



Student perspectives on sustainability: examining pro-environmental behaviors in tourism through latent class cluster analysis

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Abstract

Tourism has emerged as a significant driver of the global economy. As its economic impact grows, concerns regarding environmental sustainability have intensified. This paper highlights the critical role of young tourists, who exhibit a heightened awareness of environmental issues and advocate for sustainable practices. By conducting a survey among young Italian university students, the study identifies distinct segments based on family background, self-defined political orientation, and travel habits. Using latent class cluster analysis, the findings aim to improve understanding of pro-environmental behaviors among youth, offering insights for policy makers to foster sustainable tourism practices, fine-tune communication, incentives, and pricing, and advance sustainable tourism through evidence-based strategies.

Keywords Young tourists · Sustainable tourism · Latent class cluster analysis · Pro-environmental behavior

1 Introduction

Tourism is a driving sector of the modern economy and has experienced a profound expansion in recent decades. Although hard-to-predict events, such as the COVID-19 pandemic that slowed tourism growth in 2020–2021, the World Travel and Tourism Council (WTTC 2022) indicates that tourism contributes 7.6% of global GDP. Similarly, the labor market also benefits from the effects of the tourism sector, which created 22 million new jobs

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worldwide in 2022 (WTTC 2022). As the tourism sector became a more significant part of the economy, concerns about its impact on the environment began to arise.

The issue of environmental sustainability in general has become of paramount importance nowadays, especially in human activities that can induce a progressive deterioration of natural resources, such as, among others, tourism (Weaver 2014). The WTO provided a widely accepted definition of sustainable tourism in 1993, stating it as “*Tourism that meets the current needs of tourists and host regions while preserving and enhancing opportunities for the future*”. Various actions have been taken by governments and institutions to address the negative impact of tourism on the environment, including the implementation of the European Charter for Sustainable Development (Europarc Federation 2010) and the ETIS toolkit (ETIS 2017). This problem has been approached in the literature from two sides, one focused on exploring the relationship between tourism supply and sustainability (e.g., Massidda and Etzo 2012; Xu and Dong 2020), and another investigating the characteristics of the demand for tourism and tourists (e.g., Ashraf et al. 2020; Han 2021). The latter state that the behavior of tourists can significantly reduce the environmental impacts of tourism (Xu and Dong 2020; Wang et al. 2020; Wu et al. 2021), achieving sustainability in the sector (Bridges and Wilhelm 2008; Garvey and Bolton 2017). Following this road, it seems clear that of great importance in preserving the environment of tourist destinations is the point of view of the tourists and their attitude to implement green practices. Analyzing tourists means identifying groups of them with common characteristics, so that they correctly identify demand segments to define long-term destination strategies (Dolnicar 2004) and to understand the dynamics of destination environmental sustainability.

An interesting focus can be made on a specific subgroup of tourists, namely young people. Since attention to the environment is a relatively recent issue, younger age groups are those more involved in its preservation. The new generations exhibit a greater awareness of environmental degradation and advocate for the imperative shift towards sustainable practices in human endeavors, aligning with long-term sustainability goals. Moreover, the engagement of young people in environmental protection assumes paramount importance, serving dual purposes: firstly, they play a pivotal role in comprehending the future trajectory of sustainable tourism trends; secondly, they represent the cohort upon which proactive measures must be directed to instigate a shift towards more sustainable consumption patterns among future generations, thereby fostering environmental sustainability within the tourism sector (Pendergast 2009; Vukic et al. 2015).

The present paper focuses on young tourists and endeavors to explore their desire for toward pro-environmental behavior based on individual characteristics, family history, social context, and travel habits. The main goal of the present research is to find segmentation patterns by means of latent class cluster analysis on the youngster that can ensure greater commitment towards the reduction of the environmental footprint of tourism. To investigate the phenomenon, a survey was conducted on young Italian students at the university level. This study is the first to reveal a willingness–recollection gap among Italian Gen-Z tourists—youth who say they would pay for eco-certified lodging but cannot remember ever using one—thereby shifting the literature from the well-known intention–behavior paradox to the under-explored problem of eco-signal salience.

The paper is structured as follows. A review of the relevant literature on sustainable tourism and the pro-environmental behavior, especially of young tourists, is presented in Sect. 2, while Sect. 3 introduces the implemented statistical methodology. The data used for

the classification are discussed in Sect. 4 and the results are presented in Sect. 5, providing valuable insights to contribute to the existing literature and offering suggestions for policy makers. Remarks in Sect. 6 summarize key findings, proposes avenues for future research and discuss limitations of the study. Section 7 concludes the paper.

2 Literature background

Given the economic and social importance of the tourism sector globally and given the magnitude of the environmental impacts resulting from this massive industry, sustainable tourism is an increasingly studied topic by researchers (see, e.g., Butler 1999; Fayos-Solà et al. 2014; Lu and Nepal 2009). However, despite the fact that a considerable number of indicators have been offered in the literature to drive improvements in environmental sustainability in tourism, the actual implementation of these indicators and the resulting outcome has been poor (Madhavan and Rastogi 2013). It means that the successful transition of tourism to sustainability involves a multifaceted process encompassing various dimensions, including the natural environment, economic viability, and societal welfare, along with various individual-related aspects such as external, philosophical, and internal challenges (Stremikiene et al. 2021). Thus, it is clear that individuals play a crucial role in the protection of the environment, by means of sustainable consumption behaviors (Wang et al. 2020). In this framework, Han (2021) reports the terms *environmentally responsible behaviors*, *environmentally sustainable behaviors*, *environmentally protective/preserving behaviors*, *ecological behaviors*, and *green behaviors* as referable to the same expected behavior in this direction. Tourists impacted by such a new awareness also prompted tour operators capable of providing green experiences (Wang et al. 2018). Several studies have delved into the behavioral and motivational aspects of the *sustainable tourist*, identifying at least four distinct segments: the ecotourist (see, e.g., Beall and Boley 2022), nature-based tourist (see, e.g., Fredman et al. 2012), responsible tourist (see, e.g., Goodwin 2016) and green tourist (see, e.g., Dolnicar and Matus 2008). In studies focusing on tourism demand, particularly within the realm of ecotourism, Blamey (2001) emphasizes nature, education, and sustainability as primary criteria for delineating the ecotourist segment. Similarly, Khanra et al. (2021) underscore the importance of sustainable behavior and reflections on the carbon footprint in travel as critical areas that warrant further research. Important contributions on the subject have also been made by Weaver and Lawton (2007), who distinguishes hard from soft ecotourists according to the degree of motivation that drives their behavior and to the willingness to pay premium prices to support sustainable travel practices, showing that true ecotourists are rare and concentrated in wealthier countries. However, the defined categories lack precise delimitation, exhibiting both behavioral and attitudinal overlaps, along with individual characteristics such as age, occupation, and education (Buffa 2015).

Recently, increasing attention has been directed to young people as current and prospective consumers of tourism services and products (Leask et al. 2015). Within the tourism sector, researchers (see, e.g., Pendergast 2009; Williams et al. 2010) have dedicated efforts to studying Generation Y (namely, born between 1981 and 1996) and Generation Z (namely, born after 1997). Despite ongoing debate about differences between the two, these younger cohorts share defining characteristics that markedly differentiate them from previous generations. As noted by Moscardo et al. (2011), emerging generations display distinctive skills,

behaviors, and values, possess enhanced communication abilities, a high proficiency in the English language, and enjoy rapid access to a vast array of information through readily available technology (Yeoman et al. 2010). Furthermore, they represent the first cohort to primarily socialize online (Reinikainen et al. 2020), generally boast higher levels of education compared to preceding generations (Moscardo et al. 2011), possess abundant resources and discretionary time (Gardyn 2002), and exhibiting a reduced inclination towards saving, preferring present consumption, particularly in pursuit of memorable experiences (Jennings et al. 2009). All these characteristics have contributed to the formation of a generation aware of environmental sustainability issues, which in their tourist behaviors shows different levels of commitment to sustainability (Buffa 2015). Many researchers explore the phenomenon of young ecotourists through the lens of values (Schwartz 1994) and motivations (Fayos-Solà et al. 2014; Gillison et al. 2019), focusing on behavioral aspects and investigating the personality traits of young individuals or perceptions of sustainability (Sánchez-Fernández et al. 2019).

Research on sustainable tourism frequently draws on established behavioral theories to explain why travelers engage in pro-environmental actions. A prominent framework is the Theory of Planned Behavior (TPB), which posits that behavioral intentions are jointly determined by an individual's attitudes toward behavior, perceived social pressures (subjective norms), and perceived behavioral control (PBC) over behavior (Menegaki and Tugcu 2025). This theory has been widely applied in tourism studies to understand eco-friendly practices. For example, tourists are more likely to adopt pro-environmental behaviors (such as choosing eco-friendly accommodations or reducing waste) when they hold positive attitudes toward sustainability and feel capable of making a difference (Menegaki and Tugcu 2025). TPB provides a useful lens by suggesting that such attitudes and social influences must be coupled with a sense of control or ability to predict actual sustainable behaviors. In particular, recent work underscores that extending TPB with personal moral norms (i.e. an internal sense of ethical obligation) can enrich its explanatory power for ethical tourism decisions (Menegaki et al. 2024). An extended TPB framework including moral norms offers a robust account of young tourists' willingness to pay (WTP) for sustainable services, as it captures both classic social-cognitive predictors and internalized ethical drive (Menegaki et al. 2024). By integrating these constructs, the framework helps bridge the gap between pro-environmental intentions and actions in tourism (Menegaki et al. 2024).

Another relevant perspective is the Value-Belief-Norm (VBN) theory, which emphasizes the role of deeply held values and personal norms in driving environmental action. VBN theory proposes that pro-environmental behavior flows from one's core environmental values, the belief in the threat and consequences of environmental problems, and the activation of a personal norm or moral obligation to act (Menegaki and Tugcu 2025). This lens is very pertinent to understanding the variation in youth tourism sustainability commitments. It helps explain why some young travelers are more willing than others to make personal sacrifices (e.g. paying a premium for eco-certified accommodations or choosing low-carbon travel options) in order to reduce their environmental impact (Menegaki and Tugcu 2025). Those youth who strongly embrace altruistic and biospheric values (e.g., caring about nature and future generations) are likely to feel a stronger moral duty to act sustainably, translating into greater willingness to pay for green tourism offerings. Empirical evidence supports this connection between values and WTP: tourists with a stronger pro-environmental value ori-

entation (and awareness of environmental issues) tend to demonstrate a higher willingness to pay for green initiatives (Menegaki and Tugcu 2025).

Beyond these cognitive theories, it is crucial to consider the quality of motivation behind pro-environmental behavior, as described by Self-Determination Theory (SDT). SDT distinguishes between extrinsic motivations (doing something due to external pressure or reward) and intrinsic motivations (doing something out of inherent interest or personal conviction). In the sustainability context, this distinction maps onto the difference between acting due to social expectations and acting due to internal values. In particular, the integration of a moral norm into TPB already reflects an attempt to capture intrinsic motivation (i.e., an internalized sense of doing the right thing) as opposed to mere compliance with external social norms (Menegaki et al. 2024). Recent studies suggest that pro-environmental actions in tourism are often driven more by personal conviction than by social pressure. For example, Menegaki et al. (2024) found that while young consumers generally care about environmental issues, external social influences (subjective norms) alone have little effect on their willingness to pay a premium for eco-certified hotels. Instead, the decision to support sustainability appears to be a “personal and individual decision” grounded in one’s own values and perceived responsibilities. This insight resonates with SDT: Youth who identify strongly with sustainable principles (intrinsic motivation) are more likely to consistently engage in and pay for green tourism practices, whereas those acting only due to external encouragement may waver if that encouragement fades. In summary, aligning sustainable tourism offerings with the internal motivations of young travelers (e.g., the desire to act according to their values) while also strengthening supportive social norms can significantly strengthen their pro-environmental behaviors.

With this paper, we underscore the conceptual relevance of our focus on the motivations of youth and the willingness to pay for sustainability. These theories collectively illuminate how attitudes, social influences, personal values, and motivation types interact to shape pro-environmental behavior in the tourism context. The sustainability behaviors of young tourists can be understood as the result of both psychosocial factors and internalized ethical commitments. This theoretical framework not only addresses the motivational structures behind youth pro-environmental action but also justifies our investigation by linking the observed patterns (from latent class analysis) to established constructs. Finally, focusing on environmental motivations among young travelers is crucial, as these are likely to lead to more enduring and impactful pro-environmental engagement in the future (Menegaki 2025).

3 Latent class cluster analysis

To explore patterns of varying propensities for environmental sustainability, a cluster analysis method, namely Latent Class Cluster Analysis (LCA), must be employed. LCA operates as a probabilistic algorithm, presuming that the data originate from a multivariate distribution (or mixed-mode data, as termed by Everitt 1988; Everitt et al. 1992), which models the probabilities of an observation belonging to each cluster. It is crucial to note that in LCA, membership probabilities (which dictate the number and nature of clusters) are defined post-hoc, i.e., determined by the data themselves based on whether they belong to the latent class. LCA falls within the category of mixture models, as cluster membership is not defined

univocally; rather, it is expressed in terms of a higher or lower probability of membership in latent classes based on manifest variables (Wedel and Kamakura 2000). Several researchers (e.g., Rigdon et al. 2010) have highlighted the limitations of a priori methods compared to a posteriori method (Wedel and DeSarbo 1994), especially when analyzing questionnaire results, where the assumptions about clusters made a priori by the researcher may not adequately capture response diversity (DeSarbo and DeSarbo 2001). The data-driven, a posteriori nature of segments or clusters constitutes a considerable advantage in analyses involving categorical variables (i.e. surveys) because its probabilistic nature facilitates addressing the prevalent issue of heterogeneity (e.g., Kamakura and Wedel 1995; Vermunt and Magidson 2002), which can distort or invalidate segmentation analyses, particularly when attempting to identify patterns not directly observable (e.g., attitudes towards sustainability). Thus, through LCA, researchers can uncover unobserved and often unobservable characteristics, enabling them to offer a segmentation that accounts for the heterogeneity resulting from the unobservability of classes themselves. Finally, a further advantage of LCA over other segmentation methods is that it provides an objective and formal measure for determining the exact number of clusters. Using the Bayesian information criterion (BIC, i.e. a decreasing function of the sum of the squares of the residuals of the estimated model, expresses a measure of goodness of fit), it is easy to compare different models, assuming an increasing number of latent classes, and finally choosing the one with the lowest BIC (i.e. the model that minimizes the sum of the squares of the residuals).

The following is the formal algorithm of the latent class cluster analysis for mixed variables (Vermunt and Magidson 2002):

$$f(\mathbf{y}_i|\theta) = \sum_{k=1}^K \pi_k \prod_{j=1}^J f_k(y_{ij}|\theta_{jk})$$

In this formalization:

- y_i represents the vector of observed variables (endogenous variables, items, or dependent variables) for observation i , reflecting the scores of an individual object on the observed variables. Conditional independence within latent classes is assumed.
- $\sum f(y_i|\theta)$: is the joint probability density of the sets of variables y_{ij} for observation i conditional on the model parameters θ . This represents the joint distribution of variables for an observation within the dataset.
- $\sum_{k=1}^K$: indicates the sum over all K latent classes in the model. In LCA, K represents the number of k unobserved latent classes or groups in the dataset.
- π_k : is the parameter representing the a priori probability of an observation belonging to a latent class k . In other words, π_k is the probability that a randomly chosen observation belongs to class k before observing the data.
- $\prod_{j=1}^J$: indicates the productivity on all variables j in the set of variables \mathbf{y}_i .
- $f_k(y_{ij}|\theta_{jk})$: is the conditional probability density model for variable j for the latent class k , which describes the distribution of the variable y_{ij} for observation i given membership of class k .
- θ_{jk} are the parameters of the model that define the distribution of the variable y_{ij} for

class k .

To summarize, the formulation describes how the joint probability density of the sets of variables for each observation can be decomposed into a weighted sum of the conditional probability densities for each latent class, where the weights are given by the a priori probabilities of belonging to the latent classes. Within each latent class, the conditional probability density is expressed as the product of the conditional probability densities for each variable within the set of variables. As anticipated, the two most important advantages of using the LCA method in survey-based studies are the ability of the model to fit non-normal distributions of the data (such as nominal or categorical variables) and the lower number of a priori assumptions required by the researcher on the number of clusters. LCA allows the data to express which number of clusters offers the best model (in terms of fit). This can be tested with methods such as likelihood-ratio tests between nested models, or measures such as the Akaike information criterion (AIC), consistent Akaike information criterion (CAIC), and BIC (Fraley and Raftery 1998). These measures consider both the goodness of fit of the model to the data and its complexity, with more complex models being penalized; in general, a model that minimizes BIC over other models is considered preferable. To ensure the robustness of the clusters obtained with LCA, particularly in the absence of access to the entire population of young tourists. However, LCA facilitates the identification of distinct cluster characteristics more effectively, particularly as the algorithm is well-suited for studies involving categorical variables.

In the tourism research domain, LCA has been increasingly applied to segment travelers based on their environmental attitudes and behaviors, aligning with the goals of sustainable tourism studies (e.g. Agyeiwaah and Bangwayo-Skeete 2024; Alarcón-del-Amo et al. 2023). These applications highlight that LCA is well-suited for tourism studies, and it enables researchers to pinpoint clusters of tourists who share similar sustainability-related characteristics, thus informing targeted marketing and policy strategies for sustainable tourism. In particular, the model-based nature of LCA overcomes the limitations of conventional clustering (e.g. k-means) by providing statistical criteria for class enumeration and allowing the inclusion of covariates (such as socio-demographics or travel habits) to better describe each segment (Alarcón-del-Amo et al. 2023).

Beyond tourism, latent class analysis has gained traction in broader social research as a tool for understanding heterogeneous attitudes and behaviors related to sustainability. For example, Bostan et al. (2024) applied LCA to categorize individuals by their participation in sustainable workplace practices and examined how these latent classes correlated with job satisfaction and burnout levels. This exemplifies how LCA can uncover meaningful sub-populations (e.g., employees with high vs. low pro-environmental engagement) that have distinct outcomes, providing valuable insights for organizational interventions. Likewise, in environmental psychology research, LCA has been used to identify unobserved groups of people with different levels of commitment to eco-friendly behaviors, thus enabling customized approaches to promote greener lifestyles (Bostan et al. 2024). The increasing use of latent class techniques across disciplines (from segmenting health-related attitudes to classifying consumer preferences) reflects a recognition that population heterogeneity is crucial to theory and practice and that LCA offers a robust means to capture that heterogeneity. In general, incorporating latent class cluster analysis into tourism research provides a rigorous,

evidence-based segmentation method that complements the sustainable tourism literature (e.g. Agyeiwaah and Bangwayo-Skeete 2024).

4 Data description and presentation

The present study is based on a survey conducted in spring semester 2023 in the University of Trento (North-East of Italy), a middle-size university. The number of students in 2023 was more than 16 thousand, of which more than 60% were non-resident students (and half of these came from neighbor regions). A sample of 300 students was selected by means of convenience sampling, such as a non-probability sampling technique where participants are selected based on their easy accessibility and availability. More precisely, our study was advertised in several social sciences courses, such as during lessons of courses in Economics, Sociology and Literature faculties. After that, the decision to participate in the study was left to the students, who were free to self-enroll on the survey web platform Limesurvey. The choice to proceed in this way was due to two main reasons. First, privacy protection constraints in contacting students, namely, to have access to their personal information including mail address or telephone number, prevented the possibility to select a random sample starting from a list. Second, we followed commonly utilized approaches in sustainability and segmentation literature (e.g., Kim et al. 2015; Barr et al. 2011). We decided to involve in the study only Italian native language students, to avoid bias due to translation or wrong understanding of the questions. Out of the administered questionnaires, 170 were fully completed, with a 57% response rate.

The questionnaire consisted of 14 questions, divided into three main sections. The first section delves into the level of knowledge and perception of young people regarding environmental sustainability within the tourism sector. The second section collects data on travel habits for holidays, expenditure patterns, and attitudes towards sustainable tourism. The final section gathers socio-demographic information, including family history, deemed pertinent for identifying discernible patterns among young people regarding travel habits, consumption behaviors, and awareness of environmental sustainability. We applied traditional validity and reliability checks to the questionnaire, such as face validity with experts in the field, pilot testing with a subset of students, reverse-coding negatively questions, applying principal component analysis and computing Cronbach's Alpha to validate consistency.

As explained in the Introduction, the aim of the present study is to examine young tourists as present and future consumers of tourism products, aiming to discern any distinguishing characteristics among those who demonstrate a heightened awareness of environmental sustainability and a greater inclination towards pro-sustainability behaviors. This includes assessing their propensity to pay a premium for environmentally friendly travel-related activities. To achieve this goal, a two-step approach was taken. Firstly, following an exploratory data analysis, a cluster analysis employing Latent Class Cluster Analysis (LCA) was conducted to outline segments of young tourists. Then, to assess whether there was a statistically significant association between identified groups and propensities to adopt pro-environmental behavior, a χ^2 test was employed.

4.1 Exploratory analysis

Table 1 shows the information on socio-demographic characteristics and travel habits, collected with the questionnaire.

The respondent group was almost equally distributed by sex, with males comprising 57% of the sample. Household income (“H_income”) serves as a pivotal indicator of young individuals’ spending capacity, particularly as many are students with limited personal income. The average household income among participants is approximately €46,000 annually, exceeding the Italian national average for 2023 (€43,800, according to ISTAT data). This discrepancy may be attributed to several factors, notably the regional distribution, with 72% of participants hailing from Northern Italy, known for its higher average income compared to other regions (ISTAT, 2023). Regarding parental education levels (“Mother_edu” and “Father_edu”), most families have at least one parent with a high school diploma (53%), while 21% have attained a university degree, with a higher percentage of maternal graduates compared to paternal. Less than 5% of parents hold advanced degrees such as Ph.D. or second level master’s degree. Respondents were also asked to express their political leanings (“Poli_or”) on five categories (“Extreme left”, “Center-left”, “Center”, “Center-right”, “Extreme right”). Approximately 30% identify themselves as politically centrist, while 46% lean towards right-wing preferences and 25% towards left-wing preferences. This distribution mirrors Italy’s general political landscape in 2022, where the center-right faction secured a majority preference of 44% in the general election. Regarding travel habits (“N_

Table 1 Variables collected with the survey. The variable “H_income” is in €/thousand. The variables “N_trav” and “Parents_trav” are in average/year

	Variable	Answers
1	Sex	A. Male; B. Female
2	H_income	A. <15; B. 15–25; C. 25–35; D. 35–50; E. >50
3	Mother_edu	A. Middle school diploma; B. High school diploma; C. Bachelor’s degree; D. Master’s degree; E. PhD or second level master
4	Father_edu	A. Middle school diploma; B. High school diploma; C. Bachelor’s degree; D. Master’s degree; E. PhD or second level master
5	Poli_or	A. Extreme left; B. Center-left; C. Center; D. Center-right; E. Extreme right
6	N_trav	A. At most one; B. Two/three times; C. More than three
7	Parents_trav	A. At most one; B. Two/three times; C. More than three
8	Book.sus	A. No; B. Yes
9	Sus.accomodation	A. No; B. Yes; C. Don’t know
10	Premium.to.sus	A. No; B. Yes; C. Depends on amount
11	Sus.Impo_general	A. Not at all; B. Little; C. Fairly; D. Very much
12	Sus.Impo_tourism	A. Not at all; B. Little; C. Fairly; D. Very much
13	Sus.Impo_future	A. Not at all; B. Little; C. Fairly; D. Very much
14	Pay.will	A. Yes, sure; B. Yes, but not happily; C. Not at all

trav”), 51% of respondents reported taking between 2 and 3 holiday trips per year, while only 12% take more than 3 trips annually. The remaining 38% take at most one holiday per year. This exploratory analysis reveals a considerable degree of variability among the characteristics of young individuals within the sample. Respondents were called also to give information about the travel habits of their parents. Specifically, 41% report at most one trip per year made by their parents, while only 18% take more than 3 trips annually.

In addition, three other collected variables were considered alongside the travel-related variables. Only 31% of respondents reveal to book sustainable travel programs (“Book.sus”) and only 11% choose to stay in sustainable travel accommodations (“Sus.accomodation”). Moreover, 55% of respondents that claim to do not know if the chosen accommodation adheres to sustainable programs. It is evident that while most sampled young individuals do not prioritize sustainable travel programs when planning their holidays, respondents displayed a certain degree of uncertainty in willing to pay a premium (“Premium.to.sus”) to mitigate their environmental impact. In fact, 16% of respondents support this possibility and 62% claim that it depends on the additional amount to pay. Collected data suggests a potential mismatch between the sustainable initiatives promoted by industry stakeholders and their actual effectiveness in implementation. The data suggests that young tourists may not actively think about sustainable travel programs, but such initiatives are becoming more available on platforms like Booking.com. Despite this, they are still willing to reduce their impact in other ways, such as by paying a premium price. This finding holds significant implications for policymakers and industry operators in terms of strategic planning and communication. Furthermore, over half of the respondents express uncertainty regarding whether they have ever stayed in sustainable facilities, underscoring the potential limitations of current promotional and communicational strategies in driving demand or fostering the ecological transition of the tourism sector. Other variables collected concern young tourists’ perception over environmental sustainability in general (“Sus.Impo_general”), for tourism industry (“Sus.Impo_tourism”), and for future investments in tourism sustainability (“Sus.Impo_future”). Responses to these questions were built on 4-levels Likert scale, according to degree of importance arranged to the sentences. Overall, the majority of young individuals attribute significance to environmental sustainability, both in general (57.6% of “Very much” and 35.3% of “Fairly”) and specifically within the tourism sector (71.2% of “Very much” and 23.5% of “Fairly”). Furthermore, there is a notable acknowledgment of the necessity for future investments to enhance the environmental performance of the tourism industry (61.8% of “Very much” and 27.6% of “Fairly”). These findings align with prior research that underscores the heightened attention and awareness among younger generations towards environmental issues (e.g., Pinho and Gomes 2023). Furthermore, it is observed that the standard deviations for general sustainability (0.73) and future sustainability (0.79) are greater than those recorded for the importance of sustainability in tourism (0.60). This suggests a higher variability and underscores the attention young people seem to place on sustainability within the tourism sector.

The questionnaire also proposed a last question regarding whether the respondent for a flight priced at €140 would be willing to spend 7% more (so €10) to offset their CO_2 emissions generated by the flight. The idea behind the building of this variable (“Pay.will”) was dictated by to test respondents’ reaction in front of a real case, in which the effort for sustainability was measurable. The percentage of respondents agreeing to pay to compensate emissions is equal to 47%, while 25% would pay the fee but not happily and 28% would not

pay at all. It is clearly stated that less than half of respondents is willing to do a direct effort in reducing the impact of their trips on the environment.

5 Results

The purpose of this study is to identify any distinctive characteristics within the young population sampled that differentiate those who are most attentive to environmental sustainability issues in tourism and are inclined to take proactive measures to mitigate the impact of their vacation.

The subsequent sub-sections will detail the results of the LCA and the association study conducted via χ^2 test to examine the relationship between the identified clusters and the variable “Pay.will”. In Appendix 1, to check the robustness of the method, the same analysis was conducted using *K*-means algorithms.

5.1 Cluster analysis

The application of LCA facilitates the identification of data-driven segments based on posterior probabilities. In this study, LCA was applied to determine the optimal number of segments. We implement it using the R package ‘poLCA’ (Linzer and Lewis 2011). The results in terms of Bayesian information criterion (BIC), Akaike Information Criterion (AIC), Log-Likelihood test, non-parametric test (Npar) and degree of freedom (DF) are reported in Table 2.

As suggested by previous studies (see, e.g., Vermunt and Magidson 2002), based on results of the BIC, the optimal fit is determined by 2 clusters. Hence, the plot for the two identified clusters is presented in Fig. 1.

Based on this evidence, Class 1 (comprising 69.7% of the sample) was labeled as *Green Advocates* (GA), as individuals in this group actively promote sustainability, demonstrate strong awareness of environmental issues, and exhibit a pronounced willingness to undertake green actions to reduce the environmental impact of their holiday. Class 2 (comprising 30.3% of the sample) was termed as *Green Learners* (GL), as individuals in this group also display awareness of the importance of environmental sustainability in tourism but are still in a learning phase regarding sustainable practices. Additionally, they show less firmness in expressing willingness to pay a premium to reduce the footprint of their tourism activities. Examining the LCA plot, it is evident that GA members tend to provide higher ratings for the variables assessing the importance of sustainability in general, in tourism and in future investments compared to GL members, who tend to respond more conservatively. Regarding sustainability variables for overnight accommodation, there is a notable difference between GA and GL. While half of the firsts consider sustainability when booking accommodation, none of the seconds do. This disparity is also reflected in their previous experiences, with

Table 2 Selection of the best number of segments, ranging from 2 to 4 clusters

	2 Classes	3 Classes	4 Classes
AIC	1688.69	1657.55	1650.32
BIC	1779.62	1795.52	1835.33
Log-Likelihood	-815.34	-784.77	-766.16
Npar	29.00	44.00	59.00
DF	141.00	126.00	111.00

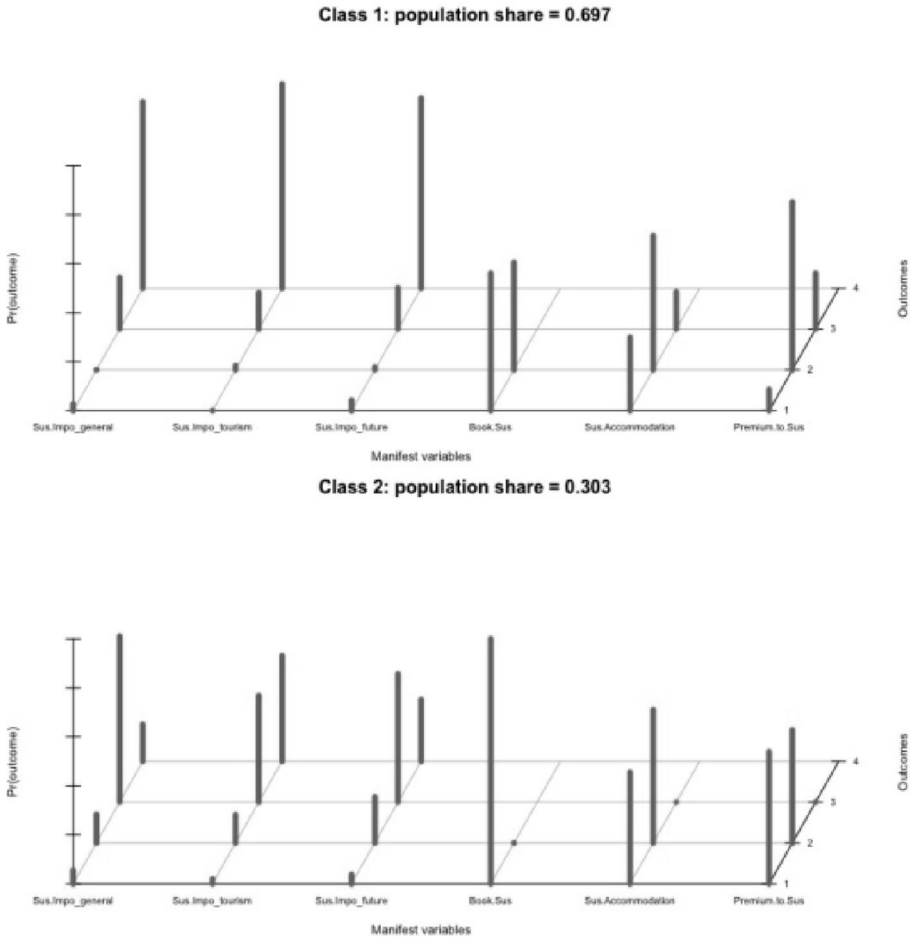


Fig. 1 Plot of LCA variables. “Sus.Impo_general”, “Sus.Impo_tourism” and “Sus.Impo_future” are on 4 levels. Variable “Book.sus” is on 2 levels. Variables “Sus.accomodation” and “Premium.to.sus” are on 3 levels

none of the GL claiming to have stayed in sustainable facilities, whereas some GA do. Furthermore, the willingness to pay a premium for sustainability differs between the two clusters. In cluster 1, 25% of young people declare themselves willing to pay extra for green actions, compared to 0% in cluster 2, where individuals are divided between those not willing to mitigate their ecological footprint with a higher outlay and those who are uncertain.

Table 3 shows the sizes of the clusters and the average scores (i.e., the mean values of the variables for the units assigned to the clusters) of both the descriptive and the cluster variables for each segment.

Additionally, Table 4 displays the percentage frequencies for the descriptive variables in the two defined clusters.

GA members have a slightly higher average household income. Indeed, while the average household income appears similar between the two clusters, there are notable differ-

Table 3 Average scores of the variables with LCA. Descriptive variables and clustering variables are shown

	LCA—GA <i>n</i> = 119	LCA—GL <i>n</i> = 51
<i>Descriptive variables</i>		
Sex	1.44	1.40
H_income	3.34	3.25
Mother_edu	2.30	2.38
Father_edu	2.21	2.23
Poli_or	3.07	3.58
N_trav	1.79	1.62
Parents_trav	2.74	2.55
<i>Cluster variables</i>		
Book.sus	1.44	1.00
Sus.accomodation	1.85	1.57
Premium.to.sus	2.15	1.47
Sus.Impo_general	3.74	2.89
Sus.Impo_turism	3.85	3.23
Sus.Impo_future	3.70	2.96

ences when examining the distribution of observations across income categories. In the GL cluster, extreme values are more frequent compared to the GA cluster. Specifically, the lowest income bracket (<€15,000/year) is reported in 15% of cases for GL, compared to 9% for GA. Regarding the level of parental education, there are no significant differences between the two segments. Travel habits also exhibit slight discrepancies between GA and GL. GA tend to travel more frequently, and according to their responses, their families also undertake more trips per year on average than GL. This may indicate greater exposure to travel experiences, potentially leading to increased awareness of tourism-related pollution issues. Lastly, another noteworthy variable showing different average scores between the segments is the self-defined political. While the average score for GL is 3.6 out of 5, it is 3.1 for GA, suggesting a stronger skewness to the right-wing sympathy for the Learners and a central position for the Advocates. Further insight into the differences between the clusters can be gleaned by breaking down the frequencies by level and computing the percentages per column, as shown in Table 4. Values highlight notable differences in the political orientation of the subjects between the two segments. GA predominantly expresses a central political orientation, with fewer individuals at the extremes (i.e., extreme-right or extreme-left). Conversely, the GL exhibits greater polarization, with over 59% of individuals defining themselves as right-wing and less than 10% expressing left-wing political ideals. This seems to suggest that as political polarization among young people increases, there is a corresponding decrease in attention to environmental issues, both in general and within the realm of tourism, leading to a reduced likelihood of engaging in green actions.

The final aspect of this study is to assess whether the two identified segments exhibit different propensities to adopt pro-environmental behavior.

5.2 χ^2 test

To determine whether there were statistically significant differences in the profile of the responses to the research question between GA and GL, a χ^2 test was performed on the

Table 4 Percentage distribution of descriptive variables for the 2 defined clusters

	LCA—GA	LCA—GL
<i>Sex</i>		
1. Males	56	60
2. Females	44	40
<i>H_income</i>		
1. <15	11	15
2. 15–25	19	17
3. 25–35	22	25
4. 35–50	21	15
5. >50	27	28
<i>Mother_edu</i>		
1. Middle school diploma	20.5	11.3
2. High school diploma	52.1	62.3
3. Bachelor's degree	8.5	7.5
4. Master's degree	14.5	15.5
5. PhD or second level master	4.3	3.8
<i>Father_edu</i>		
1. Middle school diploma	27.4	22.6
2. High school diploma	47.9	56.6
3. Bachelor's degree	6.8	1.9
4. Master's degree	12.8	13.2
5. PhD or second level master	5.1	5.7
<i>Poli_or</i>		
1. Extreme left	3.42	1.89
2. Center-left	29.06	7.55
3. Center	27.35	32.08
4. Center-right	37.61	47.17
5. Extreme right	2.56	11.32
<i>N_trav</i>		
1. At most one	32	49
2. Two/three times	56	40
3. More than three	12	11
<i>Parents_trav</i>		
1. No travels	6	13
2. At most one	34	38
3. Two/three times	41	34
4. More than three	19	15

variable “Pay.will”. The null hypothesis formulated considered that the profile of responses to question 15 was identical for GA and GL. The results are presented in Table 5.

The χ^2 test, with a statistic exceeding 29 for the segments identified by LCA, indicates that the null hypothesis of no difference between the profiles of the two groups must to be rejected. In simpler terms, the data provide high empirical evidence to suggest that GA and GL exhibit different green behavior (i.e., real willingness to pay a surcharge to offset flight CO_2 emissions). This conclusion is supported by the highly significant p – values associated with the test (<0.001). Upon examining the relative values in Table 5, it becomes clearer that most young people in the GA segment (57%) are inclined to take green actions.

Table 5 χ^2 test for the profile of the variable “Pay.will” in the two segments identified by LCA

		LCA—GA	LCA—GL
Pay.will	1. Very much agree	67	13
	2. Little agree	32	11
	3. Not at all agree	18	29
	<i>n</i>	117	53
	χ^2		29
	<i>df</i>		2
	<i>p</i> – value		<0.001

Conversely, in the GL segment, most of the respondents express clear unwillingness to pay more to mitigate environmental impact (55%).

6 Discussion and limitations

These findings are noteworthy for several reasons. Primarily, this research offers insight into segmenting young tourists based on their likelihood of taking tangible steps to reduce the environmental impact of tourism, independently of socio-demographic characteristics or motivations. The latent classes of GA and GL were distinguished by the subjects’ sensitivity to perceived importance of environmental sustainability issues and travel-related characteristics, such as the desire to book more sustainable accommodations. Among all the socio-demographic characteristics examined, political orientation emerged as the most explanatory factor for differences between subjects in the clusters. The data revealed that GL exhibit a much more skewed political orientation than GA. Although political orientation may not serve as a comprehensive predictor for inducing more sustainable tourism consumption, its candidates as a succinct although synthetic and non-exhaustive measure with strong informative power. However, it is important to note that the question concerning political preferences was formulated to collect a self-declaration of how the subject intended to be classified in a five-point scale. This can be intended as a limitation for two main reasons. First, the Italian political situation can be simply classified into five areas of belonging, but this classification may not be adequate for different socio-political contexts in other countries. Second, from the point of view of the behavioral literature, to better capture the political sympathies of the interviewees, it would have been necessary to delve deeper with more questions in order to construct a more structured item.

Another intriguing aspect pertains to the discrepancy between young people uncertainty about whether they have previously stayed in sustainable facilities and their willingness to book in such facilities in the future. This aspect has been investigated for the first time in the literature. Although neither GA (more than 50%) nor GL can definitively recall if they have utilized green accommodation services in the past, and since a notable proportion of GA express interest in making reservations at sustainable facilities, we identify a *willingness-recollection* gap. This incongruity emphasizes the importance for policymakers and practitioners to bridge the distance between willingness and experience (or recollection of experience). In other words, there seems to be a gap between what young people would be willing to do (i.e., book at eco-friendly accommodation) and what they remember doing in past holidays (i.e., knowing they ever stayed at sustainable accommodation). The meagerness of memories to be referred to environmental friendly hosting facilities, may stem

from two primary factors. Firstly, it may be an identification issue, wherein young people find it challenging to discern the most sustainable housing when booking. In this scenario, policymakers could intervene by implementing appropriate and standardized communication measures for hosting facilities, allocating funding to incentivize more establishments to adopt eco-friendly practices, or encouraging participation in independent sustainability programs such as the Green Key and BioHotels platforms. At the same time, enforcement of industry-wide sustainability standards (such as limits on resource use or emissions for tourism operators) should be strengthened (MacEachern et al., 2024); National and regional studies concur that governments must enforce accountable standards to reduce the sector's environmental footprint, while also educating tourists about the impacts of their travel (e.g., MacEachern et al., 2024). Policy examples from leading destinations include municipal bans or levies on single-use plastics and the provision of free or discounted transit passes for tourists – steps that reduce environmental pressures while nudging travelers toward responsible behavior (e.g., Greene et al. 2024). On the other hand, it may be the hosts who need to take action to improve the perception of sustainability of their facility. An accommodation, even if this is not explicitly part of green programs, but the property has invested in sustainable strategies, should make this information explicit to the tourist. In this way, the visitor would have a more vivid reminder to stay in an *environmentally conscious facility*, and this could trigger subsequent re-adoptions or approaching the environmental issue. Indeed, this analysis underscores the necessity for stakeholders in the tourism sector to delve deeper into these issues and implement concrete efforts to enhance the environmental sustainability of tourism. This entails addressing both communication and experiential aspects, whether in the booking process or on-site, to foster greater awareness and action regarding environmental impacts.

Empirical evidence highlights that effective destination management requires efficient planning, stakeholder collaboration, and a long-term vision to balance economic, environmental, and social goals (see, e.g., MacEachern et al., 2024). The role of Destination Management Organizations (DMOs) in this context can be crucial as they serve as a link between political authorities and tourism providers. Importantly, DMOs can leverage behavioral insights (“nudges”) and innovative marketing to influence tourist choices. Research shows that modifying the choice architecture, for example, presenting eco-friendly options as the default or most attractive choice, can significantly increase sustainable behaviors among tourists (Greene et al. 2024). For example, designing engaging ecotourism activities, “green” festivals, or reward programs can provide positive reinforcement, make low-impact choices fun, and reward young travelers. Conversely, strategies relying purely on punitive measures or passive messaging (e.g., guilt-based appeals or vague slogans) tend to be less effective (Greene et al. 2024).

Another crucial finding from this analysis is the statistically significant difference between GA and GL in their propensity to mitigate their environmental footprint through increased expenditure. This divergence remains significant even when considering income conditions, indicating that the willingness to pay more for sustainability is driven by factors beyond financial means. In addition, the distinction between the perception of sustainability as “fairly important” versus “very much important” emerges as a significant discriminating factor. This differentiation delineates between those who are only aware of the environmental impact of tourism (GL) and those who, in addition to awareness, demonstrate a proactive willingness to address such pollution (GA).

However, it is important to highlight some peculiarities of the study. First, this survey was conducted using a self-selected sample. This implies that there may be bias due to the greater predisposition of people sensitive to, or at least more aware of, environmental sustainability issues to respond. Furthermore, there may be a social desirability bias regarding environmental issues among young people, especially students. Finally, an important extension of this study is to conduct a longitudinal, rather than merely cross-sectional, survey to monitor changes over time in young people attitudes toward pro-environmental behaviors.

7 Conclusions

This study delves into the crucial intersection of tourism and environmental sustainability, exploring the pro-environmental behaviors of young tourists. Against the backdrop of an expanding tourism sector, concerns about its environmental impact have gained prominence. Although tourism contributes significantly to global GDP and job creation, it also poses challenges to environmental preservation. Using latent class cluster analysis, this research identifies two distinct segments among young tourists: Green Advocates (GA) and Green Learners (GL). These segments exhibit divergent attitudes toward environmental sustainability, and GA demonstrates a stronger commitment to green actions compared to GL. Key insights emerge from the analysis of variables associated with sustainability, accommodation choices, and willingness to pay a premium for eco-friendly practices. In particular, self-reported political orientation emerges as a significant explanatory factor for differences between segments, with GL exhibiting greater political polarization compared to GA. In addition, a notable finding is a discrepancy between the willingness of young people to book sustainable accommodations and their recollections of past experiences. This highlights a knowledge gap that policymakers and practitioners must address through improved communication and experiential initiatives. The study's findings have practical implications for DMOs and policymakers, offering insights to inform decision-making processes and communication strategies aimed at promoting environmental sustainability in the tourism sector. Furthermore, research contributes to the literature by providing empirical evidence and identifying distinct segments within the demographic of young tourist. In the future, stakeholders in the tourism sector must deepen their understanding of these issues and implement concrete efforts to enhance environmental sustainability. Addressing the knowledge gap and fostering greater awareness and action among young tourists are critical steps toward achieving sustainable tourism practices. Additionally, recognizing the importance of factors beyond financial means in driving pro-environmental behaviors underscores the need for multifaceted strategies to promote sustainability in the tourism sector.

Appendix 1

In the K -means algorithm, centroids are initially randomly initialized using observations in the dataset. Observations are then assigned to the cluster with the closest centroid, typically determined by a chosen distance measure such as Euclidean distance. Centroids are updated iteratively based on the mean of observations assigned to each cluster. These operations are repeated iteratively until the centroids converge or until a maximum number of iterations is

reached. K -means necessitates data normalization before implementation and often relies on principal components for graphical representation, which may compromise interpretative simplicity. Nevertheless, analyzing the size of the first two components in the X and Y axes can provide insights into the primary directions of data variation.

In the present case, the K -means algorithm has been implemented to model observations into 2 segments. The inclusion of K -means serves the purpose of comparing results between two different algorithms, thereby enhancing the robustness of the estimates.

In the following, results in terms of plot (Fig. 2), average scores of variables (Table 6) and χ^2 test (Table 7) are reported.

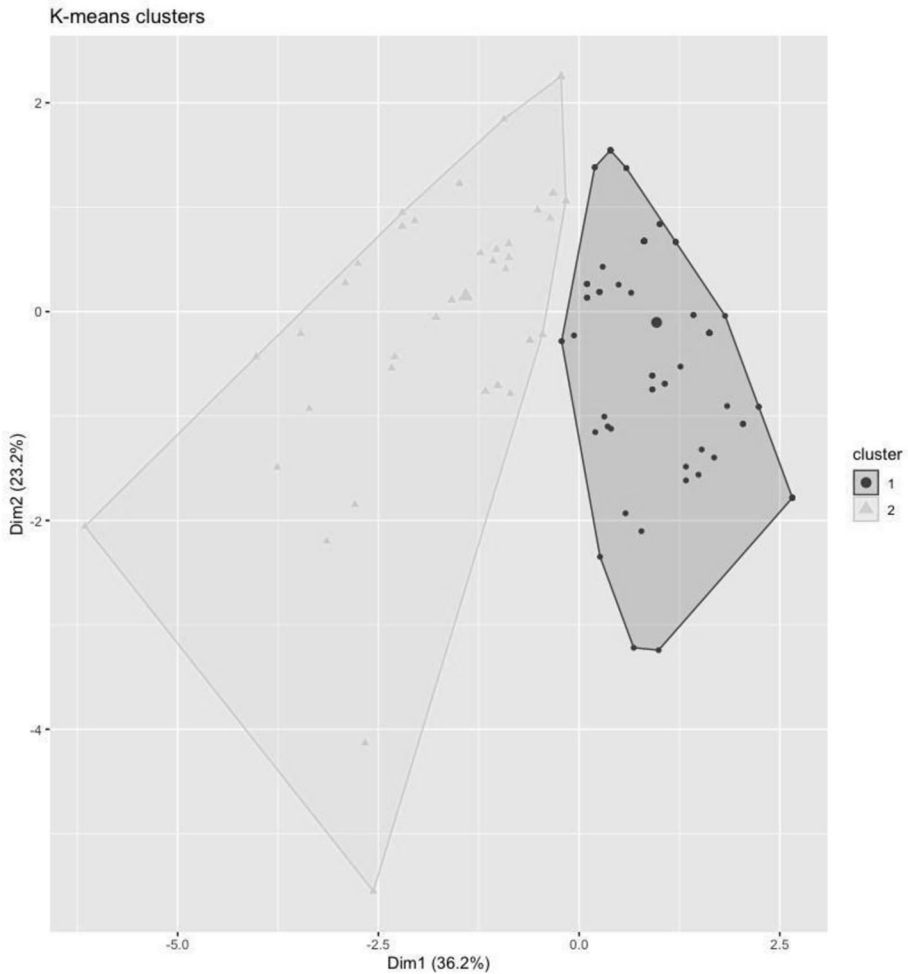


Fig. 2 Plot of K -means clustering algorithm. Centroids are reported (a principal component analysis was computed on the normalized data to get the Y and X dimensions). Variables “Sus.Impo_general”, “Sus.Impo_tourism” and “Sus.Impo_future” are on 4 levels. Variable “Book.sus” is on 2 levels. Variables “Sus.accommodation” and “Premium.to.sus” are on 3 levels

Table 6 Average scores of variables with *K*-means. Descriptive variables and clustering variables are shown

	<i>K</i> -Means Cluster1 <i>n</i> = 101	<i>K</i> -Means Cluster2 <i>n</i> = 69
<i>Descriptive variables</i>		
Gender	1.46	1.39
H_income	3.33	3.29
Mother_edu	2.28	2.39
Father_edu	2.21	2.22
Poli_or	3.05	3.49
N_trav	1.80	1.65
Parents_trav	2.76	2.55
<i>Cluster variables</i>		
Book.sus	1.50	1.01
Sus.accomodation	1.93	1.51
Premium.to.sus	2.20	1.55
Sus.Impo_general	3.82	2.96
Sus.Impo_turism	3.85	3.36
Sus.Impo_future	3.79	3.00

Table 7 χ^2 test for the profile of “Pay.will” variable in the two segments identified by *K*-means

	<i>K</i> -means_GA	<i>K</i> -means_GL
Very much agree	62	18
Little agree	27	16
Not at all agree	12	35
<i>n</i>	101	69
χ^2		33
<i>df</i>		2
<i>p</i> – value		<0.001

Author contributions The authors equally contributed to the work.

Data availability The data used in the article were collected by means of a survey on Italian students. Participants give their information anonymously, with respect to privacy rules.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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