



Research article

COVID-19: A crisis or fortune? Examining the relationship between nature relatedness and mental wellbeing during the pandemic

Prasath Selvaraj^{a,*}, Anbu Krishnamoorthy^a, Shankavi Vivekanandhan^b, Haritha Manoharan^c^a Department of Social Work, Pondicherry University, Puducherry, India^b Department of Psychiatric Social Work, National Institute of Mental Health and Neurosciences, Bengaluru, India^c School of Research Methodology, Tata Institute of Social Sciences, Mumbai, India

ARTICLE INFO

Keywords:

COVID-19

India

Nature relatedness

Pandemic

Political ideology

Wellbeing

ABSTRACT

With the progression of the coronavirus disease (COVID-19), lockdowns were introduced, movements were restricted, and the people were confined to their homes. On the other side, the social distancing measures and the shutdown of movements showed a significant impact on the ecosystem resulting in an explicit revamp of nature. These nature rejuvenation and home confinement measures were presumed to improve the human-nature connection and affect the wellbeing of the individuals. Guided by this aspect, the present study attempted to examine nature relatedness and mental wellbeing of the Indian population during the COVID-19 pandemic. We further tried to investigate the relationship between the two considering age and gender as moderators. In addition, the association between nature relatedness and various socio-demographic factors were also inquired. A three-week online survey was conducted among the general Indian population with the age group ranging from 18 to 65 years. Results exhibited a higher nature relatedness and moderate mental wellbeing among the individuals. The association between nature relatedness and mental wellbeing produced a significant positive relationship among the sample. Meanwhile, individuals with higher nature relatedness were found to be female, unemployed, research scholars, and possessing 'very liberal' political ideology. When assessed for potential moderators, neither gender nor age influenced the relationship between nature relatedness and mental wellbeing. Possible explanations of our findings were discussed that shall provide constructive directions for future research in the area of human-nature connection and public health.

1. Introduction

Environmental sustainability and public health pose significant global challenges to human existence during the 21st century (World Health Organization, 2015). While the persistent anthropogenic activities result in environmental degradation (UN, 2018), the consequences of those effects over human health and wellbeing are undeniable (Graham and White, 2016; WWF International, 2020). Recent studies have recommended for better research agendas connecting physical environments with individual's wellbeing and health (Houlden et al., 2018; Watts et al., 2015). There are several links between anthropogenic impact on the ecosystem and the related spread of certain diseases. One of the recent outcome of such complex human-nature interaction is the emergence of COVID-19 crisis that poses the need for an in-depth reflection and understanding of the relationship between human and nature (WWF International, 2020).

1.1. COVID-19, nature and wellbeing

With the growing number of COVID cases, India imposed national lockdowns effective with various phases to control the dramatic rise and spread of the coronavirus (Ghosh et al., 2020). The lockdown measures had brought in mixed emotions of both positive and negative sentiments to the Indian population. While most of the Twitter handles expressed feelings of positivity, trust and hope, there also prevailed emotions of fear, sadness, disgust and concern during the lockdown phases (Barkur et al., 2020). Likewise, a significant part of the population was influenced by media information and social media posts and expressed deep anxiety despite adequate awareness about the pandemic (Roy et al., 2020). Henceforth, various environmental changes along with the consequent economic damage and the resonating social impacts may likely have a profound influence on the behavior patterns and cause detrimental

* Corresponding author.

E-mail address: prasathselva2793@gmail.com (P. Selvaraj).<https://doi.org/10.1016/j.heliyon.2022.e09327>

Received 15 January 2022; Received in revised form 25 February 2022; Accepted 21 April 2022

2405-8440/© 2022 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

reactions upon the wellbeing of the general population (World Health Organization, 2020).

On the other hand, while humans were striving to control the pandemic spread, nature and its components were likely to thrive in the phenomenon of rejuvenation on its own. Surprisingly, there has been an impeccable improvement in the ecological frontiers of the ecosystem. A pre-dominant change in the behavioral patterns of the people had shown a significant impact on the biodiversity patterns, such as a significant increase in the air and water quality of megacities (Connerton et al., 2020) and a fall in global CO₂ emissions by 17 per cent in April 2020 (Le Quéré et al., 2020). For exemplars, the decade long polluted 'R.Ganga' observed a decline in pollution levels by 25–30 per cent during the lockdown (Aquatech, 2020), and the Indian 'Lake of Vembanad' showed a 15.9% reduction in 'total suspended particulates' in opposition to the pre-lockdown times (Yunus et al., 2020). Besides these, the media were possibly reporting general short term positive trends in the biodiversity levels, and the communications on other environmental issues were substantially given fewer preferences (Rousseau and Deschacht, 2020). Therefore, we argue that, to the general population, the COVID-19 crisis and the lockdown measures can introduce a positive mindset in the nature-based topics and implicitly push their attitude and behavior towards spending extra time in nature and feel oneself more nature-related.

1.2. Nature relatedness

Nature relatedness significantly indicates the amount of one's innate feeling to connect with nature (Nisbet and Zelenski, 2013), and the individuals' 'subjective sense of connection' to their surroundings (Nisbet et al., 2009). Terms such as "connectedness with nature" and "nature connectedness" were used in place of nature relatedness as well. Nature relatedness comprises of three components namely, the cognitive connection (incorporating natural elements within one's cognitive representation), the affective connection (sense of feeling connected to nature) and the experiential connection (perceived comfort level and familiarity with natural elements) (Nisbet et al., 2009). Nonetheless, nature relatedness is considered as a trait measure as it is not completely fixed but stable to a relative extent across situations and time period (Nisbet et al., 2009; Schultz, 2002).

Whilst previous studies have established higher nature relatedness among individuals frequently experiencing nature contact (see Nisbet et al., 2019 for example), the reverse direction of causality was also demonstrated by Arendt and Matthes (2016), in that individuals' level of nature relatedness tend to influence their contact with nature. i.e., persons with higher nature relatedness tend to spend extra time with nature, build greener spaces around their houses and prefer to watch nature-based programmes.

1.3. Mental wellbeing

In case of mental wellbeing, theories from the past continue to describe them by two aspects; the hedonic and eudaimonic wellbeing. While the hedonic wellbeing represented pleasant feeling that was measured by happiness and life satisfaction (Ryan and Deci, 2001); the eudaimonic wellbeing represented fulfilled living, functioning and life purpose (Ryff and Singer, 2008) of the individuals. Eventually, both were positively correlated and constituted a multidimensional measure of overall mental health. Accordingly, individuals with higher mental wellbeing could pose greater potential in managing life stressors and maintain positive mental health (Houlden et al., 2018).

1.4. Relationship between mental wellbeing and nature relatedness

The theoretical assumption for the association between nature and human wellbeing emerges from the biophilia hypothesis. The theory of biophilia posits that individuals' need for survival and wellbeing effects is positively linked towards their nature connection (Kellert and Wilson,

1993). The concept of urban living only began in recent years for which humans, during their evolvement with nature, always do have an innate feeling of connecting with nature and other life forms. This instinctive and intrinsic motivation for connection towards nature shall show influence on their wellbeing as well as in the purpose of their survival (Wilson, 1984).

Inspired by the hypothesis, many studies evolved in the field of environmental psychology that evidenced preferences to natural surroundings over artificial structures (Ibarra et al., 2017; Kaplan and Kaplan, 1989). Furthermore, the evidences also revealed positive aspects of mental health such as cognition (Berman et al., 2008), mood (MacKerron and Mourato, 2013), longevity and optimal health (Mitchell and Popham, 2008) in regard to the individuals' contact with nature. Despite the physical nature exposure, individuals' feeling of perceived psychological connection to nature is equally important towards ensuring potential nature-health related benefits (Seymour, 2016; Whitburn et al., 2020). A couple of recent meta-analysis researches exhibited positive association between nature connectedness and the facets of hedonic wellbeing (Capaldi et al., 2014) and eudaimonic wellbeing (Pritchard et al., 2020).

In conformity with the above idea that one's subjective connection with nature influences their mental wellbeing, we tried to explore whether the feeling of individuals' nature relatedness does create a significant impact on their mental wellbeing despite facing adverse effects during the COVID-19 pandemic.

In addition, attempting towards examining nature relatedness across various socio-demographic indicators shall aid in understanding and developing critical factors involved behind their association and interplay. Previous work has engrossed on investigating the role of personal as well as social characteristics affecting environmental concern and behavior of individuals (Gifford and Nilsson, 2014). However, to the best of our knowledge, socio-demographic indicators were less likely involved into the point of investigation for the construct of nature relatedness. Whilst very few studies (Di Fabio and Rosen, 2019; Dornhoff et al., 2019) had investigated the gender differences among institutional samples, no studies has worked until to understand the relationship between other personal and social factors such as age, locality, religion, marital status, educational status, employment status and political ideology in the matter of nature relatedness of the general population.

Besides that, evaluating the role of the socio-demographic indicators while considering the relationship between mental wellbeing and nature relatedness becomes paramount, as there exists an ample research over the impact of personal and social characteristics on wellbeing. Personal factors such as genetic history and environmental exposure can pose serious consequences on health status along with wellbeing. Social indicators play a vital role in affecting the health and wellbeing through complex interplay of economic, cultural, political and social elements. This eventually give rise to social hierarchies impacting lifestyle changes and affecting health statuses (Solar and Irwin, 2010). Recent meta-analysis study of factors associated with wellbeing revealed many social and personal characteristics that included age, gender, ethnicity, locality, educational status, health status, employment status, religion, activities engaged in, marital status and political persuasion (Dolan et al., 2008). Also, a recent systematic review reported varying association between greenspace and wellbeing across the socio-demographic factors such as gender, life course stage and level of urbanisation and physical activity (Houlden et al., 2018). However, in few studies age and gender were not found to have significant influence on the association between wellbeing and nature relatedness (e.g., Zhang et al., 2014).

2. Objectives of the study

The current research tried to address the absence of significant contributions from the literature associating nature relatedness across various socio-demographic indicators of age, gender, locality, religion, marital status, educational status, employment status and political

ideology. On saying that, the initial step of the present study is to investigate nature relatedness across the aforementioned socio-demographic characteristics.

Later, we focused onto examine the state of mental wellbeing and nature relatedness and evaluated the association between them accounting for the potential confounding socio-demographic variables. Furthermore, we worked onto examine the relationship between both the constructs considering gender and age to be the moderators since previous studies reported older individuals and women having greater association with environmental norms, attitudes, and behaviors compared to younger individuals and men (e.g., Félonneau and Becker, 2008; Pinto et al., 2011). On a whole, the findings of the present research shall help in examining the critical role of nature relatedness towards fostering public health outcomes in general and during similar pandemic situations in future.

3. Methods

A three-week online survey was conducted among the general Indian population with the age group ranging from 18 to 65 years. A cross sectional correlational research design was adopted for the study. We designed the survey questionnaire and collected data using an online open-source platform named 'KoboToolbox' (Harvard Humanitarian Initiative, 2016). The survey link was circulated across social networking platforms such as WhatsApp, Instagram, Facebook and through personal e-mail contacts of the researchers. Being mindful of the COVID-19 restrictions, we found this as a better way to minimize one on one/physical interaction between the researchers and the participants. A convenient sampling technique was followed thus encouraging the participants to roll out the survey link to as many people as possible. Upon clicking the survey link, the participants were directed to the information about the study and the appropriate informed consent was obtained.

According to Krejcie and Morgan (1970), for any population, $N \geq 300000$ for a confidence level of 95% with a 5% margin of error, the ideal sample size would be 385. Based upon this suggestion, we carried out the survey until we reached the required sample size. A total of 390 responses were recorded during the survey period. Out of which, 386 responses were found to be valid and subjected to analysis. The survey link was designed in such a way that only one response could be generated through one device, and no information that could identify the participants was collected to maintain anonymity. The present study complies with the regulations of the Institutional Ethical Committee (Human Studies) of Pondicherry University and the ethical standards laid down in the Declaration of Helsinki were followed wherever applicable.

3.1. Measures

3.1.1. Nature relatedness

The shorter version of 'Nature Relatedness Scale' was used that measured an individuals' subjective connectedness to the natural environment on a 6-item scale (for example, "I feel very connected to all living things and the earth"; Pearson's $r = 0.80$, Cronbach's $\alpha = 0.76$). We preferred the short version scale since our study nature involved evaluating connectedness components in place of environmental attitudes. Moreover, the shorter version represented similar associating patterns among happiness and other environmental constructs to that of the longer version (Nisbet and Zelenski, 2013). Every item on the nature relatedness scale is rated on a five point Likert scale ranging between strongly disagree (1) to strongly agree (5). The higher the score represents higher nature relatedness of the individual.

3.1.2. Mental wellbeing

'Short Warwick-Edinburgh Mental Well-Being Scale (SWEMWBS)' was used to assess the participants' mental wellbeing based on a 7-item scale (for example, "I have been feeling optimistic about the future"; Pearson's $r = 0.80$, Cronbach's $\alpha = 0.83$). The shorter version of the scale

was found to be largely free of bias, easy to complete and provided credible mental wellbeing measures (Stewart-Brown et al., 2009). Participants were asked to express their feeling over the past two weeks on a five-point Likert scale ranging between "none of the time, rarely, some of the time, often and all of the time". The higher scores represent higher level of mental wellbeing whereas the total scores range from 7 to 35.

3.1.3. Socio-demographic factors

Participants provided key particulars on their socio-demographic characteristics including age, gender, locality, religion, marital status, educational status, employment status and political ideology.

3.2. Sample characteristics

The average age of the participants was 24.90 years ($SD = 5.363$) with 57.8% of them being below 25 years of age. Among the survey participants, 61.7% were females, with 46.4% of them hailing from urban areas. Subsequently, 65.5% of the total participants belonged to the Hindu religion while 81.1% of them were reported single and 43% of them completed their master's degree. The participants' overall employment status showed 38.6% of them were students (alongside 14.8% of research scholars), followed by 30.6% of them being employed. Interestingly, 31.6% of the participants 'did not have an idea' of their political ideology, whereas 23.3% of them 'preferred not to reveal' their political ideology. Analysis of the data also revealed that majority 348 (90.2%) of the participants exhibited higher nature relatedness and 38 (9.8%) of them exhibited lower nature relatedness during the pandemic. In further, most of the participants, 224 (58.0%), showed moderate mental wellbeing during the pandemic, whereas 138 (35.8%) observed higher mental wellbeing, and only 24 (6.2%) reported poor mental wellbeing (Table 1).

3.3. Data analysis

IBM SPSS version 20 was used to carry out the statistical analyses of the study data. Initially, the descriptive statistics of the study variables were examined and then the tests for assumptions were performed in order to run the inferential statistics. Skewness and kurtosis values were inspected along with histogram representation that revealed approximate normal distribution of the data. Test for Outliers performed using box plots revealed no significant outliers and the homogeneity of variances in the data assessed using Levene's tests met the assumption. The statistical significance for all the above tests was set at 5% ($p < 0.05$).

Based on the fulfillment of the assumption criteria, one way ANOVA and independent t tests were employed to determine the association between nature relatedness and other socio-demographic characteristics.

Association between mental wellbeing and nature relatedness was assessed using Zero-order correlation test along with that simple regression was performed to test nature relatedness as a predictor of mental wellbeing across the given sample. In addition, hierarchical regression analysis was performed to control the effects of age and gender on the relationship between mental wellbeing and nature relatedness.

Analysis of Moderation was carried out using 'PROCESS Model 1 - Version 3.5' (Hayes, 2017) to test whether age and gender acted as significant moderators of the association between mental wellbeing and nature relatedness.

4. Results

4.1. Association between socio-demographic characteristics and nature relatedness

The independent sample t -test identified significant differences between female and male participants in their nature relatedness scores, t

Table 1. Descriptive statistics of socio-demographic and scale variables.

Variables (N = 386)	Categories	Frequency	Percent	NR Score	
				M	SD
Nature Relatedness (Mean – 23.03; SD – 3.39)	High (19–30)	348	90.2	23.72	2.78
	Low (6–18)	38	9.8	16.76	1.55
Mental Wellbeing (Mean – 23.65; SD – 4.30)	High (26–35)	138	35.8	27.98	2.24
	Moderate (17–25)	224	58.0	22.00	2.13
	Poor (7–16)	24	6.2	14.17	1.83
Age (Mean – 24.90yrs)	Below 25 years	223	57.8	22.86	3.33
	25 years & Above	163	42.2	23.28	3.47
Gender*	Female	238	61.7	23.33	3.31
	Male	148	38.3	22.56	3.47
Locality	Rural	108	28.0	23.21	3.40
	Urban	179	46.4	23.04	3.53
	Semi-Urban	99	25.6	22.84	3.13
Religion	Hinduism	253	65.5	23.03	3.35
	Islam	23	6.0	22.87	3.06
	Christianity	37	9.6	22.57	3.35
	Other	9	2.3	22.78	5.17
	Prefer not to say	64	16.6	23.42	3.45
Marital Status	Single	313	81.1	23.10	3.34
	Married	69	17.9	22.65	3.66
	Separated/Divorced	4	1.0	24.25	1.71
Educational Status	Bachelor's degree	147	38.1	22.58	3.58
	Master's degree	166	43.0	23.26	3.13
	MPhil	13	3.4	24.16	3.21
	PhD Scholar	60	15.5	23.30	3.65
Employment Status*	Student	149	38.6	22.93	3.36
	Research Scholar	57	14.8	23.47	3.58
	Employed	118	30.6	23.02	3.38
	Unemployed	40	10.4	23.88	3.22
	Home maker	22	5.7	21.13	2.93
Political Ideology**	Very Liberal	80	20.7	24.03	3.15
	Slightly Liberal	52	13.5	22.81	2.92
	Slightly Conservative	31	8.0	22.61	3.65
	Very Conservative	11	2.8	24.72	3.55
	No Idea	122	31.6	22.26	3.53
	Prefer not to say	90	23.3	23.28	3.31

* $p < 0.05$; ** $p < 0.01$.

(384) = 2.18, $p < .05$. Females (M = 23.33, SD = 3.31) were found to have higher nature relatedness than males (M = 22.56, SD = 3.47).

The one-way ANOVA results revealed statistically significant difference between the groups of employment status in relation to the nature relatedness of the participants. However, the difference between the groups in their mean scores was relatively minimal. Evaluation of pairwise differences using Tukey post hoc test revealed that the nature relatedness of the research scholar (M = 23.47, SD = 3.58, $p = 0.046$) and unemployed (M = 23.87, SD = 3.22, $p = 0.019$) groups was significantly higher compared to the homemaker group (M = 21.14, SD = 2.93). However, there was no significant differences between any other groups (Table 2).

Similarly, ANOVA results identified statistically significant difference among the groups of political ideology in regard to the nature relatedness of the participants; and the actual difference in the mean scores between groups was quite small. The pairwise comparisons evaluated using Tukey post hoc test identified that the nature relatedness score of participants with 'Very Liberal' ideology (M = 24.02, SD = 3.15, $p = 0.004$) was significantly higher compared to those who had 'No Idea' of their political ideology (M = 22.26, SD = 3.53). However, there found no statistically significant differences between any other groups of political ideologies of individuals (Table 3).

Otherwise, test results of comparison found no significant differences among the other socio-demographic characteristics of age, locality,

Table 2. ANOVA results of nature relatedness and employment status association.

Variable	Student		Research Scholar		Employed		Unemployed		Home maker		F (4,381)	η^2
	M	SD	M	SD	M	SD	M	SD	M	SD		
Nature Relatedness	22.94	3.36	23.47	3.58	23.01	3.38	23.88	3.22	21.14	2.93	2.65*	0.03

* $p < 0.05$.

Table 3. ANOVA results of nature relatedness and political ideology association.

Variable	Very Liberal		Slightly Liberal		Slightly Conservative		Very Conservative		No Idea		Prefer Not to Say		F (5,380)	η^2
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD		
Nature Relatedness	24.03	3.15	22.80	2.92	22.61	3.64	24.73	3.55	22.26	3.53	23.28	3.31	3.52**	0.04

** $p < 0.01$.

religion, marital status and educational status of the participants in respect to their nature relatedness scores.

4.2. Relationship between nature relatedness and mental wellbeing

Zero-order correlation between nature relatedness and mental wellbeing was found to be positive and significant correlated ($r = 0.219, p < .001$). Test of simple linear regression observed that Nature relatedness significantly predicted Mental Wellbeing indicating a significant role in enhancing mental wellbeing of the participants during the pandemic. Moreover, the $R^2 = 0.048$ depicted that nature relatedness explained 4.8% of the variance of mental wellbeing (Tables 4 and 5).

The overall regression model tested using hierarchical regression analysis predicted 7% of variance in mental wellbeing ($R^2 = 0.07, F(3,382) = 9.07, p < .001, VIF < 3$). Age and gender predicted 1.3% of variance in mental wellbeing. However, only age was found to be a significant predictor of mental wellbeing among them. After controlling for age and gender, the step two predicted approximately 5% of variance in the mental wellbeing, revealing that higher nature relatedness scores being associated with greater mental wellbeing (Table 6).

4.3. Gender and age as moderators

Moderator analysis performed using ‘PROCESS Model 1 - Version 3.5’ of Andrew Hayes, sought to investigate whether the association between mental wellbeing and nature relatedness was moderated by age and gender of the participants. The interaction effect of moderation analysis was found to be insignificant, $b = 0.02, 95\% \text{ CI } [-0.24, 0.27], t = 0.127, p > .05$. Hence the association between nature relatedness and mental wellbeing was neither moderated by gender nor by age of the participants; $b = 0.01, 95\% \text{ CI } [-0.006, 0.028], t = 1.23, p > .05$.

5. Discussion

In the present study, using an online survey sample from India, we worked onto evaluate the differences in nature relatedness scores among various socio-demographic characteristics and examined the association between nature relatedness and mental wellbeing without controlling for any of the socio-demographic factors. Later, we considered gender and age to be the moderators of the relationship between mental wellbeing and nature relatedness and not otherwise any other socio-demographic variables.

As an outcome, individuals with higher nature relatedness were found to be female, unemployed, research scholars, and possessing very liberal political ideology. Moreover, nature relatedness predicted mental wellbeing in a significantly positive way. When assessed for potential moderators, neither gender nor age influenced the relationship between nature relatedness and mental wellbeing. We tried to provide some possible explanations for our findings.

Table 4. Correlation analysis for nature relatedness on mental wellbeing.

Variable	N	M	SD	1	2
1. Nature Relatedness	386	23.04	3.39	-	
2. Mental Wellbeing	386	21.61	3.48	.219***	-

*** $p < 0.001$.

Table 5. Regression analysis of nature relatedness on mental wellbeing.

Predictor Variable	R	Std.Beta Value	t - value	R^2	Adjusted R^2	F (1,384)
Nature Relatedness	0.219**	0.22	4.39	0.048	0.045	19.29***

*** $p < 0.001$.

Table 6. Regression analysis showing age, gender and nature relatedness as predictors of mental wellbeing.^a

Predictors	Cumulative		Simultaneous		
	R^2 -change	F-change	B	p	VIF
Step1					
Age	0.02	F (2,383) = 3.45*	0.10	0.043	1.019
Gender			0.08	0.11	1.029
Step 2					
Nature Relatedness	0.05	F (1,382) = 19.97**	0.22	<.001	1.016

* $p < .05, **p < .001$.

^a n = 386.

5.1. Gender

Our finding that females were observed to have higher nature relatedness appears to be similar to studies in general that reported significant women-nature associations (Cartwright and Mitten, 2017; De Beauvoir, 1989). This women nature inclination can be due to the stereotypical perception that women are sensitive to nature and its components and can have possible support with theories that propose ‘people giving a female face to nature to subdue the difficulties facing from nature and to encourage a sense of harmony with the natural world’ (Roach, 2003). Meanwhile, multiple studies reported a greater environmental concern for women than men with nature connectedness as a strong moderator (Gifford and Nilsson, 2014; Milfont and Duckitt, 2004).

5.2. Employment status

Considering the significant difference in the employment status, our findings are in contrast to the results from a prior study that established a lack of significant association between employment status and connection to nature (Cartwright and Mitten, 2017).

Our finding that greater nature relatedness score for unemployed is in line with a recent study that reported a higher nature relatedness score for individuals at ‘no work’ compared to that of individuals involved at ‘full-time work’ (Dean et al., 2018). Possible claim for this can be due to the fact that unemployed individuals get more leisure time and can spend more of the time performing nature-based activities (for example; gardening, volunteering for a nature based NGO, going for a walk in a park whenever they want to, planning a short trip often to nature places etc.). Since these involve utilisation of time by the individuals, we recommend future research to focus on nature relatedness among working and non-working persons with more possible area of investigating, ‘‘How these unemployed/no work individuals spend most of their time?’’ This can open new pathway of research into understanding nature-person connection as unemployed

individuals spending their quality time in binge watching and playing video games may have lesser nature relatedness compared to those utilizing their time into gardening, volunteering for nature programmes.

Meanwhile, the higher score for research scholars compared to homemakers can be because of research scholars having a probability of working in a similar research domains related to environment such as environmental psychology, environmental economics, and any forms of science domains. This is less likely to happen for homemakers. We shall support this claim through previous studies that tend to report greater environmental knowledge and awareness for science students compared to that of non-science students (Ai Lin, 2004; Jannah et al., 2013). Therefore, future studies can take up this idea and try to investigate nature relatedness of research scholars working in different domains of research.

Although, we found females having more nature relatedness than males, the lesser nature relatedness score for homemakers (all of them identified to be women in the sample), in particular, may be due to the perception that women lack opportunities/sometimes restrict themselves from spending time outdoors and in other nature-related activities (Lovelock et al., 2016; Thompson et al., 2008). Often, the reason behind women staying indoors may be a result of inadequate facilities, knowledge about places, lack of leisure time combined with safety related concerns (Jorgensen et al., 2002; Shores et al., 2007). Reasoning with specific to Indian cultural context, the outdoor connection of women tend to be a multilayered space and involves inequalities in gender relation, power and control (Sharma-Brymer, 2018). Notably, the prevailing social and gender-specific norms and media representations of gender, typically in terms of cultural stereotypes, may also resist women from participating in nature-based recreation activities and defy them from spending time outdoors with nature.

5.3. Political ideology

Consequently, significant association between political ideology and nature relatedness of the individuals revealed that the individuals possessing 'very liberal' ideology reported higher nature relatedness score than those who had 'no idea' of their political ideology. The possible reasons supporting higher nature relatedness among 'very liberal' individuals can be because they believe in and support environmental regulations, intervention from governments involving innovative action and policy changes towards safeguarding environment degradation. These beliefs are unlikely among individuals with 'no idea' of their political ideology.

Our findings are in line with previous studies that reported association between political ideology and other forms of environmental constructs such as environmental concern, environmental behavior and environmentalism (Cruz, 2017; Roth and von Collani, 2007; Wuertz, 2015). However, there found no prior studies that evaluated the relationship between political ideology and nature relatedness. We have tried to address this research gap through our findings and suggest future researchers to further work on to replicate the association between political ideology and nature relatedness exploring its relevance across cross-cultural and different political contexts.

5.4. Nature relatedness and mental wellbeing during the pandemic

The current study results direct a positive effect of nature relatedness on the mental wellbeing of the general Indian population during the COVID-19 pandemic. The individuals with stronger relatedness to nature observed greater mental wellbeing. Our findings are in consistent with the meta-analysis studies that observed similar results of stronger eudaimonic and hedonic wellbeing for individuals with higher connectedness to nature (Capaldi et al., 2014; Pritchard et al., 2020), thus adding substantial evidence to the overall nature-wellbeing constructs.

However, an important question here is; *Whether the subjective connectedness to nature decreased the adverse effects of pandemic on the individuals resulting in higher mental wellbeing?* The answer is 'yes' and this may be due to the reason that individuals during the pandemic lockdown, acquired more leisure time and may have administered most of their time in nature. A recent study asserted this assumption by reporting that people were performing nature-based activities more than their usual way during the pandemic time (Haasova et al., 2020), and this span of contact with the natural surroundings could have helped individuals in enhancing their nature relatedness (eg., Nisbet et al., 2019). In addition, on the other hand, past studies reported that individuals with stronger nature relatedness perform nature-based activities and spend more time with nature than usual despite external environmental constraints (Arendt and Matthes, 2016; Clayton, 2003).

These acts of exposure to natural spaces may have provided individuals with restorative benefits of power from natural components (Collado et al., 2017; Hartig et al., 2014) and pushed them to be nature protective and self-protective (Clayton, 2003). Most importantly after all, the individuals with higher sense of connectedness to nature perceived the pandemic to be a more positive one than others (Haasova et al., 2020).

On a whole, these aspects of utilizing leisure time to be with nature during the lockdown, and taking the benefits out of nature involvement and maintaining positive pandemic sense can all be a reason for increased nature relatedness and decreased adverse effects of the pandemic resulting in greater mental wellbeing of the population.

However, we suggest future researchers to involve in a detailed investigation of the leisure time activities during the pandemic and its effect on nature relatedness and various health related factors. In addition, more conscience should be given towards studying the exposure to natural environments during similar pandemic situation and the risking of individuals' health and safety compliance due to the infringement of the pandemic measures.

It is unclear why age and gender did not tend to moderate the relationship between nature relatedness and mental wellbeing despite previous researches found their association with environmental norms, attitudes, and behaviors (e.g., Félonneau and Becker, 2008; Pinto et al., 2011). However, our findings are in conformity with the past meta-analytic research that reported no moderation of gender and age in the association between happiness and nature connectedness (Capaldi et al., 2014). We suggest further research has to be focused on age and gender as moderating variables in investigating their association between nature relatedness and wellbeing as well as health related constructs.

Meanwhile, some studies reported no or lesser significant relationship between nature connection and wellbeing of the individuals (Nisbet et al., 2020; Schwarzmüller-Erber et al., 2020). Therefore, on a serious note, we are trying to imply that although the person-nature connection is imperative in building one's personal wellbeing that alone cannot stand across the life's journey of a person in lending positive benefits. There may be other enervating social and cultural factors such as poverty, oppression, discrimination, stereotypes, addiction, substance use and lack of access to spaces and opportunities, that can stress negative influence on the wellbeing of the individuals and community (McCormick, 2000; Nisbet, 2011). Future researchers have to consider these factors into account while studying nature's influences on the mental wellbeing of individuals or a community during a pandemic scenario.

Studies have reported significant association among nature relatedness, environmental concern and environmental behavior, extending their scope beyond personal wellbeing and marching towards environmental wellbeing. Thus, further examination of the relationship between these personal and environmental variables during times of pandemic is also important. This shall pave a way forward in understanding the person-nature connection deeper and assist in gaining more knowledge on individuals' response to the natural crisis, and prepare them for the same.

The present study focused onto examine the state and association between nature relatedness and mental wellbeing by collecting data at a single point in time (i.e., during the peak of the first COVID-19 wave; September 2020). Because of the aforementioned study nature, the effect of continuing pandemic and the impact of successive COVID waves on both nature relatedness and mental wellbeing were not incorporated into the study. However, considering their significance, we strongly recommend future researchers to adopt a longitudinal study design and collect data at different time points (ie, between the consecutive COVID waves and or between peak and normal time of the COVID waves). By doing so, shall help in bringing out the differences in mental health and nature related concerns among the general population at various time intervals and add more knowledge on human actions during similar health related emergencies.

5.5. Limitations

The present study is limited to individuals using a smartphone, laptop and other electronic gadgets. Moreover, the data obtained were confined to people who understand English and use social media platforms. Therefore, this study is a representation of literate people, and the results could not be generalized to the entire population of the country. The results may differ among the illiterate and with the individuals who do not understand the English language.

6. Conclusion

The present study results become the first of its kind in revealing the level of nature relatedness and its influence on the mental wellbeing of the Indian population during the pandemic. Ultimately, no doubt the COVID-19 pandemic has provoked a crisis in the human population and simultaneously acted a fortune on the natural environment. Restoring person-nature connection may act as a preparedness strategy against any such pandemic in the future and promote societal wellbeing and economic growth without hurting nature's flourishing. However, in order to perform the strategy, a higher level of attention and responsibility has to be given to creating immediate green and blue spaces and in the prompt expansion of urban nature. As an outcome, these shall help individuals to escape home confinement, maintain social contact, provide a sense of connection to the outer world and enjoy significant wellbeing effects during similar lockdown times.

With due respect to that, imparting environmental education, increasing nature exposure during childhood, and having minimum current nature exposure for adults shall strengthen the person-nature connection. However, future research must focus on designing emergency nature-based pandemic interventions and provide enough support to overcome the mental health problems caused during the COVID-19 and similar pandemics in future.

Declarations

Author contribution statement

Prasath Selvaraj: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Anbu Krishnamoorthy: Conceived and designed the experiments; Analyzed and interpreted the data.

Shankavi Vivekanandhan; Haritha Manoharan: Performed the experiments; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at <https://doi.org/10.1016/j.heliyon.2022.e09327>.

References

- Ai Lin, E.L., 2004. A Study on Environmental Awareness, Knowledge and Attitude towards Tropical Rainforest Issues Among Melaka Secondary School Students. University of Malaya). University of Malaya. Retrieved from. http://studentsrepo.um.edu.my/2655/7/BAB_4.pdf.
- Aquatech, 2020. The Ganges Shows Increased Biodiversity after Lockdown. Retrieved December 11, 2020, from. <https://www.aquatechtrade.com/news/water-treatment/ganges-increased-biodiversity-after-covid-19-lockdown/>.
- Arendt, F., Matthes, J., 2016. Nature documentaries, connectedness to nature, and pro-environmental behavior. *Environ. Commun.* 10 (4), 453–472.
- Barkur, G., Vibha, Kamath, G.B., 2020. Sentiment analysis of nationwide lockdown due to COVID 19 outbreak: evidence from India. *Asi. J. Psych.* 51, 102089.
- Berman, M.G., Jonides, J., Kaplan, S., 2008. The cognitive benefits of interacting with nature. *Psychol. Sci.* 19 (12), 1207–1212.
- Capaldi, C.A., Dopko, R.L., Zelenski, J.M., 2014. The relationship between nature connectedness and happiness: a meta-analysis. *Front. Psychol.* 5 (8), 976.
- Cartwright, K., Mitten, D., 2017. Examining the influence of outdoor recreation, employment, and demographic variables on the human-nature relationship. *J. Sustain. Educ.* (January).
- Clayton, S., 2003. Environmental identity: a conceptual and an operational definition. In: *Identity and the Natural Environment: The Psychological Significance of Nature*, pp. 45–65. Retrieved from. <https://psycnet.apa.org/record/2004-14744-003>.
- Collado, S., Staats, H., Corraliza, J.A., Hartig, T., 2017. Restorative environments and health. In: *Handbook of Environmental Psychology and Quality of Life Research*. Springer, Cham, pp. 127–148.
- Connerton, P., de Assunção, J.V., de Miranda, R.M., Slovic, A.D., Pérez-Martínez, P.J., Ribeiro, H., 2020. Air quality during covid-19 in four megacities: lessons and challenges for public health. *Int. J. Environ. Res. Publ. Health* 17 (14), 1–24.
- Cruz, S.M., 2017. The relationships of political ideology and party affiliation with environmental concern: a meta-analysis. *J. Environ. Psychol.* 53, 81–91.
- De Beauvoir, S., 1989. *The second sex*. In: *Vintage Books, second ed.* Vintage Books, New York.
- Dean, J., Shanahan, D., Bush, R., Gaston, K., Lin, B., Barber, E., et al., 2018. Is nature relatedness associated with better mental and physical health? *Int. J. Environ. Res. Publ. Health* 15 (7), 1371.
- Di Fabio, A., Rosen, M., 2019. Accounting for individual differences in connectedness to nature: personality and gender differences. *Sustainability* 11 (6), 1693.
- Dolan, P., Peasgood, T., White, M., 2008. Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *J. Econ. Psychol.* 29 (1), 94–122.
- Dornhoff, M., Sothmann, J.-N., Fiebelkorn, F., Menzel, S., 2019. Nature relatedness and environmental concern of young people in Ecuador and Germany. *Front. Psychol.* 10 (3), 453.
- Félonneau, M.L., Becker, M., 2008. Pro-environmental attitudes and behavior: revealing perceived social desirability. *Rev. Int. Psychol. Soc.* 21 (4), 25–53.
- Ghosh, A., Nundy, S., Mallick, T.K., 2020. How India is dealing with COVID-19 pandemic. *Sens. Int.* 1 (7), 100021.
- Gifford, R., Nilsson, A., 2014. Personal and social factors that influence pro-environmental concern and behaviour: a review. *Int. J. Psychol.* 49 (3), 141–157.
- Graham, H., White, P.C.L., 2016. Social determinants and lifestyles: integrating environmental and public health perspectives. *Publ. Health* 141, 270–278.
- Haasova, S., Czellar, S., Rahmani, L., Morgan, N., 2020. Connectedness with nature and individual responses to a pandemic: an exploratory study. *Front. Psychol.* 11 (9), 1–15.
- Hartig, T., Mitchell, R., De Vries, S., Frumkin, H., 2014. Nature and health. *Annu. Rev. Publ. Health* 35 (1), 207–228. Annual Reviews Inc.
- Harvard Humanitarian Initiative, 2016. *KoBoToolbox | Data Collection Tools for Challenging Environments*. Harvard Humanitarian Initiative (HHI), Boston, MA, USA. Retrieved from. <https://www.kobotoolbox.org/>.
- Hayes, A., 2017. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. Guilford Press. Retrieved from. <https://books.google.com/books?hl=en&lr=&id=8ZM6DwAAQBAJ&oi=fnd&pg=PP1&ots=21C9oOYkYB&sig=BJYSafTzkyY4kLM0bWGHUXqEg>.
- Houlden, V., Weich, S., Porto de Albuquerque, J., Jarvis, S., Rees, K., 2018. The relationship between greenspace and the mental wellbeing of adults: a systematic review. *PLoS One* 13 (9), e0203000.

- Ibarra, F.F., Kardan, O., Hunter, M.R., Kotabe, H.P., Meyer, F.A.C., Berman, M.G., 2017. Image feature types and their predictions of aesthetic preference and naturalness. *Front. Psychol.* 8 (APR), 1–16.
- Jannah, M., Halim, L., Meerah, T.S.M., Fairuz, M., 2013. Impact of environmental education kit on students' environmental literacy. *Asian Soc. Sci.* 9 (12), 1–12.
- Jorgensen, A., Hitchmough, J., Calvert, T., 2002. Woodland spaces and edges: their impact on perception of safety and preference. *Landsc. Urban Plann.* 60 (3), 135–150.
- Kaplan, R., Kaplan, S., 1989. *The Experience of Nature: A Psychological Perspective*. Cambridge University Press, UK.
- Kellert, S.R., Wilson, E.O., 1993. *The Biophilia Hypothesis*. Island Press, Washington DC. Retrieved from. <https://catalogue.nla.gov.au/Record/36639/Cite>.
- Krejcie, R.V., Morgan, D.W., 1970. Determining sample size for research activities. *Educ. Psychol. Meas.* 30 (3), 607–610.
- Le Quéré, C., Jackson, R.B., Jones, M.W., Smith, A.J.P., Abernethy, S., Andrew, R.M., et al., 2020. Temporary reduction in daily global CO₂ emissions during the COVID-19 forced confinement. *Nat. Clim. Change* 10 (7), 647–653.
- Lovelock, B., Walters, T., Jellum, C., Thompson-Carr, A., 2016. The participation of children, adolescents, and young adults in nature-based recreation. *Leisure Sci.* 38 (5), 441–460.
- MacKerron, G., Mourato, S., 2013. Happiness is greater in natural environments. *Global Environ. Change* 23 (5), 992–1000.
- McCormick, R., 2000. Aboriginal traditions in the treatment of substance abuse. *Can. J. Counsell.* 34 (1), 25–32. Retrieved from. <https://psycnet.apa.org/record/2000-13956-003>.
- Milfont, T.L., Duckitt, J., 2004. The structure of environmental attitudes: a first- and second-order confirmatory factor analysis. *J. Environ. Psychol.* 24 (3), 289–303.
- Mitchell, R., Popham, F., 2008. Effect of exposure to natural environment on health inequalities: an observational population study. *Lancet* 372 (9650), 1655–1660.
- Nisbet, E.K., 2011. A Nature Relatedness Intervention to Promote Happiness and Environmental Concern. Carleton University.
- Nisbet, E.K., Shaw, D.W., Lachance, D.G., 2020. Connectedness with nearby nature and well-being. *Front. Sustain. Cities* 2 (18), 1–13.
- Nisbet, E.K., Zelenski, J.M., 2013. The NR-6: a new brief measure of nature relatedness. *Front. Psychol.* 4 (11), 1–11.
- Nisbet, E.K., Zelenski, J.M., Grandpierre, Z., 2019. Mindfulness in nature enhances connectedness and mood. *Ecopyschology* 11 (2), 81–91.
- Nisbet, E.K., Zelenski, J.M., Murphy, S.A., 2009. The nature relatedness scale. *Environ. Behav.* 41 (5), 715–740.
- Pinto, D.C., Nique, W.M., Añaña, E. da S., Herter, M.M., 2011. Green consumer values: how do personal values influence environmentally responsible water consumption? *Int. J. Consum. Stud.* 35 (2), 122–131.
- Pritchard, A., Richardson, M., Sheffield, D., McEwan, K., 2020. The relationship between nature connectedness and eudaimonic well-being: a meta-analysis. *J. Happiness Stud.* 21 (3), 1145–1167.
- Roach, C.M., 2003. *Mother/nature: Popular Culture and Environmental Ethics*. Indiana University Press. Retrieved from. https://www.google.co.in/books/edition/Mother_Nature/znCJ4C7hl=en&gbpv=1&pg=PP1&printsec=frontcover.
- Roth, M., von Collani, G., 2007. A head-to-head comparison of big-five types and traits in the prediction of social attitudes: further evidence for a five-cluster typology. *J. Indiv. Differ.* 28 (3), 138–149.
- Rousseau, S., Deschacht, N., 2020. Public awareness of nature and the environment during the COVID-19 crisis. *Environ. Resour. Econ.* 76 (4), 1149–1159.
- Roy, D., Tripathy, S., Kar, S.K., Sharma, N., Verma, S.K., Kaushal, V., 2020. Study of knowledge, attitude, anxiety & perceived mental healthcare need in Indian population during COVID-19 pandemic. *Asi. J. Psych.* 51 (4), 102083.
- Ryan, R.M., Deci, E.L., 2001. On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annu. Rev. Psychol.* 52 (1), 141–166.
- Ryff, C.D., Singer, B.H., 2008. Know thyself and become what you are: a eudaimonic approach to psychological well-being. *J. Happiness Stud.* 9 (1), 13–39.
- Schultz, P.W., 2002. Inclusion with nature: the psychology of human-nature relations. In: *Psychology of Sustainable Development*. Springer US, Boston, MA, pp. 61–78.
- Schwarzmueller-Erber, G., Stummer, H., Maier, M., Kundi, M., 2020. Nature relatedness of recreational horseback riders and its association with mood and wellbeing. *Int. J. Environ. Res. Publ. Health* 17 (11), 1–16.
- Seymour, V., 2016. The human-nature relationship and its impact on health: a critical review. *Front. Public Health* 4, 260.
- Sharma-Brymer, V., 2018. Locations of resistance and agency: the actionable space of Indian women's connection to the outdoors. In: *The Palgrave International Handbook of Women and Outdoor Learning*. Springer International Publishing, Cham, pp. 307–318.
- Shores, K.A., Scott, D., Floyd, M.F., 2007. Constraints to outdoor recreation: a multiple hierarchy stratification perspective. *Leisure Sci.* 29 (3), 227–246.
- Solar, O., Irwin, A., 2010. A conceptual framework for action on the social determinants of health. In: *World Health Organisation*, 28. WHO, Geneva.
- Stewart-Brown, S., Tennant, A., Tennant, R., Platt, S., Parkinson, J., Weich, S., 2009. Internal construct validity of the warwick-edinburgh mental well-being scale (WEMWBS): a rasch analysis using data from the scottish health education population survey. *Health Qual. Life Outcome* 7, 1–9.
- Thompson, C.W., Aspinall, P., Montarino, A., 2008. The childhood factor: adult visits to green places and the significance of childhood experience. *Environ. Behav.* 40 (1), 111–143.
- UN, 2018. *UN climate change annual report 2018*. In: *United Nations*. Retrieved from. <https://unfccc.int/sites/default/files/resource/UN-Climate-Change-Annual-Report-2018.pdf>.
- Watts, N., Adger, W.N., Agnolucci, P., Blackstock, J., Byass, P., Cai, W., et al., 2015. Health and climate change: policy responses to protect public health. *Lancet* 386 (10006), 1861–1914.
- Whitburn, J., Linklater, W., Abrahamse, W., 2020. Meta-analysis of human connection to nature and proenvironmental behavior. *Conserv. Biol.* 34 (1), 180–193.
- Wilson, E.O., 1984. *Biophilia*, first ed. Harvard University Press, Cambridge.
- World Health Organization, 2015. *Health in 2015: from MDGs, millennium development goals to SDGs, sustainable development goals*. In: *World Health Organisation*. Retrieved from. https://apps.who.int/iris/bitstream/handle/10665/200009/9789241565110_eng.pdf?sequence=1&isAllowed=y.
- World Health Organization, 2020. *Mental Health and Covid-19*. Retrieved December 11, 2020, from *World Health Organization website*. <https://www.who.int/teams/mental-health-and-substance-use/mental-health-and-covid-19>.
- Wuertz, T.R., 2015. *Personality Traits Associated with Environmental Concern*. Walden University.
- WWF International, 2020. *The loss of nature and rise of pandemics - protecting human and planetary health*. In: *Www.Panda.Org*. Retrieved from. https://wwfint.awsassets.panda.org/downloads/the_loss_of_nature_and_rise_of_pandemics_protecting_human_and_planetary_health.pdf.
- Yunus, A.P., Masago, Y., Hijioka, Y., 2020. COVID-19 and surface water quality: improved lake water quality during the lockdown. *Sci. Total Environ.* 731, 139012.
- Zhang, J.W., Howell, R.T., Iyer, R., 2014. Engagement with natural beauty moderates the positive relation between connectedness with nature and psychological well-being. *J. Environ. Psychol.* 38, 55–63.