

Relationships between service quality and customer satisfaction in airlines: Evidence from SEM and ANN based on AIRQUAL model

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Abstract

Given the fierce competition in the airline industry, prioritising service quality is essential for airlines seeking sustainable success. This study aims to examine the influence of perceived service quality on customer satisfaction among Turkish air travellers, based on the AIRQUAL model. Data were collected via a self-administered questionnaire from 242 respondents, using volunteer sampling at Samsun Çarşamba Airport in Turkey. A multi-analytical approach, combining partial least squares structural equation modelling (PLS-SEM) and artificial neural network (ANN) modelling, was employed in the data analysis. The findings reveal that all five dimensions of AIRQUAL significantly and positively affect customer satisfaction. The ANN results further corroborate these findings, identifying image and airline tangibles as the strongest predictors of customer satisfaction based on relative importance.

Keywords: Airline industry, Service quality, AIRQUAL, Customer satisfaction, PLS-SEM, Artificial neural network (ANN).

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1. Introduction

The history of the airline industry dates to the early 1900s. However, it gained significant momentum, especially after the Second World War. As of 2023, 4.2 billion passengers were served (ICAO, 2024), and projections suggest this number will reach 10 billion by 2040 (IATA, 2022). As the airline industry continues to evolve, it also faces many challenges. Airlines operate in a highly sensitive sector subject to various disruptions. Currently, airlines are facing several challenges, including rising inflation rates, currency depreciation, energy supply issues, demand fluctuations, stricter regulations, digitalisation and technology costs, and legal enforcement related to sustainability (Ragab *et al.*, 2024). In addition to these difficulties, airlines must compete in a fiercely competitive environment (Sengur *et al.*, 2022). One of the main reasons for this development is that, following deregulation, airlines began to operate in an intensely competitive environment. Government-initiated deregulation removed many restrictions, allowing airlines to independently determine market entry, access, pricing, and capacity (Trapani & Olson, 1982). This transition provided airlines greater flexibility, encouraged the entry of new competitors, and greatly intensified competition within the industry. This situation forces airlines to develop strategic plans and find more innovative solutions. By doing so, airlines can not only ensure the sustainability of their current operations but also prepare for potential threats and seize future opportunities (Bartle *et al.*, 2021; Henrique Lopes Guerra, 2021). At this point, adopting a customer-centric service approach to better meet passenger needs and focusing on service quality is a key element of an airline's competitive advantage (Bett & Njuguna, 2022; Jiang & Zhang, 2016). To achieve a sustainable competitive advantage, it is essential to allocate resources to services that aim to achieve high levels of customer satisfaction and to prioritise activities that create value for customers (Wilfred *et al.*, 2024).

Service quality is a key driver of business performance in competitive environments (Gallarza *et al.*, 2017; Lucini *et al.*, 2020). Superior service quality not only ensures passenger satisfaction but also directly influences customer retention and profitability, making it a key strategic imperative for airlines globally (Chow & Fung, 2018; Hussain *et al.*, 2015). Numerous studies have focused on measuring service quality (Aydın & Yıldırım, 2012; Li *et al.*, 2017; Pabedinskaitė & Akstinaitė, 2014).

The significance of service quality in the airline industry has long been acknowledged by practitioners and academics. A wealth of studies have examined the critical role of service quality in shaping passenger satisfaction and loyalty, establishing it as a pivotal determinant of business success (Hapsari *et al.*, 2017; Singh, 2021). In this context, service quality encompasses various dimensions, such as in-flight services, ground support, and overall customer experience, which collectively shape customer perceptions of value (Koklic *et al.*, 2017; Li *et al.*, 2017). Notably, the AIRQUAL model has been widely used to measure these dimensions effectively, offering valuable insights for improving airline operations (Bari *et al.*, 2001; Lim *et al.*, 2024).

Traditionally, studies exploring the relationship between service quality and customer satisfaction in the airline industry have relied on single analytical methods, such as regression analysis or structural equation modelling (SEM) (Farooq *et al.*, 2018; Rajaguru, 2016; Shen & Yahya, 2021). While these approaches offer valuable insights into causal relationships, they often fall short in capturing the predictive complexities and nonlinear interactions inherent in customer satisfaction processes (Singh, 2021). Leong *et al.* (2024) also noted that relying on a single analytical approach is insufficient to provide a comprehensive and accurate explanation of the phenomenon. However, research incorporating such approaches remain scarce, especially in the context of airline service quality assessments.

Addressing this gap, this study aims to investigate the influence of service quality dimensions, as defined in the AIRQUAL model, on customer satisfaction among Turkish air travellers by utilising both structural equation modelling (SEM) and artificial neural networks (ANN). By integrating the predictive

accuracy of SEM with the advanced analytical capabilities of ANN, this research provides a comprehensive and nuanced understanding of the factors influencing customer satisfaction. This dual-methodology approach not only enhances explanatory power but also equips airline managers with actionable insights to design and deliver superior service experiences that align with evolving passenger expectations.

This study fills this gap by analysing the impact of service quality on customer satisfaction using both methods. By examining linear and non-linear relationships, this research provides deeper insights into the influence of service quality on customer satisfaction in airlines. It further explores the multidimensional relationships between variables, accounting for the effects of control variables to ensure a more robust analysis. By employing a hybrid analytical approach, this study addresses methodological limitations in prior research and provides actionable insights for airline managers to enhance service quality. Ultimately, it contributes to academic literature while offering strategic guidance on prioritising service quality dimensions to increase customer satisfaction within the AIRQUAL framework. Through its use of SEM and ANN methods, this study stands out in the literature and serves as a valuable reference for future research in this area.

The remainder of the study is divided into several sections. Section 2 explains the key concepts of service quality and customer satisfaction and develops the research hypotheses. Section 3 outlines the research methodology, including data collection and analytical techniques. Section 4 presents the results, incorporating findings from both SEM and ANN approaches. Section 5 discusses the findings, highlights theoretical and managerial implications, and addresses study limitations.

2. Literature Review

2.1. Service quality

Service quality is one of the key elements of success in the service sector (Bakir *et al.*, 2024). The concept of service quality, which emerged in the literature after the 1980s, can generally be defined as meeting customer needs at the highest level and aligning service delivery with customer expectations (Riantama, 2024). In this context, service quality is rooted in customers' perceptions of the service experience (Gronroos, 1984). In the airline industry, differentiation through service quality has become increasingly important to ensure sustainability in highly competitive market conditions (Kim *et al.*, 2024; Sak, 2024). As a result, service quality has become a key issue for airlines, necessitating measurement through various approaches (Akan & Atalık, 2024). This need has spurred the development of several approaches in the literature. Among these, the gap model, developed by Parasuraman *et al.* (1985), provides a robust theoretical framework for assessing service quality. The model is based on the comparison between customers' expectations and their perceived service experiences. According to this framework, customers evaluate service quality based on similar criteria. Building on this foundation, a series of studies led to the development of the SERVQUAL measurement tool, which includes five dimensions and 22 items. The SERVQUAL scale allows companies to systematically assess service quality across five defined dimensions: tangibles, reliability, assurance, empathy, and responsiveness.

Although SERVQUAL is widely used in various service industries and holds a significant place in the literature, it has also been criticised on several fronts (Kucharczyk *et al.*, 2011). Critics point out that the scale may not be comprehensive enough and raise concerns about its applicability across different service sectors. Additionally, there is concern that it may be difficult for customers to distinguish between expected and actual service levels. Therefore, some researchers have recommended directly measuring perceived service quality (Babakus & Boller, 1992; Kozerska, 2007; Van Dyke *et al.*, 1997). These limitations pose significant challenges, particularly in complex industries such as the airline industry, where multiple stakeholders collaborate to deliver services. This complexity highlights the need for more specialised tools to evaluate service quality effectively (Bakir *et al.*, 2017; Ghotbabadi *et*

et al., 2015). In response, various models have been developed specifically for the airline industry (Leong *et al.*, 2015). Each addresses different industry needs and provides tailored approaches to measuring service quality. Among these models, the AIRQUAL model stands out as a tool specifically designed for the airline sector, providing a more comprehensive evaluation of service quality. Unlike SERVQUAL, which consists of five dimensions and was developed to measure overall service quality, AIRQUAL is an adapted measurement tool based on the specific characteristics of the airline industry (Bari *et al.*, 2001; Rady, 2018). AIRQUAL also includes elements such as terminal tangibles and brand image, which are not covered by SERVQUAL. Therefore, it provides an opportunity to evaluate service quality in a sector-specific and context-sensitive manner.

AIRQUAL includes 35 items organised into five dimensions: airline tangibles, terminal tangibles, personnel, empathy, and image (Ekiz *et al.*, 2006). This model approaches service quality as a multidimensional concept, focusing on key factors that shape the passenger experience. It not only considers the physical tangibles of airlines and airports but also highlights the knowledge, skills, and competencies of personnel as critical components of service quality. Moreover, it emphasises addressing passengers' individual needs through empathy and incorporates strategic elements such as brand image. By holistically evaluating the passenger experience—covering pre-flight, in-flight, and post-flight stages—the AIRQUAL model provides a robust framework for understanding service quality in the airline industry (Lim *et al.*, 2024). This study aims to make a significant contribution to the literature by examining the relationship between service quality and customer satisfaction within the AIRQUAL framework, specifically tailored to the airline industry.

2.2. Customer satisfaction

Customer satisfaction has become a key objective in service operations due to its significant benefits. For companies striving to achieve success and profitability, customer satisfaction is critical (Baker, 2013). In the highly competitive airline industry, customer satisfaction is a crucial indicator of market trends (Li *et al.*, 2024). Broadly, customer satisfaction can be defined as a mental judgment of how well a product or service meets customer expectations. This judgment reflects the subjective evaluation of the gap between pre-service expectations and post-service perceptions (Bakır & Atalık, 2024).

Defining and measuring customer satisfaction is inherently challenging (Yuksel & Yuksel, 2001). To determine how satisfied customers are with the services they receive, it is first essential to identify the antecedents that drive and shape customer satisfaction (Leninkumar, 2019). In the airline industry, key factors influencing customer satisfaction include perceived value (Mayr & Zins, 2012), perceived fairness (Setiawan *et al.*, 2020), price (Asma *et al.*, 2018), trust (Saleem *et al.*, 2017), and service quality (Yingfei *et al.*, 2022), among others. These variables form the basis for understanding how customer satisfaction develops. However, among these antecedents, service quality holds particular importance due to its unique characteristics and central role in the customer experience ecosystem (An & Noh, 2009; Hussain *et al.*, 2015). Service quality significantly influences customer interactions with companies, shaping their expectations, creating perceived value, building trust, and strengthening brand image (Hassan & Salem, 2022; Yingfei *et al.*, 2022). In other words, service quality is a crucial factor that directly or indirectly influences the impact of other factors on customer satisfaction. As a result, accurately and comprehensively measuring service quality becomes a higher priority when seeking to understand and manage customer satisfaction effectively (Zeithaml *et al.*, 1996). This study aims to evaluate customer satisfaction holistically by focusing on service quality and using the AIRQUAL scale, a tool specifically developed for the airline industry. AIRQUAL is not only a measurement tool specific to the airline industry, it also provides an opportunity to assess service quality by capturing its inherently multidimensional nature more effectively than other models. The scale comprises five key dimensions: airline tangibles, terminal tangibles, personnel services, empathy, and image (Ekiz *et al.*, 2006). Within the AIRQUAL framework, the passenger experience is evaluated in terms of both physical and

emotional aspects, revealing how different dimensions of service quality influence customer satisfaction (Ekiz *et al.*, 2006). In this study, each dimension is analysed individually to determine the extent to which specific components of the passenger experience affect customer satisfaction.

2.3. Hypotheses development

In measuring service quality, airline tangibles refer to physical elements that directly influence the flight experience. These include components such as the aircraft cabin interior, flight attendants' appearances, and amenities such as restrooms (Park & Almanza, 2020). Additional factors such as aircraft cleanliness, air quality, and seating comfort are also attributed to the airline's tangible assets, as these are sensory elements that passengers can perceive (Ekiz *et al.*, 2006). Tangible elements play a critical role in shaping first impressions of service quality and have a direct effect on customer satisfaction (Verhoeven *et al.*, 2007). Existing literature emphasises the significant impact of these factors, identifying them as key determinants of customer satisfaction (Atalık *et al.*, 2019; Restuputri *et al.*, 2022; Tahanisaz & Shokuhyar, 2020). Moreover, Nadiri *et al.* (2008) demonstrated that, among the AIRQUAL dimensions, airline tangibles represent the most influential factor affecting customer satisfaction. Based on the above literature, the following hypothesis was developed:

H1. Airline tangibles have a positive influence on customer satisfaction.

Airports form a crucial part of airline service delivery (Tunčikienė & Katinas, 2020). Airport terminals, which form a significant part of the overall flight experience, are closely associated with passengers' pre-flight and post-flight experiences (Kalakou & Moura, 2021; Oflac & Yumurtacı, 2014). Terminal tangibles, therefore, refer to elements that have a direct influence on customer satisfaction when evaluating holistic service quality. Key aspects of terminal tangibles include airport capacity, availability of parking spaces, the number of stores, sufficient baggage carts, comfort in waiting areas, efficient air conditioning, and reliable security controls (Suki, 2014). These factors shape passengers' overall perception of service quality and play a pivotal role in increasing customer satisfaction. Although airport facilities are managed by airport authorities, airlines can influence service perceptions related to the terminal through strategic collaborations such as dedicated check-in areas, lounges, and coordinated service delivery (Albers *et al.*, 2005). For this reason, passengers may sometimes perceive terminal service quality as an extension of airline service quality. In this context, Ali *et al.* (2015) demonstrated that airport tangibles have a significant effect on customer satisfaction. Similarly, Ekiz *et al.* (2006) emphasised the influence of terminal tangibles on customer satisfaction. Based on the above literature, the following hypothesis was developed:

H2. Terminal tangibles have a positive influence on customer satisfaction.

Airline personnel, as the visible face of the company, play a significant role in shaping the airline's image through their interactions with customers (Babbar & Koufteros, 2008). As a bridge between the airline and its passengers, employees can identify customer needs and expectations, relay this feedback to the organisation, and contribute to service improvements that meet customer needs (Kos Koklic *et al.*, 2017). Employees' attitudes, efforts, competencies, and knowledge—aligned with company policies—are essential in enhancing service quality and ensuring customer satisfaction (Ekiz *et al.*, 2006). Moreover, employees' personal appearance and behaviour significantly influence customers' perceptions of the airline. Specifically, competence and friendliness conveyed through employees' behaviour have a directly positive effect on customer satisfaction (Verhoeven *et al.*, 2009). Research has also shown that physical appearance influences customer perceptions, with physical attractiveness increasing perceived service quality (Akan & Atalık, 2024). Consistent with these findings, Akamavi *et al.* (2015) highlight that airline personnel are a key factor in shaping customer satisfaction. Accordingly, the following hypothesis was formulated:

H3. Personnel have a positive influence on customer satisfaction.

Empathy refers to providing personal attention and responsiveness to the specific needs of customers (Parasuraman *et al.*, 1985). In the context of airline services, empathy includes responding to passenger requests, delivering specific services on time, and dealing with problems such as lost baggage or medical assistance (Ekiz *et al.*, 2006). These empathetic services influence customers' cognitive and emotional processes, shaping attitudes and ultimately contributing to customer satisfaction (Suki, 2014). The literature supports this relationship. Farooq *et al.* (2018) found that the empathy dimension has a significant impact on overall customer satisfaction in airlines. Similarly, Suki (2014) highlighted the significant impact of empathy on customer satisfaction, while Bahadur *et al.* (2018) demonstrated that empathetic behaviour has a positive effect on satisfaction by effectively addressing customer needs. In line with the above discussion, the following hypothesis was proposed:

H4. Empathy has a positive influence on customer satisfaction.

Image is a critical factor in gaining a competitive advantage (Pahrudin *et al.*, 2023). Customers' perception of an airline is shaped by their mental associations and impressions, which stem from their beliefs, experiences, and interactions with services, products, personnel, or the brand itself (Hameed *et al.*, 2024). Image plays a key role in influencing customer perceptions and increasing brand value (Moon *et al.*, 2013). By effectively managing these perceptions, a strong brand image promotes trust, builds emotional bonds, and strengthens competitive advantage (Alias *et al.*, 2024; Orth & Green, 2009). These outcomes are directly related to image's ability to influence customer behaviour (Khodadad Hosseini & Behboudi, 2017). Consequently, customers with a positive perception of a brand are more likely to be satisfied with its products and services. This relationship is well supported in the literature (Baumeister *et al.*, 2022; Hussain *et al.*, 2015; Riorini & Widayati, 2018). Based on the above, the following hypothesis was developed:

H5. Image has a positive influence on customer satisfaction.

Based on these hypotheses, the conceptual model shown in Figure 1 has been developed.

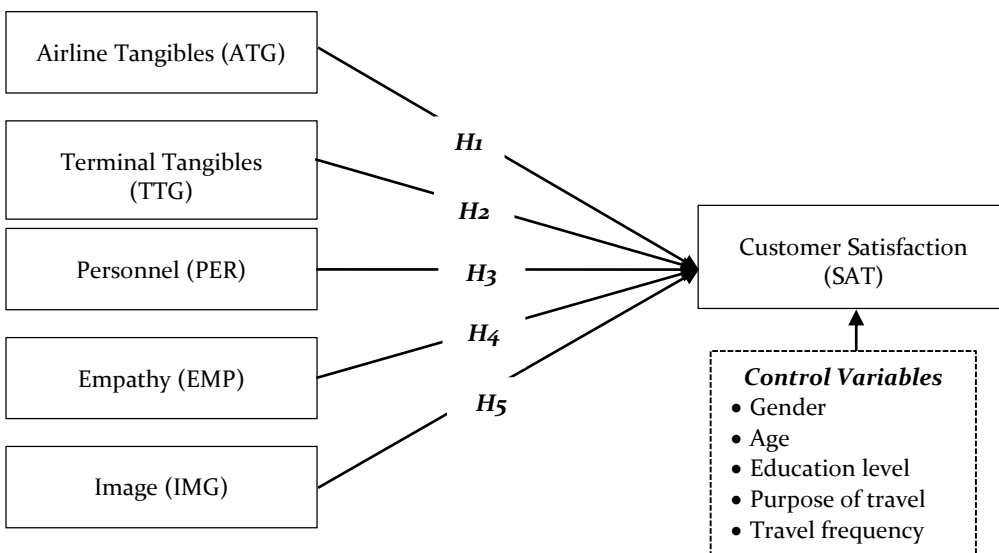


Figure 1. Conceptual model.

3. Research Methodology

3.1. Research instrument

This study employed pre-validated scales from the literature to measure constructs. The scales, originally in English, were translated into Turkish by qualified translators. To measure all constructs, we used a five-point Likert scale ranging from “1-Strongly disagree” to “5-Strongly agree.” Service quality was measured using AIRQUAL, which was developed by Bari *et al.* (2001) to assess the service quality of airlines. The items related to the dimensions of AIRQUAL (i.e., airline tangibles, terminal tangibles, personnel, empathy, and image) were adopted from Farooq *et al.* (2018). Customer satisfaction was measured using items from Leong *et al.* (2015). The measurement items are presented in **Appendix 1**.

3.2. Data collection and sampling

Since this study focuses on the impact of service quality on customer satisfaction in the Turkish civil airline industry, air travellers residing in Turkey were considered the target population. Turkey offers an ideal context for examining this critical relationship for several compelling reasons. Turkey’s airline industry has experienced remarkable growth, with the number of passengers increasing from approximately 150 million in 2013 to over 214 million by the end of 2023, despite the devastating impact of the COVID-19 pandemic—an approximate growth rate of 42.76% (DHMI, 2024). This substantial expansion provides a large and diverse customer base for analysis. Additionally, Turkey’s strategic geographic location connects Europe and Asia, serving a wide range of passengers with varying service expectations. Turkish airline passengers are a heterogeneous target group who travel both domestically and internationally for various purposes, such as business and leisure. As a result, passenger expectations vary depending on travel class and frequency. The presence of airlines operating under different business models further amplifies these diverse expectations. Unlike the airline industry in developed countries (e.g., Germany), which has reached a mature stage, the Turkish airline industry has undergone rapid liberalisation and development in a relatively short period (Gerde, 2015). This transformation has led to the emergence of consumer behaviour that is unique to Turkey. Turkish passengers demonstrate behaviour characterised by varying expectations across price-sensitive segments and tend to consider both functional and emotional factors in their decision-making process (Atalık & Özdemir, 2014). Consequently, the existence of such diverse criteria makes it more difficult to assess perceived service quality. Therefore, unlike various European countries, investigating the impact of airline service quality on customer satisfaction in Turkey provides a contextually rich and analytically valuable research setting. These factors make Turkey a fertile ground for investigating how service quality influences customer satisfaction in the airline industry.

As it is nearly impossible to reach the entire target population, this study adopted a volunteer sampling technique (Saunders *et al.*, 2016). Selecting an appropriate sample size is crucial for ensuring the rigour and quality of any study (Farooq *et al.*, 2018). Therefore, we conducted an a priori power analysis to determine the minimum sample size (Hair *et al.*, 2022; Mkedder & Özata, 2023). Using parameters for a medium effect size (0.15), a significance level of 0.05, and a power of 0.95, G*Power v.3.1.9.6 suggested a minimum sample size of 138 (Faul *et al.*, 2007). According to Cohen (1988), a medium effect size is commonly used in the social sciences to balance the risks of Type I and Type II errors. In this multivariate study, a power level of 95% was chosen to increase the likelihood of detecting an existing effect (Hair *et al.*, 2016). Accordingly, the inclusion of 242 participants in this study reflects the heterogeneity of airline passengers in Turkey, thus ensuring both representativeness and generalisability of the findings.

Before data collection, the Research Ethics Committee at Samsun University in Turkey approved the study’s procedure and questionnaire under approval number 2024-12. Following this, and after obtaining permission from the airport authority, data were collected at the domestic terminal of Samsun

Çarşamba Airport in July 2024 using a self-administered questionnaire administered to randomly approached passengers.

Of the 250 responses obtained, data screening detected construct-level missing data in eight responses where all items of a scale were omitted (Newman, 2014). These responses were removed, leaving 242 valid responses. At the item level, the highest missingness rate was approximately 1.65%, which was manageable (Zhang *et al.*, 2021). We conducted Little's MCAR test, which showed that the missing data were not completely at random ($p < 0.01$). To impute the item-level missing data, we employed the *IterativeImputer* multivariate imputation algorithm from the scikit-learn library in Python. Comparing the original and imputed datasets revealed very similar means, medians, and standard deviations, indicating that the imputation process did not introduce significant biases or distortions. As a result, we proceeded with the analyses using 242 usable responses, which met the minimum sample size requirement established by the a priori power analysis.

3.3. Modelling techniques

This study implemented a multi-analytical hybrid SEM-ANN approach to investigate the effect of service quality on customer satisfaction in the airline industry. Partial least squares structural equation modelling (PLS-SEM), a variance-based form of structural equation modelling, is particularly well-suited for analysing complex models by focusing on maximising the explained variance in dependent variables (Mkedder & Özata, 2023). Unlike traditional covariance-based SEM, PLS-SEM is variance-based, making it more suitable for exploratory research and predictive applications, especially with smaller sample sizes and non-normal data (Farooq *et al.*, 2018; Hair *et al.*, 2022). Using the WebPower tool (Cain *et al.*, 2017), Mardia's tests for multivariate normality indicated significant deviations from normality ($\beta = 305.063$, $p < 0.01$ for skewness; $\beta = 1330.924$, $p < 0.01$ for kurtosis). As such, the non-normal nature of the dataset supports our choice of PLS-SEM.

On the other hand, as shown in **Appendix 2**, the assessment of linear relationships was conducted using an ANOVA test to test for assumption violations (Mkedder & Özata, 2023). Accordingly, the analysis revealed the presence of non-linear relationships in the proposed model ($p < 0.05$). While PLS-SEM is primarily designed to address linear relationships and has some limited flexibility for handling non-linearity, it is not as robust as ANN in this regard (Mkedder & Özata, 2023; Sarstedt *et al.*, 2020). Given the presence of non-linear relationships in the data, we incorporated an ANN approach to complement PLS-SEM results. ANN is much more capable of capturing complex, non-linear relationships between variables, making it a stronger tool for modelling intricate patterns that PLS-SEM may struggle to accommodate (Leong *et al.*, 2024). However, due to the "black box" nature of ANNs, they are not suitable for causal inference or hypothesis testing (Mkedder & Özata, 2023). Therefore, the multi-analytical hybrid approach combining PLS-SEM and ANN is critical for identifying and accurately modelling non-linear dynamics, enabling more precise predictions of customer satisfaction. For PLS-SEM analysis, ADANCO v.2.4.1 was used, while ANN analysis was conducted via IBM SPSS Statistics 22.

4. Results

4.1. Demographic information

Table 1 provides an overview of the respondents' demographic characteristics. The majority of the respondents were male (53.1%) and fell within the 25-34 age range (35.5%). Most participants had attained an undergraduate degree (66.4%), suggesting a highly educated sample. Leisure was the primary purpose of travel for nearly half of the respondents (46.0%). Regarding travel frequency, a substantial proportion reported travelling 1-2 times (33.1%) in the past year. Our sample reflects the distribution of air travellers in Turkey, as observed in previous literature. Consistent with past research, the gender distribution is well-balanced, with most participants being young, well-educated, and

primarily travelling for leisure purposes (Cintamür, 2023; Polat et al., 2024; Sarılgan et al., 2022; Zungur et al., 2025).

Table 1. *Respondent demographics.*

Participant Characteristics	Categories	Frequency	Percentage (%)
Gender	Male	127	53.1
	Female	112	46.9
Age	18–24 years	74	30.6
	25–34 years	86	35.5
	35–44 years	57	23.6
	45–54 years	13	5.4
	55+ years	12	5.0
Education level	Primary school	13	5.4
	High school	54	22.4
	Undergraduate degree	160	66.4
	Graduate degree	14	5.8
Purpose of travel	Business	50	21.3
	Leisure	108	46.0
	Education	35	13.6
	Other	45	19.1
Travel frequency (Past Year)	1–2 trips	80	33.1
	3–4 trips	70	28.9
	5–9 trips	38	15.7
	10+ trips	54	22.3

4.2. Common method bias

Since this study relied on cross-sectional data from a single source, we assessed the risk of common method bias (CMB) (Tehseen et al., 2017). To address this, several post hoc statistical remedies were applied. First, Harman's single-factor test was conducted. This test identified multiple factors with eigenvalues greater than 1, and the solution restricted to a single factor accounted for just 37.38% of the variance (<50%). Therefore, CMB is not a critical issue in the dataset. Second, the full collinearity assessment approach developed by Kock (2015), specifically for PLS-SEM, was applied. The results showed that the full variance inflation factor (FVIF) values for all constructs ranged between 1.791 and 2.428, all below the threshold of 3.3 (Mkedder & Özata, 2023). These results further confirm that the threat of CMB in the dataset is minimal.

4.3. Measurement model

To validate the adequacy of the measurement model, the reliability and validity of the model were first examined, in line with standard procedures in PLS-SEM analysis (Hair et al., 2022). First, Cronbach's alpha (CA) and composite reliability (CR) values were evaluated for each construct to confirm internal consistency. Consistent with recommended thresholds, values for both metrics exceeded 0.70 (Table 2), establishing internal consistency across constructs (Polat et al., 2024). Convergent validity was assessed by examining the average variance extracted (AVE) and indicator loadings, with AVE values exceeding the minimum cut-off of 0.50 (Henseler, 2021). While some items had loadings between 0.60 and 0.70, they were retained for further analysis due to acceptable CR and AVE values, as shown in Table 2 (Hair et al., 2022). These findings confirm convergent validity.

Table 2. *Results of reliability and convergent validity.*

Construct	Indicator	Loadings	CA	CR	AVE
Airline Tangibles	ATG1	0.759	0.832	0.878	0.545
	ATG2	0.669			
	ATG3	0.760			
	ATG4	0.800			
	ATG5	0.753			
	ATG6	0.681			
Terminal Tangibles	TTG1	0.750	0.873	0.902	0.570
	TTG2	0.796			
	TTG3	0.657			
	TTG4	0.797			
	TTG5	0.724			
	TTG6	0.824			
	TTG7	0.723			
Personnel	PER1	0.722	0.901	0.922	0.630
	PER2	0.773			
	PER3	0.727			
	PER4	0.866			
	PER5	0.789			
	PER6	0.825			
	PER7	0.843			
Empathy	EMP1	0.729	0.835	0.879	0.548
	EMP2	0.714			
	EMP3	0.750			
	EMP4	0.762			
	EMP5	0.697			
	EMP6	0.786			
Image	IMG1	0.828	0.760	0.861	0.674
	IMG2	0.807			
	IMG3	0.828			
Customer Satisfaction	SAT1	0.933	0.912	0.945	0.850
	SAT2	0.913			
	SAT3	0.921			

For discriminant validity, we applied Fornell and Larcker's (1981) criterion (FLC) by comparing AVE values on the diagonal with the squared correlations among constructs. As indicated in Table 3, all AVE values exceeded the squared inter-construct correlations, thereby supporting the model's discriminant validity (Hair *et al.*, 2022).

Table 3. *Results of discriminant validity (FLC).*

Construct	ATG	TTG	PER	EMP	IMG	SAT
Airline Tangibles	0.545					
Terminal Tangibles	0.394	0.570				
Personnel	0.222	0.431	0.630			
Empathy	0.228	0.226	0.148	0.548		
Image	0.246	0.196	0.155	0.346	0.674	
Customer Satisfaction	0.345	0.353	0.280	0.324	0.351	0.850

Note: Squared correlations; AVE in the diagonal.

Furthermore, the heterotrait-monotrait (HTMT) ratio was employed to affirm discriminant validity, with the HTMT2 criterion specifically chosen for its ability to provide less biased estimates compared to the traditional HTMT (Roemer et al., 2021). Table 4 shows that all HTMT2 values were well below the conservative threshold of 0.85 (Henseler, 2021), confirming discriminant validity.

Table 4. Results of discriminant validity (HTMT2).

Construct	ATG	TTG	PER	EMP	IMG	SAT
Airline Tangibles						
Terminal Tangibles	0.737					
Personnel	0.527	0.739				
Empathy	0.569	0.551	0.430			
Image	0.620	0.510	0.458	0.732		
Customer Satisfaction	0.669	0.667	0.578	0.649	0.699	

4.4. Structural model

After assessing the measurement model, the structural model evaluation included examining model fit, the coefficient of determination (R^2), and testing the significance of path coefficients. First, the standardised root mean square residual (SRMR) value of the proposed conceptual model was found to be 0.0685. Since this value is below the threshold of 0.08, the model indicated a satisfactory model fit (Hair et al., 2022). Next, the in-sample explanatory power of the model (R^2) was assessed (Henseler, 2021). The R^2 value for the endogenous variable, customer satisfaction, was found to be 0.557. This indicates that the exogenous variables explain 55.7% of the variance in customer satisfaction, achieving sufficient explanatory power (Farooq et al., 2018).

The findings related to the significance of path coefficients are presented in Table 5. To test the significance of the hypotheses, we employed a bootstrapping procedure with 5,000 resamples, as recommended in the literature (Hair et al., 2022). As shown in Table 5, airline tangibles positively influence customer satisfaction ($\beta=0.194$, $p<0.01$), supporting H1. Terminal tangibles also have a positive effect on customer satisfaction ($\beta=0.177$, $p<0.05$), supporting H2. Personnel also contributes positively to customer satisfaction ($\beta=0.152$, $p<0.05$), providing support for H3. Similarly, empathy has a positive effect on customer satisfaction ($\beta=0.190$, $p<0.05$), supporting H4. Lastly, image has a significant positive effect on satisfaction ($\beta=0.250$, $p<0.01$), thus supporting H5. Regarding the control variables, none of the demographic variables had a significant effect on customer satisfaction. This indicates that demographic characteristics did not create any confounding effects on the findings.

Table 5. Results of hypothesis testing.

Path	Std β	t-value	p-value	95% CIs	Remark
H1. ATG -> SAT**	0.194	2.671	0.008	[0.052; 0.333]	Supported
H2. TTG -> SAT*	0.177	2.550	0.011	[0.040; 0.313]	Supported
H3. PER -> SAT*	0.152	2.358	0.018	[0.025; 0.277]	Supported
H4. EMP -> SAT*	0.190	2.550	0.011	[0.050; 0.343]	Supported
H5. IMG -> SAT**	0.250	3.814	0.000	[0.118; 0.378]	Supported
Control variables					
Gender -> SAT ^{ns}	0.047	1.073	0.283	[-0.042; 0.133]	
Age -> SAT ^{ns}	-0.003	-0.064	0.949	[-0.082; 0.073]	
Education level -> SAT ^{ns}	0.001	0.026	0.980	[-0.107; 0.105]	
Purpose of travel -> SAT ^{ns}	0.021	0.452	0.652	[-0.071; 0.113]	
Travel frequency -> SAT ^{ns}	-0.032	-0.674	0.500	[-0.120; 0.067]	

Note: ** $p<0.01$, * $p<0.05$, ns=not significant, CI=Confidence Interval, ATG=Airline Tangibles, TTG=Terminal Tangibles, PER=Personnel, EMP=Empathy, IMG=Image, SAT= Customer Satisfaction.

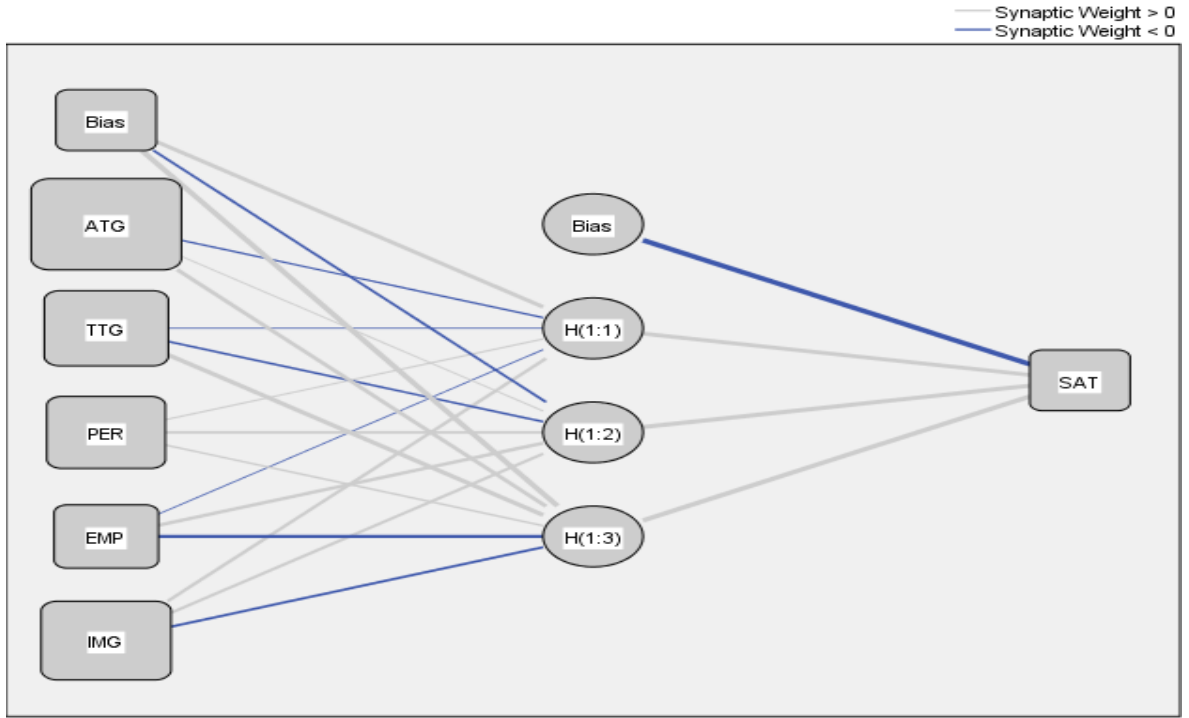
4.5. ANN results

In the second phase of the multi-analytical hybrid approach, we conducted an ANN to examine nonlinear relationships and explore the relative importance of the antecedents. ANN is a popular machine learning algorithm designed to emulate the behaviour of human neurons (Xu *et al.*, 2024). An artificial neuron, often referred to as a perceptron, serves as the fundamental unit of an artificial neural network. Similar to biological neurons, artificial neurons take in input signals, process these inputs, and produce an output signal. Each input is multiplied by an associated weight, and the weighted sum is then transformed by an activation function. The activation function introduces non-linearity, allowing the network to model and understand complex patterns and relationships within the data (Mkedder & Bakır, 2023).

ANNs are known for their ability to handle noise, outliers, and small datasets effectively (Xu *et al.*, 2024). They also work well with non-compensatory models, where a decrease in one factor need not be offset by an increase in another (Leong, Hew, Ooi, & Wei, 2020). The ANN technique is generally not recommended for testing hypotheses or analysing causal effects. Its major limitation is its “black box” nature, where the model processes inputs to generate outputs, but the intermediate steps and decision-making processes remain opaque and difficult to interpret (Liébana-Cabanillas *et al.*, 2018; Xu *et al.*, 2024). However, ANNs can reveal complex and non-linear relationships that traditional statistical methods may overlook. Although ANN is not typically recommended for hypothesis testing, its ability to model nonlinear structures and provide high predictive accuracy makes it a highly valuable tool (Tu, 1996). Owing to these characteristics, it was employed as a complementary method in this study. The complementary role of ANN enriches the interpretation of PLS-SEM results, allowing for a deeper understanding of the determinants of customer satisfaction.

As previously stated, the ANN architecture comprised three layers: the input layer, hidden layer(s), and output layer. Following the existing literature (Leong, Hew, Ooi, & Chong, 2020; Mkedder & Özata, 2023), we considered the significant predictors from the PLS-SEM analysis as the input neurons for the ANN model. In this model, the output variable was “Customer Satisfaction (SAT)”, while the input layer comprised five neurons representing airline tangibles, terminal tangibles, personnel, empathy, and image (Figure 2).

The input data for the ANN were derived from the standardised construct scores generated by ADANCO. The ANN model followed established practices in the literature (Leong *et al.*, 2024; Liébana-Cabanillas *et al.*, 2018), where hidden neurons (nodes) were automatically generated, and a sigmoid function was used as the activation function for both the hidden and output layers (Xu *et al.*, 2024). This study employed a widely used ANN approach referred to as the Multilayer Perceptron (MLP) with a backpropagation feed-forward technique (Ding *et al.*, 2019). The MLP is a type of neural network with at least one hidden layer, designed to model complex relationships by learning patterns in data through weighted connections between neurons. It typically uses a logistic activation function in its hidden layers to process inputs and generate predictions (Leong *et al.*, 2024). To reduce errors, we employed the feed-forward backpropagation (FFBP) algorithm. To address overfitting in the ANN model, a ten-fold cross-validation procedure was applied (Mkedder & Özata, 2023). Consistent with prior studies (Ding *et al.*, 2019; Mkedder & Bakır, 2023), a data partitioning approach was adopted to mitigate overfitting risk. Specifically, 90% of the data were allocated for training, while the remaining 10% was reserved for testing.



Hidden layer activation function: Sigmoid

Output layer activation function: Sigmoid

Figure 2. Neural network model.

The model fit for both the training and testing phases was evaluated using the root mean square error (RMSE) for each dataset, following the procedure outlined by Leong *et al.* (2024). This evaluation was performed over ten runs. As detailed in Table 6, the average RMSE values were notably low, with the training dataset showing an RMSE of 0.114 and the testing dataset an RMSE of 0.110. The mean difference between these datasets was minimal at 0.004, indicating strong predictive accuracy and reliability (Mkedder & Özata, 2023; Xu *et al.*, 2024).

Table 6. RMSE values of tested models.

Neural network	Training	Testing
ANN ₁	0.108	0.121
ANN ₂	0.114	0.063
ANN ₃	0.114	0.136
ANN ₄	0.124	0.092
ANN ₅	0.116	0.105
ANN ₆	0.106	0.129
ANN ₇	0.109	0.114
ANN ₈	0.122	0.100
ANN ₉	0.124	0.095
ANN ₁₀	0.106	0.148
Mean	0.114	0.110
St. Dev.	0.007	0.025

4.6. Sensitivity analysis

This section presents a sensitivity analysis to assess the contribution of each predictor to the proposed model. Sensitivity analysis evaluates the normalised importance of each input variable as a percentage, highlighting its influence on the dependent variable (Ding *et al.*, 2019). Table 7 presents the results, showing that image is the most influential predictor of customer satisfaction within the Turkish airline industry, with a normalised importance of 100%. It is followed by airline tangibles (90.98%), personnel (83.58%), empathy (80.32%), and terminal tangibles (72.24%).

Table 7. Results of sensitivity analysis.

Neural network	Model Output: Customer Satisfaction (SAT)				
	ATG	TTG	PER	EMP	IMG
ANN1	0.266	0.196	0.182	0.144	0.212
ANN2	0.238	0.157	0.182	0.200	0.222
ANN3	0.198	0.125	0.226	0.223	0.228
ANN4	0.152	0.123	0.187	0.243	0.296
ANN5	0.186	0.169	0.183	0.215	0.248
ANN6	0.234	0.206	0.147	0.201	0.213
ANN7	0.231	0.170	0.169	0.216	0.214
ANN8	0.089	0.223	0.228	0.176	0.285
ANN9	0.262	0.140	0.297	0.107	0.193
ANN10	0.275	0.182	0.156	0.156	0.230
Average importance	0.213	0.169	0.196	0.188	0.234
Normalized importance %	90.98	72.24	83.58	80.32	100.00

Note: ATG=Airline Tangibles, TTG=Terminal Tangibles, PER=Personnel, EMP=Empathy, IMG=Image.

Assessing the alignment and reliability of results across different analytical techniques is essential. Table 8 presents a comparative analysis of the outputs from PLS-SEM and ANN, by prioritising predictors based on path coefficients in PLS-SEM and normalised importance values in ANN (Mkedder & Özata, 2023). While the ranking of some predictors varies between the two methods, the findings are largely consistent. For instance, image is consistently ranked as the most significant predictor of customer satisfaction in both PLS-SEM and ANN. Similarly, airline tangibles holds the second position in both models, demonstrating alignment. This consistency reinforces the importance of these factors in the model while highlighting the complementary insights provided by PLS-SEM and ANN.

Table 8. Comparative Analysis of PLS-SEM and ANN Results.

Relationship	PLS-SEM results		ANN results		Remark
	Std. β	Ranking	Normalized Importance %	Ranking	
ATG -> SAT	0.194	2	90.98	2	Matched
TTG -> SAT	0.177	4	72.24	5	Unmatched
PER -> SAT	0.152	5	83.58	3	Unmatched
EMP -> SAT	0.190	3	80.32	4	Unmatched
IMG -> SAT	0.250	1	100.00	1	Matched

Note: ATG=Airline Tangibles, TTG=Terminal Tangibles, PER=Personnel, EMP=Empathy, IMG=Image, SAT= Customer Satisfaction.

5. Discussion

5.1. Theoretical implications

This study makes valuable contributions to the airline service quality literature by examining the effect of airline service dimensions on customer satisfaction using PLS-SEM and ANN methods. The findings extend the existing theoretical framework and offer industry-specific insights.

First, the study identifies that image positively influences customer satisfaction. This result is consistent with previous studies (Baumeister *et al.*, 2022; Hussain *et al.*, 2015; Riorini & Widayati, 2018), which suggest that a strong brand image increases customer satisfaction and promotes loyalty. The study supports the perceived value theory (Sheth *et al.*, 1991) and posits that a strong brand image increases customer satisfaction through emotional and social value components. The ANN results also confirm that image is the most significant determinant of customer satisfaction, highlighting its critical role in service quality models.

Second, the study finds that airline tangibles significantly and positively affect customer satisfaction. This finding is consistent with previous research highlighting that elements such as seating comfort and cleanliness influence customers' perceptions (Atalık *et al.*, 2019; Restuputri *et al.*, 2022; Tahanisaz & Shokuhyar, 2020). Ekiz *et al.* (2006) also identified airline tangibles as a key determinant of customer satisfaction. Both PLS-SEM and ANN results support this conclusion, establishing airline tangibles as the second most influential dimension after image. This underscores the crucial role of tangible elements and the experiences they create in driving customer satisfaction (Kos Koklic *et al.*, 2017).

Third, the study finds that empathy has a significantly positive effect on customer satisfaction. Consistent with previous research, this finding suggests that airlines delivering personalised services tailored to passengers' individual needs increase satisfaction. Within the framework of Service-Dominant Logic (SDL), empathy is regarded as a critical operant resource in value co-creation in customer-airline interactions. According to SDL, customers actively participate in the value creation process and do not act as passive recipients of services (Vargo & Lusch, 2017). Empathy facilitates understanding customer needs and delivering personalised services, contributing to customer satisfaction through mutual interaction.

Fourth, this study highlights that terminal tangibles exert a positive influence on customer satisfaction. In contrast to studies that focus exclusively on airline service quality, this finding underscores the importance of terminal service elements in shaping customer perceptions. From a service ecosystem perspective, terminal tangibles are essential physical and perceptual components that increase customer satisfaction and play a critical role in service processes. In this framework, value creation occurs through the integration of resources between airports and airlines (Baccarani & Cassia, 2017). As critical service interaction points, terminal tangibles increase customer satisfaction by improving the overall service experience. This result highlights the role of airports as connecting hubs that strengthen the service ecosystem.

Fifth, the study demonstrates that personnel have a significant positive effect on customer satisfaction. This finding emphasises that personnel not only deliver airline services but also shape the overall customer experience (Kos Koklic *et al.*, 2017). When evaluated in the context of the service profit chain, this finding supports the argument that employee qualities, satisfaction, and motivation influence customer satisfaction (Heskett *et al.*, 1994). Employees thus play a crucial role in maintaining long-term customer relationships and improving customer satisfaction, further supporting the importance of personnel in service quality processes.

In conclusion, this study makes a significant contribution to the airline service quality literature by providing both theoretical and practical insights. This study enabled the analysis of both linear and non-linear relationships between airline service quality and customer satisfaction by using a combination of PLS-SEM and ANN methods. In addition, each dimension was examined individually and comparatively analysed using the ANN method to reveal the relative predictive power of the dimensions. Furthermore, by taking a holistic view of airline services, the study contributes to the service ecosystem and advances the development of service quality theory.

5.2. Practical implications

This study offers several managerial recommendations for airline managers. Image is identified as the most influential factor affecting customer satisfaction. Airline managers should develop strategies to enhance public perceptions of their brand. An airline's image may be improved through various means, such as investing in environmental sustainability and social responsibility initiatives (Song *et al.*, 2019). In addition, promotional activities such as advertising campaigns can help build strong brand communication and establish a lasting positive image. Offering personalised airline experiences can further reinforce a positive brand image (Simarmata *et al.*, 2017).

Airline tangibles, ranked as the second most significant determinant of customer satisfaction, following brand image, are pivotal in shaping passengers' experiences. Implementing targeted policies in this area can significantly improve services and overall service quality. For example, aircraft cabin design—an essential part of airline tangibles—should focus on promoting a sense of spaciousness and comfort through elements such as lighting, colour schemes, and ambience (Han, 2013). Future aircraft procurement plans should incorporate these considerations from the outset. In addition, employee uniforms should be carefully designed to embody the airline's brand identity while emphasising both functionality and professionalism, as these attributes strongly affect customers' quality perceptions (Tu *et al.*, 2011). Given the increased importance of hygiene following the COVID-19 pandemic, airlines could introduce innovative cleaning procedures to reassure passengers (Schultz *et al.*, 2020). Establishing a transparent and traceable cleaning process would help maintain high hygiene standards and thus increase customer satisfaction and trust.

The importance of employee empathy in enhancing customer satisfaction highlights opportunities for improvement in the airline industry. To address this issue, airlines should implement targeted training programmes aimed at developing employee empathy skills and enabling them to better understand and effectively resolve customer concerns (Song *et al.*, 2024). When assessing employee performance, sensitivity in customer relationships and an empathetic approach should be taken into account as key assessment criteria. It is equally important to support employees in maintaining a compassionate relationship with passengers. Airlines can achieve this by offering professional development opportunities, introducing reward programs to recognise empathetic behaviours, and providing flexible work schedules (Choi *et al.*, 2020). These measures not only improve working conditions but also increase employee motivation and well-being, ultimately leading to a more positive and empathetic customer experience.

Terminal tangibles provide opportunities for collaboration between airline and airport managers, supporting the development of innovative airport initiatives. As airline services include pre-flight, in-flight, and post-flight processes, collaboration with key stakeholders such as airports is vital to achieving overall customer satisfaction (Auerbach & Koch, 2007; Ekiz *et al.*, 2006). Collaborative efforts could focus on various areas, from designing shared spaces to creating a seamless and integrated passenger experience. For example, digital platforms could be developed to streamline and optimise processes such as check-in and boarding, enabling passengers to manage all operations through a single application. Additionally, airports could renovate facilities to better meet passengers' needs or redesign

services, such as lounges, based on passenger feedback and airline requirements, thereby enriching the overall travel experience (de Barros *et al.*, 2007).

From a managerial perspective, the findings of this study also have significant implications for the European tourism industry. Similar to Turkey, Europe hosts a culturally diverse passenger base with different travel purposes, which requires airlines to prioritise service quality dimensions that address different customer expectations (Aksoy *et al.*, 2003). In this context, the demonstrated impact of brand image and empathy on customer satisfaction suggests that European airlines can gain a competitive advantage through brand communication strategies aimed at enhancing their image, as well as by offering personalised services. In addition, improvements in the physical attributes of airlines and terminals across the continent can contribute positively to customer satisfaction. These findings are particularly relevant at a time when the negative effects of the COVID-19 pandemic are still being felt, making the reconstruction of tourism flows and the return to pre-pandemic levels increasingly critical. In addition, the findings can inform the strategic planning of European airlines and support the development of policies aimed at increasing tourist satisfaction and enhancing destination competitiveness.

6. Limitations and Future Studies

As with any study, this research has certain limitations that offer several avenues for future investigation. First, the data for this study were collected exclusively from passengers travelling through Samsun Çarşamba Airport, limiting the generalisability of the findings to all airline passengers in Turkey. Future research could address this issue by collecting data from airports in different regions and including a broader range of demographic groups to enhance the generalizability of the results. Second, the use of cross-sectional data in this study limits the ability to infer causality between variables to a specific point in time. Employing longitudinal data in future research could capture how customers' perceptions evolve over time, thereby overcoming the limitations of cross-sectional designs and providing more robust insights. Third, this study utilised the AIRQUAL dimensions developed by Bari *et al.* (2001) to assess service quality. Future research could expand this model by including additional dimensions, such as sustainability and digitalisation, which have become increasingly important in recent years. Sustainability and digitalisation have increasingly become integral dimensions of airline service quality (Alotoum & El Hawi, 2023; Lee *et al.*, 2024). These dimensions enhance the passenger service experience by promoting environmental responsibility and improving service efficiency. Expanding the framework in this way would allow for a more comprehensive assessment of service quality, aligning with evolving industry priorities and customer expectations. Fourth, while the combined use of PLS-SEM and ANN in this study provides a robust analytical framework, the "black-box" nature of ANN presents challenges in explaining the mechanisms underlying certain relationships. To address this issue, researchers could integrate PLS-SEM with methods such as fuzzy set qualitative comparative analysis (fsQCA), necessary condition analysis (NCA), or a combination of PLS-SEM, NCA, and fsQCA (Leong *et al.*, 2024). This integrated approach could enhance interpretability and provide deeper insights into the studied relationships.

7. Conclusion

This study provides significant contributions to the literature through a comprehensive investigation of the relationship between airline service quality and customer satisfaction. The integrated use of PLS-SEM and ANN has introduced a novel perspective on service quality in the airline industry by addressing both causal relationships and non-linear patterns among variables. This multi-analytical approach offers a robust modelling framework to explain service experiences that are shaped by different customer needs and expectations. The findings reveal that the most influential dimensions of service quality are image, airline tangibles, empathy, terminal tangibles, and personnel. Beyond identifying these dimensions, the study ranked them in order of relative importance to provide airlines with

strategic guidance in their service improvement efforts. The statistical significance of factors typically treated as secondary—such as terminal tangibles—underscores the need for a more holistic approach to evaluating service quality. In this respect, the study not only extends the existing literature but also introduces a new conceptual understanding that enhances theoretical and managerial insights into the complex service quality ecosystem. Finally, the application of advanced data analysis techniques, such as ANN, has enabled the exploration of dynamic, complex, and layered relationships. Accordingly, the methodological framework employed in this study is expected to inform and inspire future research.

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Appendices

Appendix 1. Questionnaire items

Construct	Measurement items	Source
Airline Tangibles (ATG)	ATG1-Aircrafts were equipped with the newest and modern technology.	Farooq <i>et al.</i> (2018)
	ATG2-The quality of the catering service was good.	
	ATG3-The ventilation system in the planes was sufficient.	
	ATG4-The in-plane arrangement was provided well.	
	ATG5-The seats were clean and comfortable.	
	ATG6-The cleanliness of the toilets was provided regularly.	
Terminal Tangibles (TTG)	TTG1-The ventilation system in the airport terminal was sufficient.	Farooq <i>et al.</i> (2018)
	TTG2-The information counter was easily accessible to assist passengers.	
	TTG3-There were an adequate number of shops in the terminal for my needs.	
	TTG4-The directional signboards in the airport were sufficient.	
	TTG5-The security and control systems in the airport were reliable.	
	TTG6-An adequate number of luggage trolleys were available at the airport.	
	TTG7-The cleanliness of the airport toilets was well maintained.	
Personnel (PER)	PER1-Airline staff were well-dressed.	Farooq <i>et al.</i> (2018)
	PER2-Workers were aware of their duties.	
	PER3-Ticketing and reservation services were error-free.	
	PER4-Flight attendants were respectful and had a good attitude toward passengers.	
	PER5-Whenever I needed, airline personnel answered my questions.	
	PER6-Flight attendants provided equal personal care to everyone.	
	PER7-Workers were willing to help everyone on the aircraft.	
Empathy (EMP)	EMP1-During my travel, departures and arrivals occurred on time.	Farooq <i>et al.</i> (2018)
	EMP2-Transportation between the city centre and the airport was not a problem.	
	EMP3-Compensation plans were clearly communicated in case of loss or damage.	
	EMP4-My luggage was handled very carefully.	
	EMP5-The ticketing office staff were very courteous.	
	EMP6-There were enough flights to meet passengers' demands.	
Image (IMG)	IMG1-The availability of seats and promotional offers are very appealing to me.	Farooq <i>et al.</i> (2018)
	IMG2-Ticket prices are worth the services I received.	
	IMG3-The airline I used has a good brand image.	
Customer Satisfaction (SAT)	SAT1-I am satisfied with my decision to use this airline.	Leong <i>et al.</i> (2015)
	SAT2-Using this airline was a good choice for me.	
	SAT3-I feel that my experience with this airline has been enjoyable.	

Appendix 2. Linearity of relationships

Interaction	Parameter	Sum of Squares	df	Mean Square	F	p-value
SAT * ATG	(Combined)	100.869	28	3.602	6.031	0.000
	Linearity	77.452	1	77.452	129.672	0.000
	Deviation from Linearity	23.417	27	0.867	1.452	0.077
SAT * TTG	(Combined)	94.800	30	3.160	5.002	0.000
	Linearity	79.885	1	79.885	126.458	0.000
	Deviation from Linearity	14.915	29	0.514	0.814	0.740
SAT * PER	(Combined)	87.331	25	3.493	5.360	0.000
	Linearity	62.842	1	62.842	96.432	0.000
	Deviation from Linearity	24.490	24	1.020	1.566	0.051
SAT * EMP	(Combined)	103.980	32	3.249	5.472	0.000
	Linearity	73.245	1	73.245	123.343	0.000
	Deviation from Linearity	30.735	31	0.991	1.670	0.019
SAT * IMG	(Combined)	89.819	13	6.909	11.393	0.000
	Linearity	76.954	1	76.954	126.890	0.000
	Deviation from Linearity	12.866	12	1.072	1.768	0.055

Note. ATG=Airline Tangibles, TTG=Terminal Tangibles, PER=Personnel, EMP=Empathy, IMG=Image, SAT= Customer Satisfaction.

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