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Research Article

Connectedness to Nature and Well-Being: A Survey among University Employees and Medical Students

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Abstract

Both connectedness to nature and spirituality have been linked to health and well-being. However, most of the empirical evidence for the association is based on studies from English speaking areas, in particular Anglo-America. Potential mechanisms are largely unexplored. This paper is aimed at investigating these relationships in a cross-sectional online survey. Participants were employees and students at the Medical University of Vienna, Austria. The online questionnaire asked for socio-demographics, connectedness to nature and well-being with two scales each and spirituality with a single item scale. Correlation analysis found small to moderate associations between connectedness to nature and well-being. Mediation analysis with spirituality as a mediator showed significant mediation. We discuss results with respect to public health and options for further research.

Keywords: Nature connectedness; Nature relatedness; Spirituality; Mediation analysis; Public health

Introduction

Connectedness to nature (CN) is linked to health, well-being (WB), and self-reported pro-environmental behaviors [1]. It can therefore be considered a potential resource for the field of public health to foster human and planetary health. CN can be defined as an individual's cognitive, emotional, and experiential connection with the natural environment. While it is described as a trait-like individual disposition, stable over time and contexts [2] it has state-like characteristics as well and can be modified, e.g. by contact to nature [3-7] or guided imagery [8]. Manifold concepts of human-nature connection emerged in different fields of research coming along with various tools for measurement [9,10]. High correlations between these measures suggest that they might overlap, pointing towards a common underlying construct [10,11].

There is a substantial body of research showing that contact to nature has beneficial effects on health and WB [12]. Among the potential pathways that convey these beneficial effects, CN has been investigated as a predictor of health and WB by itself [13] and as an intervening variable modifying the beneficial effect between different kinds of exposure to nature as well as health and WB [1,6]. For example, CN was found to predict positive affect, life satisfaction, happiness, positive body image, vitality, well-being [13–16], and healthy behaviors [17] such as healthy eating patterns [18]. It has been shown to moderate the association between contact to green spaces and WB [1] and also mediating the effect of time spent in a garden on eudemonic WB [19]. A meta-analysis investigating the association between CN and WB found that gender and age do not moderate the association [14]. But the magnitude of the association between CN and WB differs by what kind of WB is measured: Two strains of research can be distinguished with respect to WB, research on hedonic (HWB) and research eudemonic (EWB) WB [20]. HWB refers to the notion that pleasure constitutes WB and is evaluated by assessing subjective WB as described by Diener (2000), the latter

encompasses life satisfaction, positive mood and negative mood [21]. EWB is realized in terms of a full functioning person, e.g. through experiencing meaning in life and self-actualization, a concept, where the personal potential is fully met after fulfillment of basic bodily and ego needs [20]. In general research showed that the association between CN and EWB is stronger than to HWB [1,13,14,22]. While representing two distinct strains of research, researchers call for a holistic few of WB that incorporate both aspects to gain as complete understanding of WB of humans [23].

Spirituality is another form of feeling connected to something which is non-human and also a predictor of mental health and WB. It can be broadly defined as the subjective experience of sacredness [24], the search for and belief of connectedness to a transcendental power [25], a feeling of integration with all things [26] relevant to the construction of meaning. There is evidence that spirituality is related to health and WB [27-30], and health behaviors [31]. For example, spirituality can be protective against negative effects of frailty on older individuals [32], can improve short-term emotional response to stressors [33], and can help to cope with life-threatening situations like cancer diagnosis [34]. Kamitsis and Francis [35] found that spirituality mediated the association of CN and psychological WB, the latter encompassing aspects of positive and negative feelings, psychological functioning and aspects of psychological health [36]. These findings were supported by another study conducted in Australia, also identifying spirituality as a mediator. Notably, both studies used the same operationalization for spirituality and CN, but assessed different aspects of WB as an outcome [37].

Nowadays, the link of nature to health and well-being is well-established and a vast amount of research has been published in the last decades. However, very little is known of how the current academic interest in elucidating the underlying mechanisms in the physiological and psychological pathways is reflected in actual perceptions of the Austrian population, also studies investigating this association in Europe are rare compared to the evidence from Anglo-American-countries. Therefore, we conducted a cross-sectional online study among employees and students at the Medical University Vienna, Austria, collecting self-reported data on CN, WB, and spirituality. The current study investigates the relationship between CN and WB by using two different operationalizations of CN and two comprehensive measures of WB encompassing eudemonic and hedonic aspects of WB. Additionally. We investigate the role of spirituality as a potential mediator of the relationship between CN and well-being.

Materials and Methods

Study Design

We conducted a cross-sectional study, surveying a nonrandom purposive sample of German-speaking employees and students directly associated with the Medical University Vienna, Austria, at the publicly funded university, and its teaching hospital, i.e., the General Hospital of Vienna. The study was approved by the institutional ethics committee on 18 January 2019 and by the Data Protection Committee of the Medical University Vienna on 5 April 2019. We conducted this study according to the principles of the Declaration of Helsinki and the General Data Protection Regulation. Further details of the study are outlined in a previously published article [38].

All employees and enrolled students at the university were approached via their organizational email sent out by the internal system Medcampus. The potential participants were granted single access to the survey and received an automatized reminder notification two weeks after initial contact. All responses were self-reported and anonymous. We did not offer incentives for participation. Participants gave their informed consent to voluntarily participate in the survey.

Measures

The survey consisted of a general section assessing demographic data on the professional group (employee, student, both), gender (male, female, diverse), age (ten age groups from <20 to 60+ years of age), and seniority level, i.e., year in profession (for employees) or years of studies (for students). In a further section, we assessed CN using the single item-scale, i.e. CN-SI, already used in earlier studies [13, 17,39]. Participants rated their CN on a 11-point-response format. As an additional measure, a short version of the Nature Relatedness Scale (NR-6) [40] was used that encompasses dimensions of "self" and "experience" of the NR construct. However, the scale encompasses one item on spirituality, therefore we excluded this item. Cronbach's alpha of the five-item-scale was .813.

Well-being was assessed using two questionnaires. First, the Brief Inventory of Thriving (BIT, alpha = .851) [23,41] which is a short version of the Comprehensive Inventory of Thriving (CIT), encompassing aspects of EWB as well as HWB. While the one-dimensionality of the BIT was supported by earlier validation studies, one item assessing community-related aspects of WB showed low correlations (r<.30) with other items of the scale in the validation study in the current study as well. We decided to keep it as the impact on internal consistency was marginal (-.014) and consistent with earlier validation studies in a German speaking sample finding the neighborhood/community related aspects of belonging might not be as important for WB in the German speaking are as in northern America [23]. A five-point response format ranging from "not at all" to "strong" agreement with the statements was used, with higher values representing better WB.

Subsequently, we applied the Quality of Life – Linear Analog Scale Assessment (QOL-LASA, alpha = .850) [42].

This scale was designed to assess a broad definition of WB in an economic way e.g., in cancer care where long questions would decrease completion rate. It encompasses four domains of QOL, namely physical, emotional, spiritual, and intellectual WB. In addition, one item asks for a summative rating of the overall WB during the last week. The QOL-LASA does not explicitly address aspects of EWB and HWB based on a theoretical framework, but examination of the items shows that both aspects are present. A 5-point response format was used ranging from "bad" to very good", higher scores indicating better WB.

Spirituality was assessed using a single item. Participants responded to the statement "I am a spiritual person" on a 5-point response-format ranging from "strongly disagree" to "strongly agree".

Study Sample

In total, 1253 participants responded. Six datasets were excluded from further analysis, as they only consisted system data, resulting in a total sample of n=1247. Three participants identified themselves as diverse, because of the low number we excluded these responses from statistical analysis but used the datasets for all computations not concerning gender. Characteristics of the sample are shown in Table 1.

Variables				CN		NR		Spirituality		BIT		General WB	
		n	%[a]	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age (years)	<20	26	2.1	7.23	2.18	3.32	0.81	2.42	1.21	3.89	0.83	3.69	0.97
	20-24	350	28.1	7.75	1.70	3.55	0.73	2.53	1.16	4.06	0.53	3.63	0.96
	25-29	240	19.3	7.71	1.81	3.57	0.73	2.25	1.22	3.88	0.57	3.66	0.89
	30-34	134	10.8	7.82	1.56	3.57	0.69	2.22	1.17	3.83	0.57	3.67	0.98
	35-39	121	9.7	7.85	1.74	3.46	0.70	2.69	1.15	3.95	0.53	3.66	0.89
	40-44	68	5.5	8.46	1.38	3.75	0.68	2.43	1.25	3.92	0.59	3.66	0.90
	45-49	106	8.5	8.27	1.65	3.83	0.66	2.59	1.23	3.83	0.56	3.67	0.92
	50-54	81	6.5	8.74	1.40	3.89	0.74	2.94	1.13	3.99	0.43	3.69	0.89
	55-59	75	6.0	8.73	1.40	3.88	0.70	3.00	1.36	3.92	0.48	3.86	0.78
	60+	45	3.6	8.19	1.75	3.92	0.62	3.09	1.43	3.73	0.48	3.73	0.81
Gender	Female	748	60.2	8.17	1.54	3.69	0.71	2.63	1.21	3.94	0.55	3.64	0.94
	Male	491	39.5	7.66	1.89	3.53	0.74	2.38	1.24	3.92	0.55	3.71	0.88
	Divers	3	0.2	9.00	1.00	4.33	0.23	1.33	0.58	3.63	1.16	3.67	1.53
Main Residence	Rural	298	24.2	8.32	1.59	3.74	0.70	2.64	1.15	4.01	0.57	3.72	0.93
	Urban	935	75.8	7.85	1.73	3.60	0.73	2.49	1.25	3.91	0.55	3.66	0.91
Occupation	Student	505	40.6	7.79	1.76	3.57	0.72	2.46	1.21	4.02	0.56	3.64	0.98
	Employee	587	47.2	8.21	1.61	3.70	0.72	2.66	1.26	3.87	0.53	3.71	0.87
	Both	152	12.2	7.63	1.74	3.54	0.74	2.26	1.12	3.89	0.58	3.63	0.86
Total				7.97	1.71	3.52	0.76	2.53	1.23	3.93	0.55	3.67	0.91

[a]Percentages represent proportions of valid responses. CN, Connectedness to Nature, NR: Nature Relatedness, BIT: Brief Inventory of Thriving, WB: Well-being

Table 1: Descriptive statistics of the study sample (n=1247).

Statistical Analysis

SPSS Version 26 (IBM Corp., 2019) was used for all analysis. For mediation analysis Hays PROCESS (V4) [43] tool was used as an extension of SPSS. We conducted missing data analysis on item level. Overall, 1.3 % of the data were missing. No variable showed more than 1.6 % of missing values. Cronbach's alpha was used to compute internal consistency.

Results

Sample characteristics (Table 1) and zero order correlations (Table 2) showed that females and participants who lived in rural areas reported higher CN than males and urban dwellers, respectively, older participants reported higher CN.

Association of WB and CN

Zero order-correlations showed low to medium correlations between the WB and CN indicators (Table 2). The point estimates of the correlation between the BIT and the CN are higher than the association with NR. The average WB during the last week showed negligible to small correlations with NR and CN, with spiritual WB being the strongest with respect to both CN measures. Association between the WB and CN measures remains stable after controlling for age, sex, and main residence. BIT and the QOL-LASA showed small to moderate correlations indicating that they assess overlapping, yet different aspects of WB.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Age	-											
2. Gender[a]	-.008	-										
3. Main Residence[b]	.074**	.014	-									
4. CN	.191**	-.146**	-.116**	-	.669**	.273**	.154**	.124**	.192**	.093**	.154**	.207**
5. NR	.183**	-.104**	-.085**	.688**	-	.366**	.084**	.073**	.170**	.107**	.101**	.171**
6. Spirituality	.147**	-.099**	-.052	.299**	.387**	-	-.016	-.030	.350**	.025	0.013	.140**
7. LASA Physical	.021	.055	-.039	.142**	.085**	-.008	-	.545**	.300**	.366**	.715**	.420**
8. LASA Emotional	.140**	.089**	.006	.123**	.083**	-.012	.550**	-	.403**	.401**	.735**	.452**
9. LASA Spiritual	.080**	.047	.006	.188**	.177**	.350**	.299**	.407**	-	.346**	.417**	.380**
10. LASA Intellectual	.056	.057*	.005	.086**	.109**	.029	.376**	.412**	.356**	-	.547**	.414**
11. LASA General	.042	.035	-.026	.143**	.105**	.026	.717**	.732**	.407**	.546**	-	.536**
12. BIT	-.085**	-.019	-.078**	.192**	.161**	.131**	.419**	.435**	.374**	.405**	.527**	-

* p<0.5, **p<0.01, [a]coded as male=1 female= 0, [b]coded as rural=0 urban=1, lower triangle zero order correlations, upper triangle partial correlations controlling for age, sex, and main residence. CN, Connectedness to Nature, NR: Nature Relatedness, BIT: Brief Inventory of Thriving, LASA: Linear Analog Scale Assessment

Table 2: Pearson correlations of socio-demographics, Connectedness to Nature (CN), Spirituality, and Well-being (WB).

Spirituality as a potential mediator

All three variables in the model (CN, Spirituality, and WB) were significantly correlated. The associations between spirituality and the QOL-LASA were non-significant with exception of spiritual WB. We thus conducted mediation analysis only for the BIT. Statistical significance of an indirect effect was based on 95% percentile bootstrap confidence intervals (5000 bootstrapped resamples). If lower and upper limits of the confidence intervals do not include zero, this indicates a significant test of mediation. The test of mediation of the association between CN and WB by spirituality was significant (Table 3).

Predictor	Direct Effect on Mediator				
	Estimate	**SE**	**Lower**	**Upper**	**R^2**
CN	0.372	0.1829	0.2882	0.4558	0.0578
NR	0.0917	0.0213	0.052	0.1421	0.1491
	Indirect Effect				
	Estimate	**SE**	**Lower**	**Upper**	
CN	0.0152	0.0057	0.0045	0.0272	
NR	0.023	0.0125	0.0077	0.0559	
	Direct Effect				
	Estimate	**SE**	**Lower**	**Upper**	
CN	0.1169	0.0199	0.0779	0.1559	
NR	0.0971	0.023	0.052	0.1421	
	Total Effect				
	Estimate	**SE**	**Lower**	**Upper**	
CN	0.1321	0.0194	0.0941	0.1701	0.0362
NR	0.121	0.0213	0.0793	0.1627	0.0255

CN: Connectedness to nature, NR: Nature Relatedness, Lower: Lower level 95% CI, Upper = Upper level 95% CI

Table 3: Direct, indirect and total effects of the mediation analysis with spirituality as a mediator and Brief Inventory of Thriving (BIT) as outcome.

Discussion

This cross-sectional study aimed at investigating the relationship between CN and WB as well as the role of spirituality as a potential mediator for the relationship between CN and WB. In popular media [44] as well as in research [45,46] a disconnect from nature is often proclaimed. Soga and Gaston [46] describe a disaffection spiral in which reduced contact to nature leads to lower health related benefits and environmentally friendly behavior via a loss of emotional affinity towards nature. This in turn accelerates further loss of contact with nature and CN. They call for interventions to prevent the loss of these resources for fostering both human and planetary health. To develop and evaluate these interventions a clear understanding of how CN emerges and relates to the desired outcomes is needed [47]. Our study shows that CN is related to WB using instruments that encompass a broad definition of WB suited to assess WB of a person in a holistic way combining aspects of different strains of WB-research. Spirituality was positively tested as an intervening variable explaining the positive association between CN and WB.

With respect to the association between WB and CN, we found small positive correlations. Our results thus mirrored findings of earlier studies operationalizing CN as Nature Relatedness (NR) [39,40] and connectedness to nature (CN-SI) [39]. In line with prior findings, the correlations remained stable after controlling for age and sex [14,48], additionally controlling for area of residence did not change the associations substantially. While WB measures and CN measures were consistently correlated – differences in magnitude of this relationship have already been described in meta-analysis [13,14]. For example, research on CN and WB revealed different size of

association depending on domains of WB instruments. In general, yielding stronger effect sizes for EWB in general and the facet of personal growth [40,48] in particular. In our study, we used an instrument covering both hedonic and eudemonic aspects of WB. Accordingly, the association found in our study lies somewhere between the effect sizes found for HWB und EWB. In general, CN as measured by the CN-SI yielded higher correlations with WB, except for spiritual WB. We look at two possible explanations. First, the CN-SI is a self-rating of one's own connectedness, not including more proximal indicators like (self-rated) behavior and the importance of this connection for oneself like the NR-6 does [40]. We suggest that the CN-SI might assess a broader construct covering aspects more closely related to WB. Second, however, this might increase susceptibility to concerns such as the tendency to respond affirmatively without careful consideration.

Our results support earlier findings [35,37] regarding spirituality as a mediator for the relationship of CN and WB. Prior studies on spirituality as a mediator of the association of CN and WB were conducted exclusively in English speaking populations in Australia [35,37]. Our study adds empirical evidence on a German speaking central European population. The result suggests that in the context of nature assisted interventions such as Green Care interventions not only increases and fostering of CN but spiritual experiences should be considered as a mechanism of improving health and WB. Further studies should aim to isolate the specific components shared between spiritual experiences and CN to sort out which are specific to one or the other in order to provide more specific guidance on program development. One of these could be the experience of awe [49], which it is part of both experiencing CN and spirituality.

As a limitation, our study is cross-sectional and does not allow for causal interpretation. We argue for quasi-experimental designs to unravel the mechanism at work, as aspects of CN and spirituality might not lend themselves to experimental designs. The study-sample is not representative for the population with respect to age, and education, it consisted mainly of young, highly educated urban dwellers. This specific segment of society might benefit differently from CN and spirituality compared to others. Cross-cultural comparability of the results of this study might be hampered by cultural differences. For example, in a validation study for the BIT in a German speaking population, the authors noted that the aspect of (neighborhood-related) community might not be as important for WB as in northern American culture [40]. Our findings add to this, as we also found that the item of the BIT assessing neighborhood/community aspects of WB shows low correlation to the other items of the scale. We argue that this could also be due to the composition of the samples of the validation study and ours, both consisted of participants younger and higher educated than the national average and in the current study the sample was dominated by participants who live (and work) in an urban environment.

To the best of our knowledge, this is the first study to investigate the relationship between CN and WB using the BIT as a comprehensive measure encompassing eudemonic and hedonic aspects of WB and one of the few investigating the relationship in a German-speaking country [14,48]. The results add to the notion that CN is a valuable resource for human health and WB.

Conclusions

This study explored the intricate relationship between Connectedness to Nature (CN) and Well-Being (WB) within the context of a German-speaking country, specifically Austria. Our findings contribute valuable insights to the growing body of literature on the subject. The results underscore the significance of CN as a pivotal resource for human health and well-being. This study not only reaffirms the global relevance of the CN-WB connection but also provides unique contributions by shedding light on this dynamic in a German-speaking cultural context. The positive association between CN and WB highlights the potential for leveraging connectedness to nature as a promising avenue for health promotion. Importantly, our study emphasizes the accessibility of enhancing CN, positing it as a "low-hanging fruit" for health promotion efforts.

The versatility of interventions, from immersive Wilderness programs for children and youth to simple yet effective nature walks, opens avenues for diverse strategies. Moreover, our findings suggest that even modest measures, such as creating opportunities for individuals to engage with nature, can yield tangible benefits for well-being. In light of these insights, we advocate for the integration of nature-centric interventions into health promotion initiatives. By recognizing and harnessing the inherent connection between individuals and the natural environment, we can cultivate a positive impact on well-being. As we move forward, further research and the implementation of evidence-based interventions can help unlock the full potential of connectedness to nature as a catalyst for holistic health and well-being.

Disclosure

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Author Contributions

Conceptualization, M.S., R.C., and D.H.; methodology, M.S.; validation, M.S., D.H. and R.C.; formal analysis, M.S.; investigation, M.S., R.C., D.H.; resources, D.H.; data curation,

M.S., D.H.; writing—original draft preparation, M.S., R.C., D.H.; writing—review and editing, M.S., D.H., R.C.; supervision, D.H., R.C.; project administration, D.H. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the institutional Review Board (0118/2019) and by the Data Protection Committee of the Medical University Vienna (0505/2019).

Data Availability Statement

Data supporting the study results can be provided followed by request sent to the corresponding author's e-mail daniela.haluza@meduniwien.ac.at.

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