Effect of the Covid-19 pandemic period on Zero Waste Awareness: a scale development survey in Turkey

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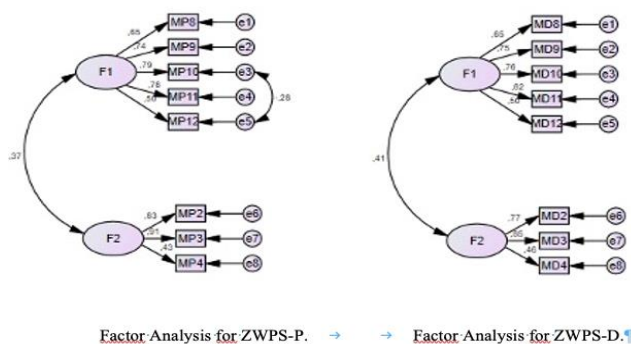
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Graphical abstract

Factor Analysis for ZWPS-P. → → Factor Analysis for ZWPS-D.

Abstract

The purpose of study was to develop and validate a scale in order to investigate the consciousness and habits of individuals on zero waste awareness pre-pandemic and during COVID-19 period in Turkey. The study group which was sampled using criteria-sampling consists of 523 individuals who have or have not been infected with the virus. The data collected were analyzed using IBM SPPS and IBM SPSS AMOS software. Cronbach's alpha coefficient calculated for internal consistency in determining the level of reliability of the developed scale was 0.82 and 0.79 for pre- pandemic and during pandemic, respectively. The Kaiser–Meyer–Olkin coefficients (0.77 and 0.79) and the Bartlett test of sphericity results (both p<0.000) showed that the sample size is satisfactory for the measurement of the construct and the items have patterned relationships. Principal component analysis generated an 8-item scale with two factors. While the 8 items chosen to explain 62% of the total variance for pre- pandemic, they explain 61% of the total variance for during pandemic. Using the results, the goodness of fit indices used (chi-square/df, RMSEA, GFI, IFI, CFI, CR, AVE) for the model have presented that the scale developed in study is valid and reliable research instrument.

Keywords: Covid-19, scale development, waste management, zero waste.

1. Introduction

The Covid-19 pandemic has changed our world in many respects from transportation, education, health, production, consumption habits to the waste that comes with them. The existing waste management systems of the countries are among the issues that are negatively affected during the pandemic. Among the reasons for this, (1) increase in some waste fractions compared to pre-pandemic (Benson *et al.*, 2021), (2) change in waste composition, frequency and timing of disposal (Malapur, 2020), (3) decrease of waste recycling rates (etc. electronic wastes) (Akcil et al., 2020), (4) the risk of infection of wastes (Fan *et al.*, 2021). The increase in the use of packaged goods and the need for disposable products related to food/goods delivery demand have caused a serious increase in plastic waste (Benson *et al.*, 2021; Klemes *et al.*, 2020; Oyedotun *et al.*, 2020). The above statements were approved by a recent publication carried out by Fan *et al*. (2021) (Fan *et al.*, 2021). Furthermore, the demand for plastic materials for medical purposes has increased significantly during the pandemic period (Klemes *et al*., 2020), especially the unconscious use of masks by people and the failure to destroy the masks have increased the risks related to the pandemic (WHO, 2020). Due to the COVID-19 pandemic, safe management of household waste has become a critical issue (UNEP-UN, 2020). According to the World Health Organization (WHO), household waste generated during home quarantine, caring for a sick family member, or during recovery should be placed in sturdy black bags and completely sealed before disposal or collection by municipal waste services (WHO, 2020).

Parallel to these, the European Union Commission (EC; The European Commission) emphasizes the protection of zero waste management, municipal waste collection services and medical waste treatment quality standards in its guide published on April 14, 2020 due to the coronavirus crisis (EC, 2020, Mihai, 2020). Zero Waste Europe (ZWE) states that the COVID-19 crisis should not prevent targeted recycling rates from being achieved (EC, 2020). Similarly, documents containing additional measures to be taken regarding waste management in the pandemic period

continue to be published (Scheinberg *et al.,* 2020). By publishing the "Zero Waste Regulation" (RG: 30829) in Turkey on 12.07.2019, it is aimed to prevent waste generation, to minimize waste if prevention is not possible, to establish an effective collection system and to ensure recycling/recovery of waste (Haksevenler *et al.,* 2020). The common sense of the practices described in the documents and guides is to develop responsible environmental behavior.

Numerous studies can be found in the literature to explain on responsible environmental behavior. The following variables found seemed to be highly related with responsible environmental behavior; knowledge of issues (Hines *et al.,* 1987; Hayward, 1990; Cotrell, 2003), knowledge of action strategies (Hines *et al.,* 1987), locus of control (Hines *et al.,* 1987; Sivek and Hugerford, 1990), attitudes (Sia *et al.*, 1986; Hines *et al.*, 1987; Hayward, 1990; Hwang *et al.*, 2000), verbal commitment and an individual sense of responsibility [Hines *et al.,* 1987], environmental sensitivity (Sivek and Hugerford, 1990; Hwang, *et al.,* 2000), reading environmental literature (Mobley *et al.,* 2010), local natural resource (Vaske and Kobrin, 2001). Surveys conducted in some regions of the USA indicate that covid-19 contributed positively on the people's eco-friendly habits (Patrick, 2020).

The change in the amount of waste generated according to waste classes during the epidemic period required updates in the existing zero waste management (EC, 2020; Mihai, 2020; Scheinberg *et al.,* 2020). Measuring how individual awareness and habits about zero waste management are affected due to the Covid-19 epidemic can facilitate making up-to-date decisions on waste management. Studies concerning waste management (Fan *et al*, 2021), electronic waste (Anonno *et al.,* 2021), household waste (Oyedotun *et al.,* 2020; Ganguly and Chakraborty, 2021) can be found in the literature, but no study has been conducted on zero waste habits during the pandemic period. For this reason, it was considered necessary to develop a scale to measure how the individual consciousness and habits formed on zero waste management due to the Covid-19 epidemic were affected.

The aim of this study was to develop and validate a Zero Waste Practice Scale (ZWPS) in order to study the consciousness and habits of individuals on zero waste awareness pre-pandemic and during pandemic stages in Turkey. A questionnaire was applied to the participants in order to determine their behavior regarding zero waste practices before and after March 2020, when some measures were just started to be implemented due to Covid-19 in Turkey.

2. Methodology

2.1. Model and participants of study

The population of the research consists of the people aged between 15 and 80 living in Turkey. The reason behind selection of this age range is their ability to respond to the questionnaire sent to them electronically. In this context, the size of the population is estimated to be approximately 45,000,000. Within the scope of the research, a web-based survey form prepared at Isparta University of Applied Sciences was sent to people living in Turkey between 7 October 2020 and 30 October 2020 with the snowball sampling method, via social media and e-mail accounts. It was calculated that a sample of at least 384 people (α=0,05, sampling error H=±0,05 and rates p=0,5; q=0,5) should be reached for the population of 45.000.000 according to the formula given by (Adam, 2020). 553 participants who have or have not been infected with the virus were reached at the end of the research. Since the prepared electronic questionnaire does not allow more than one answer to the same question or skipping a question, all data were included in the study. The research was organized according to the general screening model. The study was conducted between November 10th and December 10th of 2020.

2.2. Scale development studies

2.2.1. Development of item pool (Stage 1)

In the study, based on the information obtained from the literature, a question pool was prepared by the researcher to determine the habits for zero waste practices. The draft items created were pre-reviewed by three experts. The list of questions (survey) is presented in Table 1. The questionnaire form prepared within the scope of the research consists of three parts. In the first part, there are questions to determine the demographic characteristics of the participants and whether they have had covid-19 disease.

Table 1. Items table

Item 1	Preferring to use disposable (plastic/cardboard paper, plates, cutlery) products in social areas
Item 2	Saving water at home to protect the environment
Item 3	Saving electricity at home to protect the environment
Item 4	If possible, have it repaired broken items instead of throwing away and buying new ones
Item 5	Using a mask for reasons such as influenza, cleaning and virus outbreak, etc.
Item 6	Using gloves for reasons such as influenza, cleaning and virus outbreak, etc.
Item 7	Following the information given by the institutions/organizations related to zero waste from sources such as television, etc.
Item 8	Throwing packaging (glass, metal, plastic, paper) waste into the nearest recycling bin
Item 9	To bring the waste vegetable oils generated at home to the nearest waste collection point (application)
Item 10	Dispose of waste batteries to the nearest waste battery box
Item 11	Delivering other electronic waste to the nearest collection point
Item 12	Ensuring that organic wastes (fruit/vegetable peels, leftovers, tea pulp, etc.) are composted in your garden/nearest collection point

The question list created in Table 1 in the second part was asked to determine the habits of individuals towards zero waste practices before the pandemic (ZWPS-P; Zero Waste Practice Scale-Pre-Pandemic). In the third part, the same survey questions were applied to determine the change in the habits of individuals during the pandemic period (ZWPS-D; Zero Waste Practice Scale-During Pandemic).

Ethics committee approval of the questionnaire was obtained by the Republic of Turkey Ministry of Health, General Directorate of Health Services and Isparta University of Applied Sciences Scientific Research Publication Ethics Committee with the decision dated 07.10.2020 and numbered 31/2.

2.2.2. Validation of the question pool (Stage 2)

The draft items created were pre-reviewed by three experts. In order to carry out the reliability and validity tests of the draft scale (external validity), a group of 11 experts selected from the Environmental Engineering department was asked whether the questions were necessary or not. They were asked to examine the questions asked in terms of their purpose, content, scope, intelligibility, consistency and relevance. Revisions were made in the articles in line with the opinions, comments and suggestions of the experts. Following this, Then, an expert's opinion was sought on the issues of expression, spelling and punctuation errors. Finally, a 4-point Likert Scale format with the following descriptions: 1 never, 2 rarely, 3 usually, 4 always was prepared for the 12-item questionnaire to measure the behaviors of individuals regarding zero waste management pre-pandemic and during pandemic.

2.2.3. Pilot testing

Before the main survey, the pre-application of the draft scale was applied to a randomly selected group of 125 people in order to identify the items that individuals may have difficulty in understanding or misunderstand, and the problems that may be encountered in the application.

2.2.4. Calculation of validity and reliability (Data analysis)

The content validity of expert opinions was evaluated using the Lawshe technique (Lawshe, 1975). The analysis of the data obtained in the research was carried out with IBM SPSS 21 and IBM SPSS AMOS 26 statistical software programs. Descriptive statistics are interpreted using mean, frequency, percentage values and standard deviation. Exploratory Factor Analysis (EFA) and reliability analysis were conducted using IBM SPSS Statistics 21.0, whereas confirmatory factor analyses (CFA) were conducted in SPSS AMOS 26.0. Cronbach's alpha coefficient was calculated for internal consistency in determining the level of reliability of the developed scales. EFA and CFA are two statistical approaches used to examine the internal reliability of a measure. Exploratory Factor Analysis (EFA) was used to determine the validity of the scale, and Confirmatory Factor Analysis (CFA) was used to test the confirmability of the results from the EFA. The Bartlett test was used to decide whether the data were suitable for factor analysis, and the Kaiser-Meyer-Olkin (KMO) test was

used for sample adequacy. The 12 items (variables) were subjected to a principal component analysis (PCA) with varimax rotation to extract the number of factors corresponding to the theoretical dimensions under examination. Then, CFA was performed to test the construct validity. For the discriminant validity of the scale, the results of CR (Composite Reliability) and AVE (Average Variance Extracted) values were examined.

In surveys using Likert-type scales, data are often not normally distributed. The conformity to the normal distribution can be examined with the Q-Q Plot (Chan, 2003). Tabachnick and Fidell (2013) accept that the distribution occurs as a normal distribution when the skewness and kurtosis values are between +1,500 and -1,500 (Tabachnick and Fidell, 2013). Zero waste applications scale had a skewness value of 0.150 and a kurtosis value of -0.259 pre-pandemic and a skewness value of 0.143 and a kurtosis value of -0.352 during pandemic period thus can be accepted as normal distribution. Since the scale presented normal distribution, parametric tests were used in statistical evaluations.

Independent sample t-test was used to test whether the scores obtained from two-category unrelated samples differ significantly from each other, dependent-sample t-test was used to test the difference between two related measurements, and One-Way Analysis of Variance (ANOVA) test was applied to test whether the mean of more than two unrelated samples differed significantly from each other. The difference between the groups will be considered statistically significant if $p < 0.05$.

3. Results and discussion

3.1. Demographic profile

Study results showed that 43.8% of the participants were in the 31-45 age group, 61.5% were female, 69.6% were living in the city center and 70.2% had an undergraduate degree. It was observed that 23.1% of the participants were insured employee, 26.4% had a monthly income of 2501-4000 TL (which minimum wage earning in Turkey corresponds to 400 USD approximately), 4.3% had a corona virus infection, and 8.7% had a relative who had a corona virus infection.

3.2. Validation and reliability of the items

According to Veneziano and Hooper (1997) the minimum values of content validity criteria (CVC) for 11 experts is 0.59 and the calculated content validity index (CVI) was 0.89. Since CVI≥CVC, the content validity of the scale was found statistically significant (Veneziano and Hooper, 1997).

The minimum value of correlation coefficient to prove the existence of the accepted relationship between scores of two or more test is 0.20 (Kline, 2016). Item 1 which has low correlation coefficient was removed as it indicates a lack of patterned relationship (Table 1).

It is generally accepted that a Cronbach's alpha greater than 0.70 demonstrates acceptable reliability (Lance et al., 2006). Cronbach Alpha Internal Consistency Coefficient

confirms correlation of test with itself (Tavakol and Dennick, 2011). Cronbach's alpha coefficients calculated for internal consistency in determining the level of reliability of the developed ZWPS was 0.82 and 0.79 for both pandemic periods which the study conducted (Table 2). Thus, it can be concluded that ZWPS is a reliable and valid instrument to measure consciousness and habits of individuals on zero waste awareness pre-pandemic and during pandemic period in Turkey.

Table 2. Decision criteria found using EFA and CFA in the study

| Test criteria	Measure applied			
	ZWPS-P		ZWPS-D	
Correlation coefficient	(r < +/- .30) should be removed			
Cronbach's alpha coefficient	0.823		0.790	
Total Variance explained (%)	62.171		61.300	
KMO	0.778		0.798	
χ2	1639.474		1505.940	
Communalities	0.40 or above		0.40 or above	
Scree plot	2 factors were extracted			
Pattern matrix	Factor loading > 0.5, Average > 0.7			
Goodness of fit test χ2/df	2.77		2.60	
Bartlett's Test of Sphericity	df Sig.	28.000	df Sig.	28.000
Factors extracted	Factor 1	Factor 2	Factor 1	Factor 2
Items	8, 9, 10, 11, 12	2, 3, 4	8, 9, 10, 11, 12	2, 3, 4
Items loading	0.649, 0.743, 0.788, 0.784, 0.503	0.833, 0.913, 0.431	0.649, 0.751, 0.765, 0.818, 0.495	0.772, 0.853, 0.456
Composite reliability (CR)	0.90	0.79	0.89	0.75
Average variance extracted (AVE)	0.53	0.57	0.52	0.51
RMSEA	0.080		0.074	
Comparative fit indices CFI	0.957		0.961	
IFI	0.957		0.961	
GFI	0.963		0.966	
CMIN/df	4.908		4.057	

3.3. Results of the EFA for ZWPS-P

Prior to performing the EFA, the KMO measure of sampling adequacy and Barlett's test of sphericity were evaluated. According to the test results, the KMO value was 0.778 and the Bartlett's test of sphericity ($χ2(28) =1639.474$; $p<0.01$) was significant indicating that the sample size is satisfactory for the measurement of the construct and the items have patterned relationships (Table 2). While KMO values between 0.5 and 1.0 are acceptable, the values lower than 0.5 are indicator of inadequacy for the factor analysis. In general, most studies consider 0.6 as a threshold value for KMO (Tabachnick and Fidell, 2013). Low KMO means indicators are not highly correlated (Yong and Pearce, 2013).

The principal component analysis with Varimax rotation method was applied in order to reveal the factor pattern and identify factors (latent constructs) of the scale. Varimax rotation method diminishes the number of variables that have high loadings on each factor (Yong and Pearce, 2013). The scree plot which is the most common method for identifying the appropriate number of factors (Newsom, 2005, Wood *et al.,* 2015) was helpful for the extraction of the factors (Figures 1 and 2).

Results of the EFA carried out presented that factor loadings were above 0.50 except for the items 5, 6, and 7. In general, Items with factor loadings of 0.40 or greater were considered as rational of the construct under examination (Hinkin, 1998).
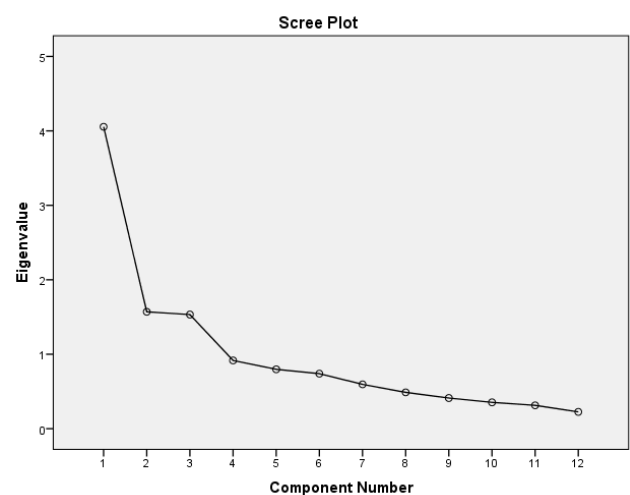
Figure 1. Scree plot for ZWPS-P.

In the analysis made for two factors, when the items were evaluated in terms of whether the factor loading met the acceptance level, it was determined that the factor loadings were at the desired level. It is seen that the factor loadings are between 0.603 and 0.894. In multifactorial designs, it is considered sufficient if the explained variance is between 40% and 60% (Tavsancil 2002; Büyükozturk, 2007). The factor loading of a variable measures the extent to which the variable is affiliated with a given factor. In this

framework, it is seen that the contribution of a defined factor to the total variance is sufficient. The PCA revealed that two factors with eigenvalues exceeding one, explaining 62.171% of the total variance in zero waste awareness. As presented in Table 2, the first factor explains 42.883% of the total variance while the second factor explains 19.289% of the total variance.
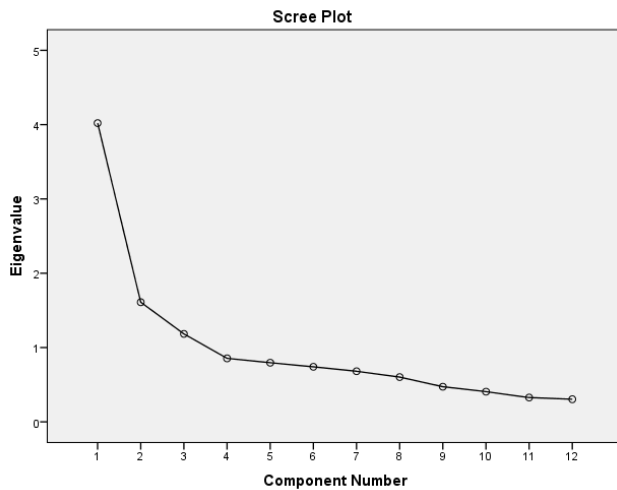

Figure 2. Scree plot for ZWPS-D.

According to PCA, items 5, 6 and 7 had low factor loadings and they were removed from the original 12 item – ZWPS. A model consisting of 8 items was developed based on two theoretical dimensions. Using the results of the PCA, first factor (F1) consists of 5 items (items 8, 9, 10, 11,12) and second factor (F2) which include 3 items (items 2, 3, 4) were obtained. The first factor (F1) involves items associated with attitudes towards recycling etc. and thus it can be pronounced as recycling attitudes factor and the second factor (F2) includes items related mostly saving etc. and thus it can be called saving attitudes (collaborative consumption practices, economy or efficiency).

When the reliability of the answers given by the participants was evaluated separately as the scale and its sub-dimensions, it was determined that the reliability coefficients for the first dimension (0.811), for the second dimension (0.748) and for the overall scale (0.804) had a high degree of reliability.

3.4. Results of the CFA for ZWPS-P

Decision on the acceptability of the model is made using the fit indices. If the model is acceptable, researchers then decide whether specific paths are significant. Many of the fit indices are calculated using the chi-square value. In general, a low chi-square value relative to the degrees of freedom (and higher p-value) indicates better model fit (Alavi *et al.,* 2020). This shows that the observed covariance matrix is similar to the predicted covariance matrix. Many researchers, such as Marsh et al. (1996) and Jaccard and Wan (1996) suggest that variety of fit indices should be applied to the model in order to deal with the limitations of each index (Marsh et al, 1996; Jaccard and Wan, 1996). According to Ullman (2001) relative chi-square ($\chi2$/df) value should be less than 2 (Ullman, 2001), according to Schumacker and Lomax (2004) it should be less than 5

(Schumacher and Lomax, 2004). Hu and Bentler (1999) state that the comparative fit indices (CFI) should be higher than 0.95 and the root mean square of the approximation (RMSEA) value should not exceed 0.08 (Hu and Bentler, 1999). Byrne (1994) refuses goodness of fit index (GFI) values lower than 0.95 (Byrne, 1994). The incremental fit index (IFI) values greater than 0.90 are regarded as acceptable (Bollen, 1989).

According to results of the CFA in the study, the structural equation modeling results of the ZWPS was not significant, and that 8 items and two sub-dimensions constituting the scale were related to the scale structure (Table 2). The model did have an acceptable fit but is being modified for improvement. While making the improvement, the variables that reduced the compliance were determined, and new covariances were created for those with high variance among the residual values (e3-e5). Afterwards, it was seen that the better values for the fit indices were provided in the renewed fit index calculations. According to the results of the first level multi-factor analysis, when the goodness of fit (compliance) indices of the ZWPS are examined; RMSEA 0.080; GFI 0.957; IFI 0.957; CFI 0.957; $\chi2$ = 4.908 (p=0.000). It can be concluded that the ZWPS-P model has acceptable fit indices (Table 2).

The factor loadings for each factor are shown in Table 2 and the model for the first level CFA of the ZWPS-P is shown in Figure 3. As presented, factor loadings vary between 0.43 and 0.83. Factor loadings were found to be above 0.40 which fulfils desired criteria of lowest 0.40 (Polit and Beck, 2004). Ü
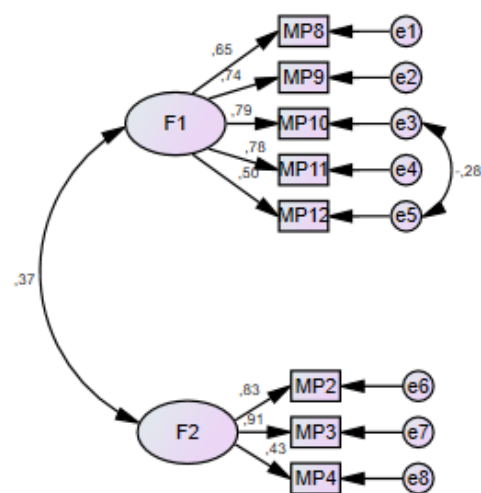

Figure 3. Model of First-Level Multi-Factor Confirmatory Factor Analysis for ZWPS-P.

The composite reliability (CR) value of the latent variables in the measurement model should be higher than 0.70 and the mean explained variance value should be higher than 0.50 (Hair *et al.,* 2009). As shown in Table 2, both CR and AVE values exceeded the threshold values of 0.70 and 0.50, respectively. It can be concluded that the CR and AVE values provide further evidence of reliability for the scale.

3.5. Results of the EFA for ZWPS-D

According to the test results, the KMO value was 0.798 (Table 2) and the Bartlett's test of sphericity (χ2(28) = 1505,940; p<0.01) was significant. Thus, the above indicators demonstrate that factor analysis was believed to be suitable for the measurement of the construct. Items 5, 6, 7 which had low factor loadings were removed from the dimensions, and a model consisting of 8 items was developed based on two theoretical dimensions.

The principal component analysis with Varimax rotation method was applied in order to reveal the factor pattern of the ZWPS. In the EFA carried out, factor loadings were found to be above 0.50 except for the items 5, 6, and 7. In the analysis made for two factors, when the items were evaluated in terms of whether the factor loading met the acceptance level, it was determined that the factor loadings were at the desired level. It is seen that the factor loadings are between 0.596 and 0.857. It is seen that the contribution of a defined factor to the total variance is sufficient. The PCA revealed that two factors with eigenvalues exceeding one, explaining 61.300% of the variance in zero waste awareness. As presented in Table 2, the first factor explains 42.927% of the total variance while the second factor explains 18.373% of the total variance.

According to PCA, items 5, 6 and 7 had low factor loadings and they were removed from the original 12 item – ZWPS. A model consisting of 8 items was developed based on two theoretical dimensions. Using the results of the PCA, the first factor consists of 5 items (items 8, 9, 10, 11,12) and the second factor which include 3 items (items 2, 3, 4) were obtained.

When the reliability of the answers given by the participants was evaluated separately as the scale and its sub-dimensions, it was determined that the reliability coefficients for the first dimension (0.839), for the second dimension (0.721) and for the overall scale (0.806) had a high degree of reliability.

3.6. Results of the CFA for ZWPS-D

According to results of the CFA, the structural equation modeling result of the ZWPS-D was not significant (p>0.05) and that 8 items and two sub-dimensions constituting the scale were related to the scale structure. It is presented in the Table 2 that the resulted values for the fit indices were

sufficient. According to the results of the first level multi-factor analysis, when the goodness of fit (compliance) indices of the ZWPS-D are examined; RMSEA 0.074; GFI 0.966; IFI 0.961; CFI 0.961; χ2/df = 4.057. It can be concluded that the ZWPS-D model has acceptable fit indices (Table 2).

The factor loadings for each factor are shown in Table 2 and the model for the first level CFA of the ZWPS is shown in Figure 4. As presented, factor loadings vary between 0.46 and 0.85 which fulfils desired criteria of lowest 0.40 (Polit and Beck, 2004). The composite reliability value of the latent variables in the measurement model should be higher than 0.70 and the mean explained variance value should be higher than 0.50 (Hair et al., 2009). As shown in Figure 4, both CR and AVE values were above the threshold values of 0.70 and 0.50, respectively. As a result, it can be concluded that the scale had distinctive validity.
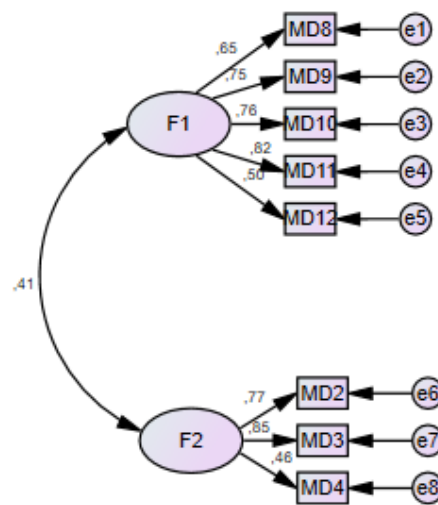

Figure 4. Model of First-Level Multi-Factor Confirmatory Factor Analysis for ZWPS-D.

Test results showed that the zero waste practices scale and sub-dimension scores pre-pandemic and during pandemic did not show a statistically significant difference according to the participants' age, gender, place of residence, education level, profession, monthly income, and the status of having a corona virus infection (p>0.05).

Table 3. Distribution of Zero Waste Practices Scale and Sub-Dimensions Scores (Pre-pandemic and during pandemic)

	F1 Pre-Pandemic	F1 During Pandemic	F2 Pre-Pandemic	F2 During Pandemic	Pre-Pandemic Total	During Pandemic Total
$\bar{x} \pm SS$	6.35±3.97	6.64±4.07	6.63±1.83	6.65±1.88	12.98±4.93	13.29±5.05
T	-5.752	-0.309	-3.753			
P	0.000	0.757	0.000			

According to Janmaimool and Khajohnmanee (2019), acquiring an environmentally friendly habit can be affected by various factors such as motivation, sense of responsibility, social norms, etc. and it requires some time (Janmaimool and Khajohnmanee, 2019). Zero Waste Regulation is one of the new regulations published in

Turkey on 12.07.2019 (Demirel et al., 2021). Communities continue to be informed throughout the country via television and social media, on the other hand, projects and seminars on Zero Waste Management in pre-university education institutions and awareness raising activities were started rapidly from a young age. However, the

restrictions due to the Covid-19 pandemic have also caused the division of education life, and moreover, people's health problems and vital concerns due to the pandemic have taken precedence over all issues. Results showing not a statistically significant difference on Zero Waste habits according to the demographic characteristics of the participants can be attributed to the fact that the public does not have sufficient knowledge and awareness about the subject. A survey study conducted on consumer behavior in electronic waste management in Bangladesh supports this idea. In the study, it was aimed to create a perception of electronic waste recycling and management in consumers, and it was concluded that training activities in which the benefits of e-waste recycling would be explained to the public would increase sensitivity (Annonno *et al.,* 2021).

Although the results of the study suggest that gender, age, income and occupation do not have a strong relationship with zero waste awareness, literature findings (Hiramatsu, *et al.,* 2016). confirm that these variables have a strong relationship with environmental awareness. According to Jusoh et al. (2018), knowledge, attitudes and subjective norms play an important role in the behavior of individuals towards zero waste awareness (Jusoh *et al.,* 2018). Fearon and Adraki (2014) state that gender and religion have an effect on waste disposal behavior (Fearon and Adraki, 2014). In a study conducted by Patel et al. (2017) in India on the socio-demographic factors and pro-environmental behaviors of consumers has shown that married consumers score higher than singles, middle-aged consumers (36-50) show more environmentalist behavior than young people, higher education is increasing environmental consciousness and unmarried women do not avoid paying more for energy efficient goods (Patel *et al.,* 2017).

The results of the independent sample t-test and one-way Anova (F) test, which was conducted to determine whether the ZWPS (pre-pandemic and during pandemic) and sub-dimensions of the participants, differ according to the descriptive characteristics, are given in the Table 3.

The results showed that the participants' ZWPS and F1 sub-dimension scores showed a statistically significant difference between pre-pandemic and pandemic periods (p<0.05) (Table 3). The increase in the recycling attitudes sub-factor (F1) can be interpreted as the prolongation of the time spent at home during the pandemic period, so that packaging, batteries, electronic wastes are released more than in the normal period, and people spend more time on recycling. As a result, the tendency to throw packaging waste, waste batteries, waste oils and electronic wastes into recycling bins has increased during the pandemic period. With the pandemic, the shift of settlement from city to village has also increased the opportunity for people to have a garden. This may have increased the use of organic wastes to be converted into fertilizers.

It was found that the ZWPS and F2 sub-dimension scores of the participants did not show a statistically significant difference according to the pre-pandemic and pandemic

period (p>0.05) (Table 3). During the pandemic period, both electricity and water use increased, and saving was not considered much in order to provide hygienic conditions.

4. Conclusions

The purpose of this study was to construct an instrument to measure consciousness and habits of respondents on zero waste awareness pre-pandemic and during Covid-19 pandemic periods in Turkey. A nationwide online survey was conducted on participants' zero-waste awareness and habits before and after the pandemic date of March 2020, all over the world.

The study results can be listed as follows:

(1) Following all necessary statistical analysis, a scale with two factors and 8 items were generated. 4 items were removed as a result of principal component analysis. In conclusion, the first factor consists of 5 items while the second factor consists of 3 items. KMO and Barlett tests indicate that 8 item scale is valid and reliable for the measurement. The results show that two subfactors, recycling and saving attitudes that affect the behavior of participants towards zero waste awareness.

(2) According to the test results, the zero waste practices scale and sub-dimension scores did not show a statistically significant difference according to the age, gender, place of residence, education level, occupation, monthly income and whether or not they had coronavirus of the participants who had coronavirus infection before and during the pandemic. It is a fact that more time is needed to reduce the amount of waste before it is formed, to understand the economic benefits of recycling and saving, and the importance of zero waste management.

(3) The F1 (attitudes towards recycling) sub-factor showed a statistically significant difference between pre-pandemic and pandemic periods (p<0.05). During the pandemic period, people showed more sensitive behavior in delivering waste to recycling bins. The public's interest in recycling can be increased with waste collection bins that local governments can place in the city. Facilitating access to waste collection bins will also increase the rates of separation of wastes at source.

(4) The F2 (attitudes towards saving) sub-factor compared to the pre-pandemic and pandemic period did not show a statistically significant difference (p>0.05). Over time, the spread ways of the Covid-19 pandemic and the conditions for effective hygiene are more clearly understood. While saving electricity and water on the one hand, practices should be developed for effective hygiene conditions on the other.

(5) The results of the study can contribute to zero waste awareness. The use of the developed questionnaire scale in scientific studies in different periods may be useful in terms of determining how the consciousness on Zero Waste Management is progressing.

(6) sAdditional measures will likely be needed to address the waste problem. Therefore, environmental education

must be supported to promote zero waste and environmental awareness.

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