

# Revealing Topics in Health & Fitness Mobile App Category User Reviews: A Topic Modeling Approach

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## ABSTRACT

Mobile devices and platforms, as an essential part of today's marketing, lead to significant opportunities for marketing decision-makers. Understanding the consumer through online reviews regarding social interactions, e-commerce, and daily activities becomes fundamental in digital marketing. The mobile app market consists of several categories with different characteristics, which require examination in different contexts. The study focuses on health & fitness category in the context of Türkiye market and mobile apps. The research aims to evaluate health & fitness mobile application market through Google Play Store user reviews and research questions are related to discovering topics and sub-topics in the user reviews. Consistent to research aims, the study adopts a topic modeling approach utilizing BERTopic model on 17.921 online reviews for 20 mobile apps. The study concludes 80 individual topics grouped into 10 topic groups namely: activities & fitness, advertisement overload & presence, dissatisfaction, experience sharing, features, feedback & question, functionality, privacy, recommended & not recommended, satisfaction. Theoretical contributions through four theories and practical implications of the study can shed light on future researches and industrial applications.

**Key Words:** Health, Fitness, Mobile Application, User Reviews, Word Of Mouth

**JEL Classification:** M31

## Sağlık & Fitness Mobil Uygulama Kategorisi Kullanıcı Değerlendirmeleri Konularının Ortaya Çıkarılması: Bir Konu Modelleme Yaklaşımı

### ÖZ

Günümüz pazarlamasının vazgeçilmez bir parçası olan mobil cihazlar ve platformlar, pazarlama karar vericileri için önemli fırsatlar oluşturmaktadır. Tüketicinin sosyal etkileşimler, e-ticaret ve günlük aktiviteler hakkındaki çevrimiçi değerlendirmeleri üzerinden tüketiciyi anlamak dijital pazarlamada temel bir konu haline gelmiştir. Mobil uygulama pazarı, farklı bağlamlarda incelenmesi gereken farklı özelliklere sahip birkaç kategoriden oluşmaktadır. Çalışmada sağlık & fitness kategorisine Türkiye pazarı ve mobil uygulamalar bağlamında odaklanılmıştır. Araştırmanın amacı, Google Play Store kullanıcı yorumları üzerinden sağlık ve fitness mobil uygulama pazarını değerlendirmektir ve araştırma soruları, kullanıcı yorumlarındaki konuların ve alt konuların keşfedilmesiyle ilgilidir. Araştırma amaçlarına uygun olarak, çalışmada 20 mobil uygulama için 17.921 çevrimiçi yorum üzerinde BERTopic modelini kullanan bir konu modelleme yaklaşımı benimsenmiştir. Çalışmada 80 ayrı konu başlığı altında 10 konu grubu (aktiviteler & fitness, aşırı reklam yüklemesi / reklam varlığı, memnuniyetsizlik, deneyim paylaşımı, özellikler, geri bildirim & soru, işlevsellik, gizlilik, önerme & önermeme, memnuniyet) oluşturulmuştur. Çalışmanın dört teori üzerinden teorik katkıları ve pratik çıkarımları gelecekteki araştırmalara ve endüstriyel uygulamalara ışık tutmaktadır.

**Anahtar Kelimeler:** Sağlık, Fitness, Mobil Uygulama, Kullanıcı Değerlendirmeleri, Kulaktan Kulağa Pazarlama, Ağızdan Ağıza Pazarlama

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## **INTRODUCTION**

Digital platforms, social media, and mobile devices have transformed today's consumer into a consumer who uses mobile devices and shapes her consumption habits and social interactions through mobile devices. In mobile marketing, which has become one of the critical areas of marketing, understanding and better interpreting consumers has become inevitable in terms of competition. Mobile applications and the mobile world pose significant potential for the brands. According to Data.ai's (2024) report, daily time spent per user refers to 5 hours on the micro side, while the mobile economy in 2023 has a \$533 billion economic value, and the app store has \$171 billion of that economic value on the macro side. The substantial value of mobile applications leads marketers to search for individual contexts and markets, and the data available on digital platforms enables marketers to study the different aspects of marketing-related concepts.

The study's research questions rely on two main phenomena: the variety of users' conversations in different categories and the variety of users' conversations in different markets. For the first phenomenon; Noei et al. (2019) highlight that a few common topics exist among the categories and each category has specific topic set in their study employing 4.193.549 user reviews of 623 Android apps. For the second phenomenon, Srisopha et al. (2019) compare the U.S. and the other countries for the 15 most downloaded iOS apps, and they conclude every country has proportionally inconsistent factors relative to the U.S. It is concluded in the literature that focusing on a targeted category of apps can provide more specific insights (Chembakottu et al., 2023), and this study focuses on health & fitness category to discover the topics included in the online reviews. The first research question, 'What are the generic topics included in the conversation?' represents a first-level approach to understanding the users, while the second one, 'What are the sub-topics included in the conversation?' reflects the detailed approach of the study. Consistent with the research question, this study employs the topic modeling approach to discover the topics included in the dataset. The study starts with a literature review section, continues with the methodology, and presents the findings and conclusion with theoretical background and future research directions.

### **I. LITERATURE REVIEW**

#### **A. eWOM and Marketing Decision-Making**

The classic word-of-mouth view suggests that people are social beings and share experiences regarding products and services with their social circles, which leads to more effect than messages with a commercial agenda (such as advertising). With the introduction of the digital world, the impact, previously limited to people's close social circle, has now been extended to include people they do not know. Internet forums can be influential sources for consumers (Bickart & Schindler, 2001), and today's consumers can shape their decisions by reading hundreds of comments written by people they do not know on digital channels before purchasing a service, such as a hotel or a trip. With the influence of digitalization, the classical word-of-mouth (WOM) concept has diversified into electronic word-of-mouth (eWOM).

The impact of the eWOM concept on marketing can be examined from two main perspectives: impact on the consumer and brand. The broad scope of WOM's impact on the consumer can be addressed in three main sections: i) impact on the consumer's pre-purchase awareness and attitudes, ii) impact on the consumer's risk, trust, and purchase decision during the purchase phase, iii) impact on the consumer's post-purchase interactions. The consumer's pre-purchase phase is when brands create brand awareness in the consumer's mind in classical marketing and brand theory (Keller & Parameswaran, 2019), and positive attitudes towards the brand are developed. The consumer's purchase phase is the phase that follows the previous phase but also includes various obstacles or challenges. In an everyday e-commerce consumer scenario, when a customer who has already developed a positive attitude towards a product and service has to decide between different brands during the purchase, they can reduce the perceived risk (Hussain et al., 2017) by evaluating online comments and accelerating the purchase decision. Here, activities within the scope of eWOM are accelerating activities toward purchase. Finally, the interaction of consumers with other users after purchasing the product and service is the third effect of eWOM. The results of recommending to other users or writing negative comments will affect the brand's activities in the market (Srivastava & Sivaramakrishnan, 2021). Based on all three areas, it is concluded that eWOM comprehensively affects consumers, and brands need to make decisions regarding the consequences of its effects on consumers.

The decisions to be taken by marketing decision-makers regarding eWOM can be summarized as i) understanding consumer and market reactions, ii) discovering new product or service features or innovative or improvement ideas, and iii) conducting competitive analysis or understanding competitive environment. The first decision group is related to understanding the positive or negative effects of the interactions made by consumers. At this stage, the number of interactions obtained, the topics they contain as content, and the emotional content (sentiment) of the content can be used as indicators (Tang et al., 2016; Kim et al., 2019). The second decision group refers to discovery of new features or innovative/improvement ideas (Christensen et al., 2018; Zhang et al., 2021; Wang et al., 2023) which indicates that suggestions or additional features regarding products and services can be discovered through the data consumers share on digital platforms. Customers currently using the product or service can share with the brands which issues can be improved or which issues they are not satisfied with, which can provide an opportunity for product development. The third decision group, conducting competitive analysis or understanding the competitive environment, refers to the brand examining its own content and other brands in the market in eWOM content (Wang et al., 2018; Lee et al., 2022). Accordingly, when eWOM content related to brands in the market is monitored, brands with positive or negative aspects can be identified, and this allows for the identification of areas of potential development or weak areas that can be used for competitive analysis. Based on all these, it is concluded that marketing decision-making activities regarding eWOM are essential for marketing efficiency and competitiveness.

The concept of eWOM impacts many different sectors of the marketing field in different ways/levels. This study focuses on the health and fitness sector, and the context of mobile applications is examined within the scope of the Turkish market.

### **B. Health & Fitness Consumers**

Among the different application categories in the mobile application market, users of the health and fitness category are distinguished by their characteristic features. For the health side, it can be concluded that intrinsic and extrinsic factors play a role in using digital tools when searching for information. According to Bach and Wenz (2020), many people use the Internet to seek information related to their body and their health. On the intrinsic and extrinsic side, Soni et al. (2021) focus on mobile health applications in young consumer context and conclude the motivation to engagement and engagement to loyalty chain in their study. They present the antecedents of engagement as need for autonomy, need for competence and need for relatedness as the intrinsic motivations, and perceived playfulness, the level of challenge as extrinsic motivations. For the fitness side, Dam et al. (2018) evaluates the fitness app use in their study and presents app adoption intentions as internal competition orientations and gratifications, exercise self-efficacy, attitudes toward the app and social utility motives. The diversity of several usages and motivations of digital tools in health and fitness context makes the evaluation of eWOM effect on consumers crucial.

The role of eWOM on health and fitness consumers can be reflected in several aspects, such as the adoption of new technologies, socializing with networks, or other people and communities, and purchasing or use intentions. Consumers interact with their social circles through traditional and digital ways, and the information exchange can affect their further actions, like the adoption of new products and services. Adoption of new technologies is examined in Kraemer et al. (2023) study that incorporates word of mouth concept together with conspiracy beliefs and they conclude conspiracy beliefs of consumers as major threat for the success of public health apps. The relationship between eWOM and adoption is also valid on the reverse side, as Gu et al. (2018) conclude the relationship between satisfaction and intention to continue to use the mobile internet-based health services and WOM in their study. The second role is related to socializing or social networking side of health & fitness consumers. Consumers participating in the digital social channels can use them for several uses such as getting the informational and emotional support (Liang & Scammon, 2011), motivate and showcase about fitness topic (Easton et al., 2018) and sharing information with others (Park et al., 2016). The last role of the eWOM concept in health & fitness consumers is related to purchase or usage intentions, which have been studied in recent literature in several contexts and constructs such as psychological predictors (Acikgoz et al., 2023), users' satisfaction and investment size (Chiu et al., 2020), and social support & stickiness (Yin et al., 2021).

The diversity and potential of eWOM concepts pose a wide range of platform variety for online users several contexts, including the health & fitness

context. Social media platforms are the first platform on which users can participate in groups or communities, or interact with other users through the hashtags or accounts, while the brands can leverage social media for marketing and brand-related purposes (Laestadius & Wahl, 2017; Naraine et al., 2021). With their visual presentation aspect and video support, Instagram and YouTube present socializing opportunities to individual users in the fitness category on social media. The second platform type refers to specialized communities on platforms like Reddit in which users can participate in communities of any interest (Oliveira & Marques dos Santos, 2022; Pınarbaşı, 2023). The last platform type, mobile applications, has significant characteristics with the help of technology as standalone technological applications that allow users to use mobile devices with them. The features included in smart devices, such as step-tracking, mobile databases, and integration to personal health values, enable users to use various sides of the mobile applications, which makes it a crucial context for marketing research. This study focuses on eWOM data regarding mobile applications through a topic modeling approach to understand the topics included in the context of health and fitness.

## **II. DATA COLLECTION AND METHODOLOGY**

Consistent with research questions aiming to understand the topic environment of the health & fitness category, the study focuses on the Google Play Store which has a global reach and a significant user base in the Türkiye market. Mobile app markets are already employed for eWOM research (Chen et al., 2021; Noei & Lyons, 2022; Çallı, 2023; Mondal et al., 2024) and structured data availability in the marketplace poses potential for eWOM research in the existing context.

For the sampling decision, this study uses Sensor Tower (2024) website, which publishes the top charts for several countries and applications. Google Play store reviews are selected as the sample base, Türkiye market as the location, Health & Fitness category as the app category, and 18.08.2024 as the date of popular chart information. Following the decision of mobile apps in sample selection, Python language (Van Rossum & Drake Jr, 1995) on Google Colab (2024) platform is employed for data collection. Google-play-scraper data package (Mingyu, 2024) is used in the study to retrieve the data and the data collection takes place on 19.08.2024. Retrieving the data uses the following parameters; language as Turkish, country as Türkiye, sort type as Most Relevant and count as 1000. For the sample set, 17.921 reviews from 20 mobile applications are obtained.

Online reviews data are one of the mediums that consumers use in eWOM and they contain several elements such as text, recommending status, rating scores and multimedia. According to Zhao (2021), the text content has greater amount of information than numerical rating data; however, this also leads to a challenge about extracting the relevant information from the text content. General approach as a solution to that challenge refers to text mining and Fan et al. (2006) describe the key to text mining as the creation of technology that is a combination of computers' speed and accuracy and human's linguistic capabilities. The main idea of text mining is extracting meaningful patterns. There are various sub-approaches

included within text mining, such as sentiment analysis (for emotions extraction), semantic analysis (for relationships), and topic modeling (for discovering topics).

Topic modeling simply refers to the detection of the topics included in the text by employing computational methods. According to Alghamdi and Alfalqi (2015), the documents are mixture of topics and the topic is a probability distribution over words in the topic modelling concept. Topic modelling methodology is one of the methodologies that is employed in health and fitness contexts in many studies in the literature (Uncovska et al., 2023; Pal et al., 2023; Chembakottu et al., 2023). According to Barde and Bainwad (2017), topic modelling starts with pre-processing of text and follows bag-of-words approach which considers how many times the words are included in the documents leading to a matrix titled as “term-document” matrix, then topic model is trained on the term-document matrix to calculate the topics.

As the traditional topic models rely on bag-of-words assumption that ignores the ordering of words information (Alghamdi & Alfalqi, 2015), leading to neglecting of contextual details which can be problem for detailed examination. The newer approaches such as BERT (Devlin et al., 2018) - a transformers-based model has been used a solution to get contextual details. According to Yoo et al. (2024) the traditional deep learning-based models process the text as one word at a time sequentially, but BERT processes the complete sequence of words simultaneously, and using huge text data to pre-train the model and using masked language modeling and next sentence prediction it can understand the data in context. BERTopic (Grootendorst, 2022) has a similar nature and it is a topic modelling technique consists of three steps; i) documents are converted into embedding representations using a pre-trained model, ii) result embedding dimensions are reduced, iii) topic representations are extracted from the clusters of the documents. BERTopic offers greater flexibility and accuracy in topic extraction (Liu & Wan, 2024) and it is employed in several contexts such as metaverse usage (Oh et al., 2023), online food delivery (Ma et al., 2024) and green restaurants (Shahhosseini & Khalili Nasr, 2024). Since the study focuses on discovery of topics, this study uses transformers-based model approach (BERTopic) rather than traditional topic models with bag-of-words approaches.

Topic modelling process is employed through BERTopic (version 0.16.3) methodology with language = multilingual, min\_topic\_size = 10, n\_gram\_range = 1,1 and top\_n\_words = 10 parameters. In the first round of analysis, all topics are concluded as raw topics that leads to 192 clusters. In the second round, the individual topics are named and the non-solid topics are eliminated which result in 80 topics at the final stage. Finally, 80 topics are named and grouped into 10 main topic cluster groups in the study.

### **III. FINDINGS AND DISCUSSION**

For a balanced dataset, the count parameter in the data retrieving function is set to 1000 for each application; however, the sorting by Most Relevant parameter returns non-exact values for each application. Table 1 presents the name of the mobile application and the volume of online review information.

**Table 1.** Sample Description

Name	N	Name	N
Six Pack in 30 Days	1000	Weight Loss for Women: Workout	1000
Period Calendar Period Tracker	1000	MAC+: Gym & Home Workouts	675
Step Counter - Pedometer	1000	Mi Fitness (Xiaomi Wear)	1000
Step Counter - Pedometer	1000	Heart Rate Monitor - Pulse App	1000
Splits Training in 30 Days	1000	Pepapp - Period Tracker	1000
Blood Pressure Tracker: Bp Log	14	Health Kit	232
Lose Weight App for Men	1000	Sweatcoin • Walking Step Counter	1000
Home Workout - No Equipment	1000	Blood Pressure App	1000
Workout for Women: Fit at Home	1000	Wearfit Pro	1000
Lose Weight App for Women	1000	e-Nabız	1000

According to Table 1, most of the apps have 1000 reviews while the “MAC+: Gym & Home Workouts”, “Health Kit” and “Blood Pressure Tracker: Bp Log” have lower amount of online reviews due to parameter options. Understanding the sampleset requires a descriptive approach and Figure 1 utilizes evaluation of rating score distributions.

**Figure 1.** Rating Score Distribution

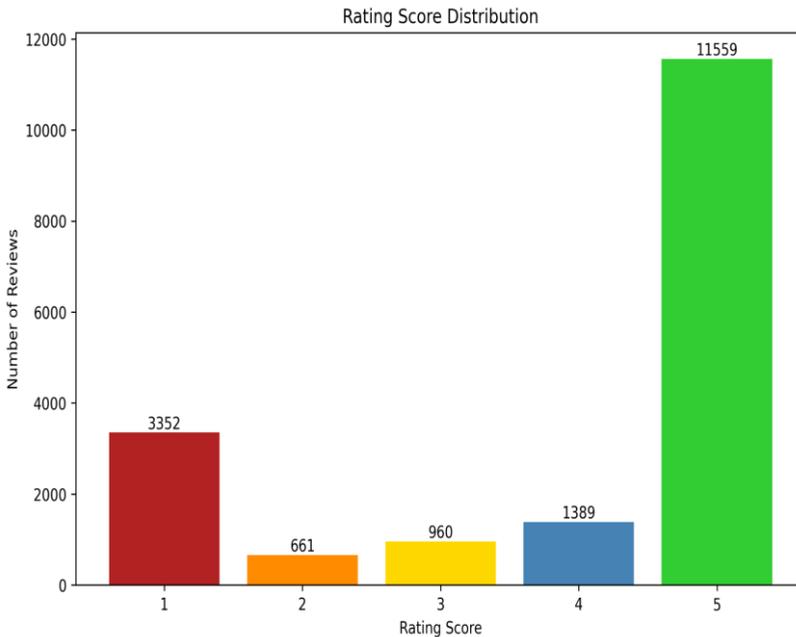


Figure 1 presents the rating score distribution in the dataset and highlights the dominance of 5-star ratings, which account for 64% (11.559) of the 17.921 total reviews. 1-star ratings follow the most dominant one with 18% (3.352) and these results indicate that users in health & fitness category apps mostly express polarities in the user reviews. 4-star ratings have 7% with 1389 reviews, 3-star ratings have 5% with 960 reviews, and finally, 2-star ratings have 3% of all reviews with 661 reviews.

Topic modeling through BERTopic results in 192 topics and representative words and reviews for the topics. The obtained topic items are examined

individually and named according to their clarity of expression. The topics with explicit expressions are named and combined under the main topic groups. At the end of the naming and combination process, ten topic groups and 80 individual topics are concluded in the study. Table 2 shows the main topic groups with their statement and Table 3 presents the representative user reviews for the main topic groups. Table 4 includes the topic group structure in the study, while the representative words for each topics are also included in Attachment 1.

**Table 2.** Topic Modelling Results

Main Topic Group	Statement
Activities & Fitness	The topic group contains sub-themes such as home exercise, fat burning, weight loss in fitness, and exercise topics. It highlights the context-based expressions in the health and fitness mobile application category.
Advertisement Overload & Presence	The intensity of advertisements in mobile applications can be frustrating, and users reflect on their experiences in user reviews.
Dissatisfaction	The topic group includes both general dislike and paid features-related user expressions. It represents the negativity side of the user reviews in the market.
Experience Sharing	Users of fitness apps tend to share their personal experiences and exercise activities with others with respect to the nature of word-of-mouth communication.
Features	Mobile apps have a wide range of variety in terms of mobile app features, and the features are reflected in user reviews in several sub-topics. This topic group signals the usage and experience of users with mobile applications.
Feedback & Question	Users share their feedback with mobile app developers/brands and ask questions in their reviews.
Functionality	The topic group, similar to the features topic group, represents the main functionality issues included in mobile apps. Apart from the individual features of context-based applications, this category contains generic topics such as app crashes, connection problems, and language support. This topic group and features topic group complement each other.
Privacy	Users are skeptical about their privacy and personal data. Therefore, they write their statements about the responsibility of the data publicly in their reviews.
Recommended & Not Recommended	The topic group represents the user reviews' dual side of recommendation activity. As word-of-mouth theory indicates, people may share their recommendations / not recommendations with others.
Satisfaction	The different aspects of user satisfaction included in the topic group represent the positive side of the user reviews.

Individual topics produced in the topic modeling are evaluated and grouped into the broad thematic topic groups in Table 2. The topic groups represent the thematic structure of the conversation and present the range of topic groups. In addition to the topic group descriptions in Table 2, Table 3 includes one sample user review of each group's complementary perspective.

**Table 3.** Representative Reviews for Topic Groups

Topic Group	Representative Reviews (English Translation)
Activities & Fitness	"This is a legendary program for those who are at home and cannot go to gyms. Personally, I don't like to do sports, but I created a program here, I do it six days a week, first I jump rope and then I do sports, I haven't started more, but I feel the effect. Zumba also attracted my attention, I think I should do it in the evenings. Thank you to everyone who contributed to the program, I believe it will help me a lot in my slimming journey."
Advertisement Overload & Presence	"Continuous advertisements, I click on something and wait for the advertisement to end, it is so slow that the ads do not end immediately, we understand that there will be 1 or 2 ads, but why is there in everything, I press the back button, again advertising, the application is nice, I don't want to delete it, but the ads are annoying."
Dissatisfaction	"I've been using the app almost since it came out, the good times when it didn't have ads. Now, if I click on the calendar, I get ads and I can't get through. I'm sorry, it's time to part ways, Pepapp. I have a nervous breakdown every time I try to use it. There can't be so many ads. I hope these words of mine will be taken into consideration. If not, you know, because I am no more."
Experience Sharing	"I used it every day, my belly melted and the muscles became slightly prominent, it is a very effective program when you are persistent and determined, and it is free :) thank you very much for this beautiful program 🍌"
Features	"It's a very good app that shows our steps and how many calories we burn, I think you should try it :)))"
Feedback & Question	"It's an app that can definitely have an impact if you are consistent. But it also makes you wonder why the men's version doesn't have the extra features that the women's version has. The profile, stretching and extra movement sections in the female version should be added to this app too!"
Functionality	"It wants to update so I can't enter the system but it won't update either. I deleted and reinstalled the app and the same problem persists."
Privacy	"I downloaded the application on 21.05.2024 and wanted to use the fingerprint, I do not give permission for my fingerprint to be used anywhere other than the pulse measurement application, if it is used elsewhere, the play store and this application are responsible."
Recommended & Not Recommended	"👍👍👍 very nice application, I recommend it to everyone. :)"
Satisfaction	"Very good, deserves 5 stars"

Table 3 presents the overview of the topic groups through the sample reviews for each topic group. The presented topic groups can be evaluated in three perspectives: i) context-specific topic groups, ii) negativity-positivity polarities, and iii) common categories with other mobile app categories.

The first perspective contains "Activities & Fitness" and "Experience Sharing" topic groups, and they are the context-based categories specific to health & fitness category. Users of health & fitness mobile apps share their experiences, opinions and comments with other users on web due to eWOM nature and it can a great source for understanding the patterns in consumer ideas in the marketplace. In these topic groups, marketing decision-making can process the underlying topics and themes leading to satisfaction and dissatisfaction which can be customer insight source for marketing actions. The second perspective relies on the topic groups including "Dissatisfaction", "Recommended & Not Recommended", and "Satisfaction". The polarities (positive or negative) reflected in the topic groups are useful for the factors leading to satisfaction and dissatisfaction; however, the sub-components can not be the same with other category apps as the users in health & fitness categories may have special factors / characteristics that affect the positive / negative general issues. It is concluded that secondary-level examination into individual topics can be useful for better marketing decision-making. The third

groups contain “advertisement overload & presence”, “features”, “feedback & question”, “functionality”, and “privacy” and the topic groups have lack of significance in the first-level. However, examining sub-topics or components in the topic group may signal the context-specific customer insights for the decision-making. For example the “feedback & question” topic category is a common category for other types of mobile app categories; but the user reviews in the health & fitness category may be the starting point for feature improvements, performance improvements that lead to competitive activities. Since the eWOM conversation consists of reviews regarding several mobile applications, evaluation of not only a specific mobile app’ reviews but also other apps’ reviews may lead to broader perspective.

The three perspectives and the main topic groups present the overview of the conversation in health & fitness category but they are lack of detailed explanations. Table 4 focuses on the individual topics and presents the topics included in the topic groups by adding the representative words for each topic.

**Table 4.** Individual Topics & Topics Groups in the Study

Topic Group	Individual Topic	Topic Group	Individual Topic	Topic Group	Individual Topic	
Activities & Fitness	30 Day Workout	Features	Accurate Measurement	Features	Period Tracking and Motivation Support	
	Exercise - Flexibility		Age-Appropriate Usage		Pregnancy Features	
	Exercise Challenge (Level)		App Missing		Seamless Transition to New Device	
	Exercise Programme		Audio Features		Sleep Data	
	Fat Burning		Blood Pressure Problem		Step Counter	
	Home Exercise		Calendar Problem		Step Tracking	
	Weight Loss & Daily Weight Monitoring		Calorie Burn Calculation & Tracking		Turkish Language Support	
Advertisement Overload & Presence	Advertisement Overload		Exercise		Video/Animation Presence	
	Advertisement Presence		Feature Recommendation		Voice Coach/Command System	
	Advertisement & Feedback		Heart Rate Tracking/Monitoring		Water Intake Reminder	
Dissatisfaction	Paid Features		Instructors		Feedback & Question	Exercise Feedback to Others
	Dislike		Measurement			Feedback to Others
Experience Sharing	First Day & First Time		Medical Records & Reports		Feedback & Question	Gender-Specific Focus
	Personal Experience		Motivation Support			Informing Other Users
	Product Experience	Nutrition	Misleading Advertising			
	Progress & Experience	Offline Functionality	Question - Confusion about Pricing			

<b>Topic Group</b>	<b>Individual Topic</b>	<b>Topic Group</b>	<b>Individual Topic</b>
Feedback & Question	Star Rating Expression	Privacy	Personal Information
	Trust & Deception		Fingerprint
	Usage Guidance Need		Recommendation to Others / Download
Functionality	App Crashes / App Malfunction / Launch Problems / Page Load Issues	Recommended & Not Recommended	Not Recommending to Others
	Connection/Synchronization Problems		Not Worth It
	Data Backup & Synchronization		Gender Specific Recommendation
	Device Compatibility	Satisfaction	Challenge & Enjoyment Together
	Effectiveness		Detailed User Experience
	Excessive Battery Usage		Ease of Use
	Google Account Access Request		Effectiveness
	Language Support		Free Usage
	Login Problems		Praise
	Measurement Problem		Rating Stars / Rating the App
	Membership		Thanking
	Password Problems		
	Phone Number Requirement to Access the App		
	Product / Device / Smartwatch Related Issues		
	Subscription Cancellation		

Table 4 itemizes the main-topic groups and the individual topics that are combined through the examination of topics. The table presents ten groups with eighty individual topics with representative words. The most diverse categories refer to features (26 topics), functionality (15), feedback & question (9), satisfaction (8) and activities & fitness (7).

The novelty in Table 4 refers to the individual topics concluded in the topic groups that signal the phenomenon in the related context. For example, the features topic group (with 21 individual topics) contains several context-specific topics that can signal the significant topics for consumers such as blood pressure problems, calorie burn calculation, nutrition, step tracking and sleep data. These common topics signal the “standard” features that can be estimated. However, specific topics are concluded in the study for improving consumer insights retrieval, such as motivation support in the apps, instructors, and voice coach/command system. The common or standard features and specific or individual features can be combined for better decision-making in marketing, and it can lead to understanding the competitive environment when the knowledge is paired with the actors in the marketplace.

Functionality topic group contains the sub-topics (15) related to main functions included in the apps, rather than the specific features. Topics like app crashes, device compatibility, login problems signal the main usage problems that users have experience in health & fitness categories. User experiences are reflected

in the category and fifteen individual topics signal the diversity of functionality which can be obstacles for better customer experiences.

“Activities and fitness” topic group contains seven individual topics namely; “30-Day Workout”, “Exercise - Flexibility”, “Exercise Challenge (Level)”, “Exercise Programme”, “Fat Burning”, “Home Exercise” and “Weight Loss & Daily Weight Monitoring”. The topics represent the “Fitness” side of the Health & Fitness category mobile applications and highlights the aspects of the fitness as exercise, fat, weight related topics. Evaluating the users’ comments on home exercise imply the mobile applications usage pattern in consumer behavior, as the users can use mobile applications to do sport activities at home. Another consumer insights is 30-day Workout topic as one of the mobile app in sample set contains similar concept in the name of the app.

Individual sports-related topics are presented in “Activities & Fitness” topic group and “Experience” topic group complements the topic group by the experiences shared by users in the user reviews. As eWOM theory implies people tend to share their experiences with others through digital channels and this implication is included in the dataset through four individual topics namely as “First Day & First Time”, “Personal Experience”, “Product Experience”, and “Progress & Experience”. According to the findings, people are sharing experiences through three different perspectives as personal, product and progress and they also mention about their first day or first time in the user reviews. This topic category highlights the personal nature of the eWOM and it can be used for understanding the specific market characteristics.

“Satisfaction” topic group reflects mainly the positive side of the user reviews and the individual topics such as ease of use and effectiveness confirm the previous consumer research. There are also generic topics such as “praise”, “rating stars / rating the app”, and “thanking” included in the dataset. In addition to generic topics in the topic group, “challenge & enjoyment together”, “detailed user experience” and “free usage” implies the characteristics of the Türkiye market in health & fitness category.

#### **IV. CONCLUSION**

This study aims to evaluate Health & Fitness category applications in the Turkish market through user comments on the Google Play Store and examines 17.921 reviews of 20 mobile apps. Topic modeling methodology via the BERTopic approach is employed, and 192 raw topic outputs are evaluated. The study presents 80 topic titles combined in 10 topic groups: Activities & Fitness, Advertisement Overload & Presence, Dissatisfaction, Experience Sharing, Features, Feedback & Question, Functionality, Privacy, Recommended & Not Recommended, Satisfaction.

eWOM theory (Westbrook, 1987) is the base theorem included in the study and it is reflected in the topic findings in the forms of “Experience Sharing”, “Feedback & Question”, “Recommended & Not Recommended” topic categories. Users interact with the other users and the mobile app developers / brands through the user reviews and the study contributes to eWOM theory through the extension

by health & fitness category in Türkiye market context. The second theoretical root refers to Technology Acceptance model (Davis et al., 1989) and it is reflected in the study through “ease of use” and “effectiveness” topics in the conversation. As the health & fitness categories application contain features that need to be accepted / adopted by users, the expressions of ease of use and effectiveness are crucial to understand the customers in the context. The third theoretical root refers to the theory of planned behavior (Ajzen, 1991) which is reflected in the study through “Privacy” topic group. The personal information shared to mobile applications for health & fitness topics can be the source of privacy-related concerns for the mobil users, as concerns are reflected in the conversation. The final theoretical roots in the study is the Herzberg’s Two Factor Theory (Herzberg et al., 1959; Herzberg, 1966). Since users mention their positivity directly in “Satisfaction” topic group and some of the individual topics included in “Features” and “Functionality” topic groups, the reviews can reflect the factors that lead to customer satisfaction in health & fitness context and understanding the individual factors or factor groups contribute to better decision-making in mobile app context.

Following the theoretical roots, ten topic groups also have managerial implications for marketing decision-making. The first implication is about “Advertisement Overload & Presence” which includes the dissatisfaction regarding the ads in the mobile apps. Although the advertisements in mobile apps part of the revenue for the apps, the degree of advertisements or the inclusion of ads in the mobile apps can lead to changes in the user satisfaction. The second one refers to “Experience” topic group that reflects the personal experiences of the users in the marketplace. Therefore it can be used for discovering the market-based characteristics regarding the user experience for the mobile app market or individual mobile app. The last implication covers both “Features” and “Functionality” topic groups, as they contain the individual topics regarding the usage of the mobile apps. The developers / managers of mobile apps can utilize the feedbacks included in online reviews to improve the user experience.

The study extends the previous research on health & fitness apps in several aspects. One of the previous studies, Cho et al. (2020) examine the sustained usage of health and fitness apps by technology acceptance model with investment model through the CFA and structural equation modelling. The study confirms the perceived ease of use and perceived usefulness concepts by concluding the topics in the topic set. In another study, Stancu et al. (2022) studied the features of health apps by employing three discrete choice experiments and asking participants. This study extends this approach by employing online review data available in the marketplace and concludes the features expressed in the reviews through the topic modelling. In the contextual side, the study contributes to existing eWOM research regarding contextual extension by the health and fitness category and the Turkish market. eWOM research on health & fitness category or other categories in Turkish market contains several studies (Pınarbaşı & Canbolat, 2018; İnal & Cagiltay, 2019; Akbolat et al., 2019); however there is limited research on the combination which makes the detailed examination of the context valuable as the Türkiye digital

market offers significant market potential. The study also extends the methodological approach by employing BERTopic - a transformers-based model- to extract the topics in the dataset. Previous approaches, such as latent Dirichlet allocation used in the studies (Blei et al., 2003), purely focus on the probabilities and co-occurrence of texts together while partly neglecting the contextual subtleties. In contrast, the transformer-based approaches consider the context within which the texts are included.

The study has scope limitations as it focuses on the Türkiye market and Health & Fitness category- and methodological scope limitations as it employs the BERTopic topic modeling approach. Additional methodologies such as sentiment analysis (Canbolat & Pinarbasi, 2020), text mining (Hong & Park, 2019) and network analysis (Pinarbaşı, 2020) can be employed for the online review data for health & fitness context. The combination of sentiment analysis and topic modelling can reveal the pairs of sentiments-topics in the conversation and inclusion of additional perspectives such as longitudinal/cross-country can enrich the understanding of the marketplace.

#### **Research and Publication Ethics Statement**

In all processes of the article, the research and publication ethics principles of the Journal of Management and Economics are followed.

#### **Yazarların Makaleye Katkı Oranları**

The entire article was written by the first author.

#### **Declaration of Interest**

The author has no conflict of interest with any person or organization.

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