

## Consumer attitudes toward single-use food packaging: an Italian case study

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### Abstract

In response to growing concerns about plastic pollution and the need for sustainable alternatives, this study investigates how Italian consumers perceive and engage with single-use plastic packaging in the food sector. Using data collected from 2,269 respondents through an online survey, the research examines how sociodemographic characteristics shape motivations, behaviors, and support for regulatory interventions. Results show that 74% of respondents are strongly motivated to reduce single-use plastics, and 81% consider the environmental impacts to be highly relevant. Women, older individuals, those with higher education, and respondents in better economic conditions display significantly higher pro-environmental engagement, including more frequent purchasing of nonplastic packaging and stronger support for regulation. In contrast, Generation Z consistently emerges as the least engaged group, reporting lower motivation, weaker support for policy measures, and the lowest willingness to pay for biodegradable alternatives. These insights highlight the need for differentiated policies and communication strategies that consider the diversity of consumer profiles. Overall, these findings provide actionable evidence for developing targeted policy tools to reduce plastic use in the agri-food sector.

*Keywords:* Consumer behavior; Environmental policy; Single-use plastics; Sociodemographic factors; Sustainability

### Highlights

- Strong sociodemographic differences were found in motivations, behaviors, and policy support regarding single-use plastic packaging.
- Generation Z consistently shows lower engagement and weaker willingness to support policy and market interventions compared to older generations.
- Women, higher-educated, and economically better-off consumers display stronger pro-environmental attitudes, with higher willingness to adopt sustainable packaging.

### Introduction

The proliferation of single-use plastic poses a critical challenge for environmental sustainability, as such packaging significantly contributes to pollution, greenhouse gas emissions, and harm to terrestrial and marine ecosystems (Fiore *et al.*, 2022; Thushari and Senevirathna, 2020).

As noted by FAO (2021), over the past several decades, plastic has become essential for the agri-food systems due to its low cost, versatility, and durability, which are essential in a large number of applications. However, despite the fact that plastics can enhance productivity,

reduce food loss, and improve efficiency (Meziani *et al.*, 2024), their long-term use together with poor collection and disposal has caused them to accumulate in the soil and in water, leading to serious problems for the environment and the health of individuals, among which is the emerging issue of microplastics (Maesano *et al.*, 2025; Tan *et al.*, 2021).

The European Union (EU) has taken significant steps in recent years to address growing concerns about plastic waste, especially from single-use items. The issue of plastic waste was first systematically tackled in the 2015 Circular Economy Action Plan (European Commission, 2015), which outlined a shift away from the traditional “take-make-dispose” model toward more sustainable patterns of production and consumption. Plastic packaging quickly became a priority area due to its environmental impact and the increasing volume of waste it generates. In 2018, the European Strategy for Plastics in a Circular Economy set the ambitious goal that by 2030 all plastic packaging placed on the Union market should be reusable or recyclable (European Commission, 2018). A year later, the Single-Use Plastics Directive (EU) 2019/904 introduced bans and restrictions on common single-use products, particularly those related to food, and strengthened producer responsibility and labeling obligations (European Parliament and Council, 2019). This was followed in 2020 by the second Circular Economy Action Plan, launched under the European Green Deal, which emphasized eco-design, consumer rights, and circular business models (European Commission, 2020). More recently, the EU adopted an updated legislative package including the Packaging and Packaging Waste Regulation and Regulation (EU) 2025/351, which came into force in 2025 and introduced binding targets for reuse, recyclability, and the reduction of overpackaging across member states (European Commission, 2025). In parallel, the 2022 proposal for a revised Packaging and Packaging Waste Directive further tightened requirements to limit excessive packaging and harmonize sustainable solutions across the internal market (European Commission, 2022).

However, addressing plastic pollution will require more than regulatory changes alone. A meaningful shift in production and consumption depends on targeted collective action, as no individual or corporate effort alone is sufficient to reduce plastic waste (Frantzi *et al.*, 2021; Tudor & Williams, 2021). Academic studies have pointed out that mitigation measures are most effective when stakeholders act in coordination (Pettipas *et al.*, 2016; Viaggi *et al.*, 2021). Among these, consumers play a particularly important role, as their everyday purchasing decisions shape market trends and can reinforce or undermine sustainability-driven policies (Thøgersen, 2010).

Indeed, consumers have shown to have ambivalent attitudes toward plastic packaging. Though environmental awareness is increasing, attitudes do not always translate into rejection of plastic. Indeed, as noted by Fernqvist *et al.*, (2015), many consumers recognize plastic packaging, especially single-use plastics and plastic bags, as dangerous to sustainability. Yet, at the same time, this awareness often coexists with the belief that plastic packaging conveys superior product protection and quality. This point is reinforced by Elgaaied-Gambier (2016) who argues that consumers might link plastic with hygiene, durability, and freshness, characteristics that are particularly relevant in the context of food products.

In this context, understanding consumer perceptions and behaviors toward single-use plastics for food is important in promoting a transition to a more sustainable economic model (Cao *et al.*, 2025).

Recent research indicates that consumers are aware of the environmental impact of plastic packaging and show willingness to adopt more sustainable alternatives (Herrmann *et al.*, 2022). For instance, a study conducted in Germany by Breuer *et al.* (2024) explores the factors shaping German consumers’ intention to adopt reusable packaging system (RPS) for takeaway food. The authors find that personal moral norms, attitudes, subjective norms, and perceived behavioral control play a significant role in shaping this intention. However, despite the widespread consumption of takeaway food, actual RPS usage remains low, suggesting the importance of addressing drivers to effectively foster more sustainable packaging behaviors. Building on this behavioral perspective, a related field study from Drechsel *et al.* (2025) conducted in German supermarkets investigated how consumers form preferences toward environmentally friendly packaging alternatives during real purchasing situations. The findings show that consumer decisions are more strongly influenced by emotional responses than by rational knowledge. While environmental concerns raise awareness and shape preferences, they exert a weaker effect on actual behavior intentions compared to more immediate emotional and contextual drivers (Drechsel *et al.*, 2025). In the United Kingdom, Czine *et al.* (2025) investigated how consumers evaluate environmentally friendly packaging alternative for bottled water. The study identified that individuals with strong nature-related and green consumption values are more likely to choose biodegradable options and to reject single-use bottle water product. Beyond environmental concern, other studies have focused on the role of everyday routines and social practices in challenging plastic consumption (Rabiu & Jaeger-Erben, 2024) and explored how digital technologies and communication platforms shape consumer engagement with plastic-related behaviors (De Fano *et al.*, 2022).

Despite these insights, important gaps remain. First, to the best of our knowledge, most existing studies have focused on Northern and Central European contexts, particularly Germany and the United Kingdom (Breuer *et al.*, 2024; Czine *et al.*, 2025, Drechsel *et al.*, 2025; Herrmann *et al.*, 2022; Macht *et al.*, 2023; Nuojua *et al.*, 2024; Rhein and Schmid, 2020), leaving European Mediterranean countries such as Italy underrepresented in the literature. Instead, analyzing the Italian case study could provide very interesting insights as, in this country, the implementation of EU Directives on single-use plastic has faced delays, resulting in infringement procedures by the European Commission (Santos, 2022). Italy's debated position on allowing the use of biodegradable plastic, even if not approved by EU, highlights the conflict between national laws and broader EU environmental goals (Casadei, 2024), providing a valuable case study to analyze consumers' attitudes to plastic products in such a debated political context.

As for the Italian context, existing contributions have primarily addressed the issue of single-use plastics from macro-level, often focusing on policy interventions or environmental awareness tools (D'Ascenzo *et al.*, 2025; Senese *et al.*, 2023). While these approaches are valuable, they tend to overlook the attitudinal drivers that influence consumers' behavior regarding plastic use. In particular, there is a notable lack of studies that segment consumers based on sociodemographic factors (e.g., age, gender, education, and income), in the case of the use of single-use plastic, which are well-documented predictors of environmental behavior (Li *et al.*, 2019).

Since previous findings have shown that the influence of such factors can vary significantly across different cultural and market contexts, more context-specific analyses are needed (Barone *et al.*, 2025).

Based on this background, this study seeks to address these gaps by investigating Italian consumers' attitudes, behaviors, and policy preferences regarding single-use plastic packaging in the food industry, by shedding light on the sociodemographic factors behind attitudes and behaviors, highlighting which groups are more likely to support certain measures.

Insights can enable policymakers, environmental organizations, and businesses to design inclusive strategies that catalyze behavioral change and engage the public in pro-environmental initiatives. They can also inform the tailoring of targeted interventions to promote pro-environmental behavior and bridge the knowledge–action gap.

## Materials and Methods

Data for this study were collected in Italy through an online survey disseminated via social media, specifically Instagram and Facebook, which enabled rapid and wide circulation of the questionnaire at low cost. The data collection took place between July and August 2024. The survey was hosted on Google Forms and was shared through public posts and targeted messages on the authors' social media pages. The questionnaire link was posted three times per week (Monday, Wednesday, and Friday) and participants were encouraged to share it within their networks. The survey employed a nonprobability convenience sampling strategy, augmented by a chain-referral (snowball) approach: initial respondents were asked to share the questionnaire within their networks. This combined convenience–snowball sampling strategy is widely recognized in exploratory research designs and consumer behavior studies, where the goal is to identify attitudinal patterns and sociodemographic differences among respondents rather than to infer estimates for the general population (Kayam and Hirsch, 2012; Ting *et al.*, 2025). Several measures were adopted to reduce sampling and reporting bias: participation was voluntary and anonymous, attitudinal items were measured using validated Likert scales to minimize interpretation bias, and consistency checks were applied to exclude incomplete or unreliable responses. Moreover, the questionnaire was disseminated across heterogeneous social and demographic networks to avoid overrepresentation of individual clusters. As such, the study does not aim at population representativeness but at mapping behavioral tendencies within the sampled population.

A total of 2,277 responses were collected, of which 2,269 were considered valid. Eight responses were excluded because the respondents did not provide consent for data processing in accordance with European data protection regulations (EU GDPR). The methodological approach was adapted from the framework proposed by Walker *et al.* (2021)<sup>1</sup>. Specifically, to explore consumers' attitude and behavior toward single-use plastic, the following aspects were investigated: motivation to reduce the amount of single-use plastic food packaging; perception of environmental impacts caused by single-use plastic food packaging; shopping habits for nonplastic packaging goods; intention to increase purchase of green

1. The approach developed by Walker *et al.* (2021) was selected as it was already validated in a peer-reviewed publication. This choice ensures a solid methodological foundation and allows comparability with previous research. Although the original instrument was developed in a non-EU context (namely, Canada), the constructs investigated are not country-specific but grounded in behavioral and environmental psychology. Before administering the study, the Italian version was reviewed for linguistic and cultural appropriateness and pretested on a small pilot group to ensure clarity and consistency in the Italian context.

packaging; and opinions regarding a proposed ban on all the single-use plastics in food packaging.

Next, consumers were asked about their attitudes toward regulatory policies and incentives aimed at reducing the use of single-use plastic packaging using the following questions: public opinion on strengthening plastic packaging regulations; incentives for biodegradable packaging; holding companies accountable for single-use plastic; and consumers' perceptions of the government tax toward single-use plastic food packaging. Lastly, consumers were asked about their willingness to pay (WTP) for biodegradable packaging. Responses were measured using a five-point Likert scale ranging from "strongly disagree" to "strongly agree."

The sociodemographic information comprised gender, age category, education, economic condition, and area of residence.

Although large sample sizes often approximate normality, the dependent variables are ordinal by design and measured using Likert-type scales. Therefore, nonparametric tests were preferred, as they avoid assumptions of interval-scale measurement and distributional normality. To ensure the robustness of the findings, we conducted additional checks using parametric tests, which yielded consistent results.

The data were analyzed using Stata 18. As the data were not normally distributed, differences in attitudes and behaviors across sociodemographic groups were assessed with the Kruskal–Wallis H test (Kruskal and Wallis, 1952). In the case of significant omnibus results, Dunn's rank-sum post hoc test with Bonferroni family-wise error correction was used for pairwise comparisons (Bonferroni, 1936; Dunn, 1964); adjusted p-values from Dunn's test are reported in parentheses. To examine gender-based differences and differences by area of residence, the nonparametric Mann–Whitney U (Wilcoxon rank-sum) test was used (Mann and Whitney, 1947).

## Results

### Demographic characteristics

Respondents are predominantly female (86%), with Millennials accounting for half of the sample; educational attainment is generally moderate, as 61% report an higher-secondary (high-school) degree. In terms of socioeconomic positioning, 65% self-identify as being in good economic condition, and the sample is mostly urban, with 69% residing in cities or large towns (Table 1). The predominance of women is consistent

with prior consumer studies on food choices, where females are typically overrepresented due to their greater involvement in household food purchasing, meal planning, and nutrition-related decision-making (Pieniak *et al.*, 2010). Such a gender composition thus mirrors the demographic profile of active food consumers rather than a sampling distortion. Overall, the socio-demographic structure of the sample aligns with typical consumer science research on food attitudes and sustainable consumption (Grunert, 2011; Migliore *et al.*, 2015; Proi *et al.*, 2025).

### Consumers' attitude and behavior

#### *Motivation to reduce the amount of single-use plastic food packaging*

When asked whether environmental impacts motivate them to minimize the amount of single-use plastic food packaging, nearly 74% of respondents selected "strongly agree." Table A.1 shows the percentage of replies for each socioeconomic group.

Mean motivation (operationalized via Likert scores) differed across age, income, and education groups according to the Kruskal–Wallis test. Dunn's post-hoc comparisons

**Table 1. Demographic characteristic of the Italian sample interviewed (n = 2.269).**

Category	Frequency	Percent
<b>Gender</b>		
Female	1945	86
Male	324	14
<b>Age category</b>		
Generation Z	603	26
Millennials	1128	50
Generation X	417	18
Baby Boomers	121	6
<b>Education</b>		
Compulsory education	92	4
High school education	1377	61
Bachelor's degree	290	13
Postgraduate degree	510	22
<b>Economic condition</b>		
Very difficult	17	1
Difficult	59	2
Neither poor nor rich	557	25
Good	1473	65
Very good	163	7
<b>Region of residence</b>		
Rural	703	31
Urban	1566	69

(Bonferroni-adjusted) showed that Generation Z reported significantly lower average ranks than Millennials ( $p < 0.01$ ), Generation X ( $p < 0.01$ ), and Baby Boomers ( $p < 0.01$ ), indicating that Generation Z was less motivated to reduce single-use plastic food packaging.

In terms of economic status, participants who perceived themselves to be in a good economic condition were significantly less motivated to reduce the use of single-use plastic food packaging than those who declared to be in a very good economic condition ( $p < 0.05$ ). Similarly, participants who perceived themselves to be in neither poor nor rich economic condition were significantly less motivated to reduce the use of single-use plastic food packaging than those who declared to be in a very good economic condition ( $p < 0.01$ ). Statistically significant difference was not found between the remaining economic condition groups ( $p > 0.05$ ).

Those with a compulsory education were significantly less motivated to decrease single-use plastic than those who had a bachelor's degree ( $p < 0.05$ ). Similarly, those with high school education were significantly less motivated than those with a degree specialization ( $p < 0.01$ ). In contrast, those with a postgraduate specialization were significantly more motivated than those with compulsory education ( $p < 0.05$ ) and those with high school education ( $p < 0.01$ ). There was no significant difference between those who lived in urban and rural areas.

Lastly, significant differences were found among female and male respondents ( $p < 0.01$ ), suggesting that women express stronger personal motivation to decrease the use of single-use plastic food packaging than men.

### **Environmental impacts caused by single-use plastic food packaging**

Nearly 81% of respondents strongly agreed that the environmental impacts caused by single-use plastic food packaging are important. Statistically significant differences were found across generations, economic condition levels, and education levels. The Dunn test highlighted the following significant differences between different demographic segments.

Generation Z reported significantly lower rank-sum scores in perceived environmental impact compared to those in Generation X ( $p < 0.05$ ) and Baby Boomers ( $p < 0.05$ ), thus showing weaker perception of environmental impact among younger individuals.

With regard to education level, perceived environmental impact was significantly less for those with a compulsory

education compared to those with a bachelor's degree ( $p < 0.01$ ). Similarly, those with high school education perceived environmental impact to be significantly less important than those with a bachelor's degree ( $p < 0.01$ ). Similarly, individuals with university or postgraduate degrees were found to have significantly higher perceived environmental impact than those with compulsory education ( $p < 0.01$ ) and high school education ( $p < 0.01$ ). Regarding economic condition, participants in a very good economic condition reported significantly higher rank-sum scores for perceived environmental impact than those in good economic condition ( $p < 0.05$ ).

In contrast, individuals with a good economic condition showed significantly higher rank-sum scores than those with a fair economic condition ( $p < 0.05$ ), suggesting a lower level of agreement with the importance of environmental impact on plastic packaging. These results suggest that individuals with better economic resources place more importance on the environmental consequences of single-use plastic packaging.

As for the results of the Mann–Whitney U test, the analysis revealed a statistically significant difference in median scores between men and women, suggesting that women place significantly greater importance on the environmental consequences of single-use plastic packaging than men.

### **Shopping habits for nonplastic packaging goods**

When participants were asked if they actively shop for nonplastic packaging goods while grocery shopping, 72% of respondents reported doing so. The Kruskal–Wallis H test revealed statistically significant differences between active shopping for nonplastic packaging and the socio-demographic variables considered. The Dunn test revealed the following significant differences between different demographic segments.

Generation Z exhibited significantly lower rank-sum scores in the self-reported frequency of consciously purchasing nonplastic packaging than Millennials ( $p < 0.001$ ) and Baby Boomers ( $p < 0.01$ ). A comparable, though more modest, difference emerged when compared with Generation X.

These results suggest that participants belonging to younger generational groups were less likely to engage in environmentally conscious purchasing behaviors. There were no significant differences between Millennials, Generation X, and Baby Boomers ( $p > 0.05$ ).

Regarding education, participants with high elementary education showed significantly lower rank-sum scores

in the frequency of consciously purchasing nonplastic packaging compared to those with a bachelor's degree ( $Z = -2.46, p < 0.05$ ). Similarly, those with postgraduate specialization demonstrated significantly more sustainable purchasing behaviors compared to both elementary ( $p < 0.01$ ) and diploma holders ( $p < 0.01$ ). There were no statistically significant differences between diploma holders and university graduates, or between elementary and middle school students.

In terms of economic conditions, participants who belonged to a fair economic condition showed significantly lower rank-sum scores in the frequency of consciously purchasing nonplastic packaging compared to those with a very good economic condition ( $p < 0.01$ ), suggesting less sustainable shopping behaviors among less wealthy individuals. There were no other significant pair-wise differences between economic condition levels ( $p > 0.05$ ).

According to the Mann–Whitney U test, women scored significantly differently from men in terms of actively shopping for nonplastic packaging goods ( $p < 0.01$ ), suggesting that women are significantly more likely than men to report actively purchasing nonplastic-packaged products when shopping.

Lastly, no significant differences were found based on area of residence.

### **Intention to increase purchase of green packaging**

Nearly 49% of respondents strongly agreed with the intention to increase their purchase of green packaging in the next 6 months. The results revealed statistically significant differences across all the sociodemographic variables considered, except for area of residence. The Dunn test revealed the following significant differences between different demographic groups.

Generation Z had significantly lower rank-sum scores in the intention to increase their purchase of green packaging over the next 6 months, compared to Millennials ( $p < 0.01$ ), Generation X ( $p < 0.01$ ), and Baby Boomers ( $p < 0.01$ ), indicating weaker future pro-environmental purchasing intentions. In addition, Millennials had significantly lower intentions than Generation X ( $p < 0.05$ ). Differences with Baby Boomers followed a similar pattern, although the comparison between Generation X and Baby Boomers was not statistically significant ( $p > 0.05$ ).

Regarding education level, respondents with a postgraduate specialization had significantly higher rank-sum scores than those with a high school education to

increase their purchase of green packaging ( $p < 0.01$ ). No other pairwise differences among education levels were statistically significant ( $p > 0.05$ ).

In terms of economic conditions, participants with a fair economic condition reported significantly lower rank-sum scores in the intention to increase their purchase of green packaging over the next 6 months, compared to those with a very good economic condition ( $p < 0.01$ ), indicating stronger intentions to increase sustainable packaging purchases among those with higher perceived financial well-being. No other pairwise differences among economic condition groups were statistically significant ( $p > 0.05$ ), although the contrast between very good and good economic conditions approached significance ( $p > 0.05$ ).

Finally, the Mann–Whitney U test revealed a statistically significant difference between men and women ( $p < 0.01$ ), revealing that women are significantly more likely than men to report intentions to increase their purchases of eco-friendly packaging in the near future.

### **Ban on all the single-use plastics in food packaging**

When consumers were asked if they support a ban on all the single-use plastics in food packaging, The Mann–Whitney test revealed significant differences between men and women ( $p < 0.05$ ). These results indicate that women were significantly more likely than men to support a complete ban on single-use plastic food packaging, although the difference was modest in magnitude (Table 2).

No other significant differences were found in the case of the other sociodemographic variables.

### **Consumers' attitudes toward regulatory policies and incentives aimed at reducing the use of single-use plastic packaging**

*Public opinion on strengthening plastic packaging regulations*  
Roughly 72% of respondents expressed strong support for tightening Italian regulations on single-use plastic food packaging. The Kruskal–Wallis test showed significant differences across generations, and Dunn's Bonferroni-adjusted post-hoc tests identified the following significant pairwise differences.

Generation Z showed significantly lower rank-sum scores in agreement with the need for stricter regulations on single-use plastic, compared to Millennials ( $p < 0.01$ ) and Generation X ( $p < 0.01$ ).

**Table 2. Consumer behavior and motivational traits across sociodemographic groups.**

Factor	Motivation to reduce plastic	Perceived environmental impact	Shopping behavior	Intention to increase green	Support ban
Gender	Women > Men ( $p = 3.1 \times 10^{-6}$ )	Women > Men ( $p = 2.7 \times 10^{-10}$ )	Women > Men ( $p = 8.8 \times 10^{-9}$ )	Women > Men ( $p = 4.5 \times 10^{-7}$ )	Women > Men ( $p = 0.0118$ )
Generation	Gen Z < Millennials, Gen X, Baby Boomer ( $p = 5.1 \times 10^{-9}$ )	Gen Z < Gen X, Baby Boomer ( $p = 0.0067$ )	Gen Z < all ( $p = 2.4 \times 10^{-9}$ )	Gen Z < all; Millennials < Gen X ( $p = 4.5 \times 10^{-10}$ )	n.s. ( $p = 0.3433$ )
Education	Higher > lower ( $p = 1.2 \times 10^{-5}$ )	Higher > lower ( $p = 1.5 \times 10^{-5}$ )	Higher > lower ( $p = 4.0 \times 10^{-5}$ )	Postgraduate > High school ( $p = 0.0060$ )	n.s. ( $p = 0.7789$ )
Economic condition	Very good > others ( $p = 0.0042$ )	Very good > others ( $p = 0.0004$ )	Very good > fair ( $p = 0.0314$ )	Very good > fair ( $p = 0.0081$ )	n.s. ( $p = 0.8774$ )
Urban/Rural	n.s. ( $p = 0.7091$ )	n.s. ( $p = 0.4072$ )	n.s. ( $p = 0.8711$ )	n.s. ( $p = 0.9552$ )	n.s. ( $p = 0.7097$ )

Kruskal–Wallis H test with Dunn's post-hoc test for comparisons across sociodemographic groups (education, economic condition, and age), and Mann–Whitney U test for gender and area-of-residence comparisons.

As for the economic condition, individuals in a fair economic condition reported significantly lower rank-sum scores in agreement with the need for stricter regulations on single-use plastic compared to those in a difficult economic condition ( $p < 0.05$ ). Conversely, participants in a difficult economic condition showed significantly higher rank-sum scores than those in a very difficult situation ( $p < 0.05$ ).

According to the Mann–Whitney test, significant differences were found between men and women. Specifically, women showed significant stronger support for stricter regulatory measures on plastic packaging. No difference was found between individuals with different levels of education or those living in urban or rural area.

### Incentives for biodegradable packaging

When participants were asked if biodegradable packaging, compared to plastic, should receive a discount, an incentive, or a refund at the time of purchasing the agri-food product, around 54% of participants strongly agreed. As for the sociodemographic characteristics considered, results showed a significant difference only across generational groups. The Dunn test revealed several significant differences.

Specifically, Generation Z reported significantly lower rank-sum scores in agreement with offering discounts, incentives, or refunds for biodegradable packaging compared to Generation X ( $p < 0.01$ ). Similarly, Millennials showed significantly lower rank-sum scores in agreement with offering discounts, incentives, or refunds for biodegradable packaging compared to Generation

X ( $p < 0.01$ ). These results suggest that the younger generation was less supportive of financial incentives for biodegradable packaging than older generations. No significant differences were found among the other generations ( $p > 0.05$ ).

### Holding companies accountable for single-use plastic

About 52% of respondents strongly agreed that companies should pay a levy when they use single-use plastic food packaging. Results also showed significant differences across all the sociodemographic variables. The Dunn test revealed several significant differences. Specifically, as for the generation groups, Generation Z showed significantly lower rank-sum scores than Millennials ( $p < 0.01$ ), indicating weaker support for this regulatory measure. There were no other significant differences between the remaining age groups (all  $p > 0.05$ ).

As for the economic conditions, individuals who reported being in a very difficult economic condition showed significantly lower rank-sum scores in agreement with the idea that companies should pay a fee for selling food products with single-use plastic packaging compared to those in a good economic condition, those in a fair economic condition, those in a difficult economic condition, and those in a very good economic condition ( $p < 0.01$  for all comparisons). These results suggest that individuals facing more difficult economic conditions were less supportive of the implementation of a company tax on a single-use plastic packaging.

As for the education level, participants with high school education level showed stronger support for a government tax. In particular, those with compulsory education had significantly lower rank-sum scores compared to participants with only high school education ( $p < 0.01$ ), bachelor's degree ( $p < 0.01$ ), and postgraduate specialization ( $Z = -5.57$ ;  $p < 0.01$ ). Lastly, those with a high school education showed significantly lower rank-sum scores compared to participants with a postgraduate specialization ( $p < 0.01$ ).

Women reported significantly higher rank-sum scores in agreement with the idea that companies should pay a fee for selling food products with single-use plastic packaging compared to men ( $p < 0.01$ ). These results suggest that women are more supportive of implementing company fees for the use of single-use plastic packaging than men.

Individuals living in urban areas reported significantly higher rank-sum scores in agreement with the idea that companies should pay a fee for selling food products with single-use plastic packaging compared to those living in rural areas ( $p < 0.01$ ).

### Consumers' perceptions of government tax toward single-use plastic food packaging

When participants were asked if they would accept paying a government tax on single-use plastic food packaging, about 32% of participants strongly agreed.

Significant differences were found between all the sociodemographic variables used. The Dunn post hoc

test showed that Generation Z had significantly lower rank-sum scores than Millennials ( $p < 0.01$ ), indicating weaker support for paying a government tax on single-use plastic packaging. There were no other significant differences between the other age groups (all  $p > 0.05$ ) (Table 3).

As for the economic condition, participants in the very wealthy condition scored significantly higher than individuals in the fair economic condition ( $p < 0.01$ ) and those in a difficult economic condition ( $p < 0.05$ ). These results suggested that participants in a less wealthy economic condition were less willing to pay a government tax on single-use plastic food packaging.

As for the education level, those with compulsory education had significantly lower rank-sum scores compared to participants with high school education ( $p < 0.05$ ), bachelor's degree ( $p < 0.01$ ), and postgraduate specialization ( $p < 0.01$ ). In addition, those with high school education had significantly lower rank-sum scores compared to participants with bachelor's degrees ( $p < 0.05$ ) and postgraduate specialization ( $p < 0.05$ ). These results suggest that participants with higher education level are more likely to accept paying a government tax toward single-use plastic food packaging.

Significant differences in the Mann–Whitney U test were found between individuals living in the urban and rural areas. Specifically, participants who lived in urban areas are significantly more supportive of implementing a tax on companies that use single-use plastic packaging ( $p < 0.05$ ), compared to those living in rural areas. There were no significant differences between male and females.

**Table 3.** Policy support and financial willingness across sociodemographic groups.

Factor	Support stricter regulation	Incentives for biodegradable	Company fee	Government tax	WTP biodegradable
Gender	Women > Men ( $p = 1.3 \times 10^{-14}$ )	n.s. ( $p = 0.4272$ )	Women > Men ( $p = 3.7 \times 10^{-5}$ )	n.s. ( $p = 0.160$ )	n.s. ( $p = 0.243$ )
Generation	Gen Z < Millennials & Gen X ( $p = 0.0001$ )	Gen Z, Millennials < Gen X ( $p = 0.0003$ )	Gen Z < Millennials ( $p = 0.0051$ )	Gen Z < Millennials ( $p = 0.0019$ )	Gen Z < all others ( $p = 1.9 \times 10^{-5}$ )
Education	n.s. ( $p = 0.0398$ )	n.s. ( $p = 0.5849$ )	Higher > lower ( $p = 5.9 \times 10^{-8}$ )	Higher > lower ( $p = 5.6 \times 10^{-5}$ )	n.s. ( $p = 0.2449$ )
Economic condition	Difficult > Very difficult ( $p = 0.0018$ )	n.s. ( $p = 0.6245$ )	Very good > all others ( $p = 0.0018$ )	Very good > fair/difficult ( $p = 0.0008$ )	Very good > fair/difficult ( $p = 5.5 \times 10^{-9}$ )
Urban/Rural	n.s. ( $p = 0.3562$ )	n.s. ( $p = 0.7207$ )	Urban > Rural ( $p = 2.4 \times 10^{-5}$ )	Urban > Rural ( $p = 0.0290$ )	n.s. ( $p = 0.5649$ )

Kruskal–Wallis H test with Dunn's post-hoc test for comparisons across sociodemographic groups (education, economic condition, and age), and Mann–Whitney U test for gender and area-of-residence comparisons.

## WTP for biodegradable packaging

When participants were asked if they are willing to pay more for an agri-food product sold in biodegradable packaging, around 11% strongly agreed. Results showed significant differences across age groups and participants with different economic conditions. Specifically, Generation Z showed significantly lower rank-sum scores than Millennials ( $p < 0.05$ ), Generation X ( $p < 0.01$ ), and Baby Boomers ( $p < 0.01$ ). In addition, Millennials showed a significant lower rank-sum scores than Baby Boomers ( $p < 0.01$ ) to pay more for biodegradable packaging. Taken together, these results indicate that younger generations are less willing to pay a premium for biodegradable packaging compared to older generations.

As for the economic conditions, individuals who reported to be in a good economic condition showed significantly higher rank-sum scores in agreement with paying a premium for biodegradable packaging compared to those in a fair-economic condition ( $p < 0.01$ ). In addition, those in a fair economic condition ( $p < 0.01$ ), and those in a difficult economic condition ( $p < 0.05$ ), showed significantly lower rank-sum scores than those who declared to be in a very good economic condition. Lastly, participants in a good economic condition ( $p < 0.05$ ) and those in a very good economic condition ( $p < 0.01$ ) showed significantly higher rank-sum scores compared to those in a very difficult economic condition, suggesting a higher WTP premium for biodegradable packaging.

## Summary of sociodemographic differences

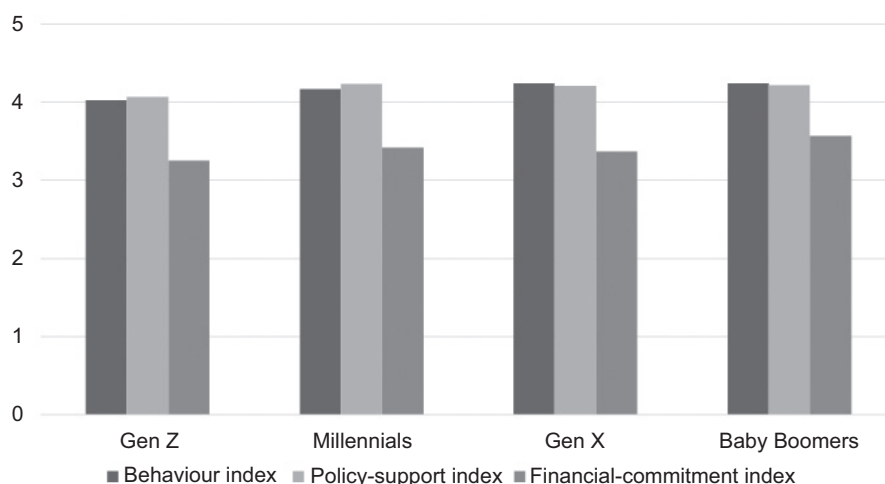
To provide a concise graphical synthesis of the main sociodemographic differences, Figure 1 reports three

composite indices across the four generational cohorts: pro-environmental behavior and motivation, policy support, and financial commitment. Each index was computed as the mean of multiple Likert-scale items capturing, respectively: (i) personal motivation, perceived environmental impact, conscious purchase of nonplastic packaging, and intentions to increase green packaging; (ii) support for stricter regulations, incentives for biodegradable packaging, company fees and government taxes on single-use plastics, and a complete ban on single-use plastic food packaging; and (iii) WTP more for biodegradable packaging and acceptance of a government tax on single-use plastics. The figure 1 shows a clear age gradient. Generation Z consistently records the lowest scores across all three indices, especially in terms of financial commitment, while Generation X and Baby Boomers display the highest levels of pro-environmental engagement. Millennials occupy an intermediate position, closer to older cohorts than to Generation Z. This graphical synthesis confirms the generational divide highlighted in the previous subsections, suggesting that younger consumers are less willing to translate environmental concerns into concrete behavioral and financial commitments.

## Discussion and Policy Implications

In this study, we have used nonparametric tests to detect differences among generational groups, gender, economic condition, and area of residence in consumers' motivations, behaviors, and policy preferences related to single-use food packaging.

The added value of this study lies in its focus on Italy as a specific case within the European policy framework



**Figure 1.** Composite indices of pro-environmental engagement by generation. The indices were calculated as the mean of multiple Likert-scale items related to behavior, policy support, and financial commitment (1 = strongly disagree; 5 = strongly agree). Higher values indicate stronger pro-environmental engagement.

on plastics. While previous research has mainly examined Northern and Central European countries, evidence on Southern Europe as well as Mediterranean countries is still limited.<sup>2</sup> Our findings contribute to filling this gap for Italy by revealing marked socio-demographic differences in attitudes and behavioral responses to single-use plastic packaging, and by identifying generational heterogeneity that has not yet been fully addressed in existing literature. Results are instrumental in facilitating the transition toward a sustainable agri-food system that increasingly relies on active consumer engagement and shared responsibility models (Brunori *et al.*, 2024).

Taken together, our results indicate that attitudes and behaviors toward single-use plastic are heterogeneous across sociodemographic segments and appear to be driven by distinct mechanisms rather than a single “green” disposition.

Compared to existing evidence from Northern and Central European countries, such as Germany and the United Kingdom, where consumers report higher willingness to adopt biodegradable packaging and stronger support for regulatory bans (Breuer *et al.*, 2024; Czine *et al.*, 2025; Drechsel *et al.*, 2025), our findings show that Italian consumers demonstrate lower WTP, particularly the younger generations. These differences suggest that the Italian case aligns only partially with the broader European trend, highlighting the role of country-specific institutional and cultural factors.

These differences can be interpreted considering broader sociocultural and institutional factors. In particular, previous studies in European and non-European contexts have often found that older adults display higher levels of pro-environmental behaviors and support for environmental policies compared to younger groups (Wang *et al.*, 2021). Moreover, previous research has consistently shown that women tend to report higher environmental concern and willingness to support environmental policies than men (Vicente-Molina *et al.*, 2018; Xiao & Mcwright, 2015). Economic well-being and education further amplify these patterns by increasing awareness of environmental impacts and access to sustainable alternative (Meyer, 2015).

According to our results, women showed stronger environmental awareness and commitment when it comes to single-use plastic packaging with greater motivation to reduce its use, placing more importance on its

environmental impact, and actively choosing products with nonplastic packaging. In addition, they expressed a clearer intention to increase their purchases of eco-friendly packaging in the near future. This environmentally conscious approach was also reflected in their attitudes toward policy measures: women were more supportive than men of stricter regulations and company fees aimed at limiting the use of single-use plastic. These results are in line with previous literature (Li *et al.*, 2019; Qadri *et al.*, 2025) which reported that women are more worried about environmental issues, favor plastic ban laws, are more pro-reduction in plastics, and are more likely to use reusable shopping bags. The key role of women in environment has also been demonstrated in a policy perspective. For example, Lodi *et al.* (2025) reported that in the case of Italian municipalities, when women hold the majority in municipal councils, they tend to inspire more environmentally responsible behavior among individuals in their communities. Our findings confirm that in the case of single-use plastic packaging, gender is a fundamental factor when designing environmental policies as well (Echavarren, 2023). To design effective marketing programs, firms should tailor their strategies to the fact that men and women differ in their attitudes toward single-use plastic food packaging. From a policy perspective, public campaigns should place particular emphasis on engaging men, with the aim of narrowing the attitude–behavior gap between genders.

Age group differences emerged as another critical factor in the analysis of the use of single-use plastic packaging. Specifically, the youngest age group, namely Generation Z, was consistently the least motivated to reduce single-use plastic. The results showed that, compared to the older generation, Generation Z agreed less with the importance of the environmental impact caused by non-single-use plastic, was less inclined to consciously choose nonplastic packaging, and less willing to increase their purchase of green packaging in the next 6 months. Besides, Generation Z was significantly less in agreement with the fact that regulations to reduce consumption of single-use plastic food packaging should be strengthened, that companies should pay a fee if they are using single-use plastic food packaging, and they were less willing to accept to pay a government tax. Generation Z was less willing to pay more for biodegradable packaging compared to the older generation. These findings do not align with previous studies on the topic which reported that Generation Z has a more positive attitude toward sustainability issues since they evaluate brand based on animal welfare, environmental sustainability, human rights, diversity, social equality, and inclusion (Pew Research Center, 2021). In addition, previous researchers showed that Generation Z has a more sustainable consumption behavior since

2. In particular, with regard to North African Mediterranean countries, despite Schouten *et al.* (2025), show that e.g., Tunisia has increasingly engaged in regulatory efforts to reduce plastic use and promote more sustainable food packaging systems, empirical studies exploring consumer perceptions, and behaviors are explored.

they don't buy unnecessary products as compared to older generations, and they tend to use reusable products (Bulut *et al.*, 2017). This could be because the connection between age and environmental issues is influenced by cultural and contextual elements as well (Qadri *et al.*, 2025). However, part of the research suggests that the environmental attitude of Generation Z is not so linear. For example, Walker *et al.* (2021) reported that participants in the 18–23 age group were less willing to pay a higher price for biodegradable packaging. D'Acunto *et al.* (2025) reported an attitude–behavior gap in the case of Generation Z with regard to hotel reviews, as they were less engaged in sustainability-related behavior, talking less about sustainability in their hotel reviews compared to older generations. Besides, Maesano *et al.* (2025) did not find a statistically significant relationship between consumer age and WTP for a hypothetical “microplastics-free” labelled bottled water. Additional studies should clarify these opposing trends and investigate variations in generational views on the use of single-use plastic packaging. With regard to the implications of results, marketers and policymakers should use different approaches with different generations, taking into account that younger generations could have a different attitude toward the use of single-use plastic. These generational differences likely reflect the influence of broader cultural and societal contexts, which play a key role in shaping how individuals perceive and engage with issues of sustainability.

Thus, environmental campaigns should be differentiated by age, making use of the higher environmental awareness in older generations.

As for the education level, the findings revealed that participants with higher levels of education showed stronger environmental motivation, greater awareness of environmental impacts, and a higher frequency of sustainable purchasing behavior. Education levels positively and significantly influenced support for environmental measures such as requiring companies to pay a fee for selling single-use plastic and supporting government taxes on single-use plastic. These results align with previous literature, suggesting that higher levels of education degrees are associated with stronger pro-environmental attitudes (Kirbiš, 2023; Wang *et al.*, 2022). To reduce single-use plastic packaging changing consume behavior in a more pro-environmental behaviors, will thus require to promote public education campaigns (Barone *et al.*, 2025; Rabiū & Jaeger-Erben, 2024).

In the case of the link between economic condition and consumers' attitude and behavior, the results showed that participants in better economic conditions demonstrated greater environmental awareness and engagement since they were significantly more motivated to reduce the use

of single-use plastic food packaging; they showed significantly higher levels of agreement with the importance of environmental impact caused by the use of single-use plastic; they were significantly less inclined to consciously choose no plastic packaging; and, lastly, those in a better economic condition showed significantly higher intention to increase their purchase of green packaging compared to those in a less favorable condition. These results are in agreement with previous research which suggested that having a higher income encourage pro-environmental behavior (Du, 2024; Aprile and Fiorillo, 2023;).

These results suggest that policymakers should remove financial obstacles to promote sustainable consumer behavior, for example, offering financial incentives and subsidies for eco-friendly packaging (Ngha *et al.*, 2025).

When examining consumers' attitudes toward regulatory measures and incentives aimed at reducing single-use plastic packaging, the relationship with declared economic conditions appears complex and nonlinear. While support for stricter regulations tends to grow as economic conditions become less favorable, this trend support for these measures— particularly those involving economic costs, such as a tax on companies using single-use plastics—declines noticeably. Conversely, participants who reported being in a better economic position were significantly more supportive of such measures compared to those in fair or difficult conditions. These findings suggest that economic vulnerability may limit individuals' willingness to endorse environmental policies (Qadri *et al.*, 2025), especially when these are perceived as potentially burdensome. As in the case of consumers' attitudes toward single-use plastic, these results highlight the necessity of policy approaches that take into account the economic capacity of individuals. In this sense, policymakers should adopt financial incentives to promote the adoption of sustainable behaviors, while making sure that people in a difficult economic situation don't carry more of the burden than others (Peñasco, 2024).

Individuals living in an urban area were more supportive of company fees for single-use plastic packaging and more supportive of implementing a tax for companies that use single-use plastic packaging compared to those living in rural areas. These results supported research which suggested that urbanizations increase awareness and encourages a pro-environmental behavior (Meloni *et al.*, 2019; Qing *et al.*, 2022). However, the results did not show any other differences in the variables between participants living in rural or urban areas. Further research is needed to explore how residences influence the use of single-use plastic packaging.

Lastly, WTP for biodegradable packaging was significantly influenced by age and economic condition. Specifically, individuals who perceive themselves to be in a good economic position reported greater readiness to pay for sustainable packaging. These results are in line with previous literature which suggested that income is positively related to WTP in the case of sustainable behavior (Gupta, 2016; Zeng *et al.*, 2025).

Moreover, the older generation (i.e., Baby Boomers) was significantly more willing to pay a premium compared to the younger generation, such as Generation Z. Our results contrast with those reported in previous studies, which reported that younger individuals were willing to pay more for biodegradable plastic bags (Mohamed Noor *et al.*, 2024; Song *et al.*, 2012). However, the findings are not entirely surprising, as reports by the EU indicate that Generation Z is the age group most at risk of poverty, which could negatively affect willingness or ability to pay for biodegradable packaging. Given these findings, policy efforts should be addressed to increase the affordability of sustainable packaging options (i.e., tax incentives), considering that younger generations are also those in financially vulnerable groups.

While this study constitutes an important contribution to a growing field of research, several limitations must be acknowledged. First, the analyzed sample is not representative of the Italian population. Although the use of web-based questionnaires facilitates the recruitment of a larger number of respondents, it inherently entails a degree of self-selection. This limitation is consistent with other studies employing convenience samples collected through similar procedures, in which younger, more highly educated, and more digitally literate individuals tend to be overrepresented (Canavari *et al.*, 2005). In the present study, this likely resulted in an overrepresentation of female participants and individuals with higher levels of education. Given that women in Italy are more likely to be responsible for food purchasing, they represent the primary decision-makers relevant to the consumption choices examined. However, the findings cannot be generalized to the broader population, despite the robustness of the relationships among variables.

Second, the reliance on self-reported preferences in a hypothetical consumption context may lead to an overestimation of willingness to purchase, as responses can be subject to biases such as self-deceptive positivity (Sörqvist *et al.*, 2016). Thus, repeating the experiment in a nonhypothetical context might improve the robustness of results (Thiene and Meyerhoff, 2021).

## Conclusions

The present study used nonparametric tests such as Kruskal–Wallis H test and Mann–Whitney U test to analyze the eventual differences among generational groups, gender, economic condition, and area of residence in consumer motivations, behaviors, and policy preferences related to the utilization of single-use food packaging.

Taken together, the results of the survey showed that there are significant differences between sociodemographic groups. This study offers valuable insights for policymakers to better understand public perceptions prior to implementing measures related to the use of single-use packaging.

First, it finds that gender is a relevant factor in determining consumers' attitude, behaviors, and policy preferences. In particular, women consistently demonstrated greater environmental awareness and motivation to reduce single-use plastic packaging. Second, another important result is the differences among age group disparities. In particular, Generation Z, the youngest age group, demonstrated significantly lower environmental concern and engagement across multiple dimensions related to single-use plastic packaging, when compared to older generation. These results indicate that generations' attitude and behavior toward environmental sustainability could be influenced by the cultural context. Lastly, our results also suggest a link between education levels and economic conditions, as individuals with higher schooling levels and better levels of economic well-being showed an overall higher pro-environmental behavior.

Despite its value addition, this study has several limitations. First, it relied on self-reported measures regarding the use of plastic packaging, which may be subject to social desirability or recall biases. Future research is encouraged to adopt experimental approaches to explore the same topic, possibly through studies conducted in laboratory setting or real supermarket environments. Second, another limitation is related to the sampling method. Participants were recruited using a nonprobability convenience sampling method via social media. This means that the sample may not be representative of the general population, as it is biased toward individuals who actively use social media. Future studies should use representative samples to enhance generalizability. Third, the focus of our study was on sociodemographic factors. Future studies should explore sociopsychological drivers that influence consumers' behavior and attitude toward single-use plastic packaging in the case of agri-food sector. Lastly, although our focus is on Italy, we acknowledge that a broader study including all European Mediterranean countries, and potentially also North

African Mediterranean countries, would be highly valuable. To the best of our knowledge, comparative research spanning the entire Mediterranean basin is currently scarce, especially regarding consumer-level dynamics. Given the well-documented ecological vulnerability of this semi-enclosed sea to plastic pollution and microplastics accumulation, such cross-Mediterranean comparisons would provide crucial insights into environmental management and policy design in the region.

## Mandatory Disclosure on Use of Artificial Intelligence

The authors declare that no AI-assisted tools were used in the preparation of this manuscript. All references have been manually verified for accuracy and relevance.

## Author Contributions

Conceptualization was done by M.A.P. and S.C.; methodology was the responsibility of M.A.P., S.C., and E.R.; software was taken care of by M.A.P., S.C., and M.P.; validation was looked into by M.A.P. and S.C.; formal analysis was done by M.A.P., S.C., and M.P.; investigation was the responsibility of M.A.P., S.C., E.R., and M.P.; resources were the responsibility of M.A.P.; data curation was done by M.A.P. and M.P.; writing—original draft preparation was taken care of M.A.P., S.C., and M.P.; writing—review and editing was taken care of by M.A.P. and S.C.; visualization was looked into by M.A.P. and S.C.; supervision was done by M.A.P.; project administration and funding acquisition were done by M.A.P. All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

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## Annex

Table A1. Percentage of respondents that declared to strongly agree with each statement.

	Support stricter regulation	Incentives for biodegradable	Company fee	Government tax	Support stricter regulation	Incentives for biodegradable	Company fee	Government tax
Gender: Female	51.6	50.2	50.9	50.3	51.6	50.2	50.9	50.3
Gender: Male	41.2	48.9	44.5	48.3	41.2	48.9	44.5	48.3
Age: Generation Z	46.5	47.6	47.5	46.9	46.5	47.6	47.5	46.9
Age: Millennials	51.6	49.6	52.0	52.0	51.6	49.6	52.0	52.0
Age: Generation X	50.9	54.6	48.5	48.5	50.9	54.6	48.5	48.5
Age: Baby Boomers	50.3	51.4	49.7	51.7	50.3	51.4	49.7	51.7
Education: Compulsory	46.0	51.2	36.8	41.3	46.0	51.2	36.8	41.3
Education: High school	49.3	49.9	49.0	48.7	49.3	49.9	49.0	48.7
Education: Bachelor's degree	50.7	48.4	52.7	53.3	50.7	48.4	52.7	53.3
Education: Postgraduate degree	52.0	50.9	53.5	53.1	52.0	50.9	53.5	53.1
Economic condition: Very difficult	38.3	49.7	29.0	34.0	38.3	49.7	29.0	34.0
Economic condition: Difficult	57.5	50.0	53.5	45.1	57.5	50.0	53.5	45.1
Economic condition: Neither poor nor rich	48.3	51.5	49.4	48.0	48.3	51.5	49.4	48.0
Economic condition: Good	50.2	49.6	50.0	50.6	50.2	49.6	50.0	50.6
Economic condition: Very good	53.0	48.6	54.7	56.2	53.0	48.6	54.7	56.2
Residence: Rural	49.4	50.3	46.5	48.1	49.4	50.3	46.5	48.1
Residence: Urban	50.3	49.9	51.6	50.9	50.3	49.9	51.6	50.9