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Modeling Recycling Behavior of Turkish Households: An Application of The Theory of Planned Behavior

Türk Hanehalklarının Geri Dönüşüm Davranışlarının Modellenmesi: Planlı Davranış Teorisinin Bir Uygulaması

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ANAHTAR KELİMELER

Yapısal eşitlik modellemesi
Planlı davranış teorisi
Niyet
Geri dönüşüm
Davranış

ÖZ

Bu çalışma, hane halkı geri dönüşümünü etkileyen faktörleri anlamak için Türk hanelerinin geri dönüşüm niyet ve davranışlarını incelemektedir. Katı atıklar, küresel ekonomiyi ve çevreyi önemli ölçüde etkilemektedir ve geri dönüşümü atık yönetimi açısından hayati hale getirmektedir. Türkiye'de hanehalklarının geri dönüşüm davranışlarına ilişkin araştırmalar sınırlı olmasına rağmen, bu faktörlerin anlaşılması daha etkili geri dönüşüm programlarının oluşturulmasına yol açabilir. Planlı Davranış Teorisi uygulanarak, çevrimiçi bir anket rastgele örnekleme yöntemi kullanılarak 415 Türk hanehalkına dağıtılmıştır. Hanehalklarının geri dönüşüm niyetleri ve davranışları Yapısal Eşitlik Modellemesi kullanılarak analiz edilmiştir. Bulgular, geri dönüşümle ilgili davranışın, Türk hane halkının niyetlerinden, tutumlarından, öznel normlarından, sonuçların farkındalığından, endişesinden ve algılanan davranışsal kontrolünden etkilendiğini göstermektedir. Bu çalışma, Türkiye'de sürdürülebilir geri dönüşüm uygulamalarını teşvik etmek için bu faktörlerin ele alınmasının önemini vurgulamaktadır.

KEYWORDS

Structural equation modeling
Theory of planned behavior
Intention
Recycle
Behavior

ABSTRACT

This study examines the recycling intentions and behaviors of Turkish households to understand the factors influencing household recycling. Solid waste significantly impacts the global economy and environment, making recycling crucial for waste management. Despite limited research on household recycling behavior in Türkiye, understanding these factors can lead to more effective recycling programs. Applying the Theory of Planned Behavior, a self-reported online questionnaire was distributed to 415 Turkish households using random sampling. The recycling intentions and behaviors of households were analyzed using Structural Equation Modeling. The findings indicate that recycling-related behavior is influenced by intentions, attitudes, subjective norms, awareness of consequences, concern, and perceived behavioral control of Turkish households. This study highlights the importance of addressing these factors for promoting sustainable recycling practices in Türkiye.

1. Introduction

Numerous critical environmental challenges pose threats to the well-being of both humanity and the planet's diverse species. These pressing environmental concerns encompass issues such as soil, air, and water pollution, deforestation, desertification, biodiversity loss, overexploitation of natural resources, and the escalating issue of unmanageable solid waste. The correlation between population growth, consumption patterns, and their repercussions has been a topic of extensive scholarly discourse (Alhassan et al., 2018). A wealth of research underscores that the surge in

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waste production and the unsustainable utilization of resources exert adverse impacts on both the environment and the global economy (Shevchenko et al., 2019).

Scholarly attention has underscored that the challenge of solid waste stemming from consumables, be it food or non-food items, necessitates concerted national and international solutions (Botetzagias et al., 2015). The growing body of literature underscores the paramount significance of efficacious solid waste management strategies. Therefore, the imperative lies in addressing human needs in a manner that aligns with ecological responsibility.

Recent insights from a systematic literature review pinpoint three pivotal techniques for curbing solid waste: reduce, reuse, and recycling (EPA, 2021). Among these, recycling assumes a foremost role in the realm of waste management (EPA, 2021). Recycling, denoting the recovery and conversion of useful materials such as paper, glass, plastics, and metals from Municipal Solid Waste (MSW) into new products to mitigate the demand for virgin raw materials, constitutes a key approach (EPA, 2021). Essentially, recycling integrates discarded materials into the manufacturing process through diverse means (Bezzina & Dimech, 2011). The methods encompass waste avoidance, reduce at the source, and recycling when waste generation is inevitable. A comprehensive analysis by Chan & Bishop (2013) underscores the multifaceted benefits of recycling, spanning economic considerations, prudent resource utilization, and energy conservation. As highlighted by Ara et al. (2021), recycling stands as a pivotal strategy to mitigate excessive waste disposal and the burden on landfills. Summing up the discourse thus far, recycling emerges as a yardstick for a nation's ecological consciousness and its commitment to waste abatement.

While recycling is firmly rooted in the practices of numerous developed nations, particularly within the European Union (EU), Türkiye's documented recycling rate remains notably lower than the EU average. Eurostat data reveals that the average municipal waste recycling rate across the EU-27 stands at 47.7%, whereas only around 11.5% of Türkiye's municipal waste was recycled in 2019. Noteworthy recycling champions in Europe include Germany, Slovenia, and Austria, with Germany projected to recycle 67.7% of its municipal waste (EUROSTAT, 2020). In accordance with municipal waste management statistics, the aggregate volume of waste collected across three significant provinces is reported as follows: 6,552,701 tons in Istanbul, 1,956,586 tons in Ankara, and 1,983,465 tons in Izmir. Subsequent analysis indicates that the total waste generated in Istanbul has been exclusively directed to waste processing facilities, while 1,941,086 tons from Ankara and 1,972,425 tons from Izmir have also undergone waste processing procedures (TURKSTAT, 2023). Notably, the expansion of recycling efforts in Türkiye corresponds to the advancement and execution of the Zero Waste Project, a comprehensive national endeavor aiming to reduce waste generation, foster recycling practices, and establish sustainable waste management strategies across the country (Zero Waste, 2023).

The complex interaction between human behavior and environmental challenges has an impact on studies to be carried out, especially in the field of recycling (Roy & Pal, 2009). Household actions emerge as a critical determinant in the success of recycling efforts (Davis et al., 2006). Positive attitudes and behaviors within households regarding recycling not only play a pivotal role in addressing pollution but also enhance the symbiotic relationship between economic and environmental gains. The cost-effectiveness of sorting recyclables at the household level, in contrast to centralized sorting facilities, underscores the importance of comprehending recycling behaviors at this foundational level. The effectiveness of recycling initiatives hinges on a thorough understanding of household perceptions toward recycling (Knussen et al., 2004; Tonglet et al., 2004b). In conclusion, recognizing and addressing household attitudes and behaviors toward recycling is crucial for the success of recycling initiatives, as they not only contribute to pollution reduction but also strengthen the interdependence between economic and environmental benefits.

Given the manifold benefits of recycling, promoting broader participation becomes paramount. This underscores the role of psychological behavioral theories (Chan & Bishop, 2013). Within this context, the Theory of Planned Behavior (TPB) has served as a framework for understanding household behaviors, particularly recycling behaviors. To facilitate effective solid waste management strategies, delving into household recycling practices is crucial, as evidenced by prior research. Notably, there is a dearth of comprehensive studies probing Turkish household recycling behaviors at the national level.

While Yilmaz et al. (2021) investigated recycling behaviors in Istanbul, Ankara, and Izmir, and Sorkun (2018) explored the influence of social norms on recycling in Seferihisar, Izmir, and Arı & Yılmaz (2016) scrutinized recycling behaviors of housewives in Eskişehir, these localized studies may not holistically capture Türkiye's diverse dynamics. Hence, this survey, encompassing households from Istanbul, Ankara, and Izmir, aims to offer a broader understanding at the national level. The purpose of this study to investigate the relationship between recycling behaviors and the Theory of Planned Behavior, aiming to discern the factors influencing individuals' intentions and actions regarding recycling practices. The study seeks to enhance our understanding of the psychological mechanisms underlying recycling behaviors, ultimately contributing to the development of targeted interventions and strategies to promote sustainable waste management practices in line with the Theory of Planned Behavior. Therefore, the main question of this study is, “What are the drivers affecting the intention and behavior of Turkish households regarding recycle?”. In this context, this study aims to analyze Turkish households’ recycle-related behaviors with the help of the

TPB.

2. Theoretical Background, Prior Literature and Hypothesis

Higher levels of domestic consumption have been closely linked to an upsurge in solid waste generation. Encouraging households to engage in recycling becomes imperative in curbing the escalation of solid waste production. Extensive literature substantiates that human behavior assumes a pivotal role in recycling practices and underscores the potential for altering household behavior to mitigate solid waste production (Roy & Pal, 2009). Consequently, investigations into household behavior have gained prominence. The realm of household behavior is intricate and multifaceted, influenced by a myriad of factors. Various theoretical frameworks have been introduced in the literature to explain recycling behavior. Notable among them are the Norm Activation Model (Schwartz, 1973), the Theory of Value-Belief-Norm (Stern, 2000), and the Theory of Planned Behavior (TPB) (Ajzen, 1985), the latter being the most widely embraced for comprehending pro-environmental behavior (Armitage & Conner, 2001). TPB is a social psychological theory that aims to explain and predict human behavior based on individuals' attitudes, subjective norms, and perceived behavioral control. The theory was developed by Icek Ajzen as an extension of his earlier work on the Theory of Reasoned Action. The key components of the Theory of Planned Behavior are attitude toward behavior, subjective norms, and perceived behavioral control. Attitude Toward Behavior refers to an individual's positive or negative evaluation of performing a particular behavior. It includes beliefs about the outcomes of the behavior and the subjective value attached to those outcomes. Subjective norms capture the perceived social pressure or influence an individual feels from others to perform or not perform a certain behavior. It includes beliefs about whether important referents (such as friends, family, or colleagues) approve or disapprove of the behavior and the individual's motivation to comply with these perceived norms. Perceived Behavioral Control reflects an individual's perception of the ease or difficulty of performing a behavior. It takes into account factors such as the individual's self-efficacy (confidence in their ability to perform the behavior) and the presence of facilitating or hindering factors. The intention to perform a behavior is considered the immediate precursor to actual behavior in the TPB. Intention is influenced by attitudes, subjective norms, and perceived behavioral control. Additionally, perceived behavioral control directly influences behavior. It's important to note that the Theory of Planned Behavior assumes that individuals are rational decision-makers who consider the implications of their actions and that their intentions are the best predictors of their behavior (Ajzen, 1985). The TPB, acknowledged for its versatility, has been extensively scrutinized as a dependable predictor of diverse behaviors, encompassing environmental actions such as water conservation (Lam, 2006), waste reduction (Bortoleto et al., 2012), food waste recycling (Mak et al., 2018), and household waste segregation (Knussen et al., 2004). Its application to recycling behaviors within households has fostered a substantial and growing body of literature, with notable contributions from researchers such as Alhassan et al. (2018), Strydom (2018), and Muniandy and Anuar (2020), who have employed the TPB to assess household recycling and waste separation practices. It is pertinent to underscore, however, that no comprehensive nationwide studies employing this approach have been conducted in the context of Türkiye.

The TPB (see Figure 1) stands as a psychological framework utilized to predict and explicate human behavior. Originating in the 1980s through the work of Icek Ajzen, the TPB is grounded in the premise that attitudes, subjective norms (SN), perceived behavioral control (PBC), and intentions collectively shape behavior. According to the TPB, an individual's intention to perform a particular activity emerges as the most substantial precursor to the actualization of said behavior. This intent is molded by attitudes, SN, and PBC. Notwithstanding its widespread adoption, researchers have consistently refined the theory due to its inherent limitations. For instance, extant research suggests the incorporation of novel variables to enhance the theory's explanatory power (Boldero, 1995; Davies et al., 2002; Tonglet et al., 2004b). Notably, in Türkiye, no comprehensive national investigation has explored the origins and ramifications of attitudes, SN, and PBC concerning recycling-related behavior. To deepen the comprehension of recycling behavior, researchers have incorporated additional variables into the model (Bezzina & Dimech, 2011). Thus, this study introduces two supplementary components, namely awareness of consequences (AC) and concern, into the model to more comprehensively characterize household recycling behavior.

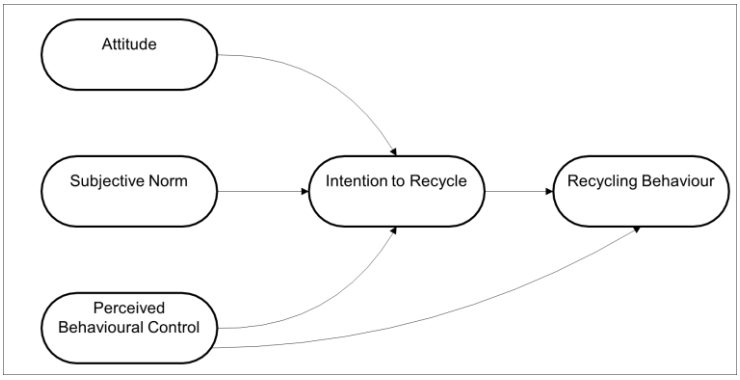

Figure 1. Theory of Planned Behavior (Ajzen, 1985; Strydom, 2018).

The established predictors within Ajzen's TPB, alongside the newly introduced variables, constitute the foundation of this study's model. Within this framework, Turkish households' recycling behaviors are explored through structural equation modeling. Attitudes, AC, SN, concern, and PBC within the TPB are all subjected to evaluation. The

model serves as a tool to assess the hypotheses formulated within the study's scope (H_1, H_2, H_3, H_4, H_5, H_6, H_7).

In Ajzen's TPB model, attitudes, intentions, PBC, and SN collectively influence the evolution of behavior. The initial hypothesis (H_1) of the TPB model probes the impact of intention on behavior. Existing research suggests a positive relationship between households' recycling intentions and their recycling-related behaviors.

H_1: Households' intention to recycle influences their recycling behavior.

Building upon Ajzen's TPB, the primary variables presumed to shape intention are posited as a continuation of the initial hypothesis. Attitudes, SN, and PBC are all poised to predict intention. Attitudes, AC, SN, concern, and PBC emerge as potential drivers of intent. Attitudes reflect an individual's inclination to engage in a behavior, shaped by their perceptions of the behavior's consequences and their valuations of those outcomes. For instance, a person might be more inclined to recycle if they perceive it as environmentally beneficial and attach significance to environmental preservation. Prior empirical investigations into the association between attitudes and recycling behavior have yielded divergent findings. While some researchers (Ramayah et al., 2012; Pakpour et al., 2014; Alhassan et al., 2018; Strydom, 2018; Muniandy & Anuar, 2020) have found a linkage between individual attitudes and recycling behavior, others (Davis et al., 2006) have reported a lack of predictive relationship. Within the framework of Ajzen's TPB, attitudes wield considerable influence over intention (H_2).

H_2: Households' attitudes toward recycling impact their recycling intentions.

Subjective norms (SN) encompass perceived social pressures that either promote or discourage engagement in a specific action. Positive peer and family endorsements of a behavior can heighten an individual's likelihood of adopting it. Empirical investigations by Mahmud & Osman (2010), Ramayah et al. (2012), Pakpour et al. (2014), Alhassan et al. (2018), Strydom (2018), and Muniandy & Anuar (2020) have indicated that subjective norms significantly influence individuals' recycling behavior. Conversely, researchers such as Knussen et al. (2004) and Tonglet et al. (2004b) have contested the explanatory power of social norms in understanding recycling behavior. This study aims to ascertain whether the recycling attitudes of others exert an impact on the recycling intentions of Turkish households (H_3).

H_3: Households' subjective norms regarding recycling have an effect on their recycling intentions.

Perceived behavioral control (PBC) reflects an individual's conviction in their ability to enact a specific behavior. A person is more likely to recycle if they perceive themselves to possess the necessary resources and competencies. Unlike SN and attitude, PBC can exert influence over both behavior and intention. As per researchers including Chan & Bishop (2013), Pakpour et al. (2014), Strydom (2018), and Muniandy & Anuar (2020), an individual's perception of PBC significantly impacts their recycling behavior. However, findings have been mixed, with some studies (Boldero, 1995; Davies et al., 2002; Ramayah et al., 2012; Muniandy & Anuar, 2020) reporting no significant role for perceived behavioral control in explaining recycling behavior. Mahmud & Osman (2010), Wan et al. (2014), Botetzagias et al. (2015), and Kumar (2019) have demonstrated the influence of PBC on individuals' recycling intentions. Conversely, other researchers (Davies et al., 2002; White & Hyde, 2012; Strydom, 2018) have found limited impact of PBC on recycling intentions. Moreover, intention has been recognized as an antecedent to recycling behavior. Scholars such as Wan et al. (2012), Chan & Bishop (2013), Pakpour et al. (2014), and Strydom (2018) have attested to the relationship between individuals' recycling behavior and their intentions. In this light, PBC is anticipated to have a bearing on both intention and behavior (H_4, H_5).

H_4: Households' perceived behavioral control over recycling impacts their recycling intentions.

H_5: Households' perceived behavioral control over recycling influences their recycling behavior.

In addition to the core variables of Ajzen's TPB, the study posits the introduction of supplementary variables to enhance the predictive power of intention, aligning with prior recycling research. AC and concern are identified as potential further drivers of behavior. AC is posited to impact recycling behavior. While Tonglet et al. (2004a), Wan et al. (2012), Wan et al. (2014), Lizin et al. (2017), and Wan et al. (2017) have established a link between AC and recycling behavior, Kumar (2019) has found no evidence of AC shaping recycling behavior. Tonglet et al. (2004a, b) have identified no significant relationship between AC and intention. Davis et al. (2006), for instance, discovered no substantial correlation between AC and intention in the context of Brixworth. Concern, as noted by Tonglet et al. (2004a, b), Wan et al. (2012), Wan et al. (2014), Lizin et al. (2017), and Wan et al. (2017), influences individuals' recycling behavior. However, Davis et al. (2006) reported limited positive correlation between concern and intention in West Oxfordshire District Council. Within the framework of Ajzen's TPB, AC and concern are projected to exert significant influence on intention (H_6, H_7).

H_6: Households' awareness of consequences regarding recycling impacts their recycling intentions.

H_7: Households' concern regarding recycling influences their recycling intentions.

3. Material and Methods

3.1. Questionaire, Variables, Scale, and Research Design

To comprehensively investigate the recycling behaviors of Turkish households within the framework of the Theory of Planned Behavior (TPB), a quantitative research methodology was employed in this study. Data collection was facilitated through Google Forms, leveraging an online survey conducted between August and September 2020. Structured questionnaires were employed to elicit information regarding sociodemographic characteristics and contextual factors intertwined with household recycling practices. The ensuing section within the results presents statistical details encompassing variable nomenclature, variable grouping, and response rates.

Moreover, the survey meticulously explored an array of aspects, encompassing recycling-related behaviors, intentions, attitudes, subjective norms (SN), perceived behavioral control (PBC), awareness of consequences (AC), and concern – all constituting potential factors within the TPB framework. Consistent with previous research grounded in the TPB (Tonglet et al., 2004b; Yılmaz et al., 2010; Bezzina & Dimech, 2011; Ramayah et al., 2012; Wan et al., 2012; Oztekin et al., 2017; Wan et al., 2017; Arli et al., 2019), the survey featured inquiries gauged through the utilization of the Likert scale (Likert, 1932). Within this scale, a 5-point continuum was employed to denote the spectrum of responses, wherein 5 signifies strong agreement and 1 signifies strong disagreement, serving as a metric to express the mean of the survey items.

3.2. Research Area and Sampling

Türkiye spans both Anatolia and the Balkan peninsula, as depicted in Figure 2, which provides a city map featuring key locations such as Istanbul, Ankara, and Izmir.

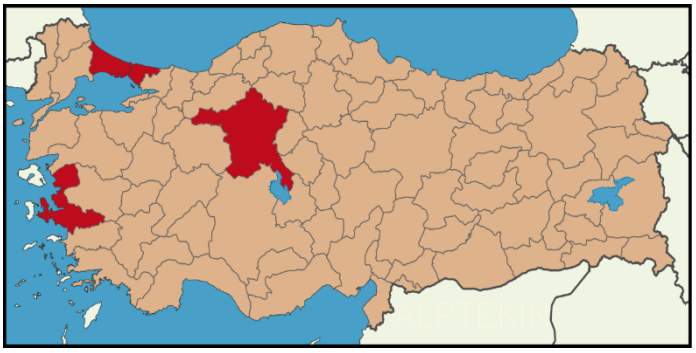

Figure 2. Map of Türkiye and Cities Included in the Study

To ensure the collection of a representative sample from the Turkish population, random probability sampling was adopted. According to TURKSTAT's 2020 statistics, Türkiye's population was estimated at approximately 83,614,000. Employing a 5% sampling error, a 95% confidence interval, and a 50% standard population proportion, a minimum sample size of 383 was established (Krejcie & Morgan, 1970). This study successfully garnered responses from 415 households across Türkiye. Notably, a robust assessment confirmed the reliability and validity of all questionnaires employed during the survey phase. The majority of respondents hailed from Istanbul (61.0%), Ankara (22.0%), and Izmir (17.0%)—the three most populous cities in Türkiye. Importantly, during the survey period, these three provinces accounted for 30.3% of Türkiye's total population.

Table 1 encapsulates the demographic information concerning the sample populace in relation to Türkiye's entire population in 2020. Pertinent data concerning Türkiye's fundamental population attributes—such as age, household size, per capita income, and gender—were sourced from the official statistics website (TURKSTAT, 2020). With the exception of age and educational attainment, the chosen sample aligns closely with the broader Turkish population across key parameters. Broadly speaking, the survey respondents, predominantly adults aged between 18 and 65, exhibit a notably high level of educational attainment. The educational level of participants can potentially influence their intentions and behaviors, according to the TPB. The TPB suggests that behavioral intentions are influenced by three main factors: attitudes toward the behavior, subjective norms, and perceived behavioral control. Education can play a role in shaping these factors. Highly educated individuals may have different attitudes toward certain behaviors based on their knowledge and understanding. Education can influence how they perceive the importance, benefits, or drawbacks of a particular behavior. The social context, including the influence of peers, family, and society, can be shaped by education. Highly educated individuals may be part of social circles where certain behaviors are more or less accepted, and this can influence their subjective norms. Education can also impact individuals' perceived control over a behavior. Highly educated individuals may feel more in control due to their knowledge and skills, or they may perceive certain behaviors as more or less feasible based on their education level. Noteworthy research comparing online and face-to-face surveys has highlighted the potential for online surveys to attract a higher proportion of educated respondents (Vaske et al., 2011). Consequently, the educational levels of the respondents exceed the Turkish average.

Table 1. Some Fundamental Participant Characteristics and Their Comparison to the General Population

Characteristics	Sample	Population*
Age	Between 18- 64 years (100 %)	Under 18 years (29,5 %) Between 18- 64 years (61,0 %) 65 years and up (9,5 %)
Household size (mean)	3.3 person	3.3 person
Per capita income (mean)	900 $** and less (91,6 %)	900 $** and less (86,2 %)
Household income (mean)	2820 $** and less (92,0 %)	2820 $** and less (93,4 %)
Gender	52,0 % of women, 48,0 % of men	54,8 % of women, 45,2 % of men

*Population data derived from the Turkish Statistical Institute

(TURKSTAT, 2020) ** 1 $ = Average 8.87 Turkish Liras in 2021 (CBRT, 2022).

3.3. Analysis Methods

Upon the completion of the study questionnaires, the primary data extracted from the questionnaires were subjected to analysis. The Statistical Package for the Social Sciences (SPSS) was enlisted for Reliability Analysis and other fundamental statistical evaluations. Additionally, the Linear Structural Relations (LISREL) program was harnessed to conduct Structural Equation Modeling (SEM) and Confirmatory Factor Analysis (CFA). The appraisal of reliability and validity of the variables anchored on the 5-point Likert Scale (Likert, 1932) was accomplished through reliability analysis. This analytical technique scrutinizes response consistency to ascertain the robustness and validity of survey participant inputs (Field, 2013). The Cronbach Alpha coefficient, a widely employed measure, was utilized in the reliability analysis. Devised by Lee Cronbach in 1951, the alpha coefficient gauges the internal consistency of a scale or test, manifesting as a value between 0 and 1. In the context of scales used in household behavior research, an alpha range of 0.00 to 0.40 is categorized as "not reliable," 0.40 to 0.60 as "low reliability," 0.60 to 0.80 as "moderately reliable," and 0.80 to 1.00 as "highly reliable" (Cronbach, 1951).

The statistical methodology of SEM serves as a potent avenue for evaluating and estimating interrelationships among variables. This versatile tool is applicable across diverse data types, encompassing continuous and categorical variables. Across disciplines such as psychology, sociology, marketing, and education, SEM is leveraged extensively, facilitating the exploration of intricate data interplays and enhancing comprehension of factors underpinning diverse behaviors. SEM hinges upon a constellation of structural equations that model the interconnections among variables. These equations are computed using data samples, and the model's adequacy is gauged through diverse statistical techniques. SEM's potency lies in its capacity to concurrently test and estimate multiple associations while accommodating potential variable interdependencies, rendering it invaluable for unraveling complex data interrelations. Its applications encompass hypothesis testing regarding variable relationships and discerning underlying determinants of phenomena. Additionally, SEM's predictive utility permits projections of future events based on inferred model relationships (Kline, 2011).

In the context of the TPB, the SEM will encompass factors deemed to exert influence on the recycling intentions and behaviors of Turkish households.

4. Results and Discussion

4.1. Background and Socio-Demographic Variables

Table 2 presents a comprehensive overview encompassing the background and sociodemographic attributes of the participants involved in this study. The analysis reveals that 48.0% of the research participants are male, while 52.0% are female. A substantial majority of respondents (86.0%) fall within the age bracket of 38 or younger. An overwhelming majority of households (98.5%) boast a high school diploma or an even higher level of educational attainment. Among the interviewed individuals, 63.5% indicated that they are not married, while 34.5% conveyed their marital status as married. The research cohort features a composition where 24.6% are individuals with children and 75.4% are those without children. Notably, the average household size for the participants stands at 3.3 individuals.

In terms of per capita household income, the distribution across households is as follows: 33.7% exhibit a per capita income below $227, 31.3% fall within the range of $226 to $500, and 35.0% surpass the threshold of $501. The survey outcomes further unveil recycling patterns, revealing that 47.7% of households engage in the recycling of glass, 41.4% actively recycle plastics, 53.5% partake in the recycling of paper, cardboard, and other materials, 41.4% contribute to the recycling of fabrics and textiles, and 39.8% demonstrate involvement in the recycling of batteries and electronic equipment..

Table 2. Background and Socio-Demographic Variables of the Questionnaire

Variables name	Group of variable	Percentage**
Gender	1. group: Woman	52,0 %
	2. group: Men	48,0 %
Age	1. group: 18-28 years	53,5 %
	2. group: 29-38 years	32,5 %
	3. group: 39-48 years	10,1 %
	4. group: 49-58 years	2,9 %
	5. group: 59 + years	1,1 %
Descriptive statistics of age (years) Min= 18,0 Max=65,0 Mean= 28,8 Sd=9,2		
Education	1. group: Low (5-8 years)	1,5 %
	2. group: Middle (9-12 years)	26,2 %
	3. group: High (13 + years)	72,3 %
Marriage status	1. group: Married	34,5 %
	2. Not married	65,5 %
Have children	1. group: having a child	24,6 %
	2. group: not having a child	75,4 %
Number of households	1. group: 1-2 person	30,1 %
	2. group: 3-4 person	53,5 %
	3. group: 5 and + person	16,4 %
Descriptive statistics number of households (person) Min=1,0 Max=9,0 Mean=3,3 Sd=1,4		
Per capita household income	1. group: 225 $ * or less	33,7 %
		31,3 %

(average per three people)	2. group: 226-500 $ * 3. group: 501 $* or more	35,0 %
Recycling status for glass materials	1. group: Yes	47,7 %
	2. group: Occasional	27,5 %
	3. group: No	24,8 %
Recycling status for plastics	1. group: Yes	41,4 %
	2. group: Occasional	32,3 %
	3. group: No	26,3 %
Recycling status for paper, cardboard and other materials	1. group: Yes	53,5 %
	2. group: Occasional	29,2 %
	3. group: No	17,3 %
Recycling status for fabrics and textiles	1. group: Yes	41,4 %
	2. group: Occasional	27,5 %
	3. group: No	31,1 %
Recycling status for batteries and electronics	1. group: Yes	39,8 %
	2. group: Occasional	28,9 %
	3. group: No	31,3 %

* 1 $ = Average 8.87 Turkish Liras in 2021 (CBRT, 2022). ** All percentage estimates in groups equal 100%.

4.2. Results of Reliability and Confirmatory Factor Analysis

Cronbach's Alpha coefficient was employed to gauge the reliability, and its resultant value of 0.81 underscores the high reliability of each of the 25 5-Point Likert items ($p = 0.000$).

Confirmatory Factor Analysis (CFA) serves as a pivotal method for evaluating the acceptance or rejection of measurement theories (Brown & Moore, 2012). Within this study, CFA was deployed to scrutinize both the validity and reliability of the measurement scales. Specifically, CFA was harnessed to scrutinize the seven primary latent variables encompassing a total of 25 observed items. The initial evaluation of the CFAs was conducted via the goodness-of-fit index. Table 3 elucidates the benchmarks for both the initial and subsequently adjusted CFAs. Consequently, the initial CFA outcomes led to an iterative refinement, culminating in the generation of modified CFA values. While prior investigations have advocated for a $\chi 2/df$ threshold capped at 3 (Scappini & Fioravanti, 2022), others have stipulated a maximum threshold of 4.5 (Mahmud & Osman, 2010). Employing Equation 1, the initial CFA yields a value of 3.8 (1).

$$\text{Chi-sq.}\ (\chi 2) / df = 969{,}2 / 254 = 3{,}8 \quad (1)$$

As indicated by the CFA results, all observed variables exhibit t-values exceeding 2, underscoring the statistical significance of each facet under investigation. Nonetheless, the comprehensive model's efficacy can be further enhanced. Consequently, the CFA output file was meticulously examined to discern potential amendments among variables. In light of addressing potential multicollinearity among variables, recommendations for modifications were proposed. Despite the reliability of the items and scales employed in this study, the presence of correlated responses due to the inherent similarity of several questions introduced multicollinearity concerns (Mahmud & Osman, 2010; Bortoleto et al., 2012; White & Hyde, 2012; Chan & Bishop, 2013; Botetzagias et al., 2015).

Table 3. The Goodness of Fit Indices Results in CFA and Modified CFA

The Goodness of Fit Index	CFA	Modified CFA	The Goodness of Fit Criterion
NFI	0,96	0,96	$0{,}95 \leq NFI \leq 1{,}00$ Perfect Fit
NNFI	0,96	0,96	$0{,}97 \leq NFI \leq 1{,}00$ Perfect Fit
CFI	0,97	0,97	$0{,}97 \leq NFI \leq 1{,}00$ Perfect Fit
IFI	0,97	0,97	$0{,}97 \leq NFI \leq 1{,}00$ Perfect Fit
RMSEA	0,082	0,79	$0.05 \leq RMSEA \leq 0.08$ Acceptable Fit

NFI=Normed Fit Index, NNFI= Non-Normed Fit Index, CFI= Comparative Fit Index, IFI=Incremental Fit Index, GFI= Goodness of Fit Index, RMR = Root Mean Square Residual, RMSEA= Root Mean Square Error of Approximation. Reference: (Barrett, 2007).

The forthcoming suggestions pertain to the adjustments in the output file driven by CFA insights: A strategic adjustment in the RB4-RB5 variables would contribute to a 36.7-unit increment in the chi-square statistic, a 24.6-unit rise in the A1-A2 chi-square statistic, and a 15.0-unit augmentation in the PBC2-PBC3 chi-square statistic. The resultant corrected value of $\chi 2/df$ is depicted in Equation (2). Comparative assessment of the goodness-of-fit indices for CFA and modified CFA is elucidated in Table 3, illustrating noteworthy improvements across all indices post-adjustment.

$$\text{Chi-square}\ (\chi 2) / df = 902.12 / 251 = 3.6 \quad (2)$$

Table 4 presents comprehensive item insights drawn from prior research endeavors. It encompasses each item's mean score on the 5-Point Likert Scale (ranging from 5 = strongly agree to 1 = strongly disagree), alongside the t-values, R2 values, and factor loadings for all observed variables integrated within the path analysis following modifications. The outcomes stemming from the CFA analysis manifest t-values surpassing the 2-threshold and R2 values frequently exceeding 0.67 (with the exception of a singular variable). This collective inference underscores the statistical significance inherent in each component.

Table 4. Results of Confirmatory Factor Analyses (Modified)

Items (25 items)	Mean score of 5-point Likert scale	Factor Loads	T-values	R^2
Recycling Behaviours				
RB1- I recycled my recyclables regularly[a]	3,78	0,9	22,96	0,8
RB2- I have demonstrated recycling behavior in the last four weeks[a]	3,73	0,87	21,95	0,76
RB3- I donate my old clothes and shoes to charity or give them to those in need. [b]	4,39	0,47	9,82	0,42
RB4- When I do not use glass, plastic, and paper waste, I sort it out and throw it in the recycling garbage can.	3,82	0,83	20,11	0,68
RB5- I sort and throw electronic waste and batteries into the recycling garbage can	3,73	0,65	14,28	0,42
Intentions				
I1- I plan to recycle my recyclables in the next four weeks. [c]	4,25	0,86	21	0,73
I2- I will recycle my recyclables every time I have them for disposal. [c]	4,17	0,85	20,71	0,72
I3- I am willing to participate in the recycling system in the future. [c]	4,3	0,69	15,36	0,47
Attitudes toward recycling behaviors				
A1- Recycling is useful. [c]	4,89	0,88	22,76	0,78
A2- Recycling is good [d]	4,9	0,93	24,79	0,86
A3- Recycling is necessary [d]	4,78	0,9	23,81	0,82
A4- Recycling is right [d]	4,87	0,94	25,43	0,88
A5- Recycling is valuable [d]	4,85	0,91	23,93	0,82
Subjective Norms (SN)				
SN1- I feel responsible for recycling. [e]	4,27	0,86	21,24	0,73
SN2- People I care about expect me to recycle. [d f]	4,38	0,86	21,49	0,74
SN3- I would feel guilty if I did not recycle my waste. [g f]	4,18	0,87	21,94	0,76
Perceived Behavioural Control				
PBC1- I would find it difficult to recycle the recyclable materials (paper, glass, plastic, etc.) regularly in the next few months [d]	2,86	0,91	22,49	0,83
PBC2- The number of outside influences that might prevent me from regularly recycling the recyclables (paper, glass, plastic, etc.) in the next few months [e]	2,81	0,82	18,97	0,67
PBC3- I have complete control over recycling the recyclables (paper, glass, plastic, etc.) regularly in the next few months. [e]	2,87	0,83	19,29	0,68
Awareness of Consequences				
AC1- Recycling conserves natural resources. [g e h f]	4,87	0,88	22,43	0,77
AC2- Recycling reduces the amount of waste that ends up in landfills [g h f]	4,85	0,84	20,89	0,71
AC3- Recycling saves energy. [c g]	4,79	0,91	23,67	0,83
Concern				
C1- I do not care about the negative environmental impact of not recycling.	1,38	0,94	25,17	0,88
C2- I do not care about the social impact of not recycling.	1,41	0,93	24,68	0,86
C3- I do not care about the economic costs of not recycling.	1,49	0,92	24,43	0,85

Fit Indices of Path Analysis (CFA): RMSEA= 0.079, p=0,000, Chi-square=902,17, df=251, x2/df=3,6, NFI=0,96, NNFI= 0,96, CFI=0,97, IFI=0,97. References: [a] Wan et al., 2012, [b] Yılmaz et al., 2010, [c] Wan et al., 2017, [d] Oztekin et al., 2017, [e] Bezzina and Dimech, 2011, [f] Arli et al., 2019, [g] Tonglet et al., 2004b, [h] Ramayah et al., 2012

The covariance matrix depicting the interrelationships among the latent variables is illustrated in Table 5. Remarkably, all covariance matrix p-values demonstrate statistical significance at the 5% level. The cross-correlations observed between latent variables intensify as their proximity to 1 increases. This analysis unequivocally reveals the inherent strength characterizing the associations among all latent variables. Furthermore, the signs preceding each coefficient (whether positive or negative) furnish vital insights regarding the directional correlations governing these relationships.

Table 5. The Covariance Matrix of the Variables for the Modified Path Analysis

	Concern	Awareness of Consequences	Subjective Norm	Attitudes	PBC	Intentions
Concern	-					
Awareness of Consequences	-0.44 (0.04*) -10.09	-				
Subjective Norm	-0.41 (0.04*) -9.17	0.44 (0.04*) 9.94	-			
Attitudes	-0.66 (0.03*) -21.56	0.89 (0.01**) 63.50	0.65 (0.03*) 20.15	-		
PBC	0.43 (0.04*) 9.53	-0.15 (0.05*) -2.79	-0.38 (0.05*) -7.95	-0.18 (0.05*) -3.45	-	

*p<0.05, **p<0.1

4.3. Results of Structural Equation Modeling

Within the realm of the Theory of Planned Behavior (TPB), Structural Equation Modeling (SEM) was deployed to meticulously probe the recycling behaviors exhibited by Turkish households. The framework entailed endogenous latent factors encompassing attitudes, subjective norms (SN), perceived behavioral control (PBC), awareness of consequences (AC), and concern. Simultaneously, exogenous latent variables encapsulated recycling-related behaviors and intentions. It is postulated that attitudes, SN, PBC, AC, concern, recycling-related behavior, and intention all interplay to exert influence. Through this conceptual framework, intricate interrelationships are established, wherein the t-values and normalized solutions between variables assume pivotal significance within both the initial SEM and the preliminary path analysis. Analogously, the SEM's fit index stands to benefit from modifications aimed at enhancement.

Table 6 furnishes a comprehensive depiction of the SEM outcomes, with the initial SEM bearing a Root Mean Square Error of Approximation (RMSEA) of 0.084, a chi-square of 1014.34, degrees of freedom (df) at 258, and a $\chi 2$/df ratio of 3.94. Comparatively, the modified SEM delivers an improved fit, characterized by an RMSEA of 0.080, a chi-square of 357.5, df at 92, and a $\chi 2$/df ratio of 3.8. These indices collectively provide a robust assessment of the SEM's alignment with the underlying data and theoretical framework.

To optimize the chi-square value in the output file, the following adjustments are recommended: refinements involving the RB4-RB5 variables led to a substantial 31.3 unit enhancement in chi-square, the A1-A2 correction improved by 25.8 units, and the PBC2-PBC3 modification yielded an 11.8 unit enhancement. With these adjustments, the modified model achieved values of RMSEA = 0.080, chi-square = 357.5, df = 92, and $\chi 2$/df = 3.8. This revised model emerges as a more fitting and acceptable representation within the established fit range.

Table 6. The Goodness of fit Results in SEM and Modified SEM

Fit Index	SEM	Modified SEM	The Goodness of fit criterion
NFI	0,96	0,96	0,95 ≤ NFI ≤ 1,00 Perfect Fit
NNFI	0,96	0,96	0,97 ≤ NFI ≤ 1,00 Perfect Fit
CFI	0,97	0,97	0,97 ≤ NFI ≤ 1,00 Perfect Fit
IFI	0,97	0,97	0,97 ≤ NFI ≤ 1,00 Perfect Fit
RMSEA	0,084	0,080	0.05 ≤ RMSEA ≤ 0.08 Acceptable Fit

NFI=Normed Fit Index, NNFI= Non-Normed Fit Index, CFI= Comparative Fit Index, IFI=Incremental Fit Index, GFI= Goodness of Fit Index, RMR = Root Mean Square Residual, RMSEA= Root Mean Square Error of Approximation. Reference: (Barrett, 2007).

The resultant structural equation (Equation 3) is delineated as follows: Behavior = (0.72 × Intention) – (0.19 × PBC), R_2 = 0.69 (3)

In this structural equation, the initial part describes the interplay between the exogenous latent variables PBC and intention, in addition to the assumption that the endogenous variable PBC influences behavior. This component of the model explains 69% of behavior. Interestingly, while the intention variable demonstrated a positive impact on behavior, the PBC variable exhibited a negative coefficient within the SEM.

Intention = (–0,55 × PBC) + (0,34 × SN) + (0,54 × C) – (0,71 × AC) + (1,16 × A), R2 = 0.76 (4)

The second portion of the SEM unveils the equation for intention (Equation 4), detailing the relationships and signs of latent variables—attitudes, SN, AC, concern, and PBC—that contribute to the explanation of intention. An impressive 76% of the intent variable's variance is accounted for by these variables (R_2 = 0.76). Notably, the sign of the PBC variable—a counterpart to the intention variable—has

been inverted from positive to negative. SN, attitudes, and concern positively influence intentions, whereas PBC and AC exert negative effects on intentions.

Behavior = (–0,59 × PBC) + (0,24 × SN) + (0,38 × C) – (0,51 × AC) + (0,83 × A), R_2 = 0,57 (5)

Furthermore, the third section of the SEM—captured in Equation 5—illuminates the interdependencies among latent variables, offering insights into how they shape behavior. This segment explains 57% of behavior (R_2 = 0.57). The mathematical formulations of these structural equations (3)-(5) are visually depicted in Figure 3, encapsulating the recycling practices of Turkish households.

Upon analysis, the mathematical and graphical results of the model reveal the following insights:

The link between Turkish recycling behavior and intentions is statistically significant (t = 13.45, standard deviation = 0.70), signifying that recycling-related intentions translate into behavior.

The latent variables of attitudes, SN, AC, concern, and PBC all wield influence on the recycling-related intentions of Turkish households. Notably, PBC emerges as a significant latent predictor for recycling behavior.

PBC exhibits a robust negative connection with the recycling behaviors of Turkish households (t = -4.13, standard deviation = -0.19), underscoring its pivotal role as a latent predictor for recycling behavior.

Recycling intentions of Turkish households are positively influenced by attitudes, SN, and concern. These latent variables play crucial roles in shaping recycling intentions.

The inverse structure of concern-related observed items (C1, C2, and C3) on a 5-point Likert scale—aligned closely with "strongly disagree" (1)—implies a negative influence. Despite this, the latent variables of concern significantly impact recycling intentions in a favorable manner.

Both PBC and AC exert negative impacts on the recycling intentions of Turkish households.

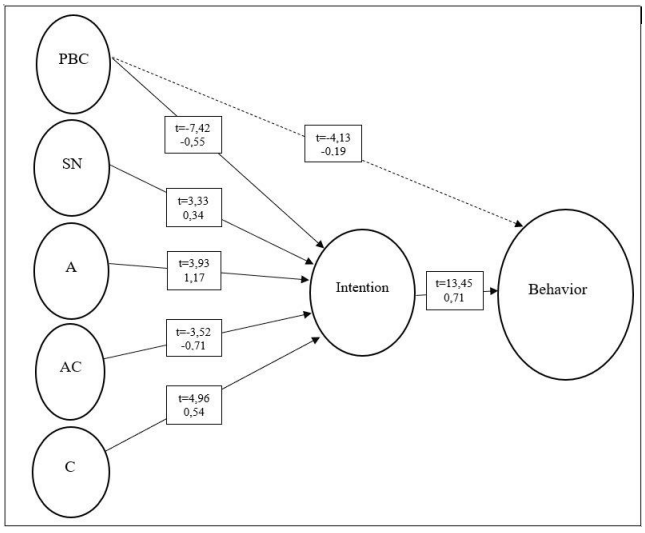

Figure 3. Structural Equation Model of Turkish Households' Recycling Behavior. Fit indices of SEM: RMSEA=0,08, Chi-square=951,17, p=0,000, df=255, x2/df=3,7, NFI=0,96, CFI=0,97, GFI=0,85

In summary, through an intricate interplay of latent variables and their complex relationships, this study's structural equation model provides an in-depth understanding of Turkish households' recycling behaviors and intentions.

Table 7 presents the covariance matrix for structural equation methods, illuminating the correlations and signs between the latent variables within the structural model.

To the best of our knowledge, no national research focusing on household recycling behavior within the context of TPB has been undertaken in Türkiye. However, two pertinent studies, conducted in distinct countries, offer valuable insights that facilitate a rapid comparison of findings (Wan et al. 2012; Strydom 2018). The outcomes of hypothesis testing in the present study are presented in Table 8.

Table 7. Covariance Matrix of the Latent Variables in the Structural Equation Method

	Intentions	Behaviors	PBC	SN	C	AC	A
Intentions	1,00						
Behaviors	0.81	1,00					
PBC	-0.55	-0.59	1,00				
SN	0.77	0.62	-0.38	1,00			
C	-0.28	-0.28	0.41	-0.41	1,00		

Strydom (2018) applied the TPB model to a sample of 2004 South African households, encompassing both intention and behavior variables. In this study, attitudes and subjective norms emerged as significant predictors of intention according to the TPB model. Conversely, perceived behavioral control (PBC) did not appear to influence the recycling intentions of South African participants. When evaluating the fit of the TPB model employed in the research, the Root Mean Square Error of Approximation (RMSEA) yielded an acceptable fit with an observed value of 0.113.

Table 8. Hypothesis Results and Comparison with Similar Studies

Hypothesis	Present Study (Türkiye)	South Africa (Strydom, 2018)	Hong Kong (Wan et al., 2012)
H_1. Households' intention towards recycling has an effect on their recycling behavior.	Accepted	Accepted	Accepted
H_2. Households' attitudes towards recycling have an effect on their recycling intentions.	Accepted	Accepted	Accepted
H_3. Households' subjective norms towards recycling have an effect on their recycling intentions.	Accepted	Accepted	Accepted
H_4. Households' PBC towards recycling has an effect on their recycling intentions.	Accepted	Rejected	Accepted
H_5. Households' PBC towards recycling has an effect on their recycling behavior.	Accepted	Accepted	-
H_6. Households' awareness of consequences towards recycling has an effect on their recycling intentions.	Accepted	-	Accepted
H_7. Households' concern towards recycling has an effect on their recycling intentions.	Accepted	-	Accepted

Wan et al. (2012) employed the TPB to model factors influencing the recycling behavior of 205 households in Hong Kong. Their model encompassed both intention and behavior variables. According to the TPB model, attitudes, subjective norms (SN), perceived behavioral control (PBC), awareness of consequences (AC), and concern were identified as significant predictors of intention.

In summation, it is evident that household recycling behavior in Türkiye, South Africa, and Hong Kong is influenced by household intentions. The recycling attitudes of households in these three countries significantly impact their recycling behaviors. Additionally, household intentions in Türkiye, South Africa, and Hong Kong are influenced by subjective norms related to recycling behavior. While PBC affects household intentions in Türkiye and Hong Kong, this relationship is not observed in South Africa. Furthermore, PBC impacts recycling practices in Türkiye and South Africa. Finally, the intentions of households in Türkiye and Hong Kong are influenced by awareness of consequences (AC) and concerns.

5. Strength, Weakness and Limitation of The Research

The paramount significance of this research lies in its comprehensive modeling of recycling intentions and behaviors among Turkish households at the national level. Consequently, this study offers a pivotal resource for national and municipal authorities, recycling experts, and future scholarly investigations. It is crucial to underscore the scientific contributions engendered by this endeavor, although certain methodological refinements can be considered.

An integral aspect pertains to methodological enhancements. Although the employment of an online questionnaire allowed for broader participant engagement and national reach, further methodological rigor could be achieved through face-to-face surveys to mitigate potential biases associated with the relatively higher education levels of online respondents. Moreover, shifting towards a 7 or 9-point Likert Scale, in lieu of the current 5-point scale, could potentially bolster model fit values.

While the current study's model fit is deemed acceptable within its scope, future research endeavors could strive for improved fit indices. Notably, the modified model, although having reduced the RMSEA value below 0.08, might benefit from further refinement to achieve an even better fit. In the context of path analysis and structural equation models, a $\chi 2/df$ value below or equal to 3 is considered ideal, which can be a pursuit for subsequent investigations.

Considering that this is the inaugural TPB-related study encompassing Türkiye in its entirety, it serves as a foundational platform for comparative analysis with findings from global counterparts. For forthcoming research, it is advisable to undertake household surveys across each province, facilitating a more nuanced understanding of recycling behaviors and intentions within diverse regional contexts. This approach could enrich the existing knowledge base and inform targeted interventions at a local level.

6. Conclusion

This study investigated the recycling behaviors and intentions of Turkish households within the framework of the Theory of Planned Behavior (TPB). Through a quantitative methodology, we gained valuable insights into the factors shaping recycling behaviors and the interplay between intentions and actions. The findings shed light on the nuanced dynamics that influence recycling practices at the household level in Türkiye.

Our analysis revealed that recycling intentions serve as a strong predictor of actual recycling behaviors among Turkish households. The TPB model demonstrated that multiple factors contribute to the formation of recycling

intentions. Perceived behavioral control (PBC), subjective norms (SN), awareness of consequences (AC), and concern collectively contribute to shaping households' intentions to engage in recycling activities. These intentions, in turn, drive the observed recycling behaviors.

In the context of the United Nations' Sustainable Development Goals, this study aligns with the goal of responsible production and consumption. The household emerges as a critical locus of action in promoting sustainable behaviors. As such, our research suggests that targeted efforts should be directed towards fostering positive recycling attitudes, enhancing recycling-related awareness, and facilitating easy access to recycling facilities.

Building upon the insights garnered from this study, several avenues for future research and practical interventions are evident. The study highlights the need to bolster recycling infrastructure across Türkiye. Increased access to recycling bins, particularly for battery and electronic waste, is essential to encourage recycling behaviors. Policymakers should strategically position recycling bins to maximize convenience for households. Comprehensive public awareness campaigns can play a pivotal role in shaping recycling behaviors. Leveraging various communication channels, including weather bulletins and news broadcasts, can effectively disseminate information and underscore the benefits of recycling. Collaborative efforts between educational institutions, local governments, and community organizations can foster a culture of recycling from an early age. Workshops, seminars, and awareness programs can empower individuals to become active participants in sustainable waste management practices. Employing behavioral economics principles, small nudges and incentives can encourage households to overcome inertia and engage in recycling activities. Tailored messages and rewards may effectively bridge the intention-behavior gap. To enhance the accuracy of future research, a combination of online and face-to-face surveys could provide a more representative sample of the population. Employing a broader Likert scale, such as 7 or 9 points, may yield greater sensitivity in gauging responses. Further research could explore cross-cultural variations in recycling behaviors using the TPB framework. Comparative studies across different countries can reveal insights into cultural influences on recycling intentions and behaviors.

In conclusion, this study advances our understanding of the recycling behaviors and intentions of Turkish households and their alignment with the Theory of Planned Behavior. The findings underscore the significance of intention in driving recycling behaviors and highlight the complex interplay of psychological and contextual factors. By implementing the suggestions outlined above, stakeholders can contribute to the realization of sustainable waste management practices and support Türkiye's commitment to responsible consumption and production.

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