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Striving with Global Stress on a Local Level: Has the COVID-19 Pandemic Changed the Relationship between People and Nature?

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Abstract: The COVID-19 pandemic had harsh consequences on human health and society across the globe. In addition to health effects, the pandemic also influenced people's values, concerns, and ethics due to lockdowns and general limitations in societal activities. In this study, we examined changes in the relationship between people and nature caused by COVID-associated stress, as well as its consequences on life quality, by comparing questionnaire-based survey data before and during the pandemic. We found that the pandemic had positive effects on individual respondents' relationships with nature. Respondents who were more affected by the pandemic rated their life quality lower than those who were less affected. In accordance, the pandemic had a negative effect on people's life quality, especially for people living in areas where the environment (coastal water quality) was in poor condition. Our results support the prediction that environmental quality may buffer against global stress and improve societal wellbeing.

Keywords: human–nature relationships; wellbeing; eutrophication; COVID-19

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1. Introduction

In the winter of 2020, the whole world faced enormous challenges caused by the COVID-19 virus. The fast-spreading virus and accompanying consequences became a global event, and the World Health Organization defined the situation as a global pandemic [1]. Undoubtedly, the biggest effect of the pandemic has been on human health worldwide [2–5], as it is considered one of the largest pandemics in world history by death toll [6–8]. However, it has also had a strong impact on almost all spheres of people's lives in every part of our planet [9–13]. For example, the pandemic and the following quarantines and restrictions have caused economic difficulties comparable to economic crisis conditions [14,15]. At the same time, scholars around the world have signaled changes happening in societies and human behavior. Bavel and his colleagues [16] highlighted significant shifts in mental health, as well as social and moral norms, as a consequence of the pandemic. The anxiety and fear related to the pandemic changed travel behavior [17,18] and increased the vulnerability of the less protected social groups [19]. The impact worsened due to the significantly complicated access to the elective surgery and healthcare system [20,21]. The level of stress caused by the pandemic effects drastically decreased the overall psychological wellbeing of the general public [22,23].

For humans, nature is the resource that upholds life. However, the aesthetic values of the environment have always been crucial, as it has played a significant role for peo-

ple's culture and has often been the main motivator for self-development through understanding processes in nature. Currently, the role of nature and access to it are important for people's health [24,25]. There are various benefits associated with accessibility to nature, such as faster recovery after surgery [26], reduced blood pressure [27], improvement with congestive heart failure [28], palliative effect on breathing diseases and allergies [29–31], reduced obesity [32], and enhanced immune system functioning [33]. Villeneuve and his colleagues [34] even discovered that access to green space in urban areas can decrease the mortality rate. On top of that, nature also has a positive effect on mental health [35–38]. For these reasons, we can expect that the surrounding environment is directly associated with life quality of people, as recent studies suggest [39].

Numerous recent studies have indicated a significant growth in interest toward nature during the COVID-19 pandemic. Morse and colleagues [40] reported about the increase in the activities related to the individual relationships with nature such as foraging, gardening, hiking, jogging, photography, relaxing alone, walking, and watching wildlife. Contrary, group activities such as camping decreased. Similarly, access to greenspaces had positive mitigating effects of the pandemic impacts on mental health [41]. Bringing greenspaces indoor (e.g., plants) and urban gardening drastically increased and became more important during the pandemic restrictions [42,43]. The restrictions led to constrained outdoor activities, making people long for the option to be out in nature. Analyzing behavioral changes due to restrictions may, therefore, illuminate the role of the environment for wellbeing. Under such circumstances, the opportunity to experience local nature might become increasingly important. Accordingly, living in a neighborhood with poor environmental quality might affect mental health negatively and increase the pandemic impacts and life quality on a personal level.

Another aspect of the impact of the pandemic on people's relationship with nature is related to the theory that pandemics such as COVID-19 are causally associated with the way humans treat nature, particularly wildlife trade [44]. A range of researchers found support for this association between human treatment of natural resources and pandemics already well before the emergence of COVID-19 [45–48]. More recently, Dobson and colleagues [49] indicated the importance of changing the global strategy in preventing future pandemics, where changes in the way how people treat nature (e.g., boosting nature protection measures) are at the core. It is, therefore, predicted, but yet scientifically unexplored, that there is a connection between the public level of concern about the environment and the opinions about the origin of the pandemic. Hence, the effects of COVID-19 on people are expected to affect people's relationship with nature by increasing people's concerns about its emergence. In order to understand how the public perceives the pandemic more generally, it is important to assess the extent to which they attribute it to the way people are (mis)treating the environment.

In this paper, we aimed to investigate if the pandemic has caused changes in the people–nature relationship and environmental concern on an individual level and if such a change is associated with a change in life quality. We hypothesize that the pandemic caused changes in the people–nature relationship both on a personal level and on a general level (opinions about others' people–nature relationship (1), and that the direction of these changes is related to the personal pandemic impact (2). We further hypothesize that respondents who were directly affected by the pandemic have stronger opinions about the statement that the pandemic was caused by the way people treat nature (3). Lastly, we predict a negative association between respondents' personal impact of the pandemic and their assessment of life quality (4) and a negative overall impact of the pandemic on life quality in the community, especially in environments that are in a poor state (5).

2. Methods

Our research was conducted in the coastal municipality of Raseborg located in the southwest of Finland in Uusimaa province (Figure 1). Raseborg has a population of almost

28,000 inhabitants. This increases significantly in the summer due to the presence of summer houseowners (up to 50%) who mostly arrive from the capital region. The municipality consists of a number of villages and three major administrative centers: Ekenäs, Karis, and Pojo. The municipality of Raseborg is situated in the same province as the capital Helsinki, where the situation with the pandemic has been worse than in other parts of Finland. The COVID-19 restrictions were administered on a province level, which means that Raseborg has continuously had the same COVID-related restrictions as the Helsinki–Espoo–Vantaa metropolis with more than 1,000,000 inhabitants.

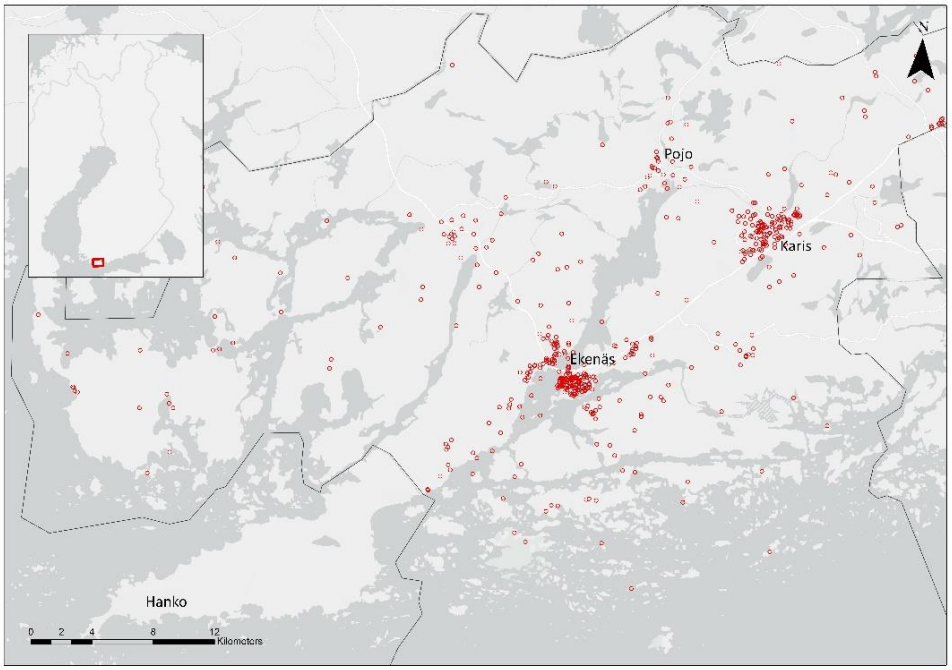


Figure 1. A map of the study area with georeferenced locations of survey respondents (red dots) and administrative municipality border (dashed line).

In May–July 2021, we conducted a survey, which was available in three languages: the official languages Swedish and Finnish, as well as in English. The questionnaire had 21 questions related to the effects of the pandemic on a personal level: (1) how the pandemic affected the respondent's own relationship with nature, (2) how the pandemic affected people–nature relationships in general, (3) the respondent's thoughts whether human exploitation of nature caused the pandemic, (4) an evaluation of the importance of natural benefits for the respondent, and (5) each respondent's life satisfaction assessment. The question about life satisfaction is assumed to reflect the personal evaluation of life quality [50]. The answers were given on a scale ranging between 0 and 10, where 0 means not affected/no relationship between nature treatment and pandemic, and 10 means strongly affected/significant relationship for the group of questions where people evaluated how they have been personally affected by the pandemic and to what extent they believe that the pandemic has been caused by the impact people have on nature. Respondents gave an assessment to predefined statements for the group of questions related to the changes in perceptions of people–nature relationship, their concern about the environment, their relationship with nature, their consumer behavior concerning environmentally friendly products, and changes in their time spent in nature (see Supplementary S1 for full questionnaire). Answers to questions 15.1–15.4 (Supplementary S1) were grouped to create a single variable reflecting changes in people–nature relationships on a personal level. In addition to questions about COVID-19 and life quality (hereafter LQ), the respondents were asked to assess the water quality (sWQ) of the coastal water in the vicinity of their address (local water quality; see Figure 1; see also Figure S2) as a representative

local environmental indicator due to the importance of the ecosystem services provided by sea for coastal communities [51,52]. We also collected sociodemographic parameters of the respondents: age, gender, education, health, and income situation as covariates in the assessment of LQ [39]. All answers in the survey were related to the specific local areas in the municipality that were associated with the proximity of the homes of the respondents.

The invitation to the online questionnaire was delivered to accessible postboxes around Raseborg. The advertisement of the survey was posted on Facebook and ran as a paid advertisement during the whole data collection period aimed at reaching people from the municipality who are 16 years and older. To increase response motivation, participants could voluntarily enter a lottery for three 50 EUR gift cards to a local supermarket. After excluding responses, which came from outside the municipality, 614 complete responses were available for the analysis. In order to improve demographic representativeness, the responses were corrected for age and gender by applying a post-survey weight based on the population age structure in Raseborg [53] using the following formula:

$$\omega_i = \frac{NK_i}{n_i},$$

where N is the number of respondents, K_i is desired distribution in the age group, and n_i is the number of respondents from the following age–gender group. In this way, we corrected the data and made them representative of the population structure.

Additionally, for the comparative analysis of changes in LQ, we used data collected in a similar survey in 2018–2019 before the pandemic. Similarly to the 2021 questionnaire this dataset consists of evaluation of life satisfaction given on a 0–10 scale, sWQ, and sociodemographic parameters of respondents: age, gender, education, health, and income situation (Supplementary S1; see also [39] for details on LQ assessment). Each response was georeferenced to the corresponding watershed, and the watershed ID was used as a random effect in the model to account for the geographical clustering and nonindependence of close data points.

For the statistical analyses, we then used Spearman and Pearson correlation methods and a linear mixed model with normal errors. First, we correlated the relationship between the personal pandemic effect and perception of the statement that the pandemic was caused by the impact people have on nature. Second, we tested the association between changes in the personal people–nature relationship and the personal effect of the pandemic. Third, we examined the relationship between the pandemic impacts on personal level and the opinion about changes in other people's relationship with nature. For these three tests, we used the nonparametric Spearman rank correlation method due to the nature of the data (ordinal). Next, we used Pearson correlation to test the relationship between LQ and the personal impact of the pandemic. Lastly, we used a linear model with normal errors to test whether LQ of people is changed during the pandemic in comparison to pre-pandemic times (data collected in 2018–2019), the full research workflow is presented in Figure 2. We followed the approach outlined in a previous study [39] where we added covariates collected in the survey which are important predictors of LQ: age, gender, income, health, education, natural benefits importance, and a factorial variable that indicated the COVID-19 pandemic effect (response collected before (0) or during (1) the pandemic).

All models were run in R statistical software v.3.6.1 [54].

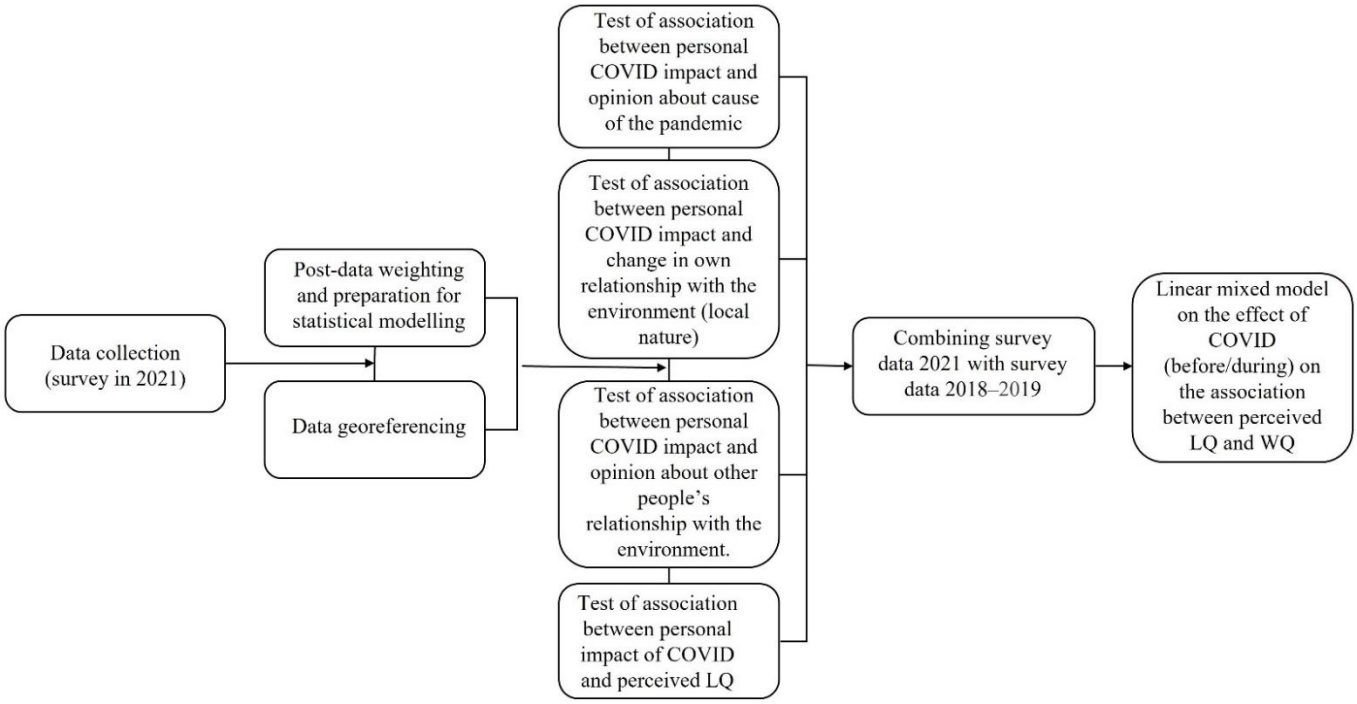
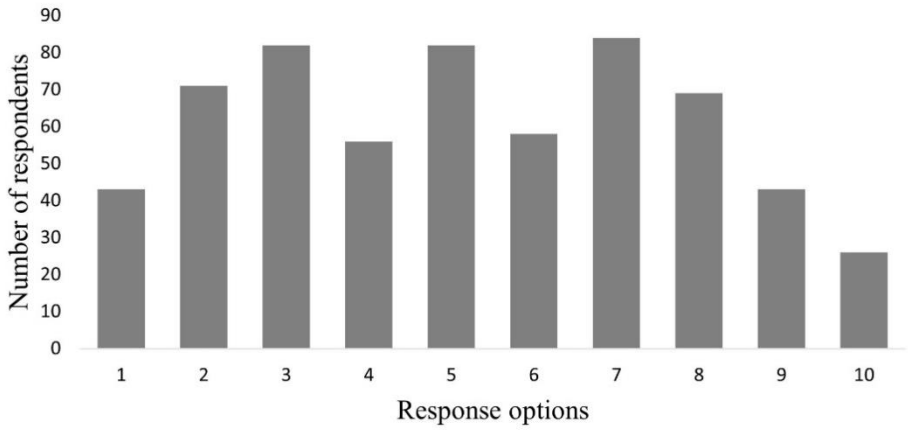


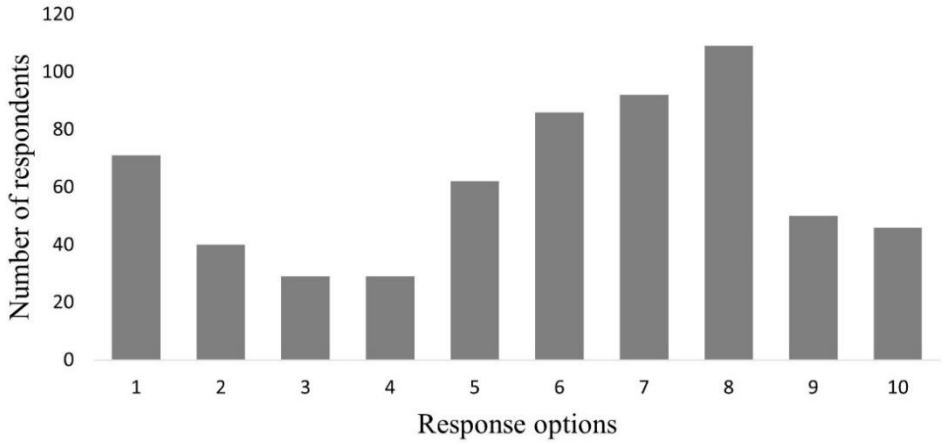
Figure 2. The research workflow of the study.

3. **Results**

We first tested the association regarding the personal COVID-19 impact on people's opinions about whether the pandemic was caused by the way how people treat nature. There was large variation in responses to these questions, and they were well distributed across the range without any prevailing response option (Figure 3a,b). We found a positive relationship between these variables ($r_{Spearman} = 0.17$, $p < 0.001$; Figure 4a).

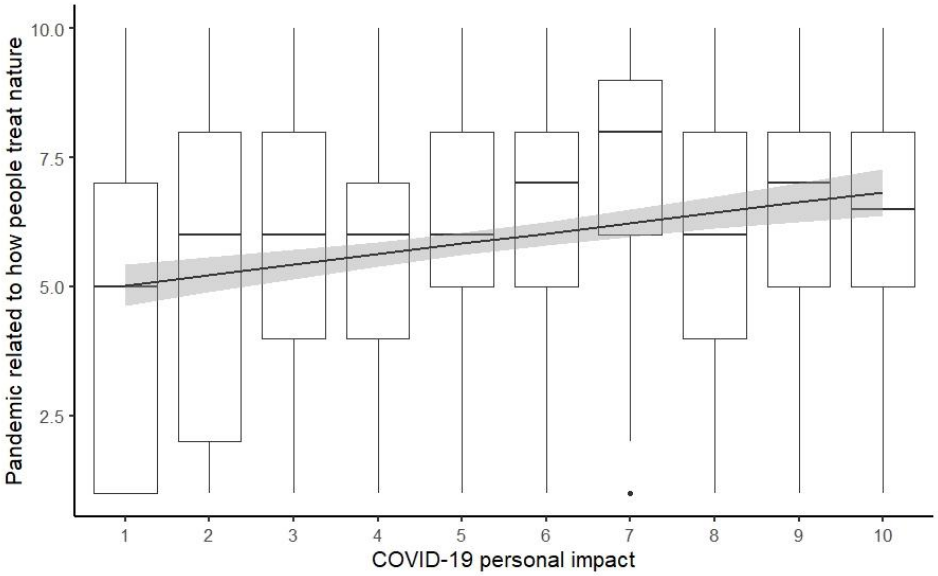


(**a**)



(**b**)

Figure 3. Histograms showing the response distribution for the questions about the personal impact of pandemic. (**a**) "How much you have been personally affected by the COVID-19 pandemic on a scale from 0 to 10?" The mean value was 5.2 ± 2.6 (SD). (**b**) "To what extent would you say that the pandemic has been caused by the impact people have on the nature?" The mean value was 5.9 ± 2.7 (SD).



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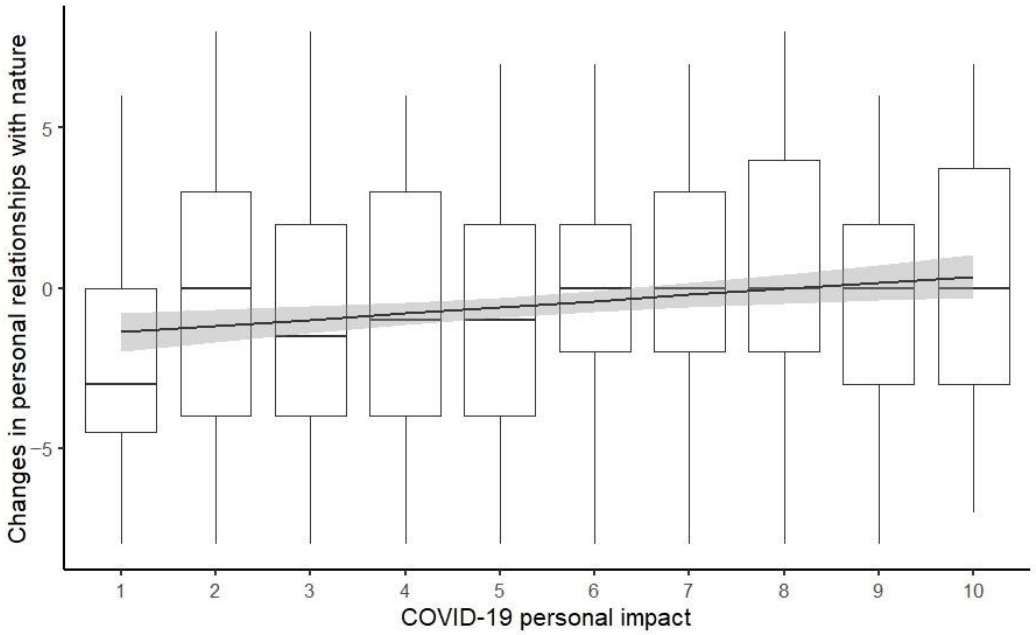

(**b**)

Figure 4. The effect of the pandemic on personal level. (**a**) The relationship between the personal impact of the pandemic and the perception of whether the pandemic was caused by the way people treat nature. (b) The relationship between the personal impact of pandemic and changes in people–nature relationship on personal level. The trendline represents regression line with associated 95% confidence intervals, the squares representing the first and third quartile (the 25th and 75th percentiles) and dots located out of the squares representing outliers in the data.

There was a positive association between the respondents' personal effect of the pandemic and changes in their relationship with nature on a personal level ($r_{Spearman} = 0.12$, $p < 0.01$; Figure 4b).

On the contrary, there was no association between the personal effect of pandemic and the perception of changes in the relationship between people and nature on a general societal level ($r_{Spearman} = 0.003$, $p = 0.95$). Across the entire sample, however, respondents typically thought that people started to care a little more about the environment during the pandemic (Figure 5).

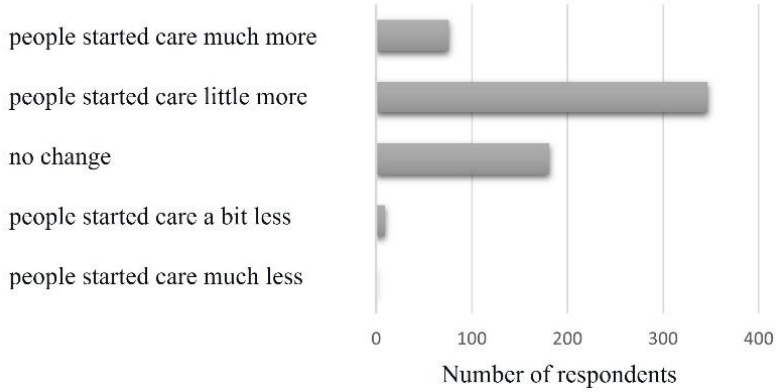

Figure 5. Response distribution for the question about the people–nature relationship ("Do you think the relationship between people and the nature has been affected by the pandemic?").

We found a negative association between the respondents' perception of personal level pandemic impact and their perception of their LQ ($r_{Spearman} = -0.13$, $p < 0.01$; Figure 6).

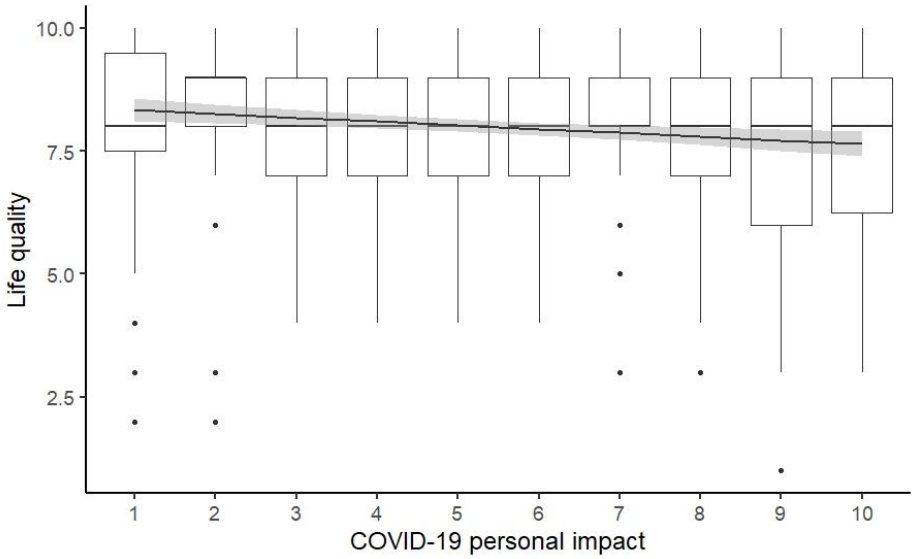

Figure 6. The relationship between the personal impact of the pandemic and perceived life quality. The trendline represents regression line with associated 95% confidence intervals, the squares representing the first and third quartile (the 25th and 75th percentiles) and dots located out of the squares representing outliers in the data.

Using a linear model approach, we found that the relationship between LQ and the environmental indicator was changed during the COVID-19 pandemic. There was a significant negative association between people's LQ and the pandemic effect; respondents from the pandemic period survey evaluated their LQ lower (see "pandemic effect" in Table 1; see also Figure 7). However, this effect was conditional on the perceived local coastal water quality. It was revealed by a significant interaction between the pandemic effect and sWQ (see "pandemic effect by sWQ" in Table 1). It reflects that people living in localities with poorer water quality perceived their LQ lower during the pandemic, whereas the pandemic did not affect LQ among people living in localities with higher water quality (Table 1, Figure 7). Among the sociodemographic parameters, health and age were positively associated with LQ, whereas males (in comparison to females) and people with lower income had lower LQ (Table 1). Education had no effect on LQ, whereas people perceiving natural benefits as more important had a higher LQ (Table 1)

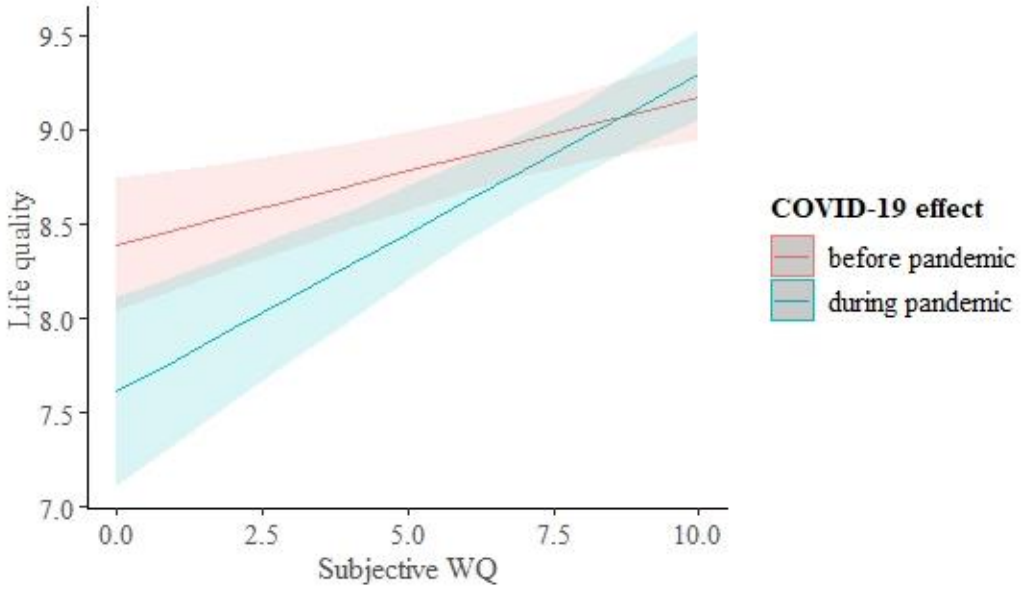

Figure 7. The interactive effect of the pandemic and perceived coastal water quality on LQ (see Table 1 for statistics). The values of LQ and subjective water quality are weighted according to the population structure. The graph shows regression lines with 95% confidence intervals.

Table 1. Linear model of the relationship between LQ and period of data collection (pre-pandemic and pandemic). In the model, the level of education is represented by two groups (1—lower education level, 2—higher education level), the level of health is represented by three groups (1—higher health level, 2—intermediate health level, 3—lower health level), the income level is represented by four groups (1—living comfortably on present income, 2—coping on present income, 3—difficult on present income, 4—very difficult on present income), and the gender is represented by two groups (1—females, 2—males), where the first level is always the reference level and not shown in the table. R^2 marginal = 0.37 and R^2 conditional = 0.38; the significance of each estimate (*t*-test) is presented as *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, and (*) $p < 0.1$; *p*-values < 0.05 are presented in bold.

Dependent Variable	Independent Variables	Estimate ± SE	DF	F	*p*
Life quality	Intercept	**5.33 ± 0.27 *** **			
	Pandemic effect	**−0.78 ± 0.28 ****	1	7.72	**0.006**
	Water quality perception	**0.08 ± 0.02 *** **	1	41.79	**<0.001**
	Pandemic effect by sWQ	**0.09 ± 0.04 ***	1	5.75	**0.017**
	Age	**0.02 ± 0.01 *** **	1	100.40	**<0.001**
	Gender	**Male—0.15 ± 0.07 ***	1	4.73	**0.03**
	Natural benefits importance	**0.23 ± 0.02 *** **	1	107.16	**<0.001**
	Income	**Coping −0.35 ± 0.08 ***; Difficult −0.90 ± 0.11 ***; Very difficult −1.50 ± 0.70 *** **	4	32.35	**<0.001**
	Health	**Intermediate −0.59 ± 0.08 *** Lower −1.94 ± 0.15 *** **	2	90.19	**<0.001**
	Education: higher education level	0.07 ± 0.07	1	0.77	0.38

4. Discussion

The COVID-19 pandemic has caused great stress for societies around the world since the spring of 2020. Due to the nature of the pandemic, it has had the largest impacts on

human health. However, the pandemic and its measures to prevent spreading (e.g., closed borders and trade restrictions) have had a huge impact on practically all other spheres of human life in addition to health. Importantly, for the study at hand, a number of studies have demonstrated the increased importance of access to nature for people during the pandemic [55,56]. Changes in the role of the environment together with economic and social disruptions caused by the pandemic can lead to significant fluctuations in LQ. In this study, we sought to investigate how the pandemic affected human–nature relationships and people's LQ. In our analysis, we focused on the personal pandemic impact expressed by individuals and its effects on the people–nature relationship and on the environment-dependent effect on LQ. Our results confirmed our expectations about the changes in the people–nature relationships caused by the pandemic effect. We found a direct positive association between a self-reported personal pandemic effect and the people–nature relationship on a personal level, suggesting changes toward pro-environmental thinking in human behavior. This can potentially be explained by the negative psychological effect of the pandemic and the related preventive measures released by governments (e.g., closure of all entertainment activities), as well as the effect of the pandemic on mental health and people's attempts to compensate by spending more time in nature.

Our findings align with other, similar analyses from the pandemic period. A number of scholars found an extraordinary increase of interest in "green areas" from the active phase of the pandemic (March 2020) and related it to the response to stress caused by the pandemic [57–59]. We also expected to see changes in the people–nature relationship due to the positive effect of nature on mental health [60,61]. We assume that the positive link between the personal impacts of the pandemic and changes in the relationship with nature on a personal level in our study can be explained by the actual effects that interactions with nature has on psychological resilience of individuals [62]. Over time, the personal impact of the pandemic consequently appears to have led to increased concern about the environment and shifts in behavior toward pro-environmental decisions (consumer behavior). Furthermore, we believe that higher awareness about environmental problems and a search for understanding causes to the pandemic of persons heavily impacted by COVID-19 could explain why we found a positive link between the personal impact of the pandemic and the opinion that the pandemic was caused by the way people treat nature.

However, we did not find an effect of personal impacts of the pandemic on the perception about the general relationship between people and nature in the society. This can at least partly be explained by the overall distribution of answers toward a positive change in the general people–nature relationship (Figure 5). The overrepresentation of responses about positive changes on a general level are potentially associated with a cumulative effect of raised public awareness about nature [63], overall increasing the demand for access to nature for society [64] and knowledge of reported reductions in environmental pollution during the pandemic worldwide [65]. This can potentially also explain our findings about the strong relationship between the pandemic impact and opinion that the pandemic was caused by the way how people treat nature. The awareness about the wildlife trade and its consequences rose during the pandemic times [44].

We further tested the effect of the pandemic on the LQ of the coastal community's inhabitants. As expected, due to the significant importance of mental and physical health for LQ [66,67], we found a negative effect of the pandemic on LQ. First, we found that the personal impact of the pandemic had a negative impact on LQ assessment, which suggests that an elevated level of stress had a negative impact on the perceived life quality. Second, we investigated whether the pandemic caused a decrease in the people–nature relationship (estimated as the covariation between perceived LQ and sWQ) with survey data collected approximately 1 year from the initial stage of the pandemic (2018–2019) and during the pandemic (2021). Since the study area is located in the coastal zone, water quality is a significant representative environmental indicator due to the importance of the ecosystem services provided by sea for the community [51,52], and it has been shown that subjective

assessment of water quality by inhabitants (sWQ) strongly reflects water quality measurements using professional scientific equipment [68], and that perceived rather than objectively measured water quality is more important for LQ in this society [39]. Our result demonstrates a strong negative effect of the pandemic on LQ. However, we found a different effect of the pandemic on LQ depending on how people perceive the quality of their local environment (see "pandemic effect by sWQ" in Table 1). During the pandemic, the LQ of people living in low-WQ areas was lower than before the pandemic, whereas the LQ of people living in high-WQ areas was not affected by the pandemic (Figure 7). Therefore, this finding highlights that the environment is important for the community during a sudden stress, such as a pandemic. The accessibility to nature, as well as maintaining a sufficient quality in the surrounding nature, can potentially mitigate the harsh effect of the stress and keep the LQ of the community at a sufficient level. Nevertheless, despite our finding of a positive effect of local environmental quality on LQ, we cannot ignore the major and leading role of traditional sociodemographic factors for LQ [39], keeping in mind the comprehensive characteristic of this measure.

5. Conclusions

Our findings highlight the significant role of the personal impact of the pandemic on changes in the human–nature relationship. Our results indicate that the level to which a person is affected by the pandemic plays a crucial role in life quality. Furthermore, we compared pre-pandemic assessments of life quality with assessments during the pandemic in the same community and identified significant negative changes. However, our findings indicated a significant role of the quality of the environment for potential mitigation of the sudden stress impact on the life quality of individuals. This signals that local governments should not underestimate the benefits of supporting local environmental initiatives (e.g., facilitating access to nature) and constantly monitoring the changes in people–nature relationships. Lastly, we believe that our results demonstrate the importance of the support of environmental protection programs by local councils for the mitigation of stress effects on societal wellbeing in the future.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14159496/s1.

Author Contributions: Conceptualization, R.G., L.R. and P.K.; Data curation, R.G.; Formal analysis, R.G. and P.K.; Methodology, R.G., L.R. and P.K.; Project administration, R.G. and P.K.; Supervision, L.R. and P.K.; Writing—original draft, R.G.; Writing—review & editing, R.G., L.R. and P.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: Ethical review and approval were waived for this study. As is common practice in non-sensitive, anonymous surveys, our survey participants were informed about the anonymity of the survey, what the survey was about and how their responses would be analysed. In accordance with the ethical recommendations of the *Finnish National Board on Research Integrity*, no advance scrutiny of the survey was needed (see https://tenk.fi/en/ethical-review (accessed on 30 May 2022)), because the questionnaire did not in any way threaten the personal integrity of the participants and whose voluntary participation in the survey could be considered as informed consent, since the relevant information about the survey was available to them at the time of responding to the survey.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data is available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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