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This is the **accepted version** of the journal article:

Muro, Anna; Feliu-Soler, Albert; Canals, Josep; [et al.]. «Psychological benefits of Forest Bathing during the COVID-19 pandemic: a pilot study in a Mediterranean forest close to urban areas». *Journal of Forest Research*, , : 2022. DOI 10.1080/13416979.2021.1996516

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1 **Psychological benefits of Forest Bathing during the COVID-19 pandemic:**  
2 **A pilot study in a Mediterranean forest close to urban areas**

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21  
22 **Abstract**

23 The practice of *Shinrin-Yoku* or Forest Bathing is an outdoor therapeutic modality with mounting  
24 evidence suggesting positive effects on individuals' psychological wellbeing and overall health.  
25 However, its benefits have mainly been studied in Asian biomes and more research is needed to  
26 evaluate if its benefits are also generalizable to other regions such as European-Mediterranean  
27 forests. To preliminarily explore this issue, 16 healthy adults were assessed before and after a 3-hour  
28 session of Forest Bathing in a Mediterranean forest near Barcelona (Spain). The study was conducted  
29 during the Covid-19 outbreak. Changes in state anxiety, negative affect, positive affect and state  
30 mindfulness were assessed. Results show significant increases in positive affect, vigour, friendship  
31 and mindfulness, and decreases in negative affect, anxiety, anger, fatigue, tension, and depressive  
32 mood. Effect sizes observed for all the outcomes were significant and large, ranging from  $d = 1.02$  to  
33  $d = 2.61$ . This study encourages more applied research of the forest therapy model and the practice of  
34 *Shinrin-Yoku* in Mediterranean forests to increase the general population's psychological wellbeing

35 and to deal with the growing prevalence of the psychological side-effects generated by the the  
36 COVID-19 in European countries such as Spain.

37

### 38 **Keywords**

39 Forest bathing, Shinrin Yoku, COVID-19, mindfulness, anxiety, depressive mood

40

### 41 **Introduction**

42 Over the past decade, recent studies performed in Asian countries have reported  
43 significant improvements for psychological functioning associated with the practice of  
44 *Shinrin-Yoku*, translated in English as Forest Bathing (FB; Hansen et al. 2017; Timko-Olson  
45 2020). *Shinrin-Yoku* is a traditional Japanese practice which implies immersing in nature  
46 whilst paying mindful attention to the one's senses (Miyazaki 2018). Essentially, FB implies  
47 walking in a forest, however, other practices conducted in nature and aimed at enhancing  
48 relaxation are commonly included in FB programmes (Forest Therapy Society, 2005). In this  
49 regard, FB, is usually performed together with contemplative and meditation practices  
50 (Timko-Olsen van Gordon et al. 2018). Meditations are used to enhance mindful awareness  
51 and focus on the present moment by observing and contemplating specific properties of the  
52 natural environment and relaxation exercises facilitate deep breathing awareness. The practice  
53 of FB was started by the Japan Forestry Agency in the 80s and today this pioneering country  
54 has more than 60 forest medicine centers that coordinate with the major health and primary  
55 care centers of major Japanese metropolises (Li 2018; Park et al. 2010). Forest therapies  
56 provide an added value to forested areas and channel the demands of contact with nature by a  
57 growing urban population with intense levels of competitiveness, disorders related to stress,  
58 addiction to screens or new technologies such as sedentarism and lifestyles associated with  
59 health problems (Morita et al. 2007; Oh et al. 2017; Wen et al. 2019). The evidence suggests  
60 that exposition to natural environments improves per se the well-being and reduces stress  
61 (Antonelli et al. 2019; Park et al. 2010; White et al. 2021). Coherently, forest-air and walking  
62 in silence yields significant improvements for positive psychological functioning (Chen et al.  
63 2018; Hansen et al. 2017; Kobayashi et al. 2018; Lyu et al. 2018; Li 2018), enhancing  
64 positive emotions and improving cognitive functions (such as attention and executive  
65 functions) and even reducing pain perception (Hansen et al. 2017; Li 2018; Wen et al. 2019;  
66 Yau and Loke 2020). The inhalation of terpenes, as main volatile oils contained in forest  
67 aerosols, have been postulated as one of the mechanisms mediating the relationship between

68 exposition to forest and neural health (Cho et al. 2017). However, the evidence is not yet  
69 conclusive regarding the effect of such volatile substances on mental health, nor if the effect  
70 would be different depending on the type or maturity of forest to which people are exposed  
71 (Bach et al. 2020).. Accordingly, the practice of FB has been incorporated into the evidence-  
72 based forest medicine and included as a key element in nature therapies (Biedenweg et al.  
73 2017; Bratman et al. 2019). However, although empirical studies in Asian countries are  
74 plentiful, more evidence is needed to confirm the therapeutic effects of exposition to forests  
75 on mental health and wellbeing in other biomes and sociocultural contexts of the world, such  
76 as the Mediterranean (Hansen et al. 2017; Mucina 2019; Wen et al. 2019), where very few  
77 empirical studies (López-Pousa et al. 2015) have been carried out to date. Unlike Asian  
78 mesophytic or deciduous forests, Mediterranean forests are part of a temperate terrestrial  
79 biome, characterized by hot, dry summers and rainy winters (Mucina 2019). Mediterranean  
80 forests occur in, but are not limited to, the Mediterranean climate zones, of big five  
81 ecoregions of the world that have Mediterranean vegetation s in mid-latitudes, and they are  
82 found in: the Mediterranean Basin, California, central Chile, southwestern Australia, and the  
83 Western Cape of South Africa. The Mediterranean biome is also called evergreen sclerophyll  
84 (scleros = hard, sharp = leaf), as it is mostly made up of hard-leaved perennials (Woodward  
85 et al. 2004).

86 Therefore, the present pilot study was designed with the fundamental aim of evalauting  
87 the changes in psychological affective state and state mindfulness after a FB session  
88 conducted in a Mediterranean forest.

89

## 90 **Materials and methods**

### 91 **Design and procedure**

92 A pre-post within-subjects design was used to evaluate psychological benefits of a  
93 Mediterrenian FB session. The study was performed with the collaboration of the Network of  
94 Natural Parks of Catalonia, that depends on the “Diputació de Barcelona”, a public  
95 administration that promotes the progress and well-being of the citizens and local  
96 governments of its territorial area. The design of the intervention was agreed with the  
97 research team in order to carry out a pilot study during the COVID-19 pandemic in the  
98 general population. The FB session was guided by a specialized therapist and was conceived  
99 as a silence walk of about 4 kms in 3 hours, with three 10-minutes stops (at the beginning, in  
100 the middle and at the end) to practice deep breathing and mindful awareness of the 5 senses.

101 The activity was framed within the European Charter for Sustainable Tourism, which is a set  
102 of good environmental practices for the management of tourism in protected natural areas,  
103 promoted by the Europarc Federation (Canals 2014; Europarc 2010). It was first scheduled  
104 for May 24th., the European Natural Parks' Day, but due to COVID-19 mobility restrictions  
105 was postponed to October 3<sup>rd</sup>. A call for participation was made through the website of the  
106 the Net of Natural Parks of Catalonia. Prior registration was requested to participate in a FB  
107 in the area of Les Arenes (geographical coordinates: 41° 38.799 N, 2° 3.457 E; 405 masl), an  
108 area of a mountain Mediterranean forest in Sant Llorenç Natural Park (Catalonia,  
109 Northeast of the Iberian Peninsula), a territory particularly representative of the  
110 Mediterranean biome and close to urban centers. The base of the massif is occupied by white  
111 pine groves (*Pinus halepensis*), very resistant to water scarcity and up to 600 masl, often  
112 being replaced in the darkest and/or tallest areas by *Pinus sylvestris* and *Pinus nigra*. These  
113 pine forests, for the most part, are the result of the human transformation of the primitive  
114 forest and in many areas appear mixed with holm oaks (*Quercus ilex*) and Mediterranean  
115 shrubs such as heather (*Erica*) and strawberry (*Arbutus unedo*). The holm oak groves are the  
116 characteristic and most widespread vegetation of the natural park, which above 800 masl is  
117 enriched with species typical of wetlands such as whitebeam (*Sorbus*), boxwood (*Buxus*) and  
118 oak (*Quercus humilis*; Lorenzo 2009).  
119 All participants consented to collaborate voluntarily and provided informed consent before  
120 participating in the study. The ethics committee of the university approved the study in  
121 advance (reference code UAB5339).

122

### 123 **Participants**

124 Eighteen people signed up for the event. Finally, 17 attended and 16 voluntarily participated  
125 in the study. The final sample analysed recorded an average age of 47.5 years (ranging from  
126 38 to 65), all participants were residents in urban areas and none of them reported the  
127 presence of serious pathologies. The majority of them (87.5%) were women and had higher  
128 education (75%) (see Table 1).

129

### 130 **Instruments**

131 Participants responded 4 standardised tests before and after the FB session. These  
132 questionnaires are world-widely used in the study of the psychological effects of FB and are  
133 cross-culturally validated for both the general and clinical populations (Hansen et al. 2017;  
134 Oh et al. 2017; Timko-Olson 2020; Wen et al. 2019):

135 **1. State-Trait Anxiety Inventory** (STAI; Guillén-Riquelme and Buela-Casal 2011;  
136 Spielberger et al. 1982): This test measures the levels of state (at the moment) and trait  
137 (global personality) anxiety with a total of 20 items in each scale and format of Likert type  
138 answers. In the present study, only anxiety-state was measured. High scores warn of altered  
139 states related to anxiety, low scores indicate emotional stability and absence of stress. In the  
140 study sample, STAI-state showed an internal consistency of Cronbach's  $\alpha = 0.77$ .

141 **2. Positive Affect and Negative Affect Scale** (PANAS; Watson et al. 1988; López-Gómez  
142 et al. 2015): It includes two subscales of 10 items each that assess the experience of positive  
143 emotions related to psychological well-being and experiencing negative emotions related to  
144 psychological distress and mental health problems. In the study sample, positive affect  
145 subscale showed an optimal internal consistency of Cronbach's  $\alpha = 0.84$ , and negative affect  
146 subscale showed an internal consistency of Cronbach's  $\alpha = 0.90$ .

147 **3. Profile of Mood States** (POMS; McNay et al. 1971; Andrade et al. 2010). This test  
148 measures 6 moods from 30 items: Anger, fatigue, vigour, friendship, tension, and depressive  
149 mood; each item can be scored in a scale ranging from 0 to 4. The subscales showed an  
150 internal consistency of Cronbach's ranging from  $\alpha = 0.74$  to Cronbach's  $\alpha = 0.92$  for the six  
151 subscales.

152 **4. State Mindfulness Scale** (M-E; Tanay and Bernstein 2013): It is composed of 21 items  
153 with a Likert-type response scale to indicate whether the sentences describe well their  
154 experiences in the last 15 minutes. It assesses two dimensions: 1) Mindfulness state of mind  
155 (eg, "I realized thoughts coming and going") and 2) Mindfulness state of the body (eg "I  
156 realized physical sensations coming and going"). In the study sample, mind mindfulness  
157 subscale showed an optimal internal consistency of Cronbach's  $\alpha = 0.92$ , and body  
158 mindfulness subscale showed an internal consistency of Cronbach's  $\alpha = 0.74$ .

159

## 160 **Statistical analyses**

161 Means (standard deviations) and frequencies (percentages) were calculated for the socio-  
162 demographics. To analyse changes in psychological indicators after the forest bath, due the  
163 small sample size, the nonparametric Wilcoxon signed-rank test was used. A 5% significance  
164 level was adopted in all two-tailed tests. For a more precise interpretation on the relevance of  
165 the results in each assessed domain, effect sizes for pre-post changes were calculated using  
166 Cohen's  $d$  according to Morris and DeShon's (2002) equation (rule of thumb for Cohen's  $d$ :  
167  $0.2 =$  small,  $0.5 =$  medium, and  $0.8 =$  large effect sizes). Bonferroni correction for multiple

168 comparisons was also applied (significance level set at  $p < 0.005$ ). Statistical analyses were  
169 conducted using the SPSS 25.0 statistical package.

170

## 171 **Results**

172 Statistically significant pre-post variations were found in the psychological indicators. More  
173 precisely, levels of anxiety, negative affect, anger, fatigue, tension and depressive mood  
174 decreased significantly after FB ( $p < 0.005$ ). Furthermore, positive affect, vigour, friendship,  
175 and mindfulness of the mind and of the body showed statistically significant pre-post  
176 increases (all  $p < 0.005$ ). Regarding positive affect, mindfulness of the mind and body,  
177 vigour, and friendship increased significantly ( $p < 0.05$ ) after FB. All observed changes were  
178 indicative of large effect sizes ( $d > 0.8$ ) and remained statistically significant after Bonferroni  
179 correction.

180

181 INSERT TABLE 1 AROUND HERE

182 INSERT TABLE 2 AROUND HERE

183

## 184 **Discussion and conclusions**

185 The results obtained in this pilot study align with previous studies in Asian forests and show  
186 how FB conducted in a Mediterranean forest near the principal urban areas of Barcelona may  
187 increase psychological well-being (Hansen et al. 2017; Timko Olson et al. 2020; Wen et al.  
188 2019). It is worth noting that significant changes have been observed in all the psychological  
189 indicators measured in the present study, with large effect sizes after one single FB session.  
190 The highest impact has been shown in anxiety and tension decreases, as well as increases in  
191 vigour, a result that is also in line with physiological studies reporting lower salivary cortisol  
192 levels in FB participants, a solid marker of relaxation and stress reduction (Antonelli et al.  
193 2019; Chen et al. 2018; Park et al. 2010). Furthermore, large increases in mindfulness  
194 indicators have been found (both for mindfulness of the body and the mind) after the FB  
195 session, pointing out the importance of mindfulness in conveying the effects of connecting  
196 with nature on psychological wellbeing (Sadowski et al. 2020; Timko-Olson et al. 2020).  
197 Our results suggest that Mediterranean FB might also enhance mental health in terms of  
198 overall emotional functioning, as previous studies report in other biomes around the world,  
199 and could be employed as a safe and effective technique for mental health prevention and

200 promotion of psychological wellbeing, decreasing levels of stress, mental fatigue, anxiety, or  
201 depressive mood (Chen et al. 2018; Hansen et al. 2017; Kobayashi et al. 2018; Lyu et al.  
202 2018; Wen et al. 2019). Additionally, since our study was conducted during Covid-19  
203 outbreak -as a preliminary proof-of-concept study- a FB session could be also seen as a  
204 potential effective resource to soften mental and emotional disturbances which are known to  
205 be intensified during the pandemic in general population (Lozano-Vargas 2020; Timko  
206 Olson et al. 2020; Salari et al. 2020; Sandín et al. 2020; Wang et al. 2020).  
207 Nevertheless, several limitations of the present study should be acknowledged. Firstly, and  
208 the most important, given the nature of this study as a pilot, a reduced sample and  
209 unrepresentative of general population was used, limiting the generability of our findings..  
210 Secondly, the lack of an active comparison group (e.g., a hiking session without therapeutic  
211 guidance or relaxation/meditation session out of nature setting) make impossible to draw  
212 meaningful conclusions from the study as an uncontrolled design impedes the possibility of  
213 attributing the observed beneficial effects to the FB itself. It is also worth noting that the FB  
214 in the present study included three short mindfulness meditations. Although mindfulness  
215 practices are usually included in FB programmes, further studies should also evaluate if FB  
216 sessions without these practices would show similar benefits. On the other hand, it is  
217 necessary to highlight the fact that this study has only evidenced short-term psychological  
218 effects and that studies including follow-up assessments are needed. More research should  
219 also be carried using longer FB programs in general population and particular samples at  
220 high-risk for developing stress-related disorders. In any case, this pilot study encourages  
221 further research of FB in Mediterranean areas and its promotion with the collaboration of  
222 public administrations (Canals 2014) in order to keep on testing its positive effects on mental  
223 and overall health. The results from this study may be specially useful for policy makers to  
224 promote healthy habits in general population, especially in urban areas, which are more  
225 prone to stress-related problems, sedentary lifestyle or screen addiction (Antonelli et al.  
226 2019; Hansen et al. 2017; Li 2018; Wen et al. 2019), disturbances which have dramatically  
227 increased during the Covid-19 pandemic (Dubey et al. 2020; Kumar and Nayar 2020;  
228 Sanabria et al. 2021; Wang et al. 2020).

229

### 230 **Disclosure statement**

231 No potential competing interest was reported by the authors.

232

### 233 **Geolocation information**



234 Geographical coordinates of the starting point of the forest bathing route: 41° 38.799 N, 2°  
235 3.457 E

236

### 237 **Acknowledgements**

238 The authors would like to thank the contribution of the Diputació de Barcelona as the public  
239 administration that has facilitated present study during the COVID-19 pandemic.

240

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