three million cases respectively (Ratanasiripong, China, & Toyama, 2018). Japan has the highest rate of suicides in developed countries, and 41% of suicides are understood to be caused by mental distress (National Police Agent, 2010). More concerningly, the rates of mental distress (depression and anxiety diagnoses) have increased in recent years (Ministry of Health Labour and Welfare (MHLW), 2017). Although some scholars suggest that this increase might be an artifact of increased access to and use of mental health services enabling a greater number of diagnoses to be made (Nishi, Ishikawa, & Kawakami, 2019), the fact that more than 20,000 people have completed suicide each year since 1998 (MHLW, 2020), of which 30,000 people have completed suicide each year from 1998 to 2011 (Shiiba, 2013), further compounds why we should care about this population. Specifically, Japanese university students are of particular risk despite an increased access to and engagement with institutional mental health services (Adachi et al., 2020). Poor student mental health not only leads to detriment in academia, such as lower grades and increased absences (Hunt & Eisenberg, 2010), but has graver impact, with about 1000 Japanese university students complete suicide every year (while

suicides in other populations and the total in Japan have been decreasing), making it the most frequent cause of death in this population (MHLW, 2020; Uchida, 2010).

In particular, stigma associated with negative mental health problems is high among Japanese people (Ando, Yamaguchi, Aoki & Thornicroft, 2013), including university students (Sakurai, Hashimoto & Shimoto, 2020). High stigma associated with negative mental health problems can compromise the effects of clinical treatment (Lally, Conghaile, Quigley, Bainbridge, & McDonald, 2013), therefore positive psychological approaches are recommended to bypass the stigma (Department of Health, 2009; Kotera, Green & Sheffield, 2020). Mental wellbeing - a state of equilibrium between an individual's capabilities and the challenges they face (Dodge, Daly, Huyton, & Sanders, 2012), pertinent to happiness, satisfaction and fulfilment (Henderson & Knight, 2012) is one such construct that is strongly related to better mental health within a student population (Kotera & Ting, 2019). In education settings, mental wellbeing is particularly important as it is related to learning effectiveness and social connectedness (Barry, Clarke, Jenkins, & Patel, 2013). These findings suggest a value of mental wellbeing to be measured in the context of shinrin-yoku retreat for Japanese university students.

Other factors comorbid with the presence of poor mental health are a lack of self-compassion and increased loneliness (Kotera, Cockerill, Chircop, & Forman, 2020; Koteta et al., 2021b; Mushtaq, Shoib, Shah, & Mushtaq, 2014). Self-compassion refers to the generation of positive self-attitudes towards oneself and the ability to understand one's own experiences in an un-biased and driven fashion, and has been associated with blunting the impact of negative experiences (Neff, 2013), increased psychological well-being (Zessin et al., 2015), and preventing the onset of anxiety and depression (MacBeth & Gumley, 2012; Van Dam et al., 2011). One potential mechanism for this is self-compassion acting on perceived stress; as was found in a mediation study within Chinese nursing students (Luo et

al., 2019). Although compassion has been identified as one of the five pathways to connecting oneself with nature (Lumber, Richardson, & Sheffield, 2017), to our knowledge, there exists no evidence outlining the impact of shinrin-yoku on self-compassion, specifically. Similarly, loneliness is a key predictor of poor mental health (Cacioppo et al., 2015). In younger people (such as students) such relationships might partially manifest through a disparity between expected and perceived qualities of social relationships (Peplau & Perlman, 1982), thus accounting for why university students might experience loneliness even though they are surrounded by, and often live with, peers (Richardson, Elliott, & Roberts, 2017). Although experiences of nature are hypothesised to reduce experiences of loneliness (World Health Organization, 2017), with such associations explicitly featured in Governmental policy (DEFRA, 2018), as with self-compassion, it remains unknown whether shinrin-yoku specifically impacts experiences of loneliness.

As such, this manuscript reports the efficacy of a three-day shinrin-yoku intervention study with specific focus on three mental health outcomes (mental wellbeing, self-compassion, and loneliness). Based on the literature documented above, we hypothesised that following the intervention, general mental wellbeing and self-compassion would be increased, and loneliness would be reduced. Comparisons are also explored with two-week follow-up measures to explore lasting efficacy of the intervention.

## **Methods**

### ***Participants***

Participants in this study were required to be over 18 years of age, enrolled in an undergraduate programme at a Japanese university in Tokyo, and without any diagnosed mental disorders. Though the arbitrary participation was informed to students, all 28 students registered in the retreat consented to participate. Twenty-five students (15 males and 10

females,  $M_{\text{age}} 20.40 \pm 2.60$ , Range 18-28 years old) completed all three assessment points (pre, post, and two-week follow-up). Nine of them were first year students, eight were second year students, five were third year students, and three were fourth year students. Five students majored in regional development studies, four in economics, three in psychology and history respectively, two in communication, and the remaining eight in various subjects including education, law, literature, and religion. Lastly, none of the students' hometown was neither Fukushima or its neighbouring prefectures: eleven from Tokyo, five from Chiba, four from Saitama, and the remaining five from the west of Japan.

### ***Materials***

The three scales (mental wellbeing, self-compassion, and loneliness) were responded to at three time points: before, straight after, and two weeks after the retreat. As recommended by McNeish and Wolf (2020), the validity of each scale was also reported.

*Mental wellbeing* was measured using the Japanese version of the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS-J; Suganuma, Hirano, Nakano & Shimoyama, 2016), a 14-item self-report measure on a five-point Likert scale (1 = 'None of the time' to 5 = 'All the time'; Stewart-Brown et al., 2009). Participants were asked to reflect on the past two weeks to respond to items such as 'I've been feeling optimistic about the future'. Although WEMWBS does not have any subscales, the 14 items cover three categories of mental wellbeing—one's psychological functioning, satisfaction from life, and ability to nurture reciprocal relationships (Stewart-Brown & Janmohamed, 2008). Internal consistency of WEMWBS-J was high ( $\alpha = .91$  in Kotera & Sheffield, 2019). WEMWBS-J had acceptable validity (goodness of fit index [GFI] = .91; Suganuma et al., 2016).

The Japanese version of the Self-Compassion Scale (SCS-J; Arimitsu, 2014) was used to measure *self-compassion*, a 26-item scale on a five-point Likert scale (1='Almost never' to

5='Almost always'). Self-compassion is commonly defined as the positive attitudes towards oneself to understand one's own experiences in an un-biased and driven fashion (Neff, 2013). SCS-J is a translated version of the Self-Compassion Scale (Neff, 2003), and the 26 items in SCS-J/SCS are divided into six subscales relating to three positive constructs and three negative constructs. The positive constructs are self-kindness (being kind and understanding towards oneself, measured on five items; e.g., 'I try to be loving towards myself when I'm feeling emotional pain'), common humanity (understanding that suffering as part of human life, measured on four items; e.g., 'When things are going badly for me, I see the difficulties as part of life that everyone goes through. '), and mindfulness (a non-judgemental mind state to observe thoughts and feelings as they arise, measured on four items; e.g., 'When something upsets me, I try to keep my emotions in balance'), whereas the negative constructs are self-judgement (being harsh and judgemental towards oneself, measured on five items; e.g., 'I'm disapproving and judgmental about my own flaws and inadequacies'), isolation (unpleasant feeling of being alone, measured on four items; e.g., 'When I think about my inadequacies, it tends to make me feel more separate and cut off from the rest of the world'), and over-identification (difficulty distancing oneself from the situation and adopting a more objective perspective, measured on four items; e.g., 'When I'm feeling down I tend to obsess and fixate on everything that's wrong'). Each subscale is calculated by summing the responses, however the total score of self-compassion is calculated by reversing the negative constructs. Internal consistencies of SCS-J were high;  $\alpha = .84$  for the total self-compassion scale, and  $\alpha = .72-.82$  for each subscale: .82 for self-kindness, .76 for self-judgment, .77 for common humanity, .72 for isolation, .73 for mindfulness and .73 for overidentification in the validation study in Arimitsu, 2014. SCS-J had acceptable validity: GFI = .86, and range of factor loadings = .46-.83 for six-factor structure, and GFI = .56 and factor loading = .84 for one-factor structure i.e., the global score of self-compassion (Arimitsu, 2014).



Lastly, the Japanese version of the University of California Los Angeles Loneliness Scale version 3 (UCLA-LS3-J; Masuda, Tadaka & Dai, 2012) was used to measure loneliness—a subjective, unwelcome feeling of loss/lack of companionship relating to a mismatch between the quantity and quality of social relationships that one has and those what one wants (Russell, 1996). Though UCLA-LS was criticised for being unidimensional, we used this scale because it was the only loneliness scale validated and available in the Japanese language at the time of the study (Atimoto & Takeda, 2019; Masuda et al., 2012). This 20-item scale on a four-point Likert scale (0 = 'I never feel this way' to 3 = 'I often feel this way') asks how often each statement applies to you (e.g., 'I am unhappy doing so many things alone'), and all responses are added to calculate the level of loneliness. UCLA-LS3-J had a good internal consistency ( $\alpha = .92$  in Masuda et al., 2012), and validity was acceptable (GFI = .74; Masuda et al., 2012).

### ***Procedure***

Two days before the retreat, students received an email from the retreat coordinator with a link to the consent form followed by the scales, to be completed by the night before the retreat. Participants then attended a three-day shinrin-yoku retreat in Takashinoyama Forest in Fukushima, Japan, facilitated by a trainer who had more than ten years of experience in nature-assisted therapy and supporting student well-being. Straight after the retreat, and two weeks after the retreat, participants responded to the same three scales. All scales were prepared online, and the links were sent to participants at each assessment point by the retreat coordinator.

Fukushima was chosen for this retreat because of its rich and diverse nature. While aiming to support students' wellbeing, this retreat was hoped to inform the recovery of Fukushima from the 2011 Tohoku Earthquake and Tsunami, and the Fukushima Daiichi

Nuclear Disaster, where in total more than 19,000 people ceased (Ministry of Internal Affairs and Communication, 2016).

Shinrin-yoku retreat consisted of an arrival at, and a walk around the area (Day 1), water activities such as paddle boarding (Day 2), and earth activities such as harvesting vegetables (Day 3). Each day, participants were engaged in 30 minutes of meditation and 30 minutes of yoga in a group to bring their four-sensory experience (sight, sound, smell, and touch) to awareness. In total, the intervention lasted for 13 hours (three hours on Day 1 and five hours on Day 2 and 3 respectively). Accommodation and the rental fees for the water activity tools were paid by the students; earth activities, meditation and yoga sessions were offered by the trainer, who was paid by the university wellbeing services. Ethical approval was granted from the university research ethics committee.

### ***Statistical Analysis***

SPSS version 25 was used for data analysis. A one-way repeated measures analysis of variance (ANOVA), once outliers were examined. To assess differences among the three assessment points, post-hoc Tukey analyses were conducted. No scores were identified as outliers using the outlier labelling rule (Hoaglin & Iglewicz 1987). Assumption of normality was of no concern as a one-way ANOVA was accurate with non-normally distributed data (Plichta & Garzon, 2009).

### **Results**

For all variables, there was homogeneity of variances, as assessed by Levene's test for equality of variances ( $p \geq .19$ )

**Table 1.** Descriptive statistics and a one-way repeated measures ANOVA for the effects of nature retreat on mental wellbeing, self-compassion, and loneliness among Japanese students ( $n = 25$ ).

	Pre-Retreat					Post-Retreat					Follow-up				
	M	SD	$\alpha$	$p_{1-2}$	95% CI	M	SD	$\alpha$	$p_{2-3}$	95% CI	M	SD	$\alpha$	$p_{1-3}$	95% CI
Mental Wellbeing	48.20	9.11	.86	.06	-13.76, .16	55.00	9.90	.92	.80	-5.12, 8.80	53.16	11.68	.95	.21	-11.92, 2.00
Self-Compassion*	2.84 <sup>a</sup>	.69	.91	.26	-.74, .15	3.14	.65	.91	.53	-.65, .24	3.34 <sup>a</sup>	.64	.92	.03	-.94, -.05
Self-Kindness	2.99	.77	.75	.61	-.84, .36	3.23	.95	.88	.95	-.68, .52	3.31	.93	.90	.41	-.92, .28
Self-Judgement	3.34	1.03	.82	.85	-.83, .53	3.18	1.06	.91	.88	-.81, .54	3.05	.90	.88	.57	-.97, .39
Common Humanity*	2.93 <sup>b</sup>	.81	.63	.17	-1.04, .14	3.38	.86	.69	.59	-.83, .35	3.62 <sup>b</sup>	.92	.82	.02	-1.28, -.10
Isolation	3.27	1.07	.86	.69	-.90, .44	2.94	.91	.74	.33	-1.07, .27	2.54	.99	.82	.07	-1.30, .04
Mindfulness*	2.98 <sup>c</sup>	.75	.59	.06	-.95, .01	3.45	.71	.55	.52	-.70, .26	3.67 <sup>c</sup>	.67	.63	.003	-1.17, -.21
Over-Identification	3.33	1.14	.87	.72	-.90, .46	3.11	.97	.81	.88	-.82, .54	2.97	.88	.74	.42	-1.04, .32
Loneliness	52.36	6.96	.69	.44	-2.34, 7.22	49.92	7.18	.71	.96	-4.24, 5.33	49.38	7.04	.71	.30	-1.80, 7.77

\* $p < .05$ . Superscripts (<sup>a-c</sup>) indicate there was a significant difference between the two. Subscripts (<sub>1-3</sub>) indicate each time point: 1 = Pre-Retreat, 2 = Post-Retreat, 3 = Follow-up.  $\alpha$  refers to our sample.

A one-way repeated measures ANOVA was conducted. Total score of self-compassion, and its subscales, common humanity and mindfulness changed statistically significantly between different assessment points (Self-compassion  $F(2, 74) = 3.57, p = .03$ ; Common humanity  $F(2, 74) = 4.08, p = .02$ ; Mindfulness  $F(2, 74) = 6.16, p = .003$ ). No significant changes were observed in mental wellbeing and loneliness. Cronbach's alphas for the mindfulness subscale were consistently low (.55-.63) and are discussed in the limitation section of this paper.

The means of self-compassion, common humanity, and mindfulness increased from pre-retreat (Self-compassion  $2.84 \pm .69$ ; Common humanity  $2.93 \pm .81$ ; Mindfulness  $2.98 \pm .75$ ) to post-retreat (Self-compassion  $3.14 \pm .65$ ; Common humanity  $3.38 \pm .86$ ; Mindfulness  $3.45 \pm .71$ ), and increased at follow-up (Self-compassion  $3.34 \pm .64$ ; Common humanity  $3.62 \pm .92$ ; Mindfulness  $3.67 \pm .67$ ). Tukey post-hoc analyses revealed that the significant mean increases were yielded from pre-retreat to follow-up in all the three variables: Self-compassion  $p = .03$ , 95%CI -0.94 to -.05,  $\omega^2 = .06$  indicating a medium effect size (Small .01, Medium .06 and Large .14; Field, 2017), Common humanity  $p = .02$ , 95%CI -1.28 to -.10,  $\omega^2 = .08$  indicating a medium effect size (Field, 2017), and Mindfulness  $p = .003$ , 95%CI -1.17 to -.21,  $\omega^2 = .12$  indicating a large effect size (Field, 2017). There was no significant mean difference from pre-retreat to post-retreat, and from post-retreat to follow-up in any variable.

## **Discussion**

This manuscript assessed whether the outcome variables of general mental wellbeing, self-compassion, and loneliness would improve following a three-day shinrin-yoku (forest bathing) retreat in rural Fukushima, Japan (and subsequent two-week follow-up), which involved a forest walk, water activities, harvesting, meditation, and yoga. As predicted, self-reported indices of self-compassion, common humanity, and mindfulness statistically

significantly increased between pre- and post-retreat, and were sustained at two-week follow up. However, there were no statistically significant differences in scores of mental wellbeing or loneliness.

Previous investigations have suggested that engagement in shinrin-yoku might bring about positive change in psychologically-relevant outcomes such as depression, anxiety, and stress (Kotera et al., 2020; Pritchard et al., 2019), even after interventions of similar length to ours (Yu & Hsieh, 2020). As such, although self-reported measures of general mental wellbeing did not change statistically significantly between the three time points, descriptive-level data did not indicate that the average means returned to baseline: it increased from 48.20 at pre-retreat to 55.00 at post-retreat. The non-significant differences may be explained by a number of reasons. First, study participation criteria excluded those with mental health disorders; quantified by participants reporting good levels of mental wellbeing at the baseline ( $M = 48.20$  of  $70.00$ ). Therefore ceiling effects might have been present. Second, the WEMWBS does not distinguish between specific dimensions of mental wellbeing. As previous literature has shown individual variation between facets of (for example) depression, anxiety, and stress (Fido, Kotera, & Asano, 2019), it remains to be seen whether shinrin-yoku might individually act upon these dimensions through more thorough evaluation. However, as noted above, nonetheless the  $p$ -value for this change was not less than  $.05$  ( $p = .057$ ), this rather substantial change ( $6.80$ ) may indicate shinrin-yoku's positive effects on mental wellbeing. Recent health research emphasises that a lack of statistically significant data does not mean the intervention was not ineffective (Drummond, 2015). As such, future investigation on shinrin-yoku should recruit a more diverse spectrum of mental wellbeing as measured through specific indices.

Our data did however evidence a statistically sustained increase in self-compassion and two of its sub-facets; common humanity and mindfulness. Self-compassion is considered

a predictor of psychological well-being (Kotera & Ting, 2019; Zessin et al., 2015), and heightened reports of self-compassions have been associated with the prevention of the onset of anxiety and depression (MacBeth & Gumley, 2012; Van Dam et al., 2011). In our introduction, we documented the absence of any existing literature pertaining to the role of nature and self-compassion specifically, however, as Lumber et al. (2017) highlight that our connection with nature can be achieved through compassion (alongside contact, emotion, meaning, and beauty), results here are not unexpected. However, without a comparison group, improvement cannot be solely attributed to shinrin-yoku, in that benefit in self-compassion might be gleaned from simply vacating their usual rural environment. Future study should ensure control groups are present to allow inter-group comparisons across time point measurements to be made. Given that self-compassion might be considered to act as a protector from negative experiences and poor mental wellbeing (Neff, 2013), future research should explore this as a potential mechanism by which shinrin-yoku acts on mental wellbeing; as was shown in another Eastern student cohort (Luo et al., 2019).

Surprisingly, our data suggests that engagement in shinrin-yoku did not bring about any statistically significant changes in self-reported levels of loneliness (and the descriptive-level change was not great either: 52.36 at pre-retreat to 49.92 at post-retreat). Loneliness has been described as a core predictor of poor mental health (Cacioppo et al., 2015); including suicidal ideation and associated behaviour via the mechanism of contributing to depression (McClelland et al., 2020). In student populations, such as ours, loneliness may be operationalised through poor quality social relationships that conceptually differ from what they expect (Peplau & Perlman, 1982; Richardson, Elliott, & Roberts, 2017). As such, one might hypothesise that shinrin-yoku moderates the more internal aspects of mental wellbeing, and not preserve the negative outcomes associated with the social elements which contribute to mental health. Such findings also go some way to placing caveats on claims by the World

Health Organization (2017) that experiences of nature can reduce the experiences of loneliness. However, of importance, this study did not measure changes in experiences of *nature connectedness*; the underlying trait that encapsulates the cognitive and affective construction of ones' interconnectedness with the natural world (Capaldi, Dopko, & Zelenski, 2014); a potential conduit of the effect of shinrin-yoku.

### ***Limitations and future research***

Limitations and future research are discussed below. First, data was self-reported and as such may be subject to response biases (Kotera, Van Laethem, & Ohshima, 2020). Recently, personality researchers (e.g., Harper et al., 2020) have urged for the use of other-reported data when exploring changes in behaviour and mental-health related outcome variables which are closely associated with behaviour as a means of mitigating this limitation. Second, and entwined with the first limitation, is that although a positive change was identified for core outcome variables, the questionnaire scales used are not suitable to measure clinically-meaningful levels of said variables, and so the clinical relevance of shinrin-yoku remains to be understood. Moreover, although SCS and UCLA-LS are commonly used to measure the levels of self-compassion and loneliness, their accuracy has been discussed (e.g., Auné, Abal, & Attorresi, 2020; López et al., 2013). Further, Cronbach's alphas for the mindfulness subscale were consistently low (.55 - .63). As the unfitness of SCS in Buddhism has been debated (e.g., Zeng, Wei, Oei, & Liu, 2016), the low alphas may be explained by the fact that the students were recruited from a Buddhism university, and the Buddhist view of mindfulness is different from SCS's definition of mindfulness, which is more aligned with the Western view. While Buddhism regards it associated with non-self, the Western view of mindfulness commonly relates to self (Kaiya, Kumano, & Koshikawa, 2016, Van Gordon et al., 2018). Finally, the use of Cronbach's alpha for reliability is questioned,

and omega is recommended in recent organisational science studies, which we did not offer (e.g., Cortina et al., 2020). However, Cronbach's alpha is currently the most common value of reliability in health research (Boateng et al., 2018). Nevertheless, these preliminary results are positive and provide concrete grounding for future intervention work with clinical groups. Finally, the shinrin-yoku intervention comprised several unique sessions, and so even though the retreat as a whole can claim to positively impact the wellbeing of those who take part, the specific mechanism underpinning this change requires more thorough exploration.

### ***Conclusion***

Taken together, our data show that engaging in a shinrin-yoku retreat over a three-day period can bring about (mostly) prolonged benefit for self-compassion among Japanese university students, who suffer from high rates of mental health problems. Although several limitations have been highlighted throughout, which all warrant more detailed examinations of the mechanisms by which shinrin-yoku modulates the aforementioned outcome variables, data reported here presents an encouraging first step for bringing about meaningful change. As mental health represents a global issue with severe financial and wellbeing implications (Patel et al., 2018; Ritchie & Roser, 2018), with disproportionate impact on students (Cabinet Office, 2012; Hunt & Eisenberg, 2010), shinrin-yoku might represent a resource- and cost-efficient intervention, which could accompany pre-existing medications and treatment programmes. Going forward, pressure-testing the duration of such retreats documented here is essential to better understand the optimum amount of time required to bring about clinically-meaningful change.



Authors declare that they have no conflict of interest.

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