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Empirical Article

A silent burden: How negative experiences with public toilets impact quality of life and life satisfaction

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Public toilets are a critical public health issue with a significant negative impact on people's lives. Unfortunately, the effect of negative experiences caused by public toilets on people's quality of life and life satisfaction is unknown. In this study, participants (n = 550) were asked to fill in a scale-based survey about their negative experiences with public toilets, quality of life, and life satisfaction. We found that people with toilet-dependent illnesses (36% of the sample) reported more negative experiences with public toilets than their counterparts. These negative experiences are also related to lower scores in some areas of participants' quality of life, such as their environmental, psychological, and physical health and life satisfaction, even after controlling for relevant socio-economic variables. Additionally, toilet-dependent individuals had particularly negative experiences in terms of life satisfaction and physical health than non-toilet-dependent people. We conclude that the impoverishment of quality of life linked to public toilets as an environmental inadequacy is traceable, estimable, and meaningful. This association is not only negative for ordinary people, but it is significantly negative for people with toilet-dependent illnesses. These results highlight that public toilets are essential to ensure collective well-being, particularly when considering those affected by their presence or lack thereof.

Key words: quality of life, environmental burden, health psychology, ibd psychology.

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INTRODUCTION

A common feature of our lives is having to use toilets outside the comfort and familiarity of our homes (i.e., public toilets). As public toilets often lack the standards of quality required (Afacan & Gurel, 2015), using them represents a source of negative experiences. These negative experiences reflect a critical health problem for individuals who cannot avoid using public toilets daily, particularly if this use is a consequence of a medical condition. As such, refusing to use public toilets (or delaying having to use them) may have a psychological (Kuoch, Meyer, Austin & Knowles, 2019; von Gontard, de Jong, Badawi *et al*., 2017) and physical impact (Wu, Xue & Palmer, 2019). Therefore, the inconvenience of using deficient public toilets impacts people's daily lives, and that negative impact is larger for those with high use of it. Even though this topic is often addressed with a veil of humour and awkwardness, the appropriateness of public toilets has become a critical public health and urban design issue (The Lancet Gastroenterology & Hepatology, 2022; Webber, 2018). There are two groups of people which this burden is especially relevant: bathroom-dependent people and women, however it is not studied the impact besides this groups.

Bathroom-dependent condition

Toilet-dependent ill (TDI) people cannot delay using toilets, or it will be a painful experience for them. Toilet dependency represents a transdiagnostic umbrella term that covers a wide range of conditions, such as specific urogenital and bowel diseases (i.e., inflammatory bowel disease, irritable bowel diseases, urgency urinary incontinence, or urinary infections) and non-specific conditions that create such dependency (i.e., the consequence of medical treatment). Being a TDI person is defined by the results of a disease (i.e., the constant urgent need to use toilets) rather than the disease which causes the inconvenience (i.e., the label and diagnosis associated with that illness). Corradi, Garcia-Garzon and Barrada (2020) showed that TDI people value public toilets differently from their non-TDI counterparts regarding privacy and hygiene. Being toilet-dependent leads to specific problematic behaviors, cognitions, and emotions related to dealing with such environmental disadvantages. For TDI people, problems with public toilets lead to a diminished quality of life (Knowles Graff, Wilding, Hewitt, Keefer & Mikocka-Walus, 2018a; Knowles, Keefer, Wilding, Hewitt, Graff & Mikocka-Walus, 2018b), as they have imperative needs in an environment that cannot meet those needs (de Rooy, Greenberg & Cohen, 2001). Moreover, these individuals feel that using public toilets is an experience that tends to be particularly disgusting (Norton, Thomas, Lomax & Dudley-Brown, 2012), leading to embarrassment and adverse psychological outcomes (Hall, Rubin, Dougall, Hungin & Neely, 2005; McCormick, Hammer, Farrell *et al*., 2012).

Gender and public toilets

The design of public toilets also fails to consider specific gendered needs (Kim, de Dear, Cândido, Zhang & Arens, 2013). These unmet needs include the availability, hygiene, privacy, and usability of public toilets (Camenga, Brady, Hardacker *et al*., 2019; Corradi, Garcia-Garzon & Barrada, 2020; Hartigan,

Bonnet, Chisholm *et al*., 2020; Pascoe, 2015; Reynolds, Kowalik, Kaufman, Dmochowski & Fowke, 2020; Sommer, Skolnik, Ramirez, Lee, Rasoazanany & Ibitoye, 2020). For example, women sit on the toilet more frequently than men, making overcoming their unmet hygienic needs more challenging. Also, toilets fail to provide a supportive, safe space for menstruation, making toilet behavior after menarche a difficult and shameful experience (Pascoe, 2015; Sommer *et al*., 2020). Usually, women spend more time using public toilets than men (Greed, 1996) and tend to develop health problems related to urine retention (Palmer, Willis-Gray, Zhou, Newman & Wu, 2018). Therefore, a gendered account of urban environments related to public toilets is needed (Beebeejaun, 2017). However, how these different needs in public toilets affect women's quality of life has not been studied sufficiently.

Also, it must be noted that gender and sexual minoritized groups (i.e., transgender people and gender non-conforming people) face specific problems with public toilets which deeply affect their well-being (Hardacker, Baccellieri, Mueller *et al*., 2019; Patel, 2017; Wernick, Kulick & Chin, 2017). However, these communities are more difficult to reach and require specific research questions far from the scope of this study.

Public toilets, quality of life, and life satisfaction

Although public toilets are known to be a burden for women and TDI people, it is still unknown the impact on the well-being of the general population. Well-being can be understood as having two related elements: quality of life and life satisfaction (Diener, Lucas & Oishi, 2018). Quality of life is a multidimensional construct composed of an individual's perception of their position in life, in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns (Diener, Lucas & Oishi, 2018). Meanwhile, life satisfaction is understood as people's explicit and conscious evaluations of their lives, often based on factors that the individual deems relevant (Camfield & Skevington, 2008). Well-being is an important issue for urban planners and decision-makers to bear in mind, and it may be increased by deploying better services and an adapted environment (Michalos, 2004; Yun, Lee & Lee, 2022; Zumbo, 2003). It is a valuable intangible asset in environmental settings (Gendel-Guterman & Billig, 2021). As part of the urban environment, public toilets can affect people's well-being as providers or subtractors. Unfortunately, the level of loss of well-being due to a poor public toilet system is still unknown.

Overview and research questions

We aimed to explore the role of negative experiences with public toilets on quality of life and life satisfaction in a heterogeneous sample of TDI and non-TDI participants. We expected to find that negative experiences with public toilets are related to lower quality of life and life satisfaction scores after controlling for relevant well-being predictors such as socio-economic status, gender, age, town or city size, frequency of public toilet use for defecation, family income, and subjective socio-economic status. Our aim was not to test any specific hypotheses but to answer four exploratory research questions (RQ):

RQ1: Determine the role of gender and being TDI on the number of negative experiences with public toilets.
RQ2: Determine the association of being TDI on quality of life and life satisfaction indicators.
RQ3: Determine the association between negative public toilet experiences and quality of life and life satisfaction.
RQ4: Determine whether the association between negative experiences with public toilets is similar for TDI and non-TDI people on quality of life and life satisfaction.

METHOD

Participant and procedure

Our study includes 550 complete responses (38% men, M_{age} = 36 years old, SD_{age} = 10.3 years old) from a dataset containing 679 answers. One-hundred and ninety-eight (36% of the sample) participants responded that they had a disease or condition that led to the frequent use of toilets (i.e., being TDI). Among the TDI participants, the most reported conditions were inflammatory bowel disease (25%), irritable bowel syndrome (25%), and urinary infections (22%). Participants mainly were from cities with more than 1,000,000 inhabitants (29%), followed by those from towns and cities with between 100,000 and 500,000 inhabitants (27%) and less than 50,000 inhabitants (23%).

Data were collected through a web-based survey and distributed via social media. The link to the study survey was published on social media profiles and via generalist email lists. We presented the study to potential participants as a study about quality of life and environment. Participants provided consent after reading a description of the study and its purpose. Participants' anonymity was ensured. The survey took about 15 min to answer. The online platform which held the questionnaire remained open for a month, starting in June 2021. The Ethical Review Board of the lead author's institution approved the procedure. The data collected was part of a project with different aims and hypotheses. Data with all measures taken and scripts are available in the online repository (https://osf.io/mt7ju/?view_only=f34bcc9da4d541fe84e0ffeb9dd8e02c). We confirm that we have reported all measures (see supplementary material for access to all data collected), conditions, data exclusions, and how we determined sample sizes.

Measures

Participants provided information on gender ("male," "female." "other" and "I prefer not to answer" and whether their gender was different from that assigned at birth), town or city size ("Less than 50,000," "Between 50,000 and less than 100,000," "More than 100,000 and less than 500,000," "More than 500,000 and less than 1,000,000" and "More than 1,000,000") and subjective socio-economic status using the ladder method (Operario, Adler & Williams, 2004). In this method, participants were asked to think of a ladder where the upper levels reflect individuals with successful lives (more money and higher education). Then, they were asked to place themselves on the ladder on a 1-to-10 slider. Lastly, we asked participants about family-monthly income. Response options were: "Less than €1,100," "Between €1,101 and €1800," "Between €1,801 and €2,700," "Between €2,701 and €3,900," and "More than €3,900."

Participants were requested to report whether they were suffering from or had ever suffered any disease or condition that led to the frequent use of a toilet with yes/no response options and a text box to state their disease. Participants who stated that they were toilet-dependent answered a question about the frequency of the symptoms suffered ("Every day,"

Table 1. *Descriptive statistics by TDI and gender*

Items from NEPT	TDI *N* = 198 *M* (*SD*)	Non-TDI *N* = 352 *M* (*SD*)	Women *N* = 329 *M* (*SD*)	Men *N* = 211 *M* (*SD*)
NEPT item 1: Being unable to find an open unoccupied public toilet.	4.1 (1.6)	3.2 (1.4)	3.7 (1.6)	3.3 (1.5)
NEPT item 2: Using a public toilet that does not meet appropriate privacy standards: no lock on the door, door opening from the outside, etc.	4.3 (1.5)	3.5 (1.4)	3.9 (1.4)	3.6 (1.5)
NEPT item 3: Using a dirty, stained, flooded or bad-smelling public toilet	4.9 (1.3)	4.3 (1.3)	4.6 (1.4)	4.4 (1.3)
NEPT item 4: Using an ill-equipped public toilet: no toilet paper, no coat hanger, etc	4.9 (1.5)	4.1 (1.4)	4.6 (1.4)	4.0 (1.5)
NEPT item 5: Difficult access to a public toilet on particular premises because of certain requirements for public use	2.8 (1.8)	2.1 (1.4)	2.4 (1.6)	2.2 (1.5)
NEPT item 6: Feeling the need to hurry the time spent in the public toilet because of long ques. or requests to finish from users in that queue	3.3 (2.0)	2.2 (1.4)	2.8 (1.8)	2.3 (1.6)
NEPT item 7: Feeling unsafe or exposed in a public toilet	2.4 (1.8)	1.6 (1.2)	1.9 (1.5)	1.8 (1.4)
NEPT item 8: Rejecting an activity for fear that the toilets on the premises are inadequate for your needs	3.2 (2.0)	1.5 (1.1)	2.2 (1.7)	2.0 (1.7)

Other variables	TDI *M* (*SD*)	Non-TDI *M* (*SD*)	Welch's *t*-test *t*(*df*), *p* Cohen's *D*	Women *M* (*SD*)	Men *M* (*SD*)	Welch's *t*-test *t*(*df*), *p* Cohen's *D*
NEPT mean score	3.7 (1.3)	2.8 (0.9)	*t*(304.1) = −8.70 *p* < 0.001 −0.85	3.3 (1.2)	3.0 (1.1)	*t*(457.51) = −2.99 *p* = 0.002 −0.27
WHOQOL Physical health	3.2 (0.8)	3.8 (0.6)	*t*(336) = 8.86 *p* < 0.001 0.84	3.4 (0.8)	3.7 (0.7)	*t*(499) = 4.84 *p* < 0.001 0.40
WHOQOL Psychological	3.2 (0.8)	3.4 (0.7)	*t*(392.1) = 3.23 *p* = 0.001 0.29	3.2 (0.8)	3.4 (0.7)	*t*(477.4) = 2.99 *p* = 0.002 0.25
WHOQOL Social relationships	3.2 (0.9)	3.4 (0.9)	*t*(394) = 2.48 *p* = 0.013 0.22	3.3 (0.9)	3.3 (0.9)	*t*(431) = −0.19 *p* = 0.852 –0.02
WHOQOL Environment	3.5 (0.6)	3.8 (0.6)	*t*(387.7) = 4.02 *p* < 0.001 0.36	3.6 (0.6)	3.8 (0.6)	*t*(434) = 2.00 *p* = 0.045 0.22
SWLS	4.1 (1.3)	4.5 (1.2)	*t*(396.3) = 3.28 *p* = 0.001 0.30	4.3 (1.3)	4.4 (1.3)	*t*(448.7) = 0.91 *p* = 0.360 0.08

Note: TDI stands for toilet-dependent ill people.

"Almost every day." "One or two days each week," "One or two days each month," "Few symptoms in the last six months" and "I have been well in the last six months, in remission or absence of symptoms"). Participants were asked about the frequency of use of public toilets to urinate and defecate. Response options were "At least once a day," "More than once in a week," "At least once a week," "At least once a month," "At least once every six months," "At least once a year" and "Never," The frequency was coded as the higher the score, the more frequent toilet use.

Quality of life is defined as individuals' subjective perceptions of their position in life, taking into account the context of the culture and value systems in which they live in relation to their goals, expectations, standards, and concerns (The Whoqol Group, 1998). Quality of life was assessed using the abbreviated Spanish version of the World Health Organization Quality of Life questionnaire (WHOQOL-BREF) created by the Whoqol Group (The Whoqol Group, 1998). The scale used includes four different domains: physical health (7 items), psychological health (6 items), social relationships (3 items), and environment (8 items). We calculated the mean of each domain for each participant. Higher scores indicate higher quality of life.

Life satisfaction is the explicit and conscious evaluation of people's lives, based on factors that the individual deems relevant (Diener, Lucas & Oishi, 2018). It was assessed using the five-item questionnaire for the subjective assessment of global life satisfaction –Satisfaction With Life Scale (SWLS)– (Diener, Emmons, Larsen & Griffin, 1985; Vázquez, Duque & Hervás, 2013), employing a seven-point answer format (from 1 = strongly disagree to 7 = strongly agree). Mean scores were calculated for each participant. Higher scores represent higher life satisfaction.

We developed a scale to assess how many negative experiences with public toilets people suffer in their daily lives: the Negative Experiences with Public Toilets questionnaire (NEPT). Items were generated using qualitative data from three focus groups with four participants each. All participants were suffering from inflammatory bowel disease and had to make constant and urgent use of public toilets. All t12 participants (five men) were frequent public toilet users. All the participants worked outside their homes. Moderators asked the participants to share situations they faced in public toilet use and let participants talk about their experiences with public toilets. The focus groups lasted for about two hours, taking fifty minutes to talk about general inconveniences of illness before handling the specific questions about public toilets difficulties. The items we generated were based on the comments from the qualitative information gathered making statements which capture all the situations described by the participants checking that the situations

are different between them. The sessions were recorded as notes by the two moderators. Categories were double-checked by mapping the words onto labels and assigning each comment to a label (Braun & Clarke, 2006).

NEPT, therefore, sums up the negative experiences of people constantly exposed to the need to use public toilets (see Table 1). Response options were: "One or more times a day," "More than once a week," "About once a week," "About once a month," "About once every three months," "About once every six months" and "Never happened to me." We calculated the mean of the numerically coded responses. We numerically coded the frequency, taking the "Never happened to me" label as 1 and "One or more times a day" as 7. Therefore, the higher the score, the more negative situations with public toilets the participant faced. The NEPT scale showed high internal consistency, with a mean inter-item polychoric correlation (0.55; min = 0.42, max 0.83.) Cronbach's alpha is above the 0.80 threshold ($\alpha = 0.90$).

Analysis

We have provided descriptive statistics for the variables of interest by health status and gender with Welch's *t*-test to qualify the differences. We have also reported Spearman correlations between NEPT scores and all the control variables and outcomes of interest. We compared women and men and TDI and non-TDI participants (RQ1) by performing two regressions to predict the NEPT scores. The first model only included the control variables excluding gender (M1), and the second model (M2) included gender and being TDI as an interaction.

We tested the association of being TDI and negative experiences with public toilets with satisfaction and quality of life (RQ2, RQ3, and RQ4) by performing hierarchical linear regressions. We used four quality of life scores from the WHOQOL-BREF questionnaire and the satisfaction with life score (SWLS) as dependent variables. We tested four different models for each outcome. The first model took the control variables – socio-economic status, gender, age, town/city size, frequency of public toilet use for defecation, family income, and subjective socio-economic status – as the baseline model (M1). The second model added health status as a predictor (M2). The third included NEPT scores (M3), and the last model expanded the latter by including an interaction between NEPT and health status (M4). This hierarchical regression strategy allows us to estimate the level of explained variance in well-being by considering experiences with public toilets beyond the relevant control variables already considered.

The selected control variables were known to be related to the quality of life and life satisfaction. The selected variables are objective and subjective assessments of socio-economic status (Kushlev, Drummond & Diener, 2020; Operario, Adler & Williams, 2004; Ruggeri, Garcia-Garzon, Maguire, Matz & Huppert, 2020) and age (Baird, Lucas & Donnellan, 2010; Raggi, Corso, Minicuci *et al.*, 2016). Also, existing literature suggests that town or city size also plays a role in the reported indicators of quality of life and life satisfaction (European Commission. Directorate General for Regional Policy, 2013; Rautio, Filatova, Lehtiniemi & Miettunen, 2018). We included the frequency of use of public toilets as the use of public restrooms could be related to the dependent variables.

We reported unstandardized coefficients for the predictors of interest, adjusted R^2, the increment of adjusted R^2 for each model, and the F value of the ANOVA. Continuous variables were mean-centered before the analysis. Full models are presented in the supplementary material. Multiple regression model assumptions were visually checked (Lüdecke, Ben-Shachar, Patil, Waggoner & Makowski, 2021). All analyses were performed with the R Statistical Software (R Core Team, 2022) and the *easystats* packages (Lüdecke, Ben-Shachar, Patil & Makowski, 2020; Lüdecke, Ben-Shachar, Patil, Waggoner & Makowski, 2021). Graphical displays were made with *ggplot2* and *tidyverse* (Wickham, Averick, Bryan *et al.*, 2019; Wickham, Cook & Hofmann, 2015). Data and R code to reproduce the analysis is available in a supplementary online open repository (https://osf.io/mt7ju/?view_only=f34bcc9da4d541fe84e0ffeb9dd8e02c).

RESULTS

Descriptive results and correlations

TDI participants tended to score higher in NEPT scores (see Table 1) than their non-TDI counterparts and lower in the WHOQOL-BREF scores, particularly in physical health-related quality of life. Lower differences were found in the quality of life scores for psychological and social relationships. TDI participants also scored lower than non-TDI participants in environment-related quality of life. Regarding SWLS scores, we found the same pattern of lower scores for the TDI group.

A similar pattern emerged for gender differences. Women scored higher in the NEPT score than men. All the quality of life scores were lower for women, including their physical health, psychological and environmental quality of life. We did not find statistically significant differences regarding gender for social relationships or SWLS scores.

The Spearman correlation analysis revealed that NEPT scores are negatively associated with family income, subjective social status and educational level and positively with the frequency of toilet use to defecate, being TDI and being a woman (see Table 2). Regarding the quality of life scores, NEPT scores were negatively associated with physical health, psychological and environmental quality of life. The results showed a significant negative association between SWLS and NEPT, and no other relationships with NEPT scores were found to be statistically significant.

Differences in NEPT

We compared two regression models to predict NEPT scores, M1, which only had control variables and M2, which included the interaction between gender and TDI status among the control variables. We selected model M2 ($F[540, 3] = 17.91$, $p < 0.001$), which explained 22% of the adjusted variance and an increase of 7% over the only control model. In Fig. 1, a visual depiction of marginal means and the distribution of scores for each group is shown. TDI participants showed statistically significant higher

Table 2. *Spearman correlation between variables and NEPT score*

Variable	*r*, 95% CI, *p*
WHOQOL physical health	**−0.33 [−0.41, −0.25], $p < 0.001$**
WHOQOL psychological	**−0.21 [−0.29, −0.12], $p < 0.001$**
WHOQOL social relationships	−0.07 [−0.16, 0.01], $p = 0.082$
WHOQOL environment	**−0.27 [−0.35, −0.19], $p < 0.001$**
SWLS	**−0.19 [−0.27, −0.10], $p < 0.001$**
Age	0.00 [−0.87, 0.08], $p = 0.975$
Income	**−0.11 [−0.19, −0.02], $p = 0.001$**
Subjective socio-economic status	**−0.11 [−0.19, −0.02], $p = 0.001$**
Educational level	**−0.11 [−0.19, −0.02], $p = 0.001$**
Public toilet use for defecation	**0.31 [0.23, 0.39], $p < 0.001$**
City size	0.00 [−0.08, 0.09], $p = 0.937$
Being a woman	**0.14 [0.06, 0.23], $p < 0.001$**
Being a TDI	**0.36 [0.28, 0.43], $p < 0.001$**

Notes: TDI stands for toilet-dependent ill people, while SWLS stands for Satisfaction with life score. Being a woman and being TDI is coded as one. Bold-shaded values represent statistically significant correlations.

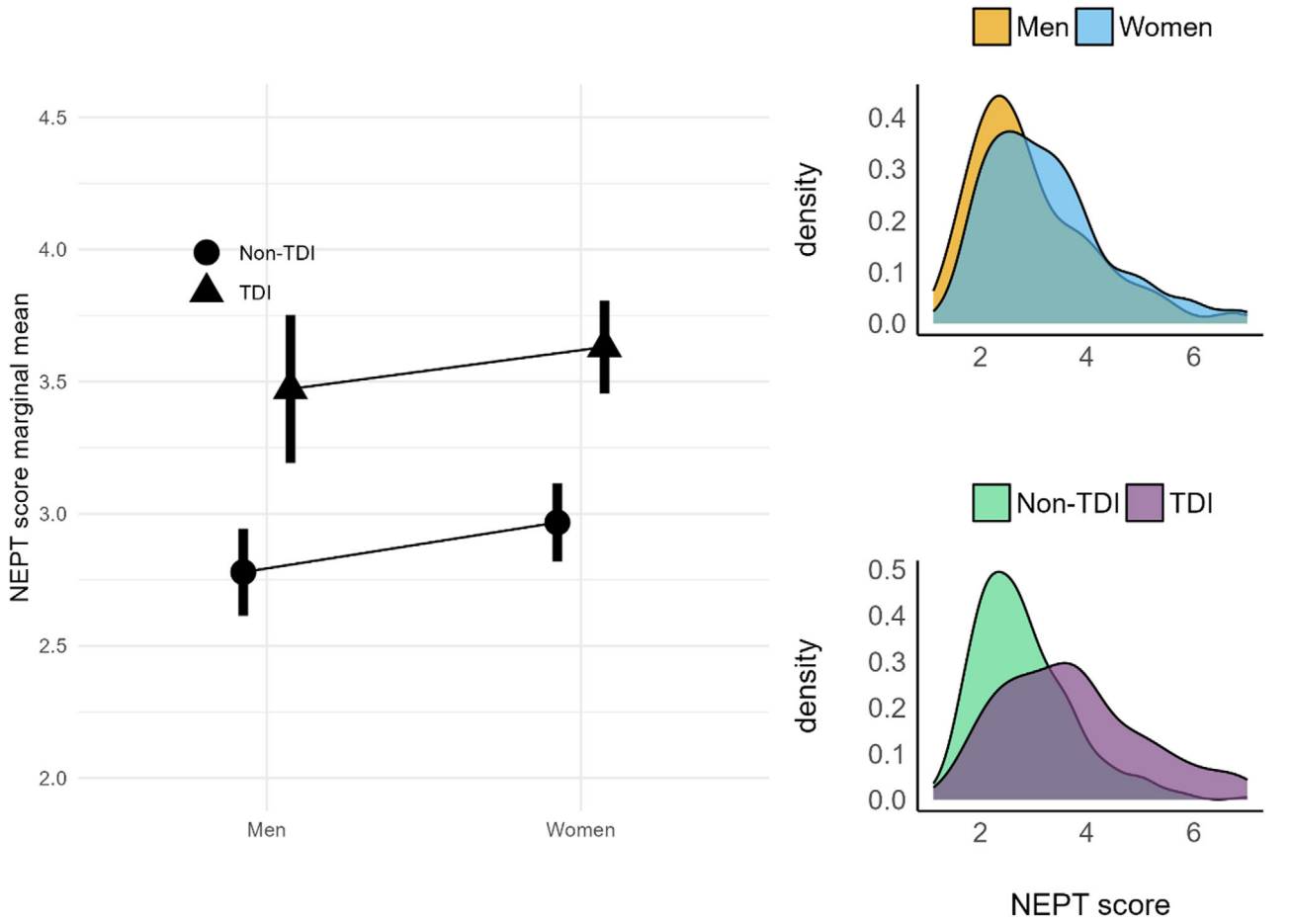

Fig. 1. Estimated marginal means and density plots of the NEPT scores by gender and TDI condition. *Note*: Vertical lines represent a 95% CI for the estimated marginal mean.

Table 3. *Adjustment indices for each step of the hierarchical regressions and coefficients*

	WHOQOL physical health		WHOQOL psychological		WHOQOL Social relationships		WHOQOL environment		SWLS	
	Model R^2	Incremental R^2, F and p compared to the previous model	Model R^2	Incremental R^2, F and p compared to the previous model	Model R^2	Incremental R^2, F and p compared to the previous model	Model R^2	Incremental R^2, F and p compared to the previous model	Model R^2	Incremental R^2, F and p compared to the previous model
M1	**0.18**	**–, 17.95, $p < 0.001$**	**0.19**	**–, 18.94, $p < 0.001$**	**0.07**	**–, 6.82, $p < 0.001$**	**0.32**	**–, 38.73, $p < 0.001$**	**.30**	**–, 34.87, $p < 0.001$**
M2	**0.26**	**0.08, 70.89, $p < 0.001$**	**0.20**	**0.01, 8.67, $p = 0.003$**	0.07	0.00, 3.57, $p = 0.059$	**0.34**	**0.02, 11.52, $p < 0.001$**	**.32**	**0.01, 12.89 $p < 0.001$**
M3	**0.32**	**0.06, 46.20, $p < 0.001$**	**0.22**	**0.02, 14.53, $p < 0.001$**	0.07	0.00, 0.35, $p = 0.477$	**0.37**	**0.03, 31.51, $p < 0.001$**	**.33**	**0.02, 15.36, $p < 0.001$**
M4	**0.33**	**0.01, 15.20, $p < 0.001$**	0.22	0.00, 0.80 $p = 0.370$	0.07	0.00, 2.62, $p = 0.105$	0.37	0.00, 2.18, $p = 0.140$	**.34**	**0.01, 7.41, $p < .001$**

Notes: Statistically significant results ($p < 0.05$) are shown in bold. R^2 refers to the adjusted fit index. M1 = only controls model, M2 = previous model including TDI status as a predictor (being TDI or non-TDI), M3 = previous model including NEPT scores as a predictor, M4 = previous model including the interaction between health condition and NEPT scores. Shaded cells denote the model selected.

NEPT scores (b_{TDI} = 0.69, 95% CI [0.36, 1.02], t[540] = 4.12, $p < 0.001$). The model also predicted higher but not statistically significant NEPT scores (b_{women} = 0.19, 95% CI [−0.03, 0.42], t[540] = 1.69, $p = 0.091$) for women regarding men. The interaction term was not significant and close to zero ($b_{TDI\ x\ women}$ = −0.03, 95% CI [−0.42, 0.36], t[540] = −0.15, $p = 0.883$).

TDI and quality of life and life satisfaction

For the five dependent variables (satisfaction with life and four dimensions of quality of life), adjustment of each model and incremental adjustment for each step are presented in Table 3. The regression models showing the relationship between those variables and NEPT score by the toilet-dependence condition, as

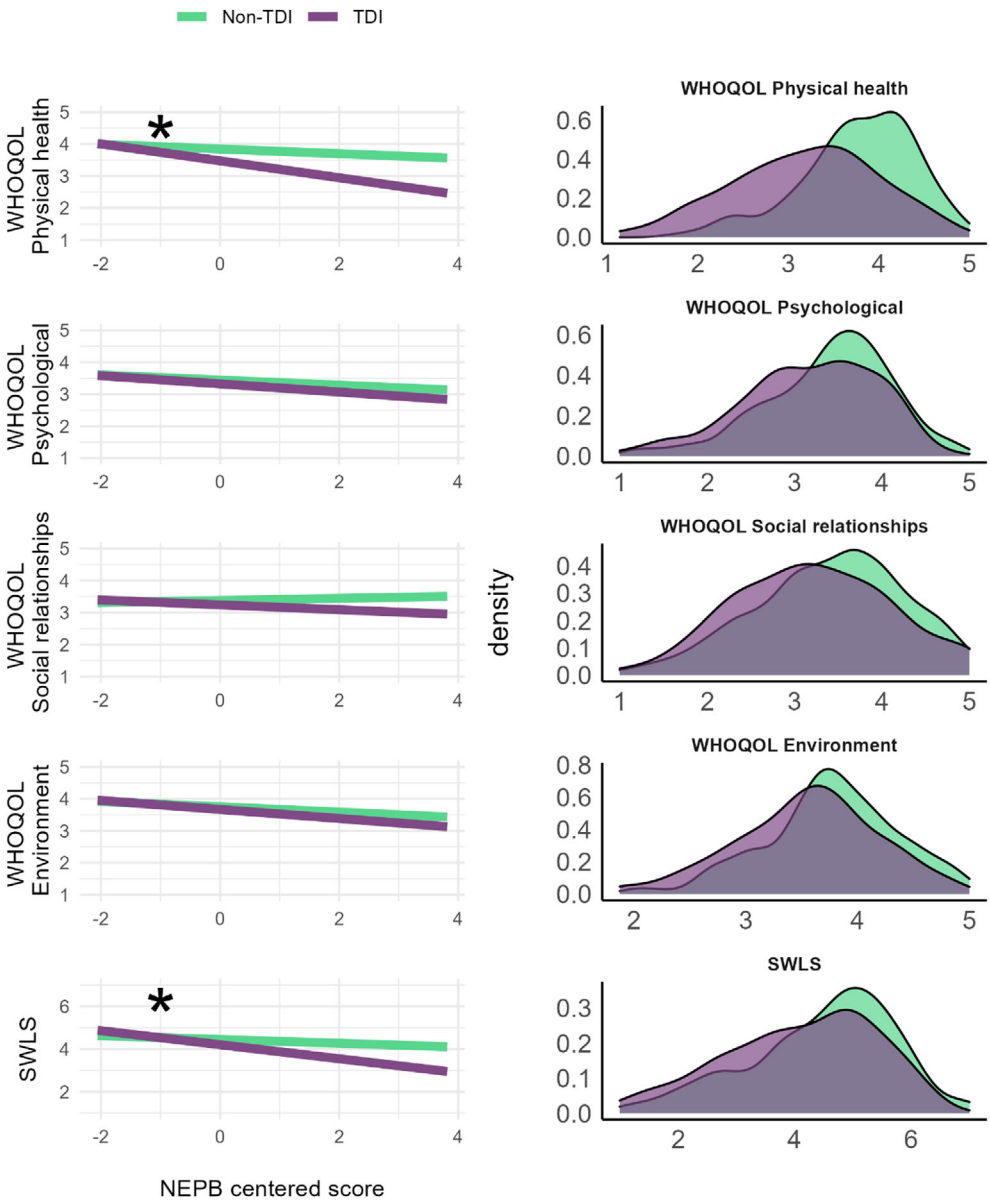

Fig. 2. Estimated regressions lines and density plots of the predicted variables. *Notes*: Left panels: estimated regression lines for each group (TDI and non-TDI). Asterisks denote a statistically significant interaction. Right panels: density plots of each predicted variable by each group.

well as distributions of each predicted variable by each group, can be seen in Fig. 2. In the supplementary material, we present the complete regression coefficients.

Physical health-related quality of life. For the physical health scale, we selected as our final model for interpretation M4, which included the interaction between health conditions and NEPT scores. It showed a statistically significant increase in variance explained when compared to M3 (i.e., same model without interaction; $F[539, 1] = 15.20$, $p < 0.001$). This model explained 34% of the variance, representing a 15% increase in explained variance compared to the control model (M1). Our results indicate that NEPT scores were negatively associated with physical health, with this negative relationship being significantly stronger for TDI individuals ($b_{TDIxNEPT} = -0.19$, 95% CI [−0.29, −0.09], $t[539] = -3.89$, $p < 0.001$).

Psychological quality of life. For the psychological quality of life, we selected M2, which included TDI status as a predictor ($F[540, 1] = 14.53$, $p < 0.001$). It explained 20% of the total variance, with a 1% increase over the only control model (M1). NEPT scores were significantly and negatively associated with psychological quality of life ($b_{NEPT} = -0.11$, 95% CI [−0.16, −0.05], $t[540] = -3.81$, $p < 0.001$). The model also predicted a lower, although not statistically significant, psychological quality of life for TDI people ($b_{TDI} = -0.07$, 95% CI [−0.25, 0.01], $t[540] = -1.78$, $p = 0.075$).

Social relationship-related quality of life. For the social relationship-related quality of life, M1 was the selected model ($F[541, 1] = 2.52$, $p = 0.060$). That is, the inclusion of gender and TDI group did not improve the explained variance ($R^2 = 0.00$).

Environmental quality of life. The model which predicted environmental quality of life the best was the one with experiences and TDI status as a predictor (M3). It showed a significant step up over the previous model M2 (i.e., the model which included being TDI as a predictor; $F[540, 1] = 32.21$

$p < 0.001$). The model selected explained 38% of the variance with a 3% increase compared to M1 (i.e. the only control model). The chosen model (M3) predicted a worse environmental quality of life for TDI participants, but the coefficient was not statistically significant ($b_{TDI} = -0.09$, 95% CI [−0.18, 0.01], $t[540] = -1.72$, $p = 0.087$). We found a significant negative relationship between negative experiences and environmental quality of life ($b_{NEPT} = -0.11$, 95% CI [−0.15, −0.07], $t[540] = -5.61$, $p < 0.001$).

Satisfaction with life. We selected the M4 model for the SWLS scores, which included the interaction between health conditions and NEPT scores. This model explained 35% of the variance, and an increase of 4% was explained regarding the only control model (M1). It showed a significant increase when compared to M3 (i.e., NEPT scores and TDI status as fixed effects but no interaction; $F[539, 1] = 7.28$ $p < 0.001$). Our results suggested a negative relationship between NEPT scores and reported satisfaction with life. This negative relationship is significantly stronger for TDI individuals ($b_{BDxNEPTI} = -0.23$, 95% CI [−0.39, −0.06], $t[539] = -2.72$, $p = 0.007$).

DISCUSSION

Our study examined the association between negative experiences with public toilets and life satisfaction and quality of life. We did it by developing a new scale to assess the negative experiences related to public toilets. We found that TDI participants suffered more negative experiences with public toilets. These negative experiences with public toilets were associated with lower scores in some domains of the quality of life (physical health, psychological and environmental quality of life) and life satisfaction of TDI and non-TDI people. However, we found that these negative experiences had a different impact on TDI people regarding physical health-related quality of life and life satisfaction.

As far as RQ1 was concerned (role of gender and being TDI on the number of negative experiences with public toilets), we found a high impact of being TDI on negative experiences with public toilets. However, we found no gender association. In other words, TDI participants suffered more negative experiences with public toilets, meaning they had more negative experiences than a non-TDI counterpart. Thus, TDI participants carry a more significant burden of negative public toilet experiences. Being a TDI is associated with the threat of negative experiences caused by an environment which is not providing adequate care. As far as gender association is concerned, we did not find statistically significant coefficients. However, future research may clarify whether women are more vulnerable to gastrointestinal and urogenital diseases and toilet-related problems specific to women.

We found that being TDI is associated with adverse outcomes regarding physical health-related quality of life and life satisfaction (RQ2: association of being TDI on quality of life and life satisfaction indicators). Our results suggest that the term TDI may identify a group of people with a particular unmet need due to a public health issue: deficient public toilets. These results have practical implications regarding practitioners working with TDI people to acknowledge the critical role that negative public toilet experiences can play in assessing physical health and life satisfaction.

We also found that negative experiences with public toilets are associated with a lower quality of life and life satisfaction in physical health, psychological and environmental terms, (RQ3: association between negative public toilet experiences and quality of life and life satisfaction) irrespective of whether a person is TDI or not. This statistically significant effect of loss of quality of life is higher in environmental and physical health terms. Negative experiences with public toilets are related to restrictions on people's independence, limiting their activity, and increased discomfort (Prodgers & Gough, 2021; Trindade, Ferreira & Pinto-Gouveia, 2020) and a worse assessment of the environment in which they live and their health status. Also, correlation analysis showed that socio-economic factors like low income and low educational level are related to more negative experiences with public bathrooms. One explanation for these results could be that people from lower socio-economic status may face a more challenging environment, resulting in less equipped public toilets. Our results suggest that negative experiences with public restrooms are not statistically related to the social relationship domain of the quality of life questionnaire. In other words, we did not find a link between negative toilet experiences and the degree of personal relationships and social support reported by participants. One plausible explanation may be the particularities of Spanish solid social networks (Alonso, 2012), which may diminish the effect of bad experiences with public toilets on personal relationships. However, future studies may have to look at specific mechanisms which led to these results.

As far as the differential impact of NEPT scores on being a TDI was concerned (RQ4: association between negative experiences with public toilets is similar for TDI and non-TDI people on quality of life and life satisfaction), we found that negative experiences with public toilets are associated with a deeper loss in physical quality of life and life satisfaction for TDI participants than non-TDI participants. The results may be interpreted as TDI participants weighing the contribution of good public toilets more than non-TDI participants. This interpretation is aligned with literature in which TDI people, such as inflammatory bowel disease patients in this case, report that access and quality of public toilets is a critical issue in their daily lives (de Rooy, Greenberg & Cohen, 2001; Norton, Thomas, Lomax & Dudley-Brown, 2012; Trindade, Ferreira & Pinto-Gouveia, 2020).

In our study, we estimate that loss of well-being associated with a flawed system of public toilets, which generates negative experiences for almost everyone, is a small but relevant link. Societies that want people to pursue a healthy lifestyle of complete physical, mental and social well-being and not merely the absence of disease – the terms set out by the World Health Organization (The Whoqol Group, 1998) – must take care of public toilets. Implications are broad and are of concern to urban planners, community social actors and political decision-makers. In light of the evidence, decision-makers involved in designing, maintaining, and owning public toilets in different organisations, from town halls to managers of hotels and restaurants, must grasp the idea of public toilets as a well-being provider rather than a threat. These needs may be more relevant to people who suffer

from a TDI condition. Still, it may be noted that the design and plan to benefit disadvantaged or vulnerable groups end up helping society as a whole (Glover, 2017).

This study has some limitations. First, the cross-sectional nature of the design limits the causal inferences. Also, the non-random sampling makes it impossible to make population estimations and limits the study to estimate relationships between variables. Another caveat is the non-inclusion of a current issue regarding public toilets, which is the effect on transgender and gender non-conforming communities (Patel, 2017; Wernick, Kulick & Chin, 2017). They are groups that are difficult to reach and have specific problems beyond this study's scope and research resources.

However, our study is the first to quantify the effect of the loss of well-being due to an environmental and public health issue that has not been explored enough using both ill and non-ill samples. Our study is the first to reflect quantitatively on the impact on the quality of life of deficient public toilets in the general population. Future studies must assess specific problems with toilets in different environments, like those toilets used outside the home in job areas.

CONCLUSION

Recent reports point to public toilets as an urban health problem (The Lancet Gastroenterology & Hepatology, 2022; Webber, 2018). However, the specific impact on quality of life was not considered until now. We showed how public toilets provide negative experiences with implications on well-being, especially for people with illnesses related to constant toilet use (TDI people). Regarding the loss of well-being, it is stronger in terms of environmental and physical quality of life. Also, we provide a tool to assess these negative experiences, and we shoed relations with several risk factors associated with them. Remove barriers for people with special needs and creating a healthier relationship with public toilets is a necessary step in addressing the needs of citizens regarding public toilets.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Supporting Information.

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