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Internet Use, Perceived General Social Fairness, and Local Environmental Satisfaction in China: Evidence from CGSS2021

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Abstract

Internet use has become an important channel through which citizens encounter and interpret information about social and environmental conditions. Using 2351 respondents from the Chinese General Social Survey 2021 (CGSS2021) in the baseline analyses, this study examines the association between Internet use frequency and local environmental satisfaction and explores perceived general social fairness as a possible social-evaluative correlate. Local environmental satisfaction is measured using a single six-category item concerning respondents' satisfaction with their surrounding natural environment. Ordered Probit models are used as the primary specification, with OLS and Ordered Logit models reported as complementary specifications. The analysis additionally reports the category distributions of the principal ordinal variables, comparisons of local environmental satisfaction across Internet use frequency categories, pairwise correlations, and variance inflation factor diagnostics. More frequent Internet use is negatively associated with local environmental satisfaction. The coefficient remains negative across the reported specifications, although its model-specific magnitude and statistical precision vary with covariate and regional adjustment. An exploratory indirect-association analysis based on 2338 respondents indicates a small indirect association involving perceived general social fairness. Both component equations treat their outcomes as ordinal and are estimated using Ordered Probit models; statistical uncertainty is evaluated using 5000 nonparametric bootstrap replications with bias-corrected 95% confidence intervals. Because the data are cross-sectional, the focal constructs are measured using single survey items, and residual confounding and sample-selection bias cannot be excluded, the findings do not establish temporal ordering or causality.

Keywords: internet use frequency; local environmental satisfaction; perceived general social fairness; CGSS2021; China



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1. Introduction

Local environmental satisfaction refers to residents' subjective evaluations of the natural environmental conditions in their immediate surroundings. It is conceptually distinct from objective environmental indicators, such as air quality indices, water quality monitoring data, pollutant emission levels, and green space coverage. Nor should it be interpreted as a comprehensive measure of environmental governance performance, ecological sustainability, or the effectiveness of specific environmental policies [1–5]. Nevertheless, local environmental satisfaction remains a meaningful subjective outcome because residents may evaluate similar environmental conditions differently depending on their prior expectations, personal experiences, access to information, institutional trust, and

broader evaluations of society and public institutions [6–15]. In this study, the term refers specifically to satisfaction with the surrounding natural environment, as measured by a single item in CGSS2021.

Internet use frequency may be associated with local environmental satisfaction through multiple and potentially competing processes. Studies focusing on Internet use, environmental communication, and media participation have reported associations with environmental knowledge, willingness to pay, and pro-environmental behavior [16–23]. Other studies concerning climate anxiety, misinformation, online public concern, and environmental belief structures indicate that information exposure may also be associated with risk-focused or less favorable subjective responses [24–29]. Related behavioral studies show that environmental knowledge, concern, norms, and satisfaction represent conceptually different outcomes [30–36]. Social comparison and perceived inequality may also shape broader subjective evaluations [37], while recent CGSS2021 evidence directly links Internet use frequency with perceived social fairness [38]. Existing findings are therefore mixed, partly because previous studies differ in the forms and purposes of Internet use examined, the platforms considered, the environmental outcomes measured, and the research designs employed. Importantly, the CGSS2021 item captures general Internet use frequency rather than intentional exposure to environmental information. It does not identify platform type, content, purpose of use, time spent online, or the intensity of exposure to environmental news. Accordingly, the present analysis estimates the association between Internet use frequency and local environmental satisfaction; it does not directly test environmental information exposure, risk amplification, or heightened expectations as underlying mechanisms.

One possible social-evaluative pathway involves perceived general social fairness. Income inequality and broader social comparisons may be associated with subjective evaluations of well-being and social conditions [37]. More directly, recent evidence based on CGSS2021 indicates that Internet use frequency is associated with perceptions of social fairness [38]. Perceived general social fairness should nevertheless be distinguished from environmental justice, which concerns the distribution, recognition, and procedural treatment of environmental benefits and burdens [39]. Related studies have linked Internet use to social trust [40], perceived social fairness to social security evaluations [41], and perceived social justice to the public acceptance of environmentally relevant facilities [42]. Environmental justice research further emphasizes that environmental fairness contains distributional, procedural, and recognition-related dimensions that are not captured by the general fairness item used in this study [43].

Taken together, these distinctions identify a specific research gap. Existing studies do not always distinguish general Internet use frequency from intentional exposure to environmental information, and relatively limited attention has been given to whether perceived general social fairness offers a distinct social-evaluative perspective on local environmental satisfaction. The present study therefore focuses on the measured associations among these three constructs rather than on unobserved digital-information mechanisms.

The study uses CGSS2021 because it contains measures of Internet use frequency, perceived general social fairness, and satisfaction with the surrounding natural environment for the same respondents. Because the survey captures subjective evaluations during the particular social and media conditions of 2021, generalization to other periods should be cautious. The study addresses four questions: (RQ1) Is Internet use frequency associated with local environmental satisfaction? (RQ2) Are the observed associations among Internet use frequency, perceived general social fairness, and local environmental satisfaction consistent with a possible indirect association? (RQ3) What is the substantive magnitude and descriptive pattern of the association across the five Internet use frequency categories?

(RQ4) How sensitive is the association to alternative ordinal-response specifications, categorical covariate coding, and regional adjustment? These questions are associational rather than causal because the cross-sectional data do not establish temporal ordering.

2. Theoretical Basis, Literature Review, and Research Hypotheses

2.1. Conceptual Framework: Social Comparison and Fairness Evaluation

Local environmental satisfaction is conceptualized as a subjective evaluative judgment formed through comparisons between experienced environmental conditions and personal expectations or socially derived reference standards [1–5]. Objective environmental conditions remain relevant, but respondents facing similar local conditions may report different levels of satisfaction because their evaluations also reflect prior experience, socioeconomic position, health, institutional trust, and access to information [6–10]. This framework therefore treats local environmental satisfaction as an individual assessment of the surrounding natural environment rather than as a direct measure of environmental governance performance [10–15].

Internet use frequency may be associated with broader information and comparison environments in which such evaluations are formed. Previous research on specific forms of digital media use has reported associations with environmental knowledge and participation, whereas other studies have linked online communication to greater attention to negative events and more demanding comparison standards [16–25]. However, the CGSS2021 item records only general Internet use frequency and does not identify the content, platform, purpose, or intensity of information exposure. Information empowerment, risk amplification, and heightened expectations are therefore treated as possible interpretations drawn from prior research rather than as mechanisms directly tested in the empirical model.

Broader comparison environments may make differences in income, opportunity, public services, and institutional performance more salient. Research on income inequality and happiness suggests that unequal social conditions can be associated with broader subjective evaluations of individuals' social circumstances [37]. More directly, recent evidence based on CGSS2021 indicates that Internet use is associated with perceptions of social fairness [38].

Perceived general social fairness is conceptually distinct from environmental justice. Environmental justice concerns the distribution, recognition, and procedural treatment of environmental benefits and burdens, whereas the CGSS2021 item captures an overall assessment of fairness in contemporary society. The framework therefore positions perceived general social fairness as a possible intermediate correlate between Internet use frequency and local environmental satisfaction, rather than as a direct measure of environmental justice or an established causal mediator. This positioning is theoretically motivated, but the cross-sectional design cannot exclude alternative temporal orderings, common causes, or parallel evaluative processes.

2.2. International Literature on Digital Media and Environmental Attitudes

International research on digital media and environmental attitudes can be organized along five dimensions: the measure of Internet use, the platform examined, the purpose of use, the environmental outcome, and the research design. Internet use has been measured through general frequency, social media use, online news consumption, or platform-specific activities. Its purposes may include information seeking, entertainment, interpersonal interaction, or civic participation, while the outcomes examined range from environmental knowledge, concern, and behavior to climate anxiety, policy support, risk perception, and local environmental satisfaction. Studies also differ in whether they use cross-sectional, longitudinal, experimental,

or quasi-experimental designs. These distinctions are important because findings concerning pro-environmental behavior, climate anxiety, or policy support cannot be directly generalized to satisfaction with the surrounding natural environment [16–27,31–36].

The literature reports both favorable and unfavorable associations. Studies focusing on intentional information seeking, environmental communication, and civic participation often report higher levels of environmental knowledge, concern, willingness to pay, or pro-environmental behavior [16–23,26,27,31–36]. Related behavioral research has applied the theory of planned behavior and norm activation theory to household PM2.5-reduction behavior, further illustrating that environmental behavior is conceptually distinct from local environmental satisfaction [44]. By contrast, research emphasizing the salience of negative news, misinformation, emotionally charged communication, or climate-related anxiety sometimes reports greater perceived risk or less favorable subjective evaluations [24,25,28,29,45–50]. These divergent findings suggest that observed associations vary according to what individuals do online, the content and platforms they encounter, the environmental outcomes being measured, and the research designs employed. Importantly, these studies do not provide a single conclusion that can be directly transferred to a general measure of Internet use frequency. Because the CGSS2021 item does not identify content, platform, purpose, or environmental information exposure, the present study interprets its coefficient as an association with general Internet use frequency rather than as direct evidence of environmental information exposure, information empowerment, risk amplification, or heightened expectations.

2.3. Chinese Evidence on Internet Use and Environmental Satisfaction

Chinese research has examined a range of environmental outcomes and explanatory pathways associated with Internet and media use. One group of studies focuses on pro-environmental behavior, environmental concern, public participation, and willingness to pay for environmental protection [16–23]. Another examines environmental satisfaction, pollution perception, subjective well-being, or evaluations of government environmental performance [9,11–13,26,28]. The findings are not uniform, partly because these studies differ in their measures of Internet use, environmental outcomes, proposed explanatory pathways, survey periods, and research designs.

The studies most closely related to the present analysis illustrate this heterogeneity. Chen et al. [12] distinguished politically oriented Internet use from entertainment-oriented use and examined government trust as a possible pathway associated with environmental satisfaction. Huang [11] examined pollution perception in relation to Internet use and satisfaction with local environmental governance, an outcome that is not identical to satisfaction with the immediate natural environment. By contrast, Liu et al. and Xiao et al. [16,17] focused on pro-environmental behavior rather than environmental satisfaction. Other studies examined perceived pollution, subjective well-being, or related subjective environmental outcomes [9,13,26,28]. These studies differ in both the meaning and measurement of Internet use and the environmental outcome, as well as in the explanatory variables considered. The present study instead uses CGSS2021, a general Internet use frequency item, a single measure of local environmental satisfaction, and perceived general social fairness. These features define its specific focus while limiting direct comparison with studies based on content-specific Internet use, environmental behavior, or broader evaluations of environmental governance.

The resulting research gap is therefore specific rather than general. Existing Chinese studies have examined government trust, pollution perception, environmental knowledge, and environmental concern, whereas perceived general social fairness has received comparatively limited attention. It remains unclear whether Internet use frequency is associated

with local environmental satisfaction after adjustment for the individual characteristics included in the analysis and whether the observed relationships among Internet use frequency, perceived general social fairness, and local environmental satisfaction are consistent with a possible indirect association pathway. The present analysis addresses these questions while recognizing the measurement limitations of the general Internet use frequency item and the inability of cross-sectional data to establish temporal or causal ordering.

2.4. Research Hypotheses and Theoretical Framework

Prior research supports competing expectations regarding the association between Internet use and environmental evaluations. Studies focusing on intentional information seeking, environmental knowledge, and civic participation often report more favorable environmental attitudes [16–23,31–36]. By contrast, research on climate anxiety, environmental risk perception, misinformation, and negatively valenced online communication suggests that digital information environments may also coincide with more risk-focused or less favorable subjective evaluations [24,25,28,29,46–50]. These studies do not directly examine local environmental satisfaction, but, together with the social comparison perspective developed above, they provide a cautious basis for a directional hypothesis. The proposed relationship remains associational rather than causal.

Hypothesis H1. *Higher Internet use frequency is negatively associated with local environmental satisfaction.*

The proposed indirect association involves two theoretically distinct relationships. First, more frequent Internet use may coincide with broader comparison environments in which differences in income, opportunity, public services, and institutional performance become more salient. Research on income inequality indicates that broader social disparities may be associated with subjective evaluations of social circumstances [37], while recent evidence based on CGSS2021 more directly reports an association between Internet use and perceived social fairness [38]. Research linking Internet use to social trust provides related contextual evidence, although social trust is conceptually distinct from perceived general social fairness [40].

Hypothesis H2a. *Higher Internet use frequency is negatively associated with perceived general social fairness.*

Second, perceived general social fairness may be positively associated with local environmental satisfaction because broader evaluations of social institutions and public conditions may also be reflected in respondents' assessments of their immediate surroundings. Environmental justice theory distinguishes general fairness evaluations from the distributive, procedural, and recognition-related dimensions of environmental benefits and burdens [39]. Previous research has associated perceived social fairness with evaluations of social security [41] and perceived social justice with public acceptance of environmentally relevant facilities [42]. A recent environmental justice study further illustrates the environment-specific fairness concerns that are not captured by the general social fairness measure used in the present study [43]. Although these outcomes and concepts differ from local environmental satisfaction, they provide indirect theoretical context for the proposed association rather than direct evidence for H2b.

Hypothesis H2b. *Perceived general social fairness is positively associated with local environmental satisfaction.*

Taken together, H2a and H2b motivate an exploratory analysis of whether the observed pattern is consistent with an indirect association involving perceived general social fairness. Because the data are cross-sectional, this analysis does not establish temporal ordering or causal mediation.

Figure 1 presents the three constructs directly measured in the study. The two component paths represent the hypothesized associations specified in H2a and H2b, while the dashed path represents the association specified in H1. The arrows indicate modeled associations and do not imply temporal ordering or causal identification. Environmental information exposure, information empowerment, risk amplification, and heightened expectations are excluded because they are not directly measured in CGSS2021.

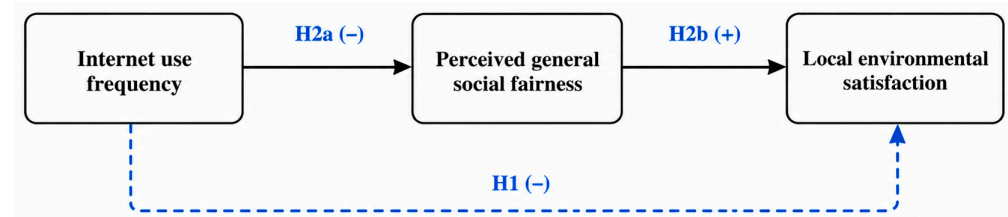


Figure 1. Conceptual framework of the hypothesized associations among Internet use frequency, perceived general social fairness, and local environmental satisfaction. Notes: H2a and H2b represent the two component associations examined in the exploratory indirect association analysis. The dashed arrow represents the direct association specified in H1. The arrows do not imply temporal ordering or causality.

3. Materials and Methods

3.1. Data Source, Sample Selection, and Survey Design

The data were drawn from the Chinese General Social Survey 2021 (CGSS2021), conducted by the National Survey Research Center at Renmin University of China. CGSS2021 used a multistage, stratified, probability-proportional-to-size sampling design and surveyed eligible permanent residents aged 18 years or older. The public-use dataset contains 8148 respondents. The questionnaire module containing the local environmental satisfaction item was administered to 2690 respondents.

After excluding 339 respondents with missing, invalid, or non-substantive responses on local environmental satisfaction or one or more variables required for the baseline specifications, 2351 respondents remained for the descriptive and baseline regression analyses. Thirteen additional respondents lacked valid perceived general social fairness data, resulting in 2338 respondents for the exploratory indirect-association analysis. The sequential construction of the analytical samples is reported in Supplementary Table S1. The distinction between the 2351-person baseline sample and the 2338-person indirect-association sample is maintained throughout the manuscript.

The module-based restriction is analytically distinct from ordinary item nonresponse: the 5458 respondents who were not administered the relevant module could not contribute outcome information to this study. Complete-case screening within the module may nevertheless alter the composition of the retained sample, and selection related to unobserved characteristics cannot be excluded. The reported estimates are therefore interpreted as conditional associations within the analytical samples rather than as estimates for all 8148 respondents.

The primary models report heteroskedasticity-robust standard errors. Province indicators are included in the expanded specifications to account for broad regional heterogeneity. The public-use analytical file and accompanying documentation used by the authors did not provide a complete and unambiguous combination of final individual weights, primary sampling unit identifiers, and stratum identifiers that could be implemented consistently

for the restricted module sample. Proxy design variables were not constructed because doing so would introduce undocumented assumptions. Accordingly, the estimates are model-based rather than fully design-based and should not be interpreted as nationally representative population estimates.

3.2. Variable Measurement and Coding

The dependent variable is local environmental satisfaction. It is measured using the CGSS2021 statement, “I am satisfied with my surrounding environment,” with responses recorded on a six-point scale ranging from 1 (strongly disagree) to 6 (strongly agree). Higher values indicate greater satisfaction with the respondent’s immediate surrounding environment. This single item captures a subjective evaluation of local environmental conditions rather than a multidimensional measure of environmental perception, objective environmental quality, government environmental performance, or ecological sustainability.

The main explanatory variable is Internet use frequency. It is measured using the CGSS2021 question asking respondents how often they used the Internet, including mobile Internet, during the preceding year. Responses are coded as 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = very frequently. Higher values indicate more frequent Internet use. This measure captures only general frequency and does not identify the platform used, purpose of use, type of content encountered, time spent online, or exposure to environmental information. The estimated coefficient should therefore not be interpreted as evidence of environmental news exposure, information empowerment, risk amplification, or heightened expectations.

Perceived general social fairness is examined as a potential pathway variable. It is measured using the CGSS2021 question, “Overall, do you think society today is fair or unfair?” Responses are coded on a five-point scale ranging from 1 = completely unfair to 5 = completely fair, with higher values indicating greater perceived general social fairness. The item captures respondents’ general evaluation of fairness in contemporary society rather than a specific assessment of income distribution, equality of opportunity, procedural fairness, or environmental justice. Because the data are cross-sectional, perceived general social fairness is not treated as a confirmed causal mediator.

The expanded covariate set includes age, gender, political status, educational attainment, urban-rural residence, logged personal income, self-rated health, subjective well-being, and province indicators. Age is entered as a continuous variable. Gender, educational attainment, political status, urban-rural residence, and province are represented using categorical indicators. In particular, educational attainment and political status are not treated as equally spaced linear scores. This coding avoids imposing the assumption that movement between substantively different categories has a constant association with local environmental satisfaction.

Self-rated health and subjective well-being are included only in the extended adjustment set because they may be associated with Internet use, environmental conditions, or both, and therefore may not function as purely pre-exposure controls. The reconstructed analysis did not contain a consistently coded occupation measure that was comparable across employed, unemployed, retired, and out-of-labor-force respondents; occupation was therefore not included. Employment- and occupation-related residual confounding, along with residual confounding from household composition, housing conditions, and objective pollution exposure, remains possible. The definitions and coding of all variables are summarized in Table 1.

Because the three focal variables are ordinal, their complete category distributions are reported rather than relying only on means and standard deviations. Internet use frequency and local environmental satisfaction each contain 2351 valid observations, whereas

perceived general social fairness contains 2338 valid observations. The distributions are shown in Table 2.

Table 1. Variable definitions and measurements.

Variable Role	Variable	Definition and Coding
Dependent variable	Local environmental satisfaction	Satisfaction with the respondent's surrounding environment; coded from 1 = strongly disagree to 6 = strongly agree, with higher values indicating greater satisfaction
Main explanatory variable	Internet use frequency	Frequency of Internet use, including mobile Internet, during the preceding year; 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = very frequently
Potential pathway variable	Perceived general social fairness	Overall assessment of whether contemporary society is fair or unfair; coded from 1 = completely unfair to 5 = completely fair, with higher values indicating greater perceived general social fairness.
Covariate	Age	Age in years; entered as a continuous variable.
Covariate	Gender	Represented by a categorical indicator.
Covariate	Educational attainment	Highest completed educational level; represented by categorical indicators.
Covariate	Political status	Political identity or affiliation; represented by categorical indicators.
Covariate	Urban-rural residence	Residential classification; represented by a categorical indicator.
Covariate	Logged personal income	Natural logarithm of personal annual income.
Covariate	Self-rated health	Ordered subjective health assessment; higher values indicate better health.
Covariate	Subjective well-being	Subjective happiness assessment; higher values indicate greater well-being.
Regional adjustment	Province	Province of residence; represented by province indicators in the expanded specification.

Table 2. Category distributions of the principal ordinal variables.

Variable and Category	Frequency	Percentage (%)	Cumulative Percentage (%)
Internet use frequency			
Never	634	26.97	26.97
Rarely	164	6.98	33.94
Sometimes	169	7.19	41.13
Often	496	21.10	62.23
Very frequently	888	37.77	100.00
Valid observations	2351	100.00	
Perceived general social fairness			
Category 1	102	4.36	4.36
Category 2	301	12.87	17.24
Category 3	508	21.73	38.96
Category 4	1250	53.46	92.43
Category 5	177	7.57	100.00
Valid observations	2338	100.00	
Local environmental satisfaction			
Strongly disagree	48	2.04	2.04
Disagree	140	5.95	8.00
Somewhat disagree	177	7.53	15.53
Somewhat agree	390	16.59	32.11
Agree	1321	56.19	88.30
Strongly agree	275	11.70	100.00
Valid observations	2351	100.00	

Notes: Percentages and cumulative percentages are calculated using the valid observations for each variable. For perceived general social fairness, Category 1 denotes the lowest fairness evaluation and Category 5 the highest.

3.3. Analytical Strategy and Complementary Specifications

The empirical analysis follows an integrated sequence. First, category distributions and unadjusted comparisons of local environmental satisfaction across the five Internet use frequency categories are reported. Bonferroni-adjusted pairwise comparisons are used as supplementary descriptive diagnostics. Second, pairwise correlations describe the bivariate relationships among the principal variables, while variance inflation factors from an auxiliary linear model assess multicollinearity in the expanded covariate specification. Third, an Ordered Probit model is used as the primary specification because local environmental satisfaction is a six-category ordered outcome. OLS is reported as a complementary observed-scale specification, and an Ordered Logit model is used to assess whether the direction of the focal association depends on the ordinal link function. Additional sensitivity specifications use categorical education and political-status indicators and province

indicators. Consistency across models is interpreted as functional-form and specification sensitivity evidence, not as causal identification. The baseline Ordered Probit model is specified as follows:

$$\text{Env}_i = \alpha + \beta \text{Internet}_i + \gamma X_i + \varepsilon_i \quad (1)$$

where Env_i denotes the local environmental satisfaction of respondent i , Internet_i denotes Internet use frequency, X_i denotes the included control variables, and ε_i denotes the random error term. The parameter β represents the conditional association between Internet use frequency and local environmental satisfaction. In the ordered Probit model, the coefficient is estimated to be an underlying latent scale and is therefore interpreted primarily in terms of its direction and statistical uncertainty rather than as a direct point change on the observed six-point scale. A significantly negative coefficient indicates that more frequent Internet use is associated with a lower latent propensity to report greater local environmental satisfaction, conditional on the observed covariates. This association is not interpreted as a causal effect.

To examine whether the observed relationships are consistent with a possible indirect association involving perceived general social fairness, two component equations are estimated using Ordered Probit models. Perceived general social fairness is treated as a five-category ordinal outcome in the first equation, and local environmental satisfaction is treated as a six-category ordinal outcome in the second. Internet use frequency is entered as an ordered five-category score, and the same covariate set is included in both equations. Because the data are cross-sectional, these equations do not establish temporal ordering or causal mediation. The component models are specified as follows:

$$\text{Fair}_i = \alpha_1 + \theta \text{Internet}_i + \gamma_1 X_i + \varepsilon_{1i} \quad (2)$$

$$\text{Env}_i = \alpha_2 + \beta' \text{Internet}_i + \lambda \text{Fair}_i + \gamma_2 X_i + \varepsilon_{2i} \quad (3)$$

where Fair_i denotes the latent propensity of respondent i to report a higher level of perceived general social fairness, and Env_i denotes the latent propensity to report greater local environmental satisfaction. The observed fairness and environmental-satisfaction categories are determined by their respective estimated cut points. Internet_i denotes Internet use frequency, Fair_i in Equation (3) denotes the observed five-category perceived general social fairness score, X_i denotes the included covariates, and ε_{1i} and ε_{2i} denote the random error terms.

Equation (2) examines the conditional association between Internet use frequency and perceived general social fairness. The coefficient θ represents the change in the latent propensity to report greater perceived general social fairness associated with a one-category increase in Internet use frequency. Equation (3) examines the associations of Internet use frequency and perceived general social fairness with local environmental satisfaction when both variables and the included covariates are entered in the model. The coefficient λ represents the change in the latent propensity to report greater local environmental satisfaction associated with a one-category increase in perceived general social fairness.

A statistically distinguishable value of θ indicates that Internet use frequency is conditionally associated with perceived general social fairness. A statistically distinguishable value of λ indicates that perceived general social fairness is conditionally associated with local environmental satisfaction after Internet use frequency and the included covariates are taken into account. Any reduction in the absolute magnitude of β' , relative to the Internet use frequency coefficient in the baseline model, is described only as a change in the conditional association and is not treated as sufficient evidence of partial mediation.

The exploratory indirect association is summarized as:

$$\text{Indirect Effect} = \theta \times \lambda \quad (4)$$

where $\theta \times \lambda$ represents the product of the Internet use frequency coefficient in Equation (2) and the perceived general social fairness coefficient in Equation (3). Statistical uncertainty for the product term is evaluated using 5000 nonparametric bootstrap replications. Bootstrap standard errors and bias-corrected 95% confidence intervals are reported. Because the component coefficients are estimated on Ordered Probit latent-response scales, the product is interpreted as an exploratory indirect association rather than as an observed-scale mediation effect or evidence of causal mediation.

Because the component coefficients are estimated on Ordered Probit latent-response scales, their product is scale-dependent and should not be interpreted as a point change on the observed five- or six-category response scales. It is therefore reported as an exploratory index of indirect association rather than as a conventional linear mediation effect. The direct and indirect coefficients are not added to calculate an observed-scale total effect or a mediated proportion. Moreover, the cross-sectional design cannot establish whether Internet use frequency temporally precedes perceived general social fairness or whether perceived general social fairness temporally precedes local environmental satisfaction. Reverse ordering, unobserved common causes, common-method covariance, and general response tendencies cannot be excluded.

Reverse ordering and unobserved confounding remain possible. The complementary specifications assess whether the direction of the focal association is sensitive to the ordinal link function, categorical covariate coding, and province adjustment.

4. Empirical Results

4.1. Descriptive and Diagnostic Results

Table 2 shows that Internet use frequency is relatively polarized: 26.97% of respondents reported never using the Internet, whereas 37.77% reported very frequent use. Local environmental satisfaction is concentrated in favorable categories, with 56.19% selecting agree and 11.70% selecting strongly agree. Perceived general social fairness is concentrated in Category 4, which accounts for 53.46% of the 2338 valid fairness responses.

Table 3 compares local environmental satisfaction across Internet use frequency categories. The highest mean occurs among respondents who used the Internet sometimes (mean = 4.734, SD = 1.066), while the lowest occurs among those who used it often (mean = 4.357, SD = 1.119). The very-frequent-use group reports a mean of 4.470 (SD = 1.109). The unadjusted pattern is therefore not strictly monotonic. Bonferroni-adjusted comparisons in Supplementary Table S2 show lower satisfaction for the often-use group than for the never-use, rarely-use, and sometimes-use groups; the very-frequent-use group also differs from the never-use group.

The correlation matrix is reported in Supplementary Table S3. Internet use frequency is weakly negatively correlated with local environmental satisfaction ($r = -0.102, p < 0.001$), while perceived general social fairness is positively correlated with local environmental satisfaction ($r = 0.166, p < 0.001$). The strongest bivariate relationship is between Internet use frequency and age ($r = -0.612, p < 0.001$), reinforcing the importance of age adjustment. VIF diagnostics in Supplementary Table S4 show a VIF of 1.88 for Internet use frequency and a mean VIF of 3.94. Higher values are concentrated among detailed educational-attainment indicators; excluding those indicators, the maximum VIF is 2.16. Thus, elevated collinearity is localized to the detailed education categories rather than the focal predictor.

Table 3. Local environmental satisfaction across Internet use frequency categories.

Internet Use Frequency	Observations	Mean	Standard Deviation	Minimum	Maximum
Never	634	4.703	1.127	1	6
Rarely	164	4.646	0.964	1	6
Sometimes	169	4.734	1.066	1	6
Often	496	4.357	1.119	1	6
Very frequently	888	4.470	1.109	1	6
Total	2351	4.540	1.112	1	6

Notes: Local environmental satisfaction ranges from 1 to 6, with higher values indicating greater satisfaction. These are unadjusted descriptive statistics based on the 2351-person baseline sample.

4.2. Baseline and Complementary Regression Results

Table 4 reports four nested Ordered Probit specifications. Model 1 includes Internet use frequency alone. Model 2 adds age, gender, and self-rated health. Model 3 additionally includes urban-rural residence, logged personal income, and subjective well-being. Model 4 further represents educational attainment and political status using categorical indicators.

Table 4. Baseline regression results: Ordered Probit model.

Variables	M1	M2	M3	M4
Internet use frequency	−0.082 *** (0.014)	−0.053 *** (0.019)	−0.052 *** (0.019)	−0.034 * (0.020)
Age		0.008 *** (0.002)	0.006 *** (0.002)	0.004 ** (0.002)
Gender indicator		−0.059 (0.045)	−0.084 * (0.046)	−0.095 ** (0.048)
Self-rated health		0.097 *** (0.024)	0.055 ** (0.025)	0.060 ** (0.025)
Urban-rural residence			−0.090 *** (0.033)	−0.076 ** (0.033)
Logged personal income			−0.011 ** (0.006)	−0.008 (0.006)
Subjective well-being			0.105 *** (0.013)	0.106 *** (0.013)
Educational-attainment indicators	No	No	No	Yes
Political-status indicators	No	No	No	Yes
Observations	2351	2351	2351	2351

Notes: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The coefficient of Internet use frequency is negative across all four Ordered Probit specifications. It is statistically distinguishable from zero at the 1% level in Models 1–3 and at the 10% level in Model 4. Because coefficients from nested nonlinear models are affected by model-specific latent-scale normalization, their absolute magnitudes are not interpreted as directly comparable measures of attenuation. The complementary OLS estimates nevertheless show a smaller negative coefficient under broader adjustment.

Table 5 reports complementary OLS specifications using the same nested adjustment sequence. The coefficient of Internet use frequency remains negative across Models 5–8. The OLS estimates are included to provide an approximate interpretation on the original six-point response scale; they are not treated as preferable to the ordinal-response models.

In the most extensively adjusted OLS specification shown in Table 5, the estimated coefficient is −0.031. Thus, a one-category increase in Internet use frequency is associated with an average decrease of approximately 0.031 points in local environmental satisfaction, conditional on the included variables. The magnitude is small relative to the six-point outcome scale.

Table 5. Baseline regression results: OLS model.

Variables	M5	M6	M7	M8
Internet use frequency	−0.068 *** (0.014)	−0.051 *** (0.018)	−0.047 *** (0.018)	−0.031 * (0.019)
Age		0.006 *** (0.002)	0.004 ** (0.002)	0.002 (0.002)
Gender indicator		−0.064 (0.045)	−0.085 * (0.046)	−0.096 ** (0.048)
Self-rated health		0.095 *** (0.024)	0.056 ** (0.025)	0.060 ** (0.025)
Urban-rural residence			−0.109 *** (0.034)	−0.093 *** (0.034)
Logged personal income			−0.011 * (0.006)	−0.007 (0.006)
Subjective well-being			0.097 *** (0.013)	0.097 *** (0.013)
Educational-attainment indicators	No	No	No	Yes
Political-status indicators	No	No	No	Yes
Constant	4.770 *** (0.052)	4.170 *** (0.182)	4.003 *** (0.196)	4.161 *** (0.209)
Observations	2351	2351	2351	2351
R-squared	0.010	0.022	0.055	0.065

Notes: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The negative direction is consistent with the Ordered Probit results, but OLS and Ordered Probit coefficients should not be compared directly because they are estimated on different scales and rely on different assumptions. Agreement in direction does not rule out residual confounding, sample selection, measurement error, or reverse ordering.

To illustrate the substantive pattern of the estimated association, Figure 2 presents the adjusted predicted probability of reporting the highest category of local environmental satisfaction across the five categories of Internet use frequency, based on the ordered Probit model. The vertical axis represents the predicted probability that respondents report being in the highest satisfaction category, while the horizontal axis represents Internet use frequency from “never” to “very frequently.” The predicted probability declines across the observed categories of Internet use frequency, which is consistent with the negative coefficient reported in the ordered Probit models. This pattern suggests that the negative association is observed across the ordered categories of Internet use frequency rather than being driven solely by respondents at one end of the distribution. Because the estimates are based on cross-sectional data, the figure describes an adjusted association and should not be interpreted as showing a causal effect.

4.3. Complementary Model Specifications

Table 6 compares the Ordered Probit and Ordered Logit links using the same covariate specification and reports a separate province-adjusted Ordered Probit model. Categorical coding of educational attainment and political status is reported in Model 4 of Table 4. The categorical-covariate and province-adjusted specifications are separate rather than cumulative models.

Across these separate specifications, the focal coefficient remains negative, although its model-specific magnitude and statistical precision vary. Because the categorical-covariate and province-adjusted specifications are not cumulative, the coefficients should not be interpreted as a single sequence of progressively more extensive adjustment.

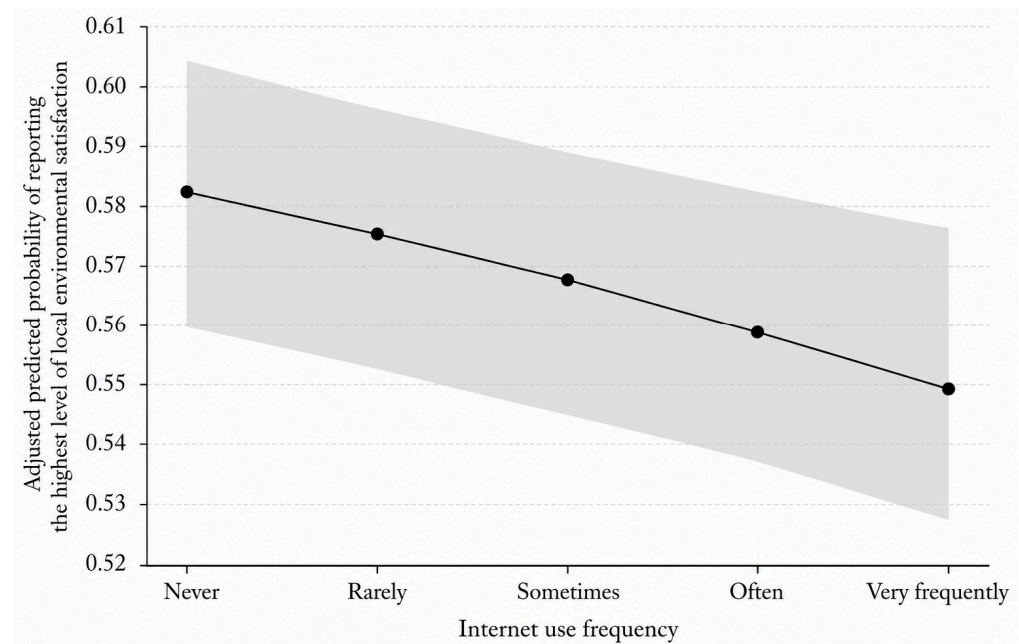


Figure 2. Adjusted predicted probability of reporting the highest level of local environmental satisfaction by Internet use frequency. Notes: Predicted probabilities are estimated from the ordered Probit model including the full set of observed covariates. The shaded area represents the 95% confidence interval.

Table 6. Complementary ordinal-response and covariate specifications.

Model Feature	M1 Ordered Probit	M2 Ordered Logit	M3 Province-Adjusted
Internet use frequency	−0.052 *** (0.019)	−0.101 *** (0.034)	−0.034 * (0.019)
Age	0.006 *** (0.002)	0.012 *** (0.003)	0.008 *** (0.002)
Gender indicator	−0.084 * (0.046)	−0.149 * (0.082)	−0.063 (0.047)
Self-rated health	0.055 ** (0.025)	0.106 ** (0.045)	0.059 ** (0.026)
Urban-rural residence	−0.090 *** (0.033)	−0.181 *** (0.058)	−0.050 (0.034)
Logged personal income	−0.011 ** (0.006)	−0.023 ** (0.010)	−0.008 (0.006)
Subjective well-being	0.105 *** (0.013)	0.198 *** (0.023)	0.110 *** (0.013)
Province indicators	No	No	Yes
Educational-attainment indicators	No	No	NO
Political-status indicators	No	No	NO
Observations	2351	2351	2351

Notes: Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Ordered Probit and Ordered Logit coefficients are expressed on different latent scales and should not be compared directly in absolute magnitude.

4.4. Exploratory Indirect-Association Analysis Involving Perceived General Social Fairness

The analysis further examines whether the observed associations among Internet use frequency, perceived general social fairness, and local environmental satisfaction are consistent with a possible indirect association pathway. The theoretical rationale is that more frequent Internet use may coincide with broader social comparison environments in which differences in income, opportunity, public services, and institutional performance become more salient. Such comparisons may be associated with individuals' general evaluations of social fairness. Perceived general social fairness may, in turn, be associated

with local environmental satisfaction because broader evaluations of the social order may relate to how respondents assess local public and environmental conditions.

However, the CGSS2021 Internet use item does not identify the content encountered online, exposure to information concerning inequality or environmental problems, or the purpose and platform of Internet use. The proposed explanation should therefore be regarded as a theoretically motivated interpretation rather than as a directly observed information process. Moreover, because the data are cross-sectional, the analysis cannot establish that Internet use temporally precedes perceived general social fairness or that fairness evaluations temporally precede local environmental satisfaction. The estimated pathway is interpreted as an exploratory indirect association rather than as evidence of causal mediation.

Table 7 reports the exploratory ordinal indirect-association analysis. Internet use frequency was negatively associated with perceived general social fairness (path a = -0.0726 , Bootstrap SE = 0.0172 , bias-corrected 95% CI [-0.1066 , -0.0393]). Perceived general social fairness was positively associated with local environmental satisfaction after Internet use frequency and the included covariates were taken into account (path b = 0.1424 , Bootstrap SE = 0.0268 , bias-corrected 95% CI [0.0890 , 0.1938]).

Table 7. Exploratory ordinal indirect-association analysis.

Association Component	Estimate	Bootstrap SE	Bias-Corrected 95% CI
Path a: Internet use frequency → perceived general social fairness	-0.0726	0.0172	[-0.1066 , -0.0393]
Path b: Perceived general social fairness → local environmental satisfaction	0.1424	0.0268	[0.0890 , 0.1938]
Direct association of Internet use frequency with local environmental satisfaction	-0.0464	0.018	[-0.0833 , -0.0135]
Exploratory indirect association, (a × b)	-0.0103	0.0033	[-0.0179 , -0.0049]

Notes: N = 2338. Perceived general social fairness and local environmental satisfaction were treated as ordinal outcomes and estimated using Ordered Probit models. The exploratory indirect association was calculated as the product of the Internet use frequency coefficient in the fairness equation and the perceived general social fairness coefficient in the environmental-satisfaction equation. Statistical uncertainty was evaluated using 5000 nonparametric bootstrap replications. Bootstrap standard errors and bias-corrected 95% confidence intervals are reported. The coefficients are expressed on latent-response scales and do not establish temporal ordering or causal mediation.

The product of the two component coefficients was -0.0103 , with a Bootstrap standard error of 0.0033 and a bias-corrected 95% confidence interval of [-0.0179 , -0.0049]. Because the confidence interval did not include zero, the observed pattern was consistent with a small negative exploratory indirect association involving perceived general social fairness. The direct association between Internet use frequency and local environmental satisfaction remained negative after perceived general social fairness was included in the model (coefficient = -0.0464 , Bootstrap SE = 0.0180 , bias-corrected 95% CI [-0.0833 , -0.0135]).

These coefficients are estimated on Ordered Probit latent-response scales and should not be interpreted as point changes on the observed response scales. Moreover, the cross-sectional design does not establish temporal ordering or causal mediation.

4.5. Summary of Empirical Findings

First, Internet use frequency is negatively associated with local environmental satisfaction in the Ordered Probit and complementary OLS specifications. The association is modest and becomes weaker after demographic, socioeconomic, subjective, categorical, and regional controls are introduced. The negative direction of the estimates is consistent with H1, although the statistical evidence becomes weaker under more extensive adjustment.

Second, the unadjusted relationship is not strictly monotonic across the five Internet use categories. The often-use group reports the lowest mean local environmental satisfaction, while the sometimes-use group reports the highest mean. A single linear Internet use coefficient therefore summarizes a more complex descriptive distribution.

Third, Internet use frequency is negatively associated with perceived general social fairness, whereas perceived general social fairness is positively associated with local environmental satisfaction. The product-of-coefficients analysis yields a small negative exploratory indirect association whose bias-corrected 95% confidence interval excludes zero. This pattern is consistent with H2a and H2b but does not establish causal mediation.

Overall, the findings provide bounded evidence of a modest conditional association and a small exploratory indirect association involving perceived general social fairness. The empirical claims are limited to the reported descriptive, ordinal-response, and Bootstrap analyses and do not extend to causal identification.

5. Discussion

5.1. Main Findings and Interpretation

The principal finding is a modest negative association between Internet use frequency and local environmental satisfaction in the CGSS2021 analytical sample. The association appears across the primary Ordered Probit, complementary OLS, and Ordered Logit specifications, but its magnitude becomes smaller after more extensive adjustment. The evidence therefore supports a conditional relationship rather than a large or specification-invariant association.

The descriptive comparisons add important nuance. Local environmental satisfaction does not decrease uniformly across the five Internet use frequency categories: the often-use group reports the lowest mean, whereas the sometimes-use group reports the highest. The negative regression coefficient should therefore be understood as an average ordered association rather than as evidence that every successive increase in Internet use corresponds to an identical decline in satisfaction.

Age is particularly relevant to interpretation. Internet use frequency is strongly negatively correlated with age, while age is positively correlated with local environmental satisfaction. Adjusting for age therefore addresses an important observable source of confounding. The low VIF for Internet use frequency indicates that this relationship does not produce severe multicollinearity for the focal predictor, although detailed education indicators show localized collinearity.

Information empowerment, risk amplification, heightened expectations, and exposure to negative environmental information remain possible interpretations derived from prior literature, but they are not directly measured by the general Internet use frequency item. The analysis therefore does not identify which online content, platform, or purpose of use is associated with the observed pattern.

The exploratory fairness results provide a distinct social-evaluative perspective. More frequent Internet use is associated with somewhat lower perceived general social fairness, and higher fairness evaluations are associated with greater local environmental satisfaction. Nevertheless, perceived general social fairness is not environmental justice, and the indirect product may reflect common response tendencies, broader institutional evaluations, or shared unobserved determinants.

Comparison with prior Chinese studies underscores the importance of measurement. Research based on politically oriented Internet use, entertainment-oriented use, government trust, pollution perception, or environmental behavior addresses constructs that differ from the general Internet use frequency and local environmental satisfaction items used here.

The present findings should therefore not be generalized to specific online activities or policy evaluations.

The revised interpretation deliberately avoids causal language. Cross-sectional associations, alternative link functions, province indicators, and multicollinearity diagnostics can assess specification sensitivity, but they cannot establish exposure timing or eliminate unmeasured confounding.

5.2. Limitations and Future Research

First, CGSS2021 is cross-sectional. The analysis cannot determine whether Internet use precedes local environmental satisfaction, exclude reverse ordering, or establish causal effects. Longitudinal and panel designs are required to evaluate temporal sequencing.

Second, Internet use frequency is measured using a single general item that does not capture time spent online, digital skills, platform type, content, motivation, active versus passive use, or exposure to environmental information. The coefficient cannot be interpreted as the association of any specific online activity.

Third, local environmental satisfaction and perceived general social fairness are each measured using single subjective items. The environmental item does not capture objective environmental quality or multidimensional environmental evaluation, while the fairness item does not distinguish distributive, procedural, opportunity-related, or environmental fairness. Common-method covariance and general response tendencies cannot be excluded.

Fourth, the analytical sample is restricted by questionnaire-module administration and complete-case screening. Of the 8148 respondents in the public-use dataset, 2690 were administered the module containing the local environmental satisfaction item; 2351 remained for the baseline analyses and 2338 for analyses involving perceived general social fairness. The sample-selection flow is transparent, but selection associated with observed or unobserved characteristics may still limit generalizability.

Fifth, the expanded models include age, gender, categorical educational attainment, categorical political status, urban-rural residence, income, subjective covariates, and province indicators, but occupation could not be represented consistently across labor-force statuses. Employment status, household structure, housing conditions, institutional trust, political interest, digital skills, and objective pollution exposure also remain incompletely measured.

Sixth, self-rated health and subjective well-being may be downstream or jointly determined variables rather than purely pre-exposure controls. Their inclusion is therefore treated as extended adjustment, and the associated estimates should not be interpreted as identifying a causal effect.

Seventh, several detailed educational-attainment indicators have elevated VIF values. Although the VIF for Internet use frequency is low, individual education-category coefficients may be imprecisely estimated. Future research could use theoretically justified broader education categories and report joint tests for the categorical block.

Finally, the lack of a complete, unambiguous set of final weights, PSU identifiers, and stratum identifiers in the analytical materials used here prevents full design-based estimation. The results should therefore be interpreted as model-based associations within the retained samples. Future studies should use fully documented survey-design variables and objective environmental indicators alongside richer Internet-use measures.

6. Practical Implications

The findings suggest that subjective evaluations of the local environment may be associated not only with experienced environmental conditions but also with the broader informational and social contexts in which such evaluations are formed. Because the

study does not measure objective environmental quality, information-disclosure practices, environmental news exposure, or the effectiveness of government communication, the following implications should be regarded as cautious policy considerations rather than as interventions directly tested by the analysis.

First, environmental information disclosure may benefit from greater clarity, accessibility, and contextual explanation. In addition to publishing indicators concerning air quality, water quality, pollution control, and environmental improvement, public agencies could explain the meaning of the indicators, relevant trends, sources of uncertainty, and the measures being undertaken. During sudden environmental events, timely and internally consistent communication concerning the nature of the event, the affected area, available evidence, and response progress may help residents interpret environmental information more accurately.

Second, environmental communication should support inclusive access and two-way public engagement. Digital platforms, government websites, community channels, and offline communication can be used together so that residents with different levels of digital access can obtain understandable environmental information and express concerns. Nevertheless, communication channels should remain accessible to populations that may face barriers to digital information or participation.

Third, the exploratory association involving perceived general social fairness highlights the possible relevance of broader social evaluations. However, perceived general social fairness is not equivalent to environmental justice, and the study does not directly measure the fairness of environmental-risk distribution, compensation, or participation. Policy implications should therefore focus on general principles of transparent decision making, meaningful public participation, consistent procedures, and equitable access to environmental services rather than assuming that environmental distributive fairness has been empirically identified as the mechanism.

Finally, environmental communication and online platform governance should emphasize information quality, openness, responsiveness, and media literacy rather than the suppression of negative discussion. Fact-checking, accessible expert interpretation, clear data visualization, and opportunities for public questions may help improve the quality of environmental discussion. Efforts to address inaccurate or misleading claims should be implemented transparently and should not restrict legitimate criticism or public participation.

7. Conclusions

Using CGSS2021 data, this study examines the association between Internet use frequency and local environmental satisfaction and explores perceived general social fairness as a possible social-evaluative correlate. The baseline analyses use 2351 respondents, while the exploratory indirect-association analysis uses 2338 respondents with valid fairness data. Ordered Probit is the primary specification, with OLS, Ordered Logit, categorical covariate coding, and province adjustment used as complementary checks.

Internet use frequency is negatively associated with local environmental satisfaction, but the magnitude is modest and remains negative across the reported specifications, although its magnitude and statistical precision vary with covariate adjustment. The descriptive pattern is not strictly monotonic: respondents reporting often-use have the lowest mean satisfaction, while those reporting sometimes-use have the highest. These results support a bounded associational interpretation rather than a uniform or causal account.

Perceived general social fairness is positively associated with local environmental satisfaction and is involved in a small exploratory indirect association. Because both component equations are ordinal and cross-sectional, the product term is scale-dependent and does not establish causal mediation or temporal ordering.

The study distinguishes general Internet use frequency from intentional environmental-information exposure, local environmental satisfaction from environmental governance performance, and perceived general social fairness from environmental justice. Unmeasured information processes remain theoretical interpretations rather than empirically identified mechanisms.

The findings should be interpreted in light of questionnaire-module restriction, complete-case selection, single-item measurement, incomplete survey-design correction, omitted objective pollution exposure, and residual confounding. Future research should combine longitudinal designs, richer Internet-use measures, multidimensional subjective scales, objective local environmental indicators, and fully documented survey-design information.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su18168062/s1>, Table S1. Sequential construction of the analytical samples; Table S2. Bonferroni-adjusted pairwise comparisons of local environmental satisfaction; Table S3. Pearson correlations among the principal variables; Table S4. Variance inflation factor diagnostics.

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