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ORIGINAL ARTICLE

Multi-item unidimensional measurement scale construct: Perceived hygiene development (pHd)

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Abstract

The recent COVID-19 pandemic experience intensified the significance of hygiene in the service industry. It is crucial to measure how service practice adaptations and technology adoptions in servicescapes have been perceived by customers regarding hygiene in the post-COVID-19 era. However, the extant hygiene scales do not serve the purpose to measure hygiene contributions of technology-specific and service practice-specific changes. Thus, the purpose of this research was to develop a multi-item unidimensional perceived hygiene construct. Sequential mixed-methods research (Qual-Quan) was employed. Participants were sampled among restaurant patrons. A four-item perceived hygiene development (pHd) construct was successfully developed. Hospitality and service researchers and practitioners can utilize this scale to measure perceived hygiene improvements of particular technology adoptions and service practice adaptations in service settings.

KEYWORDS

mixed-method research, perceived hygiene measurement, scale development, unidimensional construct

INTRODUCTION

Hygiene and cleanliness have been long-standing factors in service quality and customer satisfaction studies in service-related areas and with hospitality in particular (Choi, 2019; Moon et al., 2017; Yu et al., 2021). Due to the unprecedented global COVID-19 pandemic, hygiene and cleanliness have become priorities in the perception and evaluation of services and service environments (Gursoy & Chi, 2020; Naumov et al., 2021). As a result, desirable hygiene standards in public settings have been altered. The hygiene standards have become stricter and in doing so have become more visible (e.g., Dai & Luca, 2020). The COVID-19 pandemic has created

an environment of rapid adaptations and the adoption of new practices (Pillai et al., 2021). Service industry practitioners have adapted their servicescape (Bitner, 1992) in order to meet the hygiene expectations in service areas (Kim et al., 2021; Taylor, 2020). For instance, restaurants have practiced sanitizing common touchpoint areas, ranging from table surfaces to door handles, in their physical servicescape settings. This practice is done in full view of restaurant patrons more frequently than before (Gursoy et al., 2020). The purpose of this practice is to provide a hygienic environment as well as to, from a psychological standpoint, make customers feel safer in terms of cleanliness and hygiene (Jeong et al., 2021). With the gradual reopening of businesses in the U.S., ensuring hygiene, health, and safety for employees and customers has become a priority. Service industry establishments, in particular restaurants, did not limit their adaptations in their servicescape alone to the mandated changes (practicing 6-feet distance, wearing a mask, and capacity reduction) based on Centers for Disease Control and Prevention (CDC) guidelines (CDC, 2021; last updated June 14th, 2021). They also made additional adaptations (both technology-based and non-technology-based) in their service settings. Hudson (2020) named it COVID-aptability. Among low-touch economy discussions (Vieira de Jesus et al., 2020) for the post-COVID era, the goal has been to reduce common touchpoints in the customer journey (Lemon & Verhoef, 2016) and to create as many contact-free environments as possible in the new normal (Dube et al., 2021).

We identified a gap in the literature in that there is no hygiene construct to measure perceived hygiene development concerning adoptions and adaptations in servicescapes from the viewpoint of customers. Hygiene construct needs to be included as a contextual factor in certain cases of technology adoption in hospitality and tourism servicescapes. Robots, automation, and contactless options are becoming more popular day by day (Pillai et al., 2021). Service establishments seek technology adoption for the post-COVID era considering labor shortage (Iskender, Sirakaya-Turk, Cardenas, & Harrill, 2022). These technology adoptions may need to be measured in terms of contribution to hygiene developments as perceived hygiene improvement may impact acceptance and use of technology adoption by customers. The purpose of this study is to develop a hygiene construct to measure the perception of customers on hygiene development in technology adoption in the case of Quick Response (QR) code menus in restaurants.

LITERATURE REVIEW

COVID-19, hygiene and servicescapes

The COVID-19 pandemic reminded everyone of the importance of hygiene (Jegal et al., 2020; Yu et al., 2021). Learning how to properly wash one's hands became a trending topic on the public agenda and was seen in news reports and aired on television. The CDC even released a set of instructions about handwashing. Public health and environmental health literature already indicated the significance of hygiene (Aiello et al., 2008). Poor hygiene practices may cause certain diseases at various levels from respiratory diseases to infectious diseases (Delea et al., 2020). As Kariyono (2021) found a relationship between hygiene and bacteriological quality of service environments, it became known that hygiene is also important for public settings.

The hygiene of certain items in the servicescape (Kotler, 1973) is as important as the general cleanliness of service settings. For instance, in pre-COVID studies (Alsallaiy et al., 2016; Sirsat et al., 2013), the role of conventional restaurant menus (paper and laminated) was identified in terms of the transferability of pathogens from hands to hands, fingertips to fingertips, and other surfaces. Additionally, Bruegel and Lecocq (2020) revealed the first historical unpublished systematic restaurant hygiene research conducted in 1908 in Paris by the French

government. These findings indicated the hygiene of restaurants was more crucial in tourist areas than in non-tourist areas as hygiene violations were more common in these tourist areas.

Some studies aimed to relate servicescape with other constructs (Jeong et al., 2021). Kaminakis et al. (2019) investigated the influence of the servicescape on the interactions between customers and servers within the context of full-service restaurants. Reimer and Kuehn (2005) conducted a study on retail banking and restaurant servicescape in order to examine the relationship between servicescape and quality perception. They found that the servicescape was more influential on the hedonic service quality than the utilitarian service quality perceptions. Moreover, Harris and Ezeh (2008) suggested a correlation between servicescape and loyalty intentions.

Hygiene/cleanliness: Adoption and adaptations

Hygiene as a concept refers to practices and conditions to protect health and prevent diseases through cleanliness (Delea et al., 2020; Yu et al., 2021). Even though cleanliness and hygiene have already been included as one of the dimensions of the servicescape model by many studies (Hooper et al., 2013), due to the COVID-19 pandemic conditions, awareness of perceived hygiene has increased. Compared to other dimensions (design, ambiance, equipment, and space), hygiene and cleanliness were labeled as the most intuitive and easy to maintain (Hooper et al., 2013), whereas their absence was the most noticeable and negative factor regarding service failure (Hoffman et al., 2003). The variables used to measure hygiene in servicescape were mainly (i) the service station appeared to be hygienic, (ii) the store was very clean, and (iii) the employees were neat and tidy in appearance (Reimer & Kuehn, 2005). Similarly, Am (2018) associated the servicescape with perceived value in fine dining restaurants. The factor analysis determined five dimensions of the servicescape: ambient, hygiene, aesthetic, exterior, and tangible components. The following variables were employed to measure hygiene: dining areas are clean, restrooms are clean, walkways and exits are clean, the layout makes it easy to move around, and seating arrangement is comfortable (Hooper et al., 2013; Reimer & Kuehn, 2005).

The past studies were reviewed by adhering to hygiene and cleanliness concerning servicescapes, with a focus on restaurants in terms of measurability. Cleanliness and hygiene have been included in measurement scales and theoretical models in relation to service quality, customer satisfaction, loyalty, revisit intentions, the image of the service establishment, and restaurant selection decisions (Barber & Scarcelli, 2010; Moon et al., 2017; Pizam & Tasci, 2019). Hygiene is also a domain of first impressions of the service environment (Vilnai-Yavetz & Gilboa, 2010; Vos et al., 2019).

Throughout the literature review, we identified the interchangeable use of hygiene and cleanliness even though they reflect different notions. By definition, cleanliness and hygiene can be differentiated. While cleanliness may describe being free of dirt or stains, hygiene may describe maintaining health conditions (Oxford English Dictionary, n.d.-a, n.d.-b). Cleanliness and hygiene were important factors in the pre-COVID era; however, the past research applied a broader sense of cleanliness and hygiene to evaluate them in service settings (e.g., Barber & Scarcelli, 2010). As we all experienced firsthand, the COVID pandemic intensified our hygiene and cleanliness perceptions (Gursoy et al., 2020). All these led us to develop a reflective hygiene construct.

Almohaimmeed (2017) explored the predictive power of restaurant quality on customer satisfaction. Restaurant quality consisted of 11 dimensions where hygiene was one of the variables. However, the hygiene dimension included only clean staff and clean dining areas as sub-domains (Saglik et al., 2014). Ko and Su (2014) identified foodservice quality indicators by customers' perceptions using broad statements regarding hygiene. They did not identify hygiene as an independent factor. Instead, hygiene and cleanliness were embedded in the dining

room and restroom under the environment atmosphere domain. Staff appearance was grouped under service quality. Measurement scale SERVQUAL (Babakus & Boller, 1992; Parasuraman et al., 1988) and adapted versions SERVPERF (Cronin & Taylor, 1992) and DINESERV (Knutson et al., 1996; Stevens et al., 1995) included cleanliness and hygiene with shallow approaches. Such a limitation regarding service scales regarding hygiene and sanitation aspects is available in other service domains like healthcare (Asiamah et al., 2021).

More recently, Yu et al. (2021) identified perceived hygiene attributes as three pillars: hygiene of customer-use spaces, personal hygiene of staff, and hygiene of workspaces. Vos et al. (2019) identified dimensions of perceived cleanliness, which are cleaned, fresh, and uncluttered. The measurement scales all capture hygiene and cleanliness at a broad level or global scale. The itemization of the scales does not help to measure hygiene developments of the adoption and adaptation efforts, such as limiting touchpoints, creating contact-free environments, and adopting new technologies (e.g., Digital menus, robotics, contactless payments, and touchless check-in and check-outs). These practices may contribute to the perceived hygiene and cleanliness of services. However, existent hygiene and cleanliness measurement scales are incapable of measuring partial hygiene contributions of technological adoptions and service practice adaptations in hospitality servicescapes. Therefore, this study aims to develop a multiple-item unidimensional perceived hygiene scale to be utilized to measure perceived hygiene contributions of particular technology adoptions and specific service practice changes.

METHODOLOGY

Data collection and analysis

For the sample data, the "exempt" status was obtained by the Institutional Review Board (IRB). Churchill's (1979) seminal work and Gerbing and Anderson (1988) were referenced for the construct development process structure in this study. It is recommended to initiate a scale development process through qualitative inquiries such as literature reviews, interviews, and focus groups. For the first phase, we reviewed the literature and identified the domain of the hygiene construct (Lee, 2014). Hygiene and cleanliness dimensions were identified in a broad sense with general items (e.g., external, internal, utensils, and personnel) (Barber & Scarcelli, 2010; Choi, 2019; Naumov et al., 2021). Even though cleanliness and hygiene were used in the literature interchangeably, for our study we consistently use hygiene, because hygiene gives a more specific sense (e.g., hygiene of a particular item) as a word etymologically. As defined by the dictionary and by common use (Oxford English Dictionary, n.d.-a, n.d.-b), cleanliness is perceived as a broad sense of an environment rather than a single entity. Our approach to hygiene is specific to a particular servicescape adoption and/or innovation.

In the second phase, we conducted an ethnographic study (DeVaney et al., 2018) to observe the research area at two different times and at two different restaurant locations. Both restaurants are located on Main Street in Columbia, South Carolina, USA. These two restaurant locations were "Halls Chophouse" and "Cantina 76." These restaurants were chosen because the atmosphere of both locations is dissimilar. Halls Chophouse is an upscale fine-dining restaurant while Cantina 76 is a more casual setting. Both restaurants utilized QR code menus at their tables as a primary menu choice. During these visits, the researcher in charge of the ethnographic inquiry also communicated with four different employees (servers and managers) briefly to obtain their views and observations as well. The reason QR code menus were selected as an empirical research domain is that QR codes are widely adopted across service establishments, which allowed us to obtain the hygiene perceptions of diverse consumers.

In the third phase, interviews and a focus group were employed as research methods. A total of 16 interviews were conducted, and a focus group including seven participants was

organized in October 2020. Interviews were performed in person and one-on-one. A single interview was conducted via Zoom. All the interviews and the focus group were voice-recorded. Additionally, seven interviewees were scholarly research practitioners to obtain scholarly insights.

In the fourth phase, audio recordings were transferred in a text format. A 144-page long document was obtained. We reviewed the outcomes of the interviews and the focus group in order to determine the variables and their wording. Our goal was to develop a straightforward measurement construct and items. In this stage, the items and their wording were determined after exchanging thoughts with some peers, colleagues, and scholars (see Table 1 for the items).

The fifth phase was to run a pilot study to test initially developed items by qualitative-based inquiry (see Table 1). The pilot study was performed in late November and early December of 2020. The social networks of the researchers were utilized to find participants for the pilot research. As an incentive, the researchers donated a full-day meal for children in underdeveloped regions in the name of participants to ShareTheMeal (United Nations World Food Program).

TABLE 1 Descriptives, item correlations, and exploratory factor analysis (EFA).

					Item correlations				EFA	
	Mean	**SD**	**Skewness**	**Kurtosis**	**1**	**2**	**3**	**4**	**Loadings**	**Communalities**
Perceived Hygiene Development (pHd): 4 variables										
1. Using a QR code menu improves the overall hygiene of the dining experience.	4.13	0.79	−1.11	2.6	1	0.6	0.6	0.5	0.801	0.641
2. I perceive the restaurants utilizing a QR code menu as more hygiene-friendly.	4.14	0.84	−1.08	1.95	0.6	1	0.5	0.6	0.794	0.63
3. Having a QR code menu is a reflection of the restaurant's hygiene level.	4.05	0.85	−1.15	2.39	0.6	0.5	1	0.7	0.86	0.739
4. Having a QR code menu is an indicator of how much care the restaurant has for hygiene.	4.06	0.9	−1.22	2.21	0.5	0.6	0.7	1	0.854	0.73
Eigenvalue (>1)									2.7411	
Explained variance by the factor (%)									68.521	
KMO									0.791	
Barlett's test of significance									0	
Reliability coefficients (Cronbach's Alpha)									0.846	

Note: Likert five-point scale with 1 – strongly disagree and 5 – strongly agree. Total variance extracted by the unidimensional factor is 68.521%. There was no Item loading less than 0.5 to be omitted. Items were measured on a 5-point Likert scale.

The pilot study included a sample of 50 participants. We retained four variables for the hygiene construct for the primary analysis. Each variable had a quantitative five-point Likert scale. The survey was designed and implemented on Qualtrics, a survey software/platform. In this fifth phase, we aimed to identify anything that needed to be modified, such as item wording based on statistical indicators, before performing the actual study with a large sample.

The sixth phase and final stage was scaling determination statistically with two methods: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (Churchill, 1979; Ryu & Jang, 2008; Tabachnick et al., 2013). Our goal was not to identify any predictive or causal relationship between variables but to evaluate the number of items as a construct. The developed construct could later be used in other analyses such as multivariate analysis of variance (Pallant, 2016, p.314). Therefore, we applied EFA and CFA since our aim was to develop a construct from scratch. We used EFA as an initial method, followed by CFA (Sirakaya-Turk et al., 2017, chapter 16). Our goal was to obtain marker variables to develop an uncomplicated construct.

For factor analysis, there is no rule of thumb about cases included in the sample size. In general, a sample size greater than 300 is considered suitable (Tabachnick et al., 2013, p. 613). Some researchers recommend the ratio between participants and items regarding sample size. Nunnally and Bernstein (1994) suggested a 10 to 1 ratio. However, the general approach is the larger, the better. In this stage, we collected our designated sample (844 participants out of 968 attempts) in April 2021, on MTurk.

The statistical package programs used were SPSS-28 and MPlus8. For the model fit analysis, we used three randomly selected samples using SPSS' random samples of cases function/tool. Monte Carlo simulation and theoretical analysis findings of Kenny et al. (2015) and Taasoobshirazi and Wang (2016) suggested the optimum range of sample size (nearly between 400 and 600 observations) with small degrees of freedom to limit contradicting indications of some model fit indices such as RMSEA (Root mean square error of approximation) and CFI (Comparative Fit Index). Therefore, we ran the model fit results of three randomly selected samples (ranging between 400 and 600 data points).

RESULTS

In the sixth stage (final phase), quantitative research results (EFA & CFA) are reported in detail. Quantitative research participants were demographically categorized based on generation category. Generation Ys (1981–1996) were 55.2% (466) while 23.6% (198) were Generation Xs (1965–1980). Baby Boomers (1946–1964) were 11.4% (96). Gen Zs (1997 – Now) consisted of 7.3 percent (62) of the total sample while the Silent Generation (1945 and before) was only 2.1 percent (18).

Four variables retained for the main analysis were: (1) Using a QR code menu improves the overall hygiene of the dining experience, (2) I perceive the restaurants utilizing a QR code menu as more hygiene-friendly, (3) Having a QR code menu is a reflection of the restaurant's hygiene level, and (4) Having a QR code menu is an indicator of how much care the restaurant has for hygiene. We utilized the Likert five-point scale with "1-strongly disagree" to "5-strongly agree." Therefore, the minimum score was 1 and the maximum score was 5. Mean scores ranged from 4.05 to 4.14 with standard deviations from 0.787 to 0.901. Skewness and kurtosis values were within the acceptable range (−, +3) as regards the normality of data. With social phenomena, it is not easy to capture purely normally distributed data. However, this risk is also reduced with a large sample (200+ cases) (Tabachnick et al., 2013, p.80). No univariate outliers were found using a criterion $z = |3.3|$, ($p = 0.001$) with the minimum and maximum values (see Table 1).

Correlation values among items ranged from 0.536 to 0.709. The variables' values, which ranged around 0.5, indicated acceptable correlation values. Variable-3 and variable-4 had relatively high correlations. However, we had a conservative approach toward not removing one of them as we already had a limited number of variables. We retained variable 4 for further analysis. We projected to apply correlated errors between variable 3 and variable 4 if needed.

Besides sample size and skewness and kurtosis values regarding normally distributed data, other assumptions were also assessed prior to EFA to check the suitability of data. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value is another measure to check the suitability of data for EFA. KMO is supposed to be closer to 1 and above 0.6. Bartlett's Test of Sphericity value is supposed to be significant (the sig. value should be 0.05 or smaller). These two values are the indicators of the relevancy of variables to be employed for the same structure detection. In this study, the KMO value was 0.791, and Bartlett's test was significant ($p = 0.001$) (see Table 1). The correlation coefficients had values of 0.50 or above (Hair et al., 1998). The other assumption of EFA, correlation among items, was also met since the item-correlation values ranged from 0.536 to 0.709 (see Table 1).

EFA with direct oblimin rotation was performed to obtain the factor level as Pallant (2016, p. 325) suggested. Factor loadings (0.794, 0.801, 0.854, 0.860) exceeded the acceptable threshold (>0.5 or >7) and communalities (0.630, 0.641, 0.730, 0.739,) also exceeded the threshold value (>0.4) (Hair et al., 1998). The results indicated that each item contributed to establishing the factor structure. On the other hand, the reliability test (Cronbach Alpha's) score represented the internal consistency of the factor with a coefficient of 0.846. For exploratory studies, an alpha greater than 0.60 is acceptable (Hair et al., 1998). That is, the statistical results also indicated the reliability and validity of the unidimensional underlying factor to measure the phenomenon of "perceived hygiene development" (see Table 1).

EFA identified the presence of a single underlying component with 2.74 eigenvalues exceeding 1 and explained 68.5 percent of variance (Marcoulides & Schumacker, 1997; Ullman, 2001). These values are indicators of the validity of the construct (Churchill, 1979). The scree plot inspection also dictated the single-factor solution. The factor was named "Perceived Hygiene Development (pHd)."

CFA using the four items was performed using the MPlus8 statistical package program. We reported commonly used model fit indexes: Chi-square, Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Root mean square error of approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). These indices are sensitive to sample size. Having too large or too small sample sizes may impact all these good-of-fitness indices 'for or against' (Kenny et al., 2015; Taasoobshirazi & Wang, 2016). In addition, the degree of freedom was low in the present study. Kenny et al. (2015) revealed that RMSEA may be misleading with small degrees of freedom toward falsely a poor-fitting model. As it was concluded from the Monte Carlo simulation and theoretical analysis findings of Kenny et al. (2015) and Taasoobshirazi and Wang (2016), the optimum sample size for each index ranges between 400 and 600 observations with small degrees of freedom. Therefore, we did three random samplings with a number of observations ranging between 400 and 600 data points (n1 = 407, n2 = 503, n3 = 594) and observed their model fit indices. We also found it more reliable to obtain results from three various subsamples' fit indexes instead of a single sample.

We reported the results of commonly used goodness-of-fit statistics indicators (Table 2). The results verified the factor structure in the proposed unidimensional construct (see Table 2). Fit indices of three randomly sampled data displayed a good acceptable model fit. Chi-square test of model fit value; sample 1 ($n = 407$) was 2.989 with 0.0838 p-value, sample 2 ($n = 503$) was 1.657 with 0.198 p-value, sample 3 ($n = 594$) was 3.719 with 0.0538 p-value. Degrees of freedom for all three were 1. Comparative fit index (CFI) values were 0.997 for sample 1, 0.999 for sample 2, and 0.997 for sample 3. Tucker-Lewis index (TLI) values were 0.984 for sample 1, 0.996 for sample 2, and 0.984 for sample 3. Cut-off values for both (CFI/TLI) are 0.90 for an acceptable fit

and 0.95 for a well-fit model (Hu & Bentler, 1999). Therefore, all three samples' CF/TFI values indicated a well-fit model. Root mean square error of approximation (RMSEA) estimates were 0.070 for sample 1, 0.036 for sample 2, and 0.068 for sample 3. The cut-off value of RMSEA for an acceptable/adequate fit model is 0.08 (Browne & Cudeck, 1993; Schreiber et al., 2006). All three samples' RMSEA estimates met the criterion. Standardized root mean square residual (SRMR) values were 0.008 for sample 1, 0.005 for sample 2, and 0.007 for sample 3. The cut-off value of SRMR is ≤0.08. The criterion of SRMR was met by all three samples' values as well (see Table 2).

Five statistical parameters were included: composite reliabilities (CR), average variances extracted (AVE), Cronbach's alpha of "Perceived Hygiene Development" (pHd) factor in three samples, standardized factor loading estimates, and item reliabilities of hygiene variables in three samples. CR (≥0.7) and AVE (≥0.5) for sample 1 were respectively 0.904 and 0.701, were 0.902 and 0.697 for sample 2, and were 0.899 and 0.691 for sample 3. Loading estimates ranged between 0.734 and 0.771, and item reliabilities ranged from 0.669 to.745 for sample 1. Loading estimates ranged between 0.723 and 0.783, and item reliabilities ranged from 0.658 to.745 for sample 2. Loading estimates ranged between 0.658 and 0.745, and item reliabilities ranged from 0.641 to.738 for sample 3. The cut-off value of factor loading estimates is ≥0.4 (Kline, 2015), and item reliability (item-total correlations) is ≥0.3 (Nunnally & Bernstein, 1994). Cronbach's alpha was 0.858 for sample 1, 0.855 for sample 2, and 0.851 for sample 3. The internal consistencies of the three samples were good (≥0.8). The measurement values reflected unidimensionality (a single primary construct) (Marcoulides & Schumacker, 1997; Ullman, 2001) (see Table 2).

TABLE 2 Fit Indices (CFA).

	Sample 1	**Sample 2**	**Sample 3**		
	(*n* = 407)	**(*n* = 503)**	**(*n* = 594)**	**Cut-off values**	**✓✗**
N. of free parameters	13	13	13		
Chi-square test of model fit					
Value	2.989	1.657	3.719		
Degrees of freedom	1	1	1		
p-Value	0.0838	0.198	0.0538	≥0.05	✓
CFI/TLI					
Comparative fit index (CFI)	0.997	0.999	0.997	≥0.095	✓
Tucker-Lewis index (TLI)	0.984	0.996	0.984	≥0.095	✓
RMSEA (Root mean square error of approximation)					
Estimate	0.07	0.036	0.068	≤0.08	✓
90 percent C.I.	0.000–0.167	0.000–0.131	0.000–0.147		
Probability RMSEA ≤ 0.05	0.239	0.442	0.24		
SRMR (Standardized Root Mean Square Residual)					
Value	0.008	0.005	0.007	≤0.08	✓
Loading estimates	Between 0.734 and 0.771	Between 0.723 and 0.783	Between 0.658 and 0.745	≥0.4	✓
Item reliabilities	Between 0.669 and 0.745	Between 0.658 and 0.745	Between 0.641 and 0.738	≥0.3	✓
Cronbach's alpha	0.858	0.855	851	≥0.8	✓
CR	0.904	0.902	0.899	≥0.7	✓
AVE	0.701	0.697	0.691	≥0.5	✓

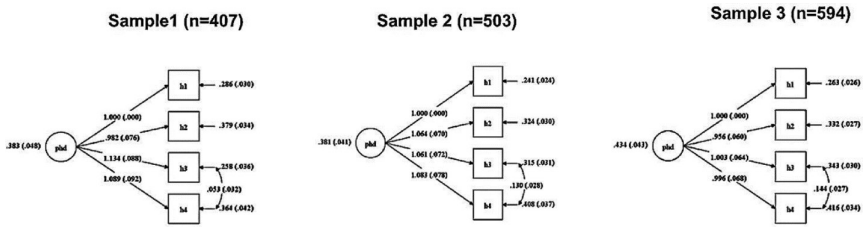

FIGURE 1 CFA results.

We also included diagrams of three samples to visually demonstrate the unstandardized factor loadings, error variances, and correlated errors between hygiene-3 and hygiene-4 variables (see Figure 1).

After determining the single-factor solution with the four items, we recommended the formula for the factor computation was:

$$\text{New construct} = (\text{Variable1} + \text{V2} + \text{V3} + \text{V4})/4.$$

$$\text{Perceived hygiene development (pHd)} = (\text{Hygiene1} + \text{Hygiene2} + \text{Hygiene3} + \text{Hygiene4})/4.$$

DISCUSSION

Research implications

This study's major contribution to the literature is to provide a multi-item unidimensional perceived hygiene scale to measure the contribution of specific service practices and particular technology adoptions to perceived hygiene, unlike other existent hygiene scales measuring general service settings. This means the scale can be used to measure hygiene contributions of any particular service practice changes and technology adoptions in services. These service practice changes and technology adoptions may vary from digital menus to outdoor dining, touchless payments to capacity reduction, and revised housekeeping services to contactless check-ins.

The scale items were generated accordingly to be service practice-specific and technology-specific. In this study, technology-specific service was taken as the domain: QR code menus. The scale aimed to capture the hygiene contribution of this technology adoption in different wording alternatives of each variable. Variable one in the scale aimed at identifying hygiene improvement of QR code menus adoption on the overall dining experience. Item two captured the hygiene-friendliness level of the service establishment due to QR code menu adoption. Variable three examined the reflection power of QR code menu adoption on the restaurant's hygiene level. And item four revealed whether these contactless technology-based restaurant menus were perceived as indicators of hygiene improvement efforts by foodservice providers. These variables can be used to measure perceived hygiene improvements of other technology adoptions (e.g, hologram-enabled hotel check-ins and touchless tech in airport design) and service practices.

Hygiene has been embedded in service phenomenon conceptualization from various aspects: service quality to servicescape, the image of service establishment to loyalty, and revisit intentions (Moon et al., 2017; Pizam & Tasci, 2019). Hygiene has been sometimes placed as a subdomain; other times it has been placed as an item in a subdomain. In some cases, hygiene has even been used interchangeably with cleanliness. Hygiene variables, in each scenario, capture general hygiene and cleanliness (e.g., dining room, utensils, personnel, and restrooms). In adoption models, it is understandable that hygiene may not be included in core modeling structures. In some instances, hygiene can be regarded as a relative advantage of adoption/

innovation and included as a contextual variable, especially under pandemic conditions and during the post-pandemic era (Iskender, Sirakaya-Turk, Cardenas, & Hikmet, 2022). However, there is no such context-specific hygiene measurement construct. The perceived hygiene development (pHd) construct developed in this study fills this gap in the literature.

Due to COVID-19, the hygiene perceptions of customers were heightened. Such an unprecedented experience can continue to impact customer perceptions in the post-COVID era. As a result of the perceptions lasting into the post-COVID era, any research aiming at examining technological or non-technological adoptions in service environments may need to capture perceived hygiene contributions as a contextual component, as well as perceived usefulness, ease of use, performance, and effort expectancy (Tamilmani et al., 2021). Hygiene would have been considered as a context-specific dimension in adoption research inquiries regarding service industries in the past, but now hygiene may need to be considered as a core component of adoption decisions. For future servicescape adoption and innovation studies, we recommend including the perceived hygiene dimension within theoretical models, if hygiene is a relevant contextual dimension, and using this construct to capture the hygiene improvement level achieved by adoptions.

Practical implications

Technological adoption and digital transformation are necessary and inevitable to some extent in the service industry during the prolonged pandemic era and the post-COVID era. The role of technology in the future of hospitality was also addressed by Iskender (2023) interview with ChatGPT. We encourage industry innovations and further adoptions that are more economical (e.g., QR code technology) in order to improve hygiene and safety of service settings considering the current financial difficulties triggered by the pandemic in the industry and global economy. This unidimensional perceived hygiene development construct enables practitioners to measure the hygiene improvements of particular service practice adaptations and specific technology adoptions (e.g., service robots, digital menus, and contactless payments) in servicescapes.

Future research and limitations

Future research can employ this scale to measure hygiene contributions of other technology adoptions and service practice adaptations in various services (e.g. restaurants, hotels, airports, etc.). Moreover, future studies can aim to capture subdimensions of the hygiene phenomenon from consumers' standpoints with a greater number of items at each touchpoint. Additionally, future research can apply comparative experimental research to juxtapose the hygiene perceptions of customers which may help practitioners to identify which technology adoption option may contribute more to the hygiene perceptions of customers. This hygiene construct may be employed to measure hygiene perceptions of non-technological practices such as shifting daily room services at hotels to room service per request.

The primary limitation of this research was to test and develop this scale based on a single technology adoption. Employing multiple technology adoptions and service practices as empirical domains would strengthen the study findings.

Conclusion

In conclusion, this generated '*Perceived Hygiene Development*' scale may have significant scholarly research and practical implications for restaurants, hospitality services, and servicescapes

in general including health and other service businesses. Through the use of this scale, researchers and practitioners can gain a better understanding of the factors that influence customer perceptions of hygiene and develop best practices for adopting technology to improve hygiene perceptions of customers.

AUTHOR CONTRIBUTIONS

This statement acknowledges the contribution of each author. Authors Ali Iskender planned the study, conducted the data analysis, and wrote the manuscript as part of the dissertation project. Authors, Dr. Ercan Turk and Dr. David Cardenas supervised the planning of the study, and data analysis and contributed to revising the article for publication.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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