A STUDY ON CIRCULAR CONSUMPTION BEHAVIOR ADDRESSING CONSUMERS' UPSTREAM AND DOWNSTREAM ACTIVITIES IN PAKISTAN

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Abstract. This study explores circular consumption behavior from the consumers' perspective. Consequently, this perspective is essential for connecting upstream and downstream circular activities, as consumers acquire products upstream and can contribute to closing the consumption loop through downstream participation. In this context, R-strategies play a key role when applied by consumers. A circular consumption behavior framework has been proposed, which is grounded in three consumer decisions: (1) purchase, (2) usage, and (3) post-use activities. This framework integrates these decisions with circular 8R-strategies connected to both upstream and downstream processes. For this purpose, data were collected from 528 respondents from Pakistan. The assessment focused on consumers' perspectives, 8R-strategies, and their mean responses. The overall mean score for circular consumption behaviors was found to be 3.00, suggesting a neutral to slightly low level of engagement among respondents. This study provides valuable insights into consumer-driven circular consumption behavior, which can support the establishment of a circular network.
Keywords: *circular consumption, circular economy, consumer behavior, 8R-strategies, e-waste, e-product*

Introduction

The environment functions as a shared property available to individual consumers; thus, the consumption of resources inevitably impacts others (Kaiser et al., 1999). Consequently, consumers' personal choices, such as lowering consumption patterns, can create a positive impact on the collective. These notions highlight the central importance of consumers and their ability to enable a circular behavioral transition (Feldman et al., 2024; Testa et al., 2024; Gomes, 2025). This transition is defined by three key consumer decision-making phases: product purchase, its usage, and post-use activities (Hunger et al., 2024). However, this behavioral transformation is highly dependent on the context and the specific product (Corsini et al., 2020), such as laptops and mobile phones (E-products). For instance, the three decision-making phases can manifest through various actions, such as choosing refurbished products during the purchase stage (Mugge et al., 2017; Koch et al., 2024). During the usage phase, behaviors may include maintenance and repair (Maitre-Ekern and Dalhammar, 2019; May and Steuer, 2025; Sonego et al., 2022) or repurposing items, like using an old smartphone as a parking meter (Zink et al., 2014). Finally, decisions to recycle are a key aspect of post-use behavior (Talukder et al., 2025; Dhir et al., 2021). Encompassing such practices constitutes circular consumption behavior conditional to consumer participation (Meißner, 2021; Testa et al., 2024), as it seems unattainable without their involvement (Maitre-Ekern and Dalhammar, 2019). Interventions to facilitate environmentally responsible behavior have been described based on two factors: their context ("when") and their purpose ("why") (van Valkengoed

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et al., 2022). The first could be answered through consumers' participation during each three phases (Camacho-Otero et al., 2018; Henriques et al., 2023; Vidal-Ayuso et al., 2023; Greene et al., 2024; Tiensuu, 2025). A consumer's environmental knowledge, for instance, plays a significant role in purchasing products (Borah et al., 2024), making it a critical factor for fostering environmentally responsible behavior. However, Testa et al. (2024) reported that majority of the respondents held a neutral stance on purchasing products made from reused or recycled contents. A second key motivation is consumers' concern for the environment and a sense of social responsibility, which often leads to a reduction in consumption patterns (Davis et al., 2021; Zimmermann et al., 2024). The literature has conceptualized R-strategies as effective ways to facilitate consumers in their consumption patterns (Reike et al., 2018; Rabiu and Jaeger-Erben, 2022; Hunger et al., 2024).

Literature advocates for embracing circular consumption practices instead of the traditional "take-use-dispose", as consumers are primary beneficiaries of E-products and thus hold a fundamental role in effective consumption cycles (Feldman et al., 2024). Consumers can contribute to both upstream and downstream activities and thus play a pivotal role throughout their consumption patterns (Jourdain and Lamah, 2024). A successful transition to this behavior is therefore dependent on the effective integration of these two activities. This connection is crucial, as 42% of consumers' disposal strategy involves storage (Shaikh et al., 2020). This practice fails to align with the principles of a circular economy, as it effectively delays products from being circulated back into the economy. Further research is needed to explore consumers' impact on the circular economy (Hunger et al., 2024) and circular consumption practices (Rabiu and Jaeger-Erben, 2022). Although research on consumption activities is growing in the context of sustainability concerns (Gomes and Lopes, 2024), the interplay between the circular economy, circular consumption practices, and a holistic view of consumer behavior has been inadequately examined (Macklin and Kaufman, 2024). Several studies have reported the specific consumer behavior concerning R-strategies and consumption patterns (e.g., Jayaraman et al., 2019; Laeequddin et al., 2022; Lopes et al., 2023; Gomes and Lopes, 2024; May and Steuer, 2025; Talukder et al., 2025). In a study of young adults' perceptions, Korsunova et al. (2021) found that recycling and reusing were the most mentioned strategies. Meanwhile, Zimmermann et al. (2024) observed that refuse, rethink, reduce, and repurpose were less frequently mentioned R-strategies.

This highlights the need to further explore consumption behavior where individuals can simultaneously play an effective upstream and downstream role. An integrated framework can be built upon the 8R-strategies, namely refuse, rethink, reduce, reuse, repair, refurbish, repurpose, and recycle. This attention is indispensable due to the rapid consumption of natural resources and the decline in sharing products and components as secondary material resources to the economy (Lim, 2017; Mesiranta et al., 2025). The conceptualization is not merely an acquisition or disposal activity but instead incorporates a set of decisions and actions considering purchasing E-products, their usage, and management of tangible components at their end-of-life.

Developing countries face significant challenges with electronic waste (e-waste), and Pakistan is a prime example of this issue. As the 26th largest generator of e-waste, Pakistan's problem is compounded by a lack of awareness (Shaikh et al., 2020). For instance, Zafar and Armughan (2025) reported that nearly 69% of respondents were unaware of the term "e-waste" and tended to store their old electronic devices at home. Similarly, Adeel et al. (2023) found that among university students, the absence of

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monetary incentives was a key reason for hindering proper e-waste disposal. This existing research highlights the need to understand consumer comprehension of consumption behavior in a context where formal policies for e-waste management are still lacking. Given the pressing issues, the understanding of consumer awareness, participation, and consumption patterns has become a critical area of inquiry. It is particularly vital to comprehend these consumption practices regarding E-products among university students and employed professionals in Pakistan, as these groups represent a significant segment of the consumer market. A study on their behavior is crucial because, as the primary owners and users of these products, their actions directly impact the success of a circular economy. Therefore, the aim of this study is to explore consumers' comprehension of the principles of the circular economy and their consumption behavior.

The objective of this study is to provide a comprehensive consumption behavior approach based on two aspects: (1) three circular consumption decisions and (2) circular activities based on 8R-strategies aiming to connect both upstream and downstream phases. These activities are considered instrumental in sustainable development (Go et al., 2015).

First, consumer behavior-based decisions and actions are discussed. This inquiry is motivated based on what decisions and actions consumers can opt for during such a phase. Second, a discussion about upstream and downstream activities based on 8R-strategies is presented. Third, consumers' responses are assessed and expressed as mean values. Notably, these perspectives are examined in the context of a developing country; Pakistan, by collecting data from two cities; Peshawar and Karachi.

The first section presents the theoretical background, followed by the methodology, results, and discussion. The paper concludes with a final section on the conclusions and limitations of the study.

Theoretical background

Three consumption decisions

Consumers conducting their consumption patterns are of paramount importance, as they can alleviate the detrimental impact on the environment resulting from their daily consumption. It is a prominent factor in the case of e-waste management (Shams et al., 2023), by investigating various consumer patterns related to it (Ismail and Hanafiah, 2020). An individual can connect upstream and downstream consumption patterns by considering three decisions and actions: (1) Circular perception, (2) functional consumption, and (3) circular applications, which are subsequently discussed.

Circular perception

The first set of activities starts with consumers having a perception about acquiring an E-product (Koch et al., 2024). For instance, purchase intention (Gomes et al., 2022), product acquisition and purchase (Maitre-Ekern and Dalhammar, 2019), Eco-labeling and sustainable information (Gomes and Lopes, 2024; Greene et al., 2024), product durability (Maitre-Ekern and Dalhammar, 2016), and sufficiency (Haase et al., 2024). Considering the philosophy of circular economy, a consumer must decide and purchase an E-product to embark on the consumption behavior from the upstream moment. A consumer's choice to purchase a refurbished, used, or second-hand E-product reflects an environmentally favorable purchasing intention. Eco-labeling and sustainable information assist

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consumers in looking out for environmentally sound attributes, such as certifications or recycled content (Van Weelden et al., 2016). Moreover, it persuades consumers to go for such E-products for being a trustworthy signal in terms of their positive environmental impact (Taufique et al., 2017; Hossain et al., 2022; Kaur et al., 2024). Another factor is the choice of a durable E-product, which can reduce end-user consumption (Bocken et al., 2016; Maitre-Ekern and Dalhammar, 2019). This is because such E-products have the intrinsic capacity to resist breakdown and decay (Haug, 2018); thus, long-term functionality seems a viable attribute given its capacity for environmental sustainability (Jensen et al., 2021; Haase et al., 2024). Finally, sufficiency is the concept of using what is available or what is adequate for a task (Haase et al., 2024). This principle emphasizes reducing consumption patterns by questioning the need to buy a new E-product when an existing one is sufficient. This is logical, as overconsumption is a major cause of environmental issues (Culiberg et al., 2023). Therefore, a consumer's refusal to make unnecessary purchases has a positive environmental impact (Sajid et al., 2024). This notion directly relates to the concept of refusal, which involves using or buying less (Reike et al., 2018).

Functional consumption

The second circular approach is the functional usage of an E-product, which reflects post-choice behavior. This includes practices in terms of product longevity (Maitre-Ekern and Dalhammar, 2019), careful handling and proper maintenance (Maitre-Ekern and Dalhammar, 2019; Jensen et al., 2021; Hossain et al., 2022), and reusing or avoiding hibernation (Jourdain and Lamah, 2024). E-product longevity is one of the major effective methods of circular consumption (Meißner, 2021). According to Laitala et al. (2021), increasing the lifespan of an E-product is an effective environmental strategy. Potentially, it increases the consumption cycle of the same device, thus making it a vital part of the circular economy (Jaeger-Erben et al., 2021; Fachbach et al., 2022). A consumer can adopt it through R-strategies, such as reuse, repair or refurbishment (Jensen et al., 2021; Sonego et al., 2022). Supporting the functional value of an E-product is conditional on careful handling in terms of maintenance and care (Ackermann et al., 2018; Van den Berge et al., 2021). It can prevent premature E-product obsolescence. A final factor is a consumer's habit of hibernation, which occurs when E-products are stored, considering their sizes and thus disrupts the circular flow of e-waste (Zhang et al., 2019; Jourdain and Lamah, 2024). This behavior can be altered through reuse/resell, sharing or donation (Sarigöllü et al., 2021).

Circular application

The last circular approach is related to post-usage decisions and actions. A consumer can adopt recycling (Talukder et al., 2025), disposal (Maitre-Ekern and Dalhammar, 2019) or return policy (Jourdain and Lamah, 2024). This approach can connect consumers' downstream activities with the consumption cycle, as E-products are usually disposed of in normal trash or accumulated in landfills (Islam et al., 2021; Sarigöllü et al., 2021). Instead of such methods, E-products can be sold again, donated or even reused by repurposing ~~it~~ them for a different purpose. Finally, consumers can also participate in recycling through information dissemination and collection centers. The aim is to become a resource provider as consumers are supplying back their E-products in the circular loops (Jourdain and Lamah, 2024). Considering the importance of e-waste, such activities will

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recover product value instead of losing it. Based on the three circular decisions and actions, a framework is presented in this regard. *Figure 1* presents the overall preliminary framework by illustrating three decisions based on consumers' upstream and downstream activities.

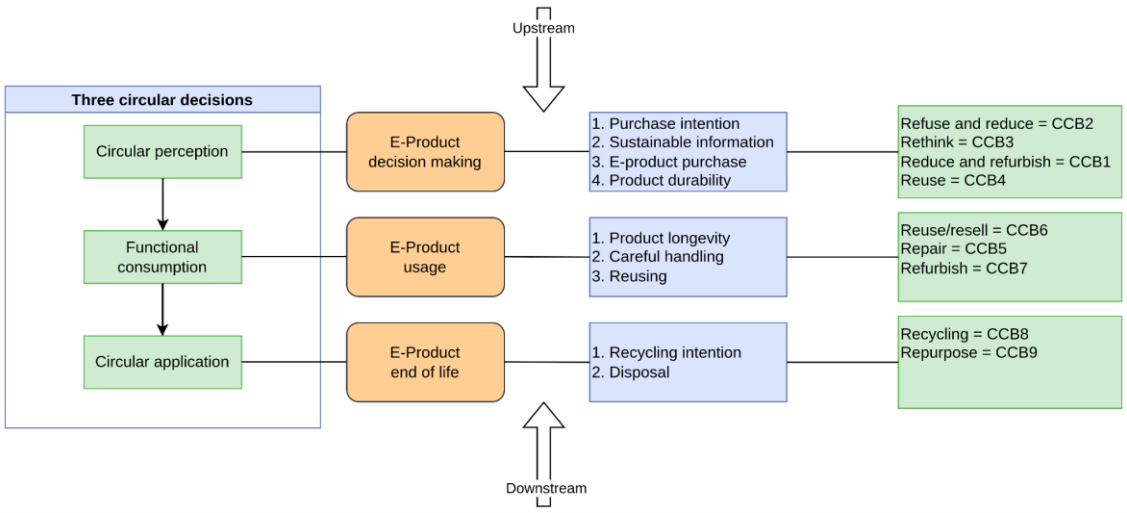

Figure 1. *Three circular decisions based on upstream and downstream activities*

Upstream and downstream circular activities

Circular consumption behavior can be adopted through upstream and downstream circular activities based on 8R-strategies. Both polar activities make circular consumption a complex phenomenon (Rabiu and Jaeger-Erben, 2022; Jourdain and Lamah, 2024; Zimmermann et al., 2024). According to Jourdain and Lamah (2024), downstream activities incorporate end-of-life activities, such as selling, donation, or proper disposal of products. Based on R-strategies, a consumer can participate in the reuse/resell and repurpose strategy through selling or donating, while a recycling strategy is pursued through disposal or returning end-of-life product at a specific collection point. Consumers are closing the materials loop and acting as a resource provider from the behavioral perspective (Koch et al., 2024). Jourdain and Lamah (2024), have termed product acquisition as upstream activities. These activities are based on purchasing decisions, for instance, purchasing a refurbished or second-hand laptop; purchasing an Eco-designed laptop or mobile phone; purchasing a product with recycled contents; and looking out for Eco-labels or certifications (Testa et al., 2024; Maitre-Ekern and Dalhammar, 2019). A consumer can opt for refuse, reduce, reuse, or refurbish R-strategies (Reike et al., 2018). R-strategies are ranked hierarchically into three approaches, from higher to lower strategies based on their circularity strength (Kirchherr et al., 2017; Potting et al., 2017). Higher circular strategies are refuse, rethink, reduce; medium strategies are reuse, repair, refurbish, remanufacture, repurpose; and lower strategies are recycle, and recover. Refuse, rethink, and reduce has an inclination of "less use" or "less purchase"; reuse, resell, repair, refurbish, and repurpose tend to make longer use of products or items, while recycling is closing the consumption cycle (Konietzko et al., 2020; Kurilova-Palisaitiene et al., 2023; Hunger et al., 2024; Koch et al., 2024). Each strategy necessitates stakeholder engagement based on their abilities and behavioral tendencies to foster circular

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consumption. Consumers can participate based on their consumption patterns and practices. Among these strategies, remanufacture and recovery are mainly related and operated by companies through industrial processes, they are not included in this study. The framework is therefore limited to the 8R-strategies. Through such ways, a consumer is acquiring products and, at the same time, supplying used products, components or secondary materials (Mugge et al., 2017). In conclusion, environmentally sound supply chain operations must be adopted (Darom et al., 2020). *Table 1* presents a brief representation of 8R-strategies from a consumer's perspective.

Table 1. *Consumer-centric circular 8R-strategies*

Code	Circular strategies	Circularity level	Purpose
R0	Refuse	High	Consumers are avoiding the purchase of unnecessary E-products, as a result, lowers consumption and e-waste generation. The motivation is the refusal of unnecessary items. Consumers are avoiding unnecessary E-products, which lowers consumption and e-waste generation. This shift is motivated by a desire to buy less and a refusal of unnecessary purchases
R1	Rethink	High	Among the options, a consumer is favoring a circular one or exploring alternatives to a non-circular one
R2	Reduce	High	It minimizes input consumption in size, volume, or purchase
R3	Reuse/resell	Medium	It is a referral to the reuse/resell of an E-product or components. Mostly, such products or items are used again with initial purpose, with or no repair. However, this perspective is mostly based on the second consumer
R4	Repair	Medium	Repairing defects to perform original function. It can be preventive, predictive or prescriptive
R5	Refurbish	Medium	Upgrading or updating an E-product, which results in improved performance. Also, an old one can be rebuilt with the structure still intact. The upgrade has higher performance as compared to the original one
R6	Repurpose	Medium	Reusing E-product or its components with a new purpose. For instance, a hard drive is an external storage drive
R7	Recycle	Low	Post-consumption activity, when e-waste is processed and dismantled, thus no longer has its original structure or function. Consumers' task is to return end-of-life E-products or components to a collection facility. It is the least circular strategy as production stages are required

Source: Potting et al. (2017), Reike et al. (2018), Hunger et al. (2024) and Zimmermann et al. (2024)

Methods

Sample participants

This study investigated consumer behavior by targeting individuals aged 18-60 years from Peshawar and Karachi, two prominent cities in Pakistan. The socio-demographic profile of the participants, including gender, age, educational qualifications, occupational status, and monthly income, is presented in *Table 2*. A total of 528 responses were

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collected from February to April 2025. This sample size is considered adequate for research, as Sekaran (2003) suggests a size greater than 30. Furthermore, this sample size is significantly larger than that used in previous studies on e-waste consumption behavior, such as the one by Shaikh et al. (2020), which utilized a sample size of 191 respondents from Pakistan.

Table 2. *Socio-demographic profile*

Variables	Labels	Counts	Percentage
Gender	Male	307	58.1%
	Female	221	41.9%
Age	18 - 24	48	9.1%
	25 - 34	207	39.2%
	35 - 44	176	33.3%
	45 - 54	84	15.9%
	55 - 60	13	2.5%
Education	Bachelors	247	46.8%
	Masters	251	47.5%
	PhD	30	5.7%
Occupational status	Student	133	25.2%
	Employed	321	60.0%
	Self-employed	62	11.7%
	Unemployed	12	2.3%
Monthly income	No income	77	14.6%
	Below 50,000 PKR	23	4.4%
	50,000 - 100,000 PKR	33	6.3%
	100,001 - 150,000 PKR	140	26.5%
	150,001 - 200,000 PKR	132	25.0%
	200,001 - 250,000 PKR	76	14.4%
	Above 250,000 PKR	47	8.9%

Questionnaire and variable scale

A closed-end structured questionnaire was disseminated to collect data through emails and electronic messaging apps. The questionnaire consists of two sections. The first section gathered respondents' demographic information, and also obtained their informed consent, ensuring confidentiality and complete anonymity. The second section focus on the respondents' views pertinent to circular consumption behavior. The construct items were adapted from various sources (Maitre-Ekern and Dalhammar, 2019; Attiq et al., 2021; Jourdain and Lamah, 2024; Talukder et al., 2025). A total of nine questions were asked, and respondents had to present their responses based on a five-point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The main variable, circular consumption behavior, is assessing consumers' perception and role of their involvement in circular practices. All items explore consumer participation in upstream and downstream activities (circular supply chains) based on 8R-strategies discussed earlier. The pertinent table is presented in the *Appendix*.

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Data analysis

A quantitative methodology was adopted for the analysis using Jamovi version 2.6.44.0. This open-source software is widely used and capable of performing a variety of statistical test (Navarro and Foxcroft, 2025). The analysis is mainly based on gender and age with inferences built on their responses to the questionnaire items.

Results

The findings from the collected data are presented in this section, beginning with the socio-demographic characteristics of the sample and then detailing the statistical interpretations of the mean scores and their implications for circular consumption behavior across different age and gender groups.

Socio-demographic profile

Table 2 presents the overall profile of the respondents. Out of 528 total respondents, 307 were male, and 221 were female. The age-wise distribution shows that the largest group of respondents are aged between 25-34 years with 207 responses, followed by 35-44 with 176 and 45-54 with 84 responses, and 48 responses for 18-24 were received, respectively. The fewest responses of 13 were received for 45-54, with 14 and 2 for aged 55-60 years. The educational background is categorized into three groups: Bachelors with 247, Masters with 251, and Ph.D. with 30 respondents. Concerning occupational status, 133 are students, 90 321 are employed, 62 are self-employed, and 12 are unemployed. The monthly income of respondents is based on Pakistani rupees (PKR). The highest number of respondents is 140, reported an income level between 100,001-150,000 PKR, whereas the lowest number of 23 respondents with an income level below 50,000 PKR. For context, Pakistan's annual GDP is $1484.70 (World Bank Report: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations = PK). This is equivalent to $123.72 per month, which translates to approximately PKR 35,103 based on a conversion rate of PKR 283.72 per $1 as of August 7, 2025.

Interpretation of mean score value

The interpretation of the findings is based on the mean score value. According to Warmbrod (2014) and Lindner and Lindner (2024), a mean value between 2.51 and 3.5 can be considered as having a moderate level suggesting a degree of variability in answers. The mean scores for the study are presented in *Table 3*. Circular consumption behavior was assessed based on 9 items. However, the average mean of 3.00 with a standard deviation of 0.831 are obtained based on 528 responses, as presented in *Table 3*.

Circular consumption behavior based on age and gender

The CCB represents the average mean of CCB1 to CCB9, which collectively capture consumer engagement with the 8R strategies (as presented in the table in the *Appendix*), the mean values provide an overall index of circular consumption behavior in relation to E-products (laptops and mobile phones). Among female respondents, the mean starts at 2.94 in the 18-24 age group and rises steadily through 3.03 (25-34), 3.19 (35-44), and peaks at 3.20 for ages 45-54, before declining to 2.84 in the 55-60 category. Male respondents exhibit a lower initial mean of 2.44 in the 18-24 group but show consistent

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improvement with age, reaching 2.94 (25-34), 2.86 (35-44), 3.22 (45-54), and peaking at 3.24 in the age group 55-60. Overall, younger females display higher propensity towards 8R-strategies than their male counterparts, while in older age group, male tendency slightly exceeds in comparison to females.

Table 3. *Mean score value of circular consumption behavior*

Items	Mean	Standard deviation	Minimum	Maximum	Level
CCB1	2.98	1.010	1.00	5.00	Moderate
CCB2	3.01	0.949	1.00	5.00	Moderate
CCB3	2.98	0.966	1.00	5.00	Moderate
CCB4	3.01	1.001	1.00	5.00	Moderate
CCB5	3.01	0.989	1.00	5.00	Moderate
CCB6	3.01	0.981	1.00	5.00	Moderate
CCB7	3.01	1.007	1.00	5.00	Moderate
CCB8	2.99	1.011	1.00	5.00	Moderate
CCB9	3.00	0.951	1.00	5.00	Moderate
CCB	3.00	0.831	1.00	5.00	Moderate

Discussion

Reduce and refurbish

The 18-24 group records a mean score of 3.13, with minor variations in the 25-34 in group with a mean of 3.09 and 35-44 with 3.12. The highest female tendency occurs in the 45-54 group at 3.18, before dropping to 2.60 in the 55-60.

In comparison to female group, the male respondents start with lower value of mean as 2.33 in the 18-24 group, indicating limited adoption for refurbished products. Scores increase substantially to 2.93 in the 25-34 group and 2.82 in the 35-44 group, peaking at 3.20 in the 45-54 group. The 55-60 group maintains a high engagement level at 3.13 (*Table 4*).

Refuse and reduce

CCB2 captures the extent to which consumers are willing to reduce e-waste by opting for refurbished E-products, rather than purchasing new devices. This behavior reflects a proactive refusal of unnecessary purchasing thus aligns within the principles of circular economy. Analysis of the mean scores by gender and age reveals distinct patterns. Among female respondents, CCB2 scores are consistently above 3.00 across most age groups, indicating moderate-to-high agreement with this behavior. The youngest females (18-24) report a mean of 3.17, suggesting that awareness of overconsumption risks is already prevalent in this group. The 25-34 group shows a slight decrease to 3.03, followed by a rise to 3.17 in the 35-44 group. Scores then drop marginally to 3.03 in the 45-54 group and further to 2.80 in the 55-60, possibly reflecting generational differences in purchase patterns.

For males, the trend is more variable. The 18-24 group records a comparatively low mean of 2.63, indicating weaker adoption of Refuse and Reduce practices at younger ages. However, engagement improves with age, reaching 2.96 in the 25-34 group and peaking at 3.24 in the 45-54 category; the highest male score for CCB2. Interestingly, the 55-60 group scores 3.13, slightly lower than the preceding age group but still above the overall male average.

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Table 4. *Mean score value of circular consumption behavior split by age and gender*

	Gender	Age (in years)	CCB1	CCB2	CCB3	CCB4	CCB5	CCB6	CCB7	CCB8	CCB9	CCB
Mean	Female	18 - 24	3.13	3.17	2.88	2.96	2.96	2.92	3.04	2.75	2.71	2.94
		25 - 34	3.09	3.03	2.93	2.99	3.13	3	3.07	3.03	3.06	3.03
		35 - 44	3.12	3.17	3.22	3.2	3.2	3.17	3.18	3.17	3.27	3.19
		45 - 54	3.18	3.03	3.15	3.21	3.18	3.23	3.31	3.28	3.26	3.2
		55 - 60	2.6	2.8	3	3	2.8	2.8	3.2	2.6	2.8	2.84
	Male	18 - 24	2.33	2.63	2.58	2.25	2.54	2.46	2.54	2.42	2.25	2.44
		25 - 34	2.93	2.96	2.93	2.94	2.9	2.99	2.91	2.94	2.92	2.94
		35 - 44	2.82	2.88	2.84	3	2.85	2.88	2.81	2.84	2.84	2.86
		45 - 54	3.2	3.24	3.16	3.11	3.27	3.2	3.24	3.27	3.33	3.22
		55 - 60	3.13	3.13	3.38	3.5	3	3.25	3.38	3.13	3.25	3.24
Standard deviation	Female	18 - 24	1.03	0.917	1.08	1.04	1.04	1.21	0.908	0.989	0.806	0.888
		25 - 34	1.05	0.932	0.968	1.03	0.977	0.978	0.937	0.963	0.931	0.806
		35 - 44	0.832	0.838	0.911	0.808	0.96	0.867	0.965	0.908	0.813	0.688
		45 - 54	0.97	1.04	0.988	1.03	0.854	1.01	1.03	1.1	0.88	0.829
		55 - 60	0.548	0.447	0.707	0.707	0.447	0.447	0.837	0.548	0.447	0.279
	Male	18 - 24	1.05	1.21	1.1	1.11	1.02	1.06	1.18	1.21	0.989	0.97
		25 - 34	1.03	0.935	0.917	1.02	1.07	1.04	1.04	1.08	0.993	0.867
		35 - 44	0.999	0.919	0.947	1.01	0.884	0.883	0.9	0.838	0.947	0.755
		45 - 54	1.18	1.07	1.07	1.03	1.05	1.01	1.17	1.1	1	0.959
		55 - 60	0.354	0.835	0.744	0.535	0.535	0.463	0.518	0.835	0.463	0.426

Rethink

Among female respondents, CCB3 scores indicate moderate engagement across all age groups. The youngest group (18-24) reports a mean of 2.88, suggesting that while some sustainability considerations are made, environmental product evaluation is not yet a dominant decision factor. Scores increase from to 2.93 for the 25-34 group and rise more to 3.22 in the 35-44 group indicating stronger inclination to looking out for Eco-labels and certification before purchasing decisions. The 45-54 group records a mean of 3.15, while the 55-60 group maintains a similar level at 3.00, showing relatively stable behavior.

Male respondents display a different trajectory. The 18-24 group records a mean of 2.58, indicating low engagement in researching environmental attributes before purchase. However, this score rises to 2.93 in the 25-34 group and remains nearly same at 2.84 in the 35-44 group. The highest male score appears in the 55-60 category at 3.38, closely followed by the 45-54 group at 3.16. This upward trend with age suggests that older male consumers may place greater value on product sustainability, possibly influenced by increased environmental awareness.

Reuse/resell

The engagement in female respondents with reuse/resell (CCB4) behavior is relatively consistent and moderately high across most age groups. The 18-24 group records a mean of 2.96, which increases marginally to 2.99 in the 25-34 group, before rising more substantially to 3.20 in the 35-44 group. The highest mean of 3.21 in female occurs in the

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45-54 group, suggesting that consumers are most likely to consider durability for reuse/resell. However, drop in mean value to 3.00 in the 55-60 group, indicating a decline in emphasis on product durability.

For male respondents, the pattern is more varied. The 18-24 group shows the lowest engagement of mean 2.25, showcasing limited focus on reuse/resell during purchasing. The value increases significantly in the 25-34 group to 2.94 and reach their highest value in the 55-60 group at 3.50, demonstrating the highest score for CCB4 across all gender and age. The group 35-44 and 45-54 is showing 3.00, and 3.11, respectively. It reports strong engagement, highlighting a generally upward trend age-wise.

Females record a mean of 2.92 for reuse/resell (CCB6) in the 18-24 group, rising to 3.00 in the 25-34 group, highest at 3.23 in the 45-54 group, and lowering at 3.17 for ages 35-44, to 2.80 in the 55-60 group. Males mean score at 2.46 in the group 18-24, increase to 2.99 in 25-34, dipping to 2.88 for 35-44, rising again to 3.20 in 45-54, with a highest value at 3.25 in the 55-60 group.

Repair

The female group of 18-24 reports a mean score of 2.96, which rises to 3.13 in the 25-34 group, showing a positive shift towards repairing. The peak mean value is 3.20 in the 35-44 group, indicating the highest female commitment to repair practices, before slightly declining to 3.18 in the 45-54 group and dropping more noticeably to 2.80 in the 55-60 category.

A relatively low inclination to opt for repairs is observed in 18-24 male group which records the mean of 2.54. However, the trend rises in the 25-34 group with mean of 2.90 and 2.85 in the 35-44 group. The group 45-54 reaches higher tendency towards repairing with a mean value of 3.27. The 55-60 group shows a mean value of 3.00 suggests a shift in consumer priorities.

Refurbishment

For female respondents, the 18-24 age group shows a mean score of 3.04, which increases to 3.07 in the 25-34 category. The value rise further to 3.18 in the 35-44 group, peaking at 3.31 in the 45-54 category. Moreover, the value declined to 3.20 in the 55-60 group.

The group 18-24 in male respondents shows a mean score of 2.54, indicating relatively low engagement with refurbishment practices. The 25-34 group progresses to 2.91, while the 35-44 group records a slight drop to 2.81. A notable increase occurs in the 45-54 group with a mean value of 3.24, followed by a peak at 3.38 in the group 55-60.

Repurpose

Among female respondents, the group 18-24 records a mean score of 2.71, suggesting modest early-life engagement with repurposing practices. Engagement rises steadily to 3.06 in the 25-34 category and peaks at 3.27 in the 35-44 group. The 45-54 group maintains a similar high score of 3.26. However, it declines to 2.80 in the 55-60 group, indicating reduced tendency with repurposing behaviors in later years.

Male respondents begin at a lower mean of 2.25 in the 18-24 group, pointing to limited early adoption of repurposing habits. Scores increase to 2.92 in the 25-34 category and 2.84 in the 35-44 group, before peaking at 3.33 in the 45-54 group. The 55-60 group also maintains a strong level of engagement with a mean score of 3.25.

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Recycling

The female respondents in the 18-24 age group reports a mean score of 2.75, indicating a moderate inclination toward recycling. This tendency increases with age, reaching 3.03 in the 25-34 group, 3.17 in the 35-44 group, and peaking at 3.28 in the 45-54 group. However, the 55-60 group reports a drop to 2.60, suggesting a decline in recycling intentions.

The 18-24 group of male respondents reports the mean of 2.42, reflecting weaker engagement with recycling intentions. The value rises to 2.94 in the 25-34 group, dip slightly to 2.84 in the 35-44, and then climb to 3.27 in the 45-54 group. The 55-60 group maintains strong propensity towards recycling with a mean of 3.13.

Conclusion and limitations

Consumers' roles and participation across upstream and downstream activities are totally dependent upon their perception, awareness, attitudinal properties and behavior. The primary objective of this study was to assess consumers' consumption behavior based on primary data. A total mean of 3.00 shows a variation in responses from the respondents. However, the responsibility lies on all stakeholders across the supply chain to establish a more circular one. A consumer's role is to purchase circular products, prolonging their lifetime by up-keeping, repairing, and maintenance. At the same time, participating in reverse logistics through proper disposal of such products at the end of their lifespan. For this, we divided their role based on three decision-making and action phases: circular perception, functional consumption, and circular applications. These three phases can be connected by consumers by their upstream and downstream activities, which will eventually pave the way for the establishment of circular supply chains.

This study is based on self-reported data collected from respondents in two major cities of Pakistan (Peshawar and Karachi) using a convenience sampling approach. While the total dataset comprises 528 valid responses, the demographic scope was intentionally limited to university students and employed individuals, with an emphasis on respondents holding or pursuing at least a Bachelor's degree.

The analysis of 8R-strategies, reveals clear patterns in consumption behaviors across gender and age groups. Overall, the mean CCB values suggest a moderate level of engagement, with notable variations by demographic segment. Female respondents generally demonstrate higher engagement with circular practices in younger and middle adulthood, particularly in strategies such as refuse and reduce (CCB2), rethink (CCB3), and recycling (CCB8). In contrast, male respondents tend to show lower engagement in early adulthood but display a consistent upward trend with age, often matching or surpassing female scores in older age groups for strategies like refurbish (CCB7), reuse/resell (CCB6), and repurpose (CCB9).

Certain strategies, such as repair (CCB5), and reduce and refurbish (CCB1), maintain relatively high engagement across most age groups, reflecting an existing awareness of resource conservation and waste reduction. However, strategies like rethink (CCB3) and recycling (CCB8) show greater variability, indicating that environmental awareness and proactive waste management may require further promotion in specific demographics, particularly younger males. The findings underscore the importance of targeted interventions to promote consistent engagement across the 8R spectrum.

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APPENDIX

Code	R's	Items
CCB1	Reduce and refurbish	I would consider buying a refurbished [laptop/mobile phone] aiming to reduce E-waste
CCB2	Refuse and reduce	I aim to reduce unnecessary purchase of [laptop/mobile phone] and related items
CCB3	Rethink	I gather and understand information about whether [laptop/mobile phone] are Eco-friendly before purchasing them (e.g., Eco-labels, certifications, recyclability, recycled contents)
CCB4	Reuse/Resell	I take product durability into account, as reusing/reselling a durable [laptop/mobile phone] is an option when I no longer need it
CCB5	Repair	I am not embarrassed to have my [laptop/mobile phone] repaired, instead buying a new one
CCB6	Reuse/Resell	I attempt to prolong the [laptop/mobile phone] life through proper use, maintenance, and updates
CCB7	Refurbish	Upgrading/refurbishing [laptop/mobile phone] transforms its performance, functionality, and extends its lifespan
CCB8	Recycling	I plan to promote recycling of E-waste and related items to my friends, family, and peers
CCB9	Repurpose	I avoid throwing away [laptop/mobile phone], and related items (like a hard drive, USB, SD-card, battery, charger, or screen) that can be sold, reused, or donated

The nine items are placed in the table and article based on the author's own study

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