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KNOWLEDGE, ATTITUDES, AND WASTE-BIN AVAILABILITY ASSOCIATED WITH WASTE SORTING AMONG VENDORS AT X

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ABSTRAK

Pemilahan sampah di ruang publik sementara merupakan bagian penting dalam pengelolaan kesehatan lingkungan, tetapi praktik pemilahan sampah pada pedagang *Car Free Day* (CFD) masih belum optimal. Penelitian ini bertujuan menganalisis hubungan pengetahuan, sikap, dan ketersediaan tempat sampah dengan praktik pemilahan sampah pada pedagang di X. Penelitian ini menggunakan pendekatan kuantitatif analitik dengan desain *cross-sectional* dan dilaksanakan pada Mei–Juli 2026 di X. Populasi terjangkau terdiri atas 200 pedagang yang tercatat dalam daftar pedagang CFD tahun 2026. Besar sampel minimum dihitung menggunakan rumus Slovin dengan tingkat kesalahan 10% dan diperoleh 67 responden. Kuota sampel ditentukan melalui *proportional allocation* berdasarkan kategori pedagang, kemudian responden dalam setiap kategori dipilih menggunakan *purposive sampling* berdasarkan kriteria inklusi. Data dikumpulkan menggunakan kuesioner terstruktur melalui wawancara tatap muka dan didukung observasi lapangan. Analisis data meliputi analisis univariat dan bivariat menggunakan uji *Pearson chi-square* dengan tingkat signifikansi 5%. Kekuatan hubungan disajikan dalam bentuk *odds ratio* (OR) dengan interval kepercayaan (IK) 95%. Sebanyak 37 pedagang (55,2%) memiliki praktik pemilahan sampah yang baik. Pengetahuan yang kurang berhubungan signifikan dengan praktik pemilahan sampah yang kurang baik (p = 0,001; OR = 10,333; IK 95%: 3,247–32,888). Sikap yang tidak mendukung juga berhubungan signifikan dengan praktik pemilahan yang kurang baik (p = 0,001; OR = 8,369; IK 95%: 2,553–27,438). Selain itu, ketersediaan tempat sampah yang tidak memadai berhubungan signifikan dengan praktik pemilahan yang kurang baik (p = 0,028; OR = 3,086; IK 95%: 1,112–8,559). Penelitian ini menunjukkan bahwa pengetahuan, sikap, dan ketersediaan tempat sampah berhubungan dengan praktik pemilahan sampah pada pedagang CFD. Temuan ini mendukung perlunya edukasi praktis mengenai pemilahan sampah serta penyediaan tempat sampah terpilah yang mudah diakses, sesuai, dan diberi label jelas di area kegiatan CFD. Karena menggunakan desain *cross-sectional*, hubungan yang ditemukan tidak dapat diinterpretasikan sebagai hubungan sebab-akibat.
Kata kunci: sikap, ketersediaan tempat sampah, pedagang, pengetahuan, pemilahan sampah

ABSTRACT

Waste sorting in temporary public spaces is an important component of environmental health management, yet waste-sorting practices among *Car Free Day* (CFD) vendors remain suboptimal. This study aimed to analyze the associations of knowledge, attitudes, and waste-bin availability with waste-sorting practices among vendors at X. A quantitative analytic study with a *cross-sectional* design was conducted from May to July 2026 at X. The accessible population consisted of 200 vendors listed in the 2026 CFD vendor roster. The minimum sample size was calculated using the Slovin formula with a 10% margin of error, resulting in 67 respondents. Sample quotas were determined through proportional allocation across vendor categories, followed by purposive selection of eligible respondents within each category. Data were collected using a structured questionnaire administered through face-to-face interviews and supported by field observations. Univariate and bivariate analyses were performed using Pearson's chi-square test at a 5% significance level. The strength of associations was expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Overall, 37 vendors (55.2%) had good waste-sorting practices. Poor knowledge was significantly associated with poor waste-sorting practices (p = 0.001; OR = 10.333; 95% CI: 3.247–32.888). Unfavorable attitudes were also significantly associated with poor waste-sorting practices (p = 0.001; OR = 8.369; 95% CI: 2.553–27.438). In addition, inadequate waste-bin availability was significantly associated with poor waste-sorting practices (p = 0.028; OR =

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3.086; 95% CI: 1.112–8.559). The findings indicate that knowledge, attitudes, and waste-bin availability are associated with waste-sorting practices among CFD vendors. These findings support the implementation of practical waste-sorting education and the provision of accessible, appropriate, and clearly labeled separated waste bins in CFD areas. Because of the *cross-sectional* design, the observed associations should not be interpreted as causal relationships.
Keywords: attitudes, knowledge, vendors, waste bins, waste sorting

INTRODUCTION

Waste has become an increasingly important environmental health concern as the volume of waste generation continues to challenge the capacity of waste-management systems. The *Global Waste Management Outlook 2024* estimates that global municipal solid waste generation will increase substantially, from approximately 2.1 billion tonnes in 2023 to 3.8 billion tonnes by 2050. This trend indicates that waste management is not limited to collection and final disposal but also requires appropriate handling at the point of generation. Source separation is particularly important because separating waste according to its characteristics can facilitate collection, recycling, treatment, and material recovery that would otherwise be hindered when different waste types are mixed (United Nations Environment Programme, 2024).

Indonesia faces a similar challenge. National waste-management data indicate that the country generates substantial amounts of waste annually, while a considerable proportion remains inadequately managed. Food waste constitutes the largest component of the waste stream, followed by plastics, while commercial activities and markets also contribute substantially to waste generation (Kementerian Lingkungan Hidup/Badan Pengendalian Lingkungan Hidup, 2025; Sistem Informasi Pengelolaan Sampah Nasional, 2025). These conditions emphasize the importance of waste management at the source, particularly in locations where consumption and commercial activities occur intensively. Effective source separation requires not only adequate waste-management infrastructure but also appropriate practices among individuals who generate and handle waste.

The issue is also relevant in Serang City, where increasing waste generation places additional pressure on the local waste-management system. Regional development planning documents indicate that annual waste generation increased from 190,440 tonnes in 2020 to 223,961 tonnes in 2024 (Pemerintah Kota Serang, 2025). This challenge may become more pronounced in temporary public spaces where large numbers of people gather within a limited period. One such setting is *Car Free Day* (CFD), which combines physical activity, recreation, social interaction, and commercial activities in public spaces. CFD has been described as a public-space initiative that can support healthy-city programs and community participation, while also providing opportunities to promote environmentally responsible behavior (Angelica et al., 2025; Wahyuningtiyas et al., 2025). However, the concentration of visitors and vendors within a relatively short period can simultaneously increase waste generation and place greater demands on waste-management facilities.

Vendors have an important role in this context because their commercial activities involve direct interaction with consumers and generate various types of waste, including food residues, plastic packaging, beverage containers, paper, and other disposable materials. The way vendors handle this waste can affect the cleanliness of individual stalls and contribute to waste accumulation throughout the CFD area. Putra and Chandra (2025), in a study of community participation in maintaining cleanliness during CFD in Padang, identified awareness, facilities, socialization, and supervision as relevant aspects of maintaining cleanliness during CFD activities. This suggests that maintaining a clean public-event

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environment requires not only post-event cleaning but also appropriate waste-handling practices during the event.

Preliminary observations conducted by the researchers at X indicated that waste management during CFD activities was not yet optimal. Activities in the area, including CFD, were estimated to generate approximately 5–8 tonnes of waste per week. In a preliminary assessment of 10 vendors, 7 (70%) did not provide waste bins at their stalls and disposed of waste without separating organic and inorganic waste. Furthermore, 5 vendors (50%) left waste at their stalls after the event, while 3 (30%) disposed of waste into drainage channels. These preliminary findings indicate that waste-handling practices among some vendors remain inconsistent with the intended function of CFD as a healthy public space. The temporary nature of CFD may further complicate waste management because vendors operate for a limited period and depend partly on facilities, regulations, and waste-management arrangements established by event organizers.

From a behavioral perspective, knowledge and attitudes are relevant factors in understanding waste-sorting practices. Knowledge may provide individuals with an understanding of waste types, the environmental and health consequences of improper disposal, and appropriate waste-sorting procedures. Attitudes, meanwhile, reflect individuals' acceptance, concern, sense of responsibility, and willingness to engage in appropriate waste-management practices. Previous studies among vendors have reported associations between these factors and waste-management behavior. Maulana et al. (2023), for example, found a significant relationship between knowledge and attitudes and waste-management behavior among vendors at Pasar Rakyat Bebandem. Similarly, Annisa et al. (2024) reported that knowledge, attitudes, and facility availability were significantly related to waste-sorting practices among vendors at Pasar Rumbai, Pekanbaru. These findings suggest that waste-sorting behavior is influenced by both individual characteristics and the conditions that support the behavior.

However, the relationship between these factors and waste-management behavior is not necessarily consistent across settings. Martiyani et al. (2023), for example, reported a significant relationship between knowledge and waste-management behavior among vendors at Pasar Sepatan, Tangerang, but did not find a significant relationship between attitudes and waste-management behavior. Similar variations have been reported in household and community settings. Agustin et al. (2022) identified relationships involving knowledge, attitudes, and facility availability in household waste-management practices, while Mustopa and Sulistiyorini (2022) examined knowledge, attitudes, facilities, and the role of sanitation workers in relation to plastic-waste management behavior. Wijayanti et al. (2023) also demonstrated the relevance of community knowledge and attitudes to participation in waste management. These variations indicate that waste-related behavior is multidimensional and may differ according to population characteristics, environmental conditions, and available support.

The availability of waste-management facilities is particularly important because appropriate behavior requires an opportunity to act. In the context of waste sorting, knowledge and positive attitudes may not be readily translated into practice when suitable waste bins are unavailable, inaccessible, full, or unsuitable for separating different types of waste. Zulfa (2023), in a study of vendors at Pasar Umum Caruban, reported the relevance of waste-bin availability and other management-related factors to vendor participation in waste management. Suparjo et al. (2023) similarly examined waste-management factors among vendors at Pasar Sentral Lasusua and demonstrated the relevance of contextual conditions within the market

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environment. These findings reinforce the importance of considering waste sorting not only as an individual behavioral issue but also as a practice that can be facilitated or constrained by the surrounding physical environment.

The relationship between individual characteristics and environmental conditions can be further understood through behavioral frameworks. The PRECEDE-PROCEED model positions predisposing factors, including knowledge and attitudes, alongside enabling factors that facilitate or constrain health-related behavior (Kim et al., 2022; Terry, 2022). In the present study, knowledge and attitudes are considered predisposing factors, whereas waste-bin availability represents an enabling factor. This framework provides a basis for understanding why individuals who recognize the importance of waste sorting may nevertheless demonstrate different practices depending on the facilities available to them.

The Theory of Planned Behavior (TPB) provides another perspective by emphasizing attitudes and perceived behavioral control as important factors associated with behavioral intention and action. Studies applying TPB to waste management have shown that attitudes and perceived control over performing waste separation can be relevant to waste-sorting intentions and practices (Jacob & Dwipayanti, 2022; Pan & Liu, 2024; Rakhmawati et al., 2023). These theoretical perspectives are relevant to the CFD context because waste sorting requires not only knowledge of appropriate procedures but also willingness and practical opportunity to perform the behavior. Nevertheless, theoretical relevance does not establish the existence or strength of these relationships in every setting; empirical examination within the specific context remains necessary.

Most previous studies cited in this area have focused on households, permanent markets, or established communities. Vendors in traditional markets generally operate at fixed locations within relatively stable waste-management systems, while household waste management occurs within a stable residential environment (Agustin et al., 2022; Annisa et al., 2024; Martiyani et al., 2023; Mustopa & Sulistiyorini, 2022; Suparjo et al., 2023; Wijayanti et al., 2023; Zulfa, 2023). In contrast, CFD represents a temporary public-event setting characterized by a limited operating period, mobile or temporary vendor locations, fluctuating visitor density, concentrated consumption activities, and substantial dependence on facilities and management arrangements provided by event organizers. These characteristics may create different conditions for translating knowledge and attitudes into actual waste-sorting practices.

This contextual difference represents the research gap addressed by the present study. Although previous studies have established that knowledge, attitudes, and waste-management facilities may be associated with waste-related behavior, evidence concerning vendors operating in temporary public-event environments such as CFD remains limited. The temporary nature of CFD may increase the practical importance of facility availability because vendors have limited time to manage waste and may have restricted opportunities to leave their stalls for disposal. At the same time, high visitor density and concentrated commercial activity may increase both the volume and diversity of waste generated. Therefore, examining knowledge, attitudes, and waste-bin availability together in the CFD setting may provide context-specific evidence that cannot be directly inferred from studies conducted in permanent markets or household environments.

Based on this background, this study aimed to examine the associations of knowledge, attitudes, and waste-bin availability with waste-sorting practices among vendors at X in 2026. These variables were selected to represent complementary individual and environmental dimensions: knowledge and attitudes as predisposing factors and waste-bin availability as an enabling condition. The findings are expected to provide evidence for environmental health

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management in temporary public spaces and to support practical interventions, including vendor education, clear cleanliness responsibilities, and the provision of accessible and appropriately separated waste bins during CFD activities. Because this study employed a cross-sectional design, the identified relationships are interpreted as associations rather than causal effects.

METHODS

This study employed a quantitative analytic approach with a cross-sectional design. It was conducted from May to July 2026 at X. The dependent variable was waste-sorting practice, while the independent variables were knowledge, attitudes, and waste-bin availability (Notoatmodjo, 2018).

The accessible population consisted of 200 CFD vendors, including 120 food and beverage vendors, 12 clothing vendors, 28 toy vendors, 15 fruit vendors, 5 perfume and cosmetics vendors, 7 grocery vendors, and 13 school-supply vendors. The minimum sample size was calculated using the Slovin formula with a 10% margin of error, resulting in 67 respondents. Proportional allocation was used to determine the sample quota for each vendor category, followed by purposive sampling based on the inclusion criteria. The final sample allocation is presented in Table 1.

Table 1. Vendor Population and Proportional Sample Allocation

Vendor Category	Population (N_h)	Proportional Calculation	Final Sample (n_h)
Food and beverage	120	(120/200) × 67 = 40.20	40
Clothing	12	(12/200) × 67 = 4.02	4
Toys	28	(28/200) × 67 = 9.38	10
Fruit	15	(15/200) × 67 = 5.03	5
Perfume and cosmetics	5	(5/200) × 67 = 1.68	2
Groceries	7	(7/200) × 67 = 2.35	2
School supplies	13	(13/200) × 67 = 4.36	4
Total	200	—	67

Note. Proportional allocation was rounded to whole numbers and adjusted to obtain a total sample of 67 respondents. Source: CFD organizer records, 2026.

Respondents were selected based on the following inclusion criteria: active CFD vendors at X, at least three months of vending experience, willingness to participate, and ability to communicate and complete the interview independently.

Data were collected using a structured questionnaire through face-to-face interviews and supported by field observations. The questionnaire assessed knowledge, attitudes, waste-bin availability, and waste-sorting practices. Each variable was scored according to the predetermined scoring procedure and categorized using its respective median score as the cut-off point. Waste-sorting practice and knowledge were categorized as good or poor, attitudes as favorable or unfavorable, and waste-bin availability as adequate or inadequate.

Univariate analysis was performed using frequencies and percentages. Bivariate analysis used Pearson's chi-square test with a significance level of $p < 0.05$. Associations were expressed as odds ratios (ORs) with 95% confidence intervals (CIs), with poor waste-sorting practice as the outcome and good knowledge, favorable attitude, and adequate waste-bin availability as the respective reference categories.

Ethical approval was obtained from the Research Ethics Committee of Universitas Faletehan (No. 004609/UNIVERSITAS FALETEHAN/2026; June 19, 2026). Written informed consent was obtained from all participants before data collection.

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RESULTS AND DISCUSSION

Results

The study involved 67 vendors participating in CFD activities at X. The results describe the distribution of waste-sorting practices, knowledge, attitudes, and waste-bin availability, followed by an analysis of the associations between each independent variable and waste-sorting practices.

Distribution of Study Variables

The distribution of the study variables is presented in Table 2. The table shows the proportion of vendors according to their waste-sorting practices, knowledge, attitudes, and waste-bin availability.

Table 2. Distribution of Study Variables among Vendors at X (n = 67)

Variable	Category	n (%)
Waste-sorting practice	Poor	30 (44.8)
	Good	37 (55.2)
Knowledge	Poor	26 (38.8)
	Good	41 (61.2)
Attitude	Unfavorable	22 (32.8)
	Favorable	45 (67.2)
Waste-bin availability	Inadequate	26 (38.8)
	Adequate	41 (61.2)

Table 2 shows that more than half of the vendors (55.2%) had good waste-sorting practices. Similarly, most vendors had good knowledge (61.2%), favorable attitudes (67.2%), and adequate waste-bin availability (61.2%). However, a substantial proportion of vendors remained in the poor or inadequate categories, particularly 44.8% with poor sorting practices and 38.8% with inadequate waste-bin availability.

Associations with Waste-Sorting Practices

Bivariate analysis was conducted to examine whether knowledge, attitudes, and waste-bin availability were statistically associated with waste-sorting practices. The results of the Pearson's chi-square test and the corresponding ORs with 95% CIs are presented in Table 3.

Table 3. Associations of Knowledge, Attitudes, and Waste-Bin Availability with Waste-Sorting Practices

Factor	Category	Poor n (%)	Good n (%)	*p* value	OR (95% CI)
Knowledge	Poor	20 (76.9)	6 (23.1)	0.001	10.333 (3.247–32.888)
	Good	10 (24.4)	31 (75.6)		Ref.
Attitude	Unfavorable	17 (77.3)	5 (22.7)	0.001	8.369 (2.553–27.438)
	Favorable	13 (28.9)	32 (71.1)		Ref.
Waste-bin availability	Inadequate	16 (61.5)	10 (38.5)	0.028	3.086 (1.112–8.559)
	Adequate	14 (34.1)	27 (65.9)		Ref.

Note. Percentages are calculated within each factor category. OR represents the odds of poor waste-sorting practices. Ref. = reference category.

As shown in Table 3, all three variables were significantly associated with waste-sorting practices ($p < 0.05$). Poor knowledge had the strongest observed association, with vendors in this category having 10.333 times the odds of poor sorting compared with those with good knowledge. Unfavorable attitudes were associated with 8.369 times the odds of poor sorting, while inadequate waste-bin availability was associated with 3.086 times the odds. The 95% CIs for all three ORs did not include 1, supporting the statistical significance of these associations.

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Although the associations were statistically significant, the results should be interpreted as relationships rather than causal effects because the study used a *cross-sectional* design.

Discussion

Knowledge and Waste-Sorting Practices

The findings showed a significant association between knowledge and waste-sorting practices. Vendors with poor knowledge had 10.333 times the odds of poor sorting compared with those with good knowledge. This finding is consistent with Maulana et al. (2023), who reported an association between knowledge and waste-management behavior among vendors. Knowledge may provide a basis for recognizing different waste types, understanding the consequences of improper disposal, and knowing the appropriate sorting procedures.

However, the association does not mean that knowledge alone determines waste-sorting behavior. In this study, 10 vendors with good knowledge still had poor sorting practices, while six vendors with poor knowledge demonstrated good practices. This pattern indicates that knowledge may need to be supported by environmental and behavioral conditions, such as ease of access to waste facilities, established habits, organizer guidance, and cleanliness norms. Similar variation has been reported in previous studies, indicating that the relationship between knowledge and waste-management behavior may differ across settings (Agustin et al., 2022; Mustopa & Sulistiyorini, 2022; Zulfa, 2023). Therefore, education for CFD vendors should emphasize practical sorting procedures rather than only providing information about waste.

Attitudes and Waste-Sorting Practices

Attitudes were also significantly associated with waste-sorting practices. Vendors with unfavorable attitudes had 8.369 times the odds of poor sorting compared with those with favorable attitudes. This result is consistent with Maulana et al. (2023), Agustin et al. (2022), and Mustopa and Sulistiyorini (2022), which indicate that attitudes are relevant to waste-management practices.

From a behavioral perspective, favorable attitudes may reflect concern for cleanliness, a sense of responsibility, and willingness to participate in waste sorting. The Theory of Planned Behavior also places attitudes among important factors associated with behavioral intention and action (Jacob & Dwipayanti, 2022; Pan & Liu, 2024; Rakhmawati et al., 2023). Nevertheless, the presence of 13 vendors with favorable attitudes who had poor sorting practices suggests that positive attitudes do not always translate into actual behavior. Limited facilities, lack of supervision, time constraints, and the temporary nature of CFD activities may contribute to this attitude–behavior gap. This finding also corresponds with Martiyani et al. (2023), who found no significant relationship between attitude and waste-management behavior among vendors in another market setting. Thus, attitude-strengthening efforts should be accompanied by practical facilities and clear behavioral expectations.

Waste-Bin Availability and Waste-Sorting Practices

Waste-bin availability showed a significant association with waste-sorting practices. Vendors with inadequate waste-bin availability had 3.086 times the odds of poor sorting compared with vendors with adequate availability. This finding supports Zulfa (2023), who identified waste-bin availability as a factor associated with vendor participation in waste management, and is also consistent with Agustin et al. (2022), who highlighted the relevance of facility availability in household waste-management practices.

The role of facilities is particularly important in CFD because vendors operate in a temporary and relatively busy environment. Vendors may find it difficult to leave their stalls to dispose of waste if bins are located far away. In addition, bins that are not separated, clearly

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labeled, accessible, or regularly emptied may not adequately support sorting behavior. However, the finding that 14 vendors with adequate facilities still had poor sorting practices, while 10 vendors with inadequate facilities had good practices, indicates that facility availability is not the only factor involved. Suparjo et al. (2023) likewise demonstrated that waste-management practices among market vendors are influenced by contextual conditions. Therefore, providing bins should be accompanied by appropriate placement, labeling, maintenance, and behavioral guidance.

Implications for Environmental Health Management

The findings indicate that knowledge, attitudes, and waste-bin availability were all associated with waste-sorting practices among vendors at X. These findings can be interpreted through the PRECEDE-PROCEED framework, in which knowledge and attitudes represent predisposing factors and facility availability represents an enabling factor (Kim et al., 2022; Terry, 2022). The combination of these factors suggests that improving waste sorting in a temporary public-event setting may require both individual and environmental support.

The CFD context is important because it differs from permanent markets and household settings. Vendors operate for a limited period, crowd density can change rapidly, and waste facilities depend substantially on event organization. Previous studies have primarily examined permanent markets, households, or communities (Agustin et al., 2022; Annisa et al., 2024; Martiyani et al., 2023; Mustopa & Sulistiyorini, 2022; Suparjo et al., 2023; Wijayanti et al., 2023; Zulfa, 2023). The present findings therefore add context-specific evidence concerning vendors in a temporary public-event environment.

In practical terms, CFD organizers could combine brief pre-event education with clearly labeled organic and inorganic waste bins positioned close to vendor areas. Clear cleanliness responsibilities, visual reminders, and routine monitoring could further support consistent sorting practices. Such measures are in line with evidence emphasizing awareness, facilities, socialization, and supervision in maintaining cleanliness during CFD activities (Putra & Chandra, 2025). They also support the broader role of CFD as a healthy public space that integrates physical activity, social interaction, and environmentally responsible practices (Angelica et al., 2025; Wahyuningtiyas et al., 2025).

This study has several limitations. The *cross-sectional* design does not establish temporal or causal relationships between the variables. The use of *purposive sampling* and a sample of 67 vendors also limits the generalizability of the findings. In addition, questionnaire and interview responses may have been affected by social-desirability bias. Field observations were used to complement the questionnaire data, but future studies should consider larger samples and longitudinal or intervention designs to further examine these relationships.

CONCLUSION

Knowledge, attitudes, and waste-bin availability were significantly associated with waste-sorting practices among vendors at X. Poor knowledge had the strongest observed association with poor waste-sorting practices (OR = 10.333), followed by unfavorable attitudes (OR = 8.369) and inadequate waste-bin availability (OR = 3.086). These findings indicate that waste-sorting practices among CFD vendors are associated with both individual and environmental factors.

In practice, CFD organizers should combine practical education on waste sorting with clear cleanliness responsibilities and the provision of accessible, clearly labeled, and separated waste bins. However, because this study used a *cross-sectional* design and *purposive sampling*, the

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findings represent associations rather than causal relationships and should be generalized with caution. Future studies with larger samples and longitudinal or intervention designs are recommended to further examine these relationships.

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