The Virtual Coach: Examining the Impact of Perceived Privacy, Anthropomorphism, and Empathy on Overall Well-being in Fitness App Users

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Abstract

Fitness applications can potentially revolutionize personal well-being in the digital age by fusing empathy, privacy, and human-like engagement. The growing popularity of fitness applications that provide virtual coaching gives a singular chance to study how empathy, anthropomorphism, and perceived privacy affect users' general well-being. With an emphasis on the social and psychological components of virtual connections, this research strives to examine how these characteristics affect the well-being of young people who actively use fitness applications. This study used a positivist paradigm and a descriptive-causal research design. It used primary data questionnaire methods to collect the perspectives of 384 youth actively involved in fitness apps and fitness centers. The findings show that perceived empathy, anthropomorphism, and privacy significantly influence the overall well-being of youths, with empathy being the most effective predictor, followed by anthropomorphism and confidentiality. The results emphasize the significance of well-planned AI-driven interactions in fitness applications and the possibility for sympathetic, human-like virtual coaches to increase user pleasure and encourage better lives. This research advances digital health knowledge by showing relational and privacy-centered designs' significance in improving user well-being and engagement with fitness technology. Future studies might examine long-term effects and other psychological aspects in more detail, presenting information for creating

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user-centered, adaptable digital exercise settings.

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1. Introduction

Technological advancements focused on human health are becoming more important as human activity speeds up. Many jobs previously completed only by humans are now being partly or wholly automated by systems driven by artificial intelligence (Al) (Park et al., 2019). Fitness apps that act as "virtual coaches" have become increasingly popular due to the growing integration of digital technology into daily life. These apps are intended to support health and well-being by providing individualized guidance (Spanakis et al., 2016), tracking (Birkhoff & Smeltzer, 2017), and motivational support (Bitrián et al., 2023; Dahal, 2018; Ghimire et al., 2022; Solbrig et al., 2017). These applications are more than just tools; they are interactive agents that replicate human characteristics, such as empathy and anthropomorphic qualities (Cao et al., 2022; Karki et al., 2024; Joshi et al., 2023; Rahmanti et al., 2022), to engage users through personal coaching (Diederich et al., 2022; Shneiderman, 2020). Commercialized intelligent assistance systems have been widely developed and used due to recent advancements in AI and machine learning (ML) (Ghimire et al., 2023; Rai et al., 2023; Schneiders et al., 2021). This change represents an increasing tendency toward digital solutions that promote personal well-being, especially as individuals look for fitness advice that fits with current lives and is easy (Ozturk et al., 2017), accessible (Zhou et al., 2020), and customized (Shrestha et al., 2023; Tong et al., 2018). The resources that will contribute to maintaining people's well-being over time (natural, economic, human, and social capital), as well as "people's living conditions and quality of life today (current well-being)," are all included in the concept of well-being (OECD, 2019; Stray, 2020). Although young people use conversation-based AI, new developments in AI-based text analysis have produced previously unheard-of performance improvements in several conventional AI applications, including online search, automated machine translation, and question-answering (Karki et al., 2023; Kjell et al., 2022; Sharma et al., 2023). Digital technologies are increasingly used to mediate most human experiences, ranging from politics and personal relationships to health and education (Calvo et al., 2020; Dahal et al., 2020).

If deploying AI-driven apps results in unwanted (and undesirable) data use, the blend of characteristics poses privacy problems (Willems et al., 2023). A wide range of health data, including patient data from multi-omic methods, clinical, behavioral, environmental, and medication data, as well as data from the scientific literature,

may be analyzed by AI technologies (Wang & Preininger, 2019). Privacy and trust in the usage of digital technology are hot topics. To promote long-term engagement and pleasure, users' perception of security and confidence in how fitness apps handle their data (Kusyanti & Prastanti, 2017) is correlated with perceived privacy (Chang et al., 2018). Perceived anthropomorphism, or the degree to which users believe the virtual coach is human-like, may improve the quality of interactions and increase the likelihood that users will follow routines and suggestions from the app.

Furthermore, the virtual coach's apparent empathy might foster an emotional bond that raises user motivation, encouraging consistency in health-related activities and enhancing well-being. Virtual coaches are thus crucial for improving users' general well-being. To create digital coaching platforms that are successful and appeal to users' psychological and personal needs, it is essential to comprehend how these perspectives affect users' general well-being as the usage of fitness applications grows. To provide knowledge into optimizing virtual coach interactions for optimum effect on user health and pleasure, this research examines how perceived privacy, anthropomorphism, and empathy in fitness applications affect users' well-being.

As we enter an age of unparalleled digitization, the healthcare sector aims to fully realize the promise of AI to transform patient care and increase overall well-being (Rayhan et al., 2023). As fitness apps gain popularity for helping users achieve their health objectives, the virtual coaches integrated into these apps are essential in affecting users' overall well-being. Indeed, healthcare is an important environment for human-AI cooperation (Lai and Kankanhalli, 2021). The World Health Organization's 2019 World Health Report shows a persisting worldwide physician deficit, with an average of just 15 doctors per 10,000 people. Technology frequently has both sound and adverse effects on prospective users (Dai et al., 2020). The pandemic has impacted global human patterns in new ways, resulting in the fast adoption of new technology at work, while physical separation became the norm (Cramarenco et al., 2023). In Academica, diverse perspectives on evidence are presented. Singh et al. (2021) showed that mental health applications for depression in India often lack accessible privacy rules, unambiguous data-sharing permission, and critical data security mechanisms, creating substantial ethical and safety problems. Paudel et al. (2021) found that individuals in Kathmandu experience many challenges to physical activity (PA), including a lack of knowledge, time, support, and infrastructure, but are aided by health advantages, social support, and the incorporation of PA into everyday duties such as housekeeping and active transport. Singh et al. (2021) found out that sleep problems, dietary habits, and physical activity are all significantly associated with weight status among Nepalese adolescents, implying that those with sleep issues, high soft drink consumption, and sedentary behavior are more likely to be overweight or obese. Garbett et al. (2021) found that

participants using AI computer vision fitness apps faced significant challenges with visual feedback, adaptability, and dialogue limitations, highlighting the need for design improvements in feedback, personalization, and relationship-building to improve user experience. Whelan and Clohessy (2020) revealed that the social features of fitness applications may improve and degrade well-being, as good social interactions generate a harmonious desire that decreases burnout. Still, recognition-driven interactions feed an obsessive passion that can exacerbate burnout. However, these AI-powered applications' performance depends on how users perceive aspects.

While perceived privacy is essential for building trust (Esmaeilzadeh, 2019), a lack of transparency about data security in fitness applications might cause user skepticism, undermining the advantages these platforms could otherwise provide. Farrokhi et al. (2021) discovered that combining IoT and AI in intelligent fitness improves training performance via data-driven knowledge and user connection, although data protection and interoperability remain. Kühler (2021) found that AI health applications have a paternalistic potential owing to their autonomous health data processing and individualized suggestions, raising ethical issues about AI's ability to influence health practices without human intervention. The greater the humanistic level of AI service agents, the better clients believe they are and the more likely they are to employ them (Dahal et al., 2023; Duffy, 2003; Gong, 2008; Gurung et al., 2024; Qiu et al., 2020). Empathy from virtual coaches may help users feel more connected, which may be influential in inspiring them to sustain long-term health behaviors. Wasil et al. (2021) revealed that the majority of users choose a few prominent mental health applications, such as Calm, Headspace, Reflectly, Daylio, Replika, and Wysa, which primarily concentrate on meditation, journaling, self-monitoring, and chatbot interactions. Huang et al. (2022) observed that using AI with phone-based accelerometers can accurately identify fitness activities such as running, cycling, and stair climbing, with deep neural networks achieving a high accuracy of 97.4%, thereby supporting health and well-being goals through easily accessible mobile technology. Suh and Li (2022) determined that mobile fitness (mFit) technology improves older persons' physical and psychological well-being, with various feature sets playing diverse roles, and that social support for mFit technology usage amplifies these health advantages.

The degree to which applications are viewed as having human-like features may significantly influence user engagement, but the particular consequences on well-being are unknown. Woodward et al. (2022) showed that mental health technologies, such as sensing devices and feedback interfaces, may improve clinical monitoring but face obstacles such as privacy, data gathering, and battery life when used effectively. Suwal and Uprety (2023) found that recreational activities, including physical fitness and entertainment, substantially influenced staff productivity in Nepalese commercial banks,

implying that banks that prioritize these activities may attain greater organizational productivity. Nigam and Chanda (2024) showed that digital innovations such as gamification, artificial intelligence, and machine learning play an important role in increasing user engagement and retention in fitness applications, underlining the need for more study on user, customer, and brand experience to boost app performance. KC et al. (2024) revealed that more than 75% of teenagers in Beni Municipality, Myagdi, Nepal, had insufficient physical activity levels, and internet addiction was associated with this fall, especially among late teens from nuclear households and those with higher family incomes. Shrestha et al. (2024) established a smartphone application for Human Pose Estimation (HPE) that uses the VGG-19 architecture and the COCO dataset to recognize yoga positions in real-time and provide quick feedback, making it more accessible to fitness enthusiasts and healthcare professionals. The current study focuses mainly on the technical functionality and use data of fitness applications, leaving little knowledge of how psychological aspects influence users' well-being and engagement. It is argued that "AI impacts what we can consider the good life, how we achieve "goals of well-being" and "overall common good" (VesnicAlujevic et al., 2020) and that the ability of a good life "must include an explicit conception of how to live well with technologies," and that the 'good life' means "a human future worth seeking, choosing, building, and enjoying" (Vallor, 2016 as cited in Lillywhite & Wolbring, 2024). Thus, examining how perceived privacy, anthropomorphism, and empathy in fitness app virtual coaches affect users' overall well-being is essential. Addressing this gap could bring knowledge about refining virtual coaching tactics, increasing user happiness, and, eventually, improving the quality of health outcomes facilitated by fitness applications.

The primary objective of this research is to examine the impact of perceived privacy, anthropomorphism, and empathy on the overall well-being of young people who use fitness applications with virtual coaching capabilities. The study's specific goals include examining the relationship between perceived privacy and well-being, examining how perceived anthropomorphism affects users' overall well-being, assessing the effect of perceived empathy from virtual coaches, and evaluating the influence of these factors on the well-being of youth who use fitness apps.

App developers, fitness experts, and users are among the stakeholders who will find great value in this research. The study presents knowledge that might improve the layout and operation of fitness apps. To design user-centered experiences that promote engagement and trust, developers must thoroughly understand these dynamics. This study adds to the body of knowledge on digital health treatments. By identifying important factors that impact young people's interactions with virtual coaches, the results essentially seek to increase user happiness and health outcomes, encouraging healthier lives and boosting general well-being.

The research has methodological limitations. The use of non-probability convenience sampling may restrict the generalizability of results. This study's approach collects observations at a single moment, limiting knowledge of long-term effects on well-being and perhaps missing changes in user opinions over time. The research has six parts. The introduction outlines the research topic, aims, and importance, establishing the groundwork for the study. The literature review examines current studies with perceived privacy, anthropomorphism, empathy, and well-being within the framework of fitness applications. The methodology covers the study concept, sampling strategy, data-gathering, and analytical processes. In the Presentation and Analysis section, results are methodically presented and analyzed to evaluate the correlations among variables. The conclusion summarizes essential findings and implications, whilst the future scope defines pathways for more study to enhance comprehension of virtual coaching's influence on well-being. References are listed.

2. Literature Review

This research is based on numerous core theories that clarify the connection between user interactions with fitness applications and their well-being. Albert Bandura's Social Cognitive Theory (SCT) emphasizes the significance of observational learning, imitation, and modeling (Grace-Farfaglia, 2019), elucidating how digital elements such as virtual coaches foster positive health behaviors via goal-setting and feedback, which users may embrace to improve their well-being (Khan et al., 2024; Martin et al., 2018; Young et al., 2014). Self-determination theory (SDT), developed by Deci and Ryan, shows intrinsic and extrinsic motivations (Deci & Ryan, 2012), asserting that fitness applications that satisfy the needs for autonomy, competence, and relatedness can markedly improve users' motivation and engagement (Molina & Sundar, 2020; Villalobos-Zúñiga, 2020). Anthropomorphism Theory posits that human-like characteristics in nonhuman entities enhance connection (Bhattarai et al., 2020; Prato-Previde et al., 2022; Wan & Chen, 2021), indicating that virtual coaches featuring human-like avatars can improve adherence to health routines by increasing user trust and engagement (Schlieter et al., 2024; Weimann et al., 2022). Finally, Batson's Empathy-Altruism Hypothesis posits that empathic involvement, shown by helpful virtual coach replies, enhances users' commitment, favorably influencing well-being. These theories provide a thorough framework for analyzing how perceived privacy, anthropomorphism, and empathy in virtual coaching inside fitness applications might influence user engagement and well-being, hence informing compelling digital health experiences.

Overall Well-being

Well-being is a balanced state of physical, mental, emotional, and social health, marked by satisfaction and fulfillment across life's areas. Op den Akker et al. (2016) found that using virtual animated persons in healthy living coaching systems has an essential impact on

user motivation and regulation, with feedback presentation formats influencing user perception and performance of the coaching routine. Tu et al. (2019) found that fitness applications prioritizing social engagement over fun are more effective at supporting extended physical activity and increasing users' intentions to continue using the app for regular exercise. Wang et al. (2019) found that maximizing interaction design at the instinct, behaviors, and reflection levels can improve user experience during each stage of a fitness app's lifecycle—initial trial, habit-forming, and habit-keeping, which results in higher user stickiness. James et al. (2019) found that intrinsic exercise goals increase the use of fitness app features for tracking and analyzing progress.

In contrast, social goals drive users towards socializing features, both of which improve users' well-being by aligning with their specific exercise motivations. Whelan and Clohessy (2020) found that the social features of fitness apps can foster either harmonious or obsessive passion for exercise, with a combination of both contributing to reduced burnout and improved well-being, while obsessive passion can increase burnout, affecting overall wellness. El Kamali et al. (2021) found that virtual coaches for older individuals show promise in improving mental, physical, and social well-being; more complete evaluations and multi-domain methods are required to realize their benefits entirely. Fabbrizio et al. (2023) discovered that integrating AI and IoT in tele-exercise smart devices improves individual well-being by promoting home-based physical activity. Still, hurdles remain in terms of mass adoption and technological accessibility. Hu et al. (2023) found that both personal and social-oriented features in fitness apps improve commitment to exercise and social engagement, which improves a variety of users' well-being, such as reduced emotional exhaustion and higher life satisfaction. Schlieter et al. (2024) found that using a Virtual Coach solution significantly improves the continuity of home therapy for elderly patients, exhibiting positive usability, acceptance, and effects on quality of life via customized intellectual and physical therapies. D'Addario et al. (2024) found that characteristics including autonomy, self-regulation, relatedness, flexibility, and health advantages are essential for engaging lazy people in physical activity mobile applications. Martins (2024) found that innovative digital technologies in fitness centers are integral to promoting wellness and physical activity, providing personalized guidance, and improving user experiences while emphasizing challenges such as user resistance and privacy concerns that must be addressed for successful implementation.

Perceived Privacy

Perceived privacy refers to an individual's belief about the extent to which their personal information is securely managed and protected from unauthorized access or misuse. Adhikari et al. (2014) found that though mobile health applications improve patient-centered care by enabling users to track health and fitness, they present considerable

privacy and security threats to consumers' protected health information, underscoring the necessity for enhanced security protocols in app development. Rowan and Dehlinger (2014) found that many health and fitness mobile applications had privacy policies that were difficult for ordinary users to understand, indicating a lack of care for user comprehension and insufficient clarity regarding specific program rights. Lidynia et al. (2018) found that while fitness apps and wearables are widely considered beneficial to supporting a healthy lifestyle, privacy concerns and sensitivity to data collecting remain significant obstacles to their use. Nadarzynski et al. (2019) found that the acceptability of AI-driven health chatbots is shaped by users' perceptions of utility, trustworthiness, and favorable views. Yet, hesitation remains due to worries over accuracy, cybersecurity, and limitations in empathy. Feng et al. (2021) found that Self-tracking technologies had a good influence on health and well-being through personalized goal-setting, data management, and enhanced collaboration among users and healthcare providers, while potential psychosocial drawbacks and long-term impacts require additional research.

Kühler (2021) found that by autonomously analyzing user data and providing personalized health guidance, AI-driven health and fitness apps raise ethical concerns related to AI paternalism, where the app may exert control over users' health decisions without direct human involvement. Chew and Achananuparp (2021) found that the integration of AI in healthcare may be optimized by mitigating issues related to data privacy, patient safety, and technological maturity while also advancing personalization, empathy, and public awareness of AI's potential. Hsieh and Li (2022) found that the perceived service-privacy fit considerably impacts customers' adoption of mobile applications, with benefit expectancy and privacy concerns acting as crucial mediators in this relationship. Yoon et al. (2023) found that implementing virtual reality and virtual try-on systems in at-home fitness extensively improves privacy protection and self-confidence for users, thus promoting a safer and more engaging remote exercise environment while not significantly affecting coaching satisfaction. Cerra and Apicella (2024) Found that innovations in smartphone applications powered by AI and other technologies can substantially enhance personal wellness, health literacy, and healthcare delivery. Issues related to security and safety must still be resolved for their future incorporation into health practices. Ghezelseflou and Choori (2024) found that athletes generally valued the personalized training and efficiency of AI-driven coaching technologies. Still, they also expressed concerns about technical issues, data privacy, and a lack of personal touch, emphasizing the importance of user-friendly interfaces and balancing human and AI elements in coaching. Hence, empirical studies suggest that when users perceive fitness apps as protecting their privacy, they report greater trust and comfort, contributing to enhanced well-being by reducing concerns over data security.

H1: The perceived privacy of fitness apps significantly influences individuals' overall well-being.

Perceived Anthropomorphism

Perceived anthropomorphism is the extent to which individuals attribute human-like characteristics, such as emotions or intentions, to nonhuman entities like virtual agents or digital devices (Ghimire et al., 2024; Rai & Dahal, 2024). Anthropomorphism is a trait where humans view nonhuman agents as having human qualities or characteristics (Epley et al., 2007; Martin et al., 2020; Timpano & Shaw, 2013). Schoeppe et al. (2016) found that app-based interventions can improve nutrition, physical activity, and unproductive actions, with multi-component methods exceeding stand-alone app interventions in improving health outcomes. Zhang et al. (2020) found that a model for AI chatbot behavior modification, which promotes relational and persuasive conversational abilities, can successfully facilitate lifestyle interventions that involve raising physical activity and promoting a healthy diet, providing theoretical advice for developing behavior-oriented AI chatbots. Kilic et al. (2023) found that the effectiveness of an argumentation-based digital partner in facilitating behavior change to promote healthy habits is dependent upon its ability to challenge or strengthen users' attitudes, underscoring the importance of customizing the companion's roles and self-confidence to improve user acceptance and interaction results.

Barkley et al. (2020) found that users of fitness applications participated in significantly more physical activity and demonstrated a stronger exercise identity than non-users, with exercise identity as a mediator in the positive correlation between fitness application usage and physical activity behavior. Cai et al. (2022) found that achieving goals motivation is the most essential element affecting continuous behavior in fitness app use, with significant variables being expectation approval, satisfaction, perceived simplicity of use, perceived utility, and trust. Stancu et al. (2022) found that health and fitness app users favor features that promote independence, competence, and connection, such as customizable recommendations, encouraging feedback, and gamification, which boost motivation and engagement. Kim (2022) found that upward social comparison among fitness app users added confidence and inspiration for physical activity, while downward comparison diminished self-esteem. This indicates that fitness app developers should promote comparisons with high achievers to enhance user engagement and participation in physical activities.

Lee and Lin (2023) found that AI-powered mobile fitness apps, through features such as intelligence and metaphor, increase users' intentions to continue using the apps by improving goal specificity and lowering perceived goal difficulty. Lee et al. (2023) found that AI-enabled service quality in mobile fitness applications positively affected

users' choices to continue using the app through many consumption values, including functional, emotional, social, epistemic, and conditional. Xie et al. (2023) found that anthropomorphic messages in AI, particularly emotional and auditory aspects, improve user interaction pleasure by encouraging intimacy and minimizing perceptions of privacy invasion. In contrast, visual signals primarily influence satisfaction indirectly through perceived intimacy. Thus, research has shown that anthropomorphic features in virtual coaches—such as personalized interactions and lifelike responses—can foster a deeper emotional connection, which is associated with increased user satisfaction and overall well-being.

H2: The anthropomorphism of fitness apps has a significant influence on individuals' overall well-being.

Perceived Empathy

Perceived empathy refers to a user's sense that a digital entity, like a virtual coach or app, genuinely understands and shares their emotions or experiences, fostering a supportive and engaging interaction. Papoutsi and Drigas (2017) found that mobile applications possess considerable potential to foster empathy in users, thus improving their capacity to comprehend and engage with others, positively affecting social behavior and overall well-being. Nadarzynski et al. (2019) found that while numerous users are responsive to AI-driven health chatbots, concern about empathy, accuracy, and cybersecurity hinders engagement, underscoring user-centered strategies' need to enhance acceptance and efficiency.

Baretta et al. (2019) found that app functionalities that improve user self-regulation, respond to exercise motivations, and satisfy the need for social connection are significant for initial engagement with physical activity applications. In contrast, customized and anticipatory features are essential for maintaining extended user engagement. Rueda and Lara (2020) found that though virtual reality (VR) can promote empathy via avatar-based form, they argue that ethical considerations require that empathy be directed by reason to guarantee its appropriate utilization. Luhanga et al. (2018) found that users of group fitness applications want both informational and emotional support, with features such as regular challenges improving adherence to fitness behaviors, especially among people who are passive and men. Curtis et al. (2021) found that virtual health advisors improve user experience by expressing empathy, engaging in relational behavior, and self-disclosure, showing that these human-like attributes positively influence user engagement and pleasure. Chauvin et al. (2023) found that a non-directive virtual coach who uses motivational speaking techniques is viewed as more empathic and trustworthy, considerably increasing older persons' confidence and natural desire to engage in physical exercise compared to a directive approach.

Arnone and Verma (2024) found that AI-based methods, such as motion monitoring and virtual coaching, dramatically improve sports performance, physical health, and psychological well-being in people with disabilities, eventually enhancing their overall quality of life. Sun and Yuan (2024) found that augmented reality exercise applications (AREAs) improve user happiness and intention to continue mainly through emotional value, indicating the importance of pleasurable aspects for continuous engagement in fitness environments. Kim (2024) found social support for beneficial and adverse fitness self-presentations on social media. This support helps users feel more confident in their abilities and increases their desire for physical activity. Therefore, findings indicate that perceived empathy in virtual coaches, demonstrated through personalized support and understanding, can significantly boost users' emotional fulfillment, positively influencing their well-being and engagement with fitness routines.

H3: There is a significant influence of perceived empathy of fitness apps on individuals' overall well-being.

This framework outlines the relationships in this research, indicating that different aspects influence the overall well-being of using exercise applications in conjunction.

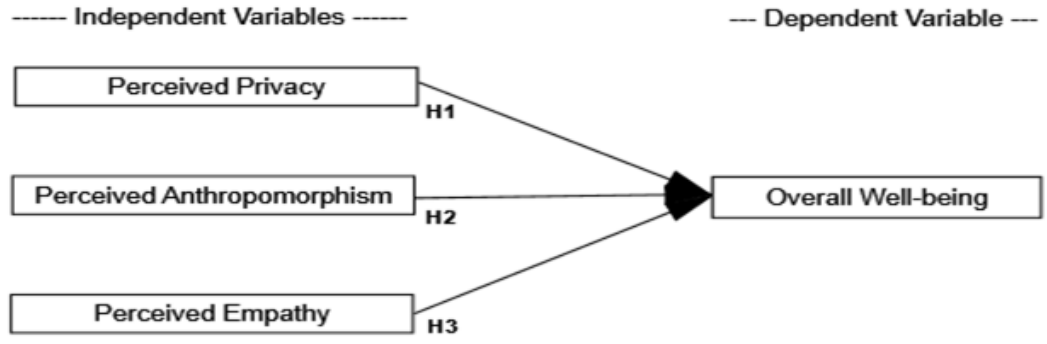

Figure 1 Research Framework

3. Methodology

This research uses a positivist paradigm, focusing on objective measurement and analysis to comprehend the connections among variables. This study employs a descriptive and causal research design to elucidate youth perceptions of virtual coaches in fitness applications and examine the causal relationships between the independent variables of perceived privacy, perceived anthropomorphism, empathy and the dependent variable of overall well-being. Descriptive analysis summarizes the gathered data, while causal analysis examines the influence of each independent variable on overall well-being.

The population for this research consists of young individuals who are members of fitness facilities and are using fitness applications to enhance their health and

fitness regimens. A non-probability, convenience sampling method is used to select participants, assuring accessibility and practicality in data collecting. A sample size of 384 respondents was established to ensure accurate and valid outcomes. The sample size is suitable for extrapolating results to the broader young demographic in fitness facilities, providing knowledge into the attitudes and experiences of fitness app users.

Primary data was gathered by a standardized questionnaire divided into two pieces. Section A gathered demographic data, including age, gender, educational attainment, exercise routines, and the fitness application used. Section B comprises statements that evaluate perceptions of privacy, anthropomorphism, empathy, and general well-being, using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) to measure respondent agreement with each statement. Data was obtained directly from participants via fitness facility surveys or internet platforms aimed at the specified demographic.

This study's instruments include four core variables, each assessed by a particular number of statements, to analyze different elements of the user experience using fitness apps. Perceived privacy consists of four statements to determine users' concerns about data security and the possible exploitation of personal information, such as "I am concerned that the information I provided to the app may be exploited" (Vimalkumar et al., 2021). Perceived anthropomorphism is measured using five statements that assess how users perceive the human-like qualities of AI applications, such as "AI applications communicate naturally" and "I believe AI applications are real and not artificial," based on the works of Balakrishnan et al. (2022), Balakrishnan and Dwivedi (2021), and Bartneck et al. (2009). According to research by Liu-Thompkins et al. (2022) and Pataranutaporn et al. (2023), Perceived Empathy consists of four statements aimed at capturing the emotional connection users feel with the fitness app, such as "I believe the fitness app cares about my progress" and "When I struggle, the app notices and responds." Finally, overall well-being is measured using six phrases from Linton et al. (2016) that highlight the app's influence on users' daily lives and health outcomes, such as "My fitness app empowers me to overcome everyday problems" and "I'm healthier since using the AI fitness app." The research includes 19 statements across various categories, which will be examined to determine their impact on the overall user experience using fitness apps.

Table 1

Details of Statements

Variables	Statements	Mean	SD.	Source

Perceived Privacy	I am concerned that the information I provided to the app may be exploited.	3.54	1.12	Vimalkumar et al. (2021)
	I fear fitness applications will allow others to access my private information.	3.71	1.16	
	I am concerned about sharing personal information with the app.	3.65	1.15	
	I'm concerned that the information I supplied may be used unexpectedly.	3.61	1.11	
Perceived Anthropomorphism	AI applications communicate naturally.	3.65	1.13	Balakrishnan et al. (2022), Balakrishnan and Dwivedi (2021); Bartneck et al. (2009).
	I believe AI applications are real and not artificial.	3.59	1.05	
	AI applications have human-like behavior.	3.52	1.04	
	AI applications seem to be conscious of their behavior.	3.76	.997	
	AI applications seem alive to me.	3.70	1.01	
Perceived Empathy	I think the fitness app cares about my progress.	3.61	1.08	Liu-Thompkins et al. (2022), Pataranutaporn et al. (2023)
	The app captures my fitness journey emotions.	3.68	1.07	
	When I struggle, the app notices and replies.	3.65	1.08	
	I relate to the app's sentiments.	3.70	1.04	
Overall Well-being	My fitness app empowers me to overcome everyday problems.	3.73	1.05	Linton et al. (2016)
	My fitness app keeps me sociable.	3.54	1.06	
	I like my app's exercises.	3.74	1.04	
	I'm healthier since using the AI fitness app.	3.48	1.09	
	AI chatbots improve my spiritual or emotional health.	3.63	1.10	
	My workout app makes me happy.	4.08	.964	

Table 1 examines user opinions of fitness apps based on four significant variables: perceived privacy, anthropomorphism, empathy, and overall well-being. Mean perceived privacy ratings range from 3.54 to 3.71, showing consumers are somewhat concerned about potentially exploiting their personal information, with significant heterogeneity in replies. Perceived anthropomorphism scores range from 3.52 to 3.76, indicating that consumers believe AI apps have human-like qualities and communicate naturally, particularly regarding behavioral awareness. Perceived empathy ratings range from 3.61 to 3.70, suggesting that users feel the app cares about their fitness journeys and understands their emotional problems. Finally, total well-being ratings range from 3.48 to 4.08, demonstrating that fitness applications influence users' lives favorably, especially regarding happiness. The lowest score in the health improvement category indicates there is still opportunity for progress. Users are worried about privacy but value fitness programs' human-like aspects and empathic reactions, which contribute favorably to their well-being.

However, individual experiences may vary significantly.

The research used statistical methods. A descriptive analysis was conducted to summarize demographic characteristics. Correlation analysis was performed. To evaluate the intensity and direction of links, this study examines the relationships between perceived privacy, anthropomorphism, empathy, and general well-being. The research examined the causal effect of perceived privacy, anthropomorphism, and empathy on overall well-being, identifying predictors of well-being among fitness app users using regression analysis. The acquired data was evaluated using IBM SPSS V26 software, which allows for more complete statistical analysis. The study's demographics are as follows:

Table 2

Respondents' Profile

Groups	Nos	%		Groups	Nos	%
Gender				*Age group*		
Male	219	57.0		18 - 25 Years	136	35.4
Female	140	36.5		26 to 39 years	248	64.6
Others	25	6.5				
Education Status				*Types of Fitness Apps Used*		
SLC/+2	39	10.2		Running/Walking Apps	148	38.5
Bachelor's level	149	38.8		Workout Apps	101	26.3
Master's and above	196	51.0		Diet/Nutrition Apps	86	22.4
	196	51.0		Yoga/Meditation Apps	49	12.8
Total of each section	384	100.0		Total of each section	384	100.0

Table 2 presents that most respondents identify as male, followed by female, with a minor percentage identifying as another gender. The age distribution data shows that most respondents are in their late twenties and thirties, with the remainder younger. Respondents' educational levels span from secondary to advanced, with over half having a Master's degree or more. Regarding fitness app preferences, the most popular applications are running/walking apps, followed by workout apps and diet/nutrition apps, with yoga/meditation apps coming in last. Each group is equally represented, with all areas having the same number of responses. The study conducted a reliability

test on the variables to ensure the study's findings were reliable and consistent.

Table 3

Reliability Results

Variables	No. of Statements	Cronbach Alpha
Perceived Privacy (PP.)	4	0.807
Perceived Anthropomorphism (PA)	5	0.791
Perceived Empathy (PE)	4	0.848
Overall Well-being	6	0.776
Total	19	0.932

Table 3 shows good internal consistency across the study's variables, which confirms the measurement scales' robustness (Taber, 2018). The results for Perceived Privacy emphasize its relevance in establishing user trust and comfort with fitness applications. Still, the dependability of Perceived Anthropomorphism implies that virtual coaches' human-like traits may improve user engagement and emotional bonds. Perceived empathy's remarkable internal consistency is important in promoting mental and emotional well-being. The excellent reliability ratings for all variables increase trust in the study's results and conclusions.

4. Presentation and Analysis

This part presents a study's findings, including descriptive results, correlation, regression analysis, and a discussion of the outcomes connected to the research goals.

Descriptive Results

The descriptive analysis presents the major features and trends using mean scores and standard deviations to show user perceptions and engagement levels.

Table 4

Descriptive Results

	N	Minimum (Min.)	Maximum (Max.)	Mean	SD
PP	384	1.00	5.00	3.6296	.90670
PA	384	1.00	5.00	3.6283	.79530
PE	384	1.00	5.00	3.6595	.88621
OWB	384	1.50	5.00	3.6997	.72566

Table 4 shows the descriptive findings for the study's core components, which include perceived privacy, anthropomorphism, empathy, and overall well-being. The findings reveal that the number of responders for each variable remains steady at 384. Scores for perceived privacy vary from one to five, with a mean of three points six, suggesting

that consumers have a generally reasonable opinion. Perceived anthropomorphism has a comparable range and means, indicating that people like the human-like features of virtual coaches. Perceived empathy has a higher mean, indicating a strong emotional connection between users and virtual coaches. Finally, total well-being ratings vary from one point five to five, with the mean suggesting that individuals had a positive view of their well-being. The standard deviations for each indicator indicate varied degrees of agreement among respondents, with total well-being having the most minor variability.

Correlation Results

Correlation analysis examines the links between variables, including their strength and direction, to identify significant associations that may contribute to users' well-being.

Table 5

Relationship Among Dependent and Independent Variables

	Variables	PP	PA	PE	OWB
Pearson Correlation	PP	1			
	PA	.764**	1		
	PE	.647**	.683**	1	
	OWB	.698**	.717**	.723**	1

***. Correlation is significant at the 0.01 level (2-tailed).*

Table 5 shows the significant relationship between perceived privacy, perceived anthropomorphism, and well-being, showing that when users believe their privacy is protected, they are more likely to regard virtual coaches as relatable and human-like. This impression of AI-powered products as trustworthy companions increases user engagement and develops a stronger emotional attachment, resulting in enhanced well-being. The strong relationship between perceived anthropomorphism and perceived empathy suggests that users who find these AI-powered virtual coaches sympathetic are more likely to feel understood and supported. This emotional resonance significantly affects their general well-being, as indicated by the strong correlation between perceived empathy and well-being. These results confirmed that managers may build more engaging and supportive user settings by putting user privacy first and creating AI systems with human qualities and empathic interactions. Such strategic alignment improves user experiences and establishes fitness applications as significant instruments for improving health and well-being in the digital era. There is significance in strategic management strategies that employ AI to build user trust and happiness, redefining the landscape of health and fitness apps.

Regression Analysis

The research examined the causal effect of each independent variable on overall well-being. Using multiple regression approaches, it identified aspects that may improve user happiness and well-being when using fitness applications.

Table 6

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig.
1	.800	.639	.636	.43751	.639	224.547	3	380	.000

Predictors: (Constant), PP, PA, PE

b. Dependent Variable: OWB

Table 6 shows the relationship between these predictors and overall well-being, implying that they account for a significant percentage of the variation in users' well-being. The model has strong explanatory power, indicating that if users' views of privacy, anthropomorphism, and empathy improve, so will their overall well-being. Furthermore, the significant F change statistic verifies the model's statistical validity, emphasizing the relevant influence of these factors on improving users' health and fitness experiences. This shows the important role that well-designed fitness applications may play in facilitating great user experiences and well-being by considering privacy concerns, relevant features, and empathic interactions.

Table 7

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	128.946	3	42.982	224.547	.000[b]
	Residual	72.738	380	.191		
	Total	201.683	383			

a. Dependent Variable: OWB

b. Predictors: (Constant) PP, PA, PE

Table 7 shows that the model is a good fit for analysis. The sum of squares for regression shows that the model explains significant variation, demonstrating its success in

predicting overall well-being. The mean square value for regression shows the average variance explained per predictor, while the residual sum of squares represents the variation that the model does not account for. The F statistic is high, indicating that the model is statistically significant and that the independent variables considerably influence overall well-being. The corresponding p-value is strikingly low, supporting the conclusion that the predictors significantly improve our knowledge of general well-being in the context of fitness app users.

Table 8

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	.956	.109		8.740	.000	.741	1.171		
PP	.199	.040	.248	5.004	.000	.121	.277	.386	2.589
PA	.245	.047	.268	5.180	.000	.152	.337	.355	2.821
PE	.310	.036	.379	8.661	.000	.240	.381	.495	2.019

a. Dependent Variable: OWB

Table 8 shows that all three independent factors significantly affected total well-being, with felt empathy as the strongest predictor. This implies that when virtual coaches provide users with emotional support and understanding, their general well-being improves significantly. Perceived anthropomorphism is strongly related, demonstrating that users who perceive virtual coaches as relevant and human-like report greater well-being. Perceived privacy, although significantly less influential than the other two criteria, is essential, indicating that users who believe their privacy is respected are more likely to have a favorable overall experience. The high t-values and strong p-values demonstrate the stability of these associations, indicating that each predictor makes a substantial contribution to the model. The confidence intervals for each coefficient do not exceed zero, indicating a positive relationship between these parameters and overall well-being. Furthermore, the collinearity statistics, which include tolerance and VIF, show that multicollinearity is not a problem, allowing the unique impacts of each variable to be confidently understood. So, developers may significantly improve users' well-being by creating a helpful and relevant user experience across several dimensions, enabling better lives and greater engagement with fitness technology. This

finding shows the importance of these elements and the revolutionary potential of well-designed AI-driven interactions in the health and fitness field.

5. Discussion

Perceived privacy is essential for consumers' comfort and confidence in fitness applications, contributing to overall well-being. Consistent with Adhikari et al. (2014), the current study reveals that although fitness apps enhance health monitoring, they raise considerable concerns about data privacy, consistent with previous research highlighting the possible hazards to user data security. Rowan and Dehlinger (2014) complement these results by demonstrating that confusing privacy rules impair user trust. Similarly, Lidynia et al. (2018) discovered that privacy concerns reduce app use, emphasizing the need for safe data procedures. However, several recent research contradicts these concerns; Yoon et al. (2023) found that virtual systems in fitness applications improve privacy, boosting trust in at-home usage. As a result, although perceived privacy is essential for well-being, the sector confronts issues balancing user accessibility and data security, emphasizing the need for user-friendly privacy regulations and improved encryption technologies to address security concerns.

Empathy in virtual fitness coaches has been shown to influence user engagement and emotional well-being substantially. Papoutsi and Drigas (2017) reported that empathic app interactions establish supportive relationships that improve well-being. Nadarzynski et al. (2019) verified that user-centered tactics, especially in AI-powered health chatbots, may improve empathy and support, yet constraints exist owing to concerns about accuracy and cybersecurity. In contrast, Rueda and Lara (2020) questioned the ethical issues of empathy in virtual encounters, emphasizing the need for reasoned empathy. This is consistent with Curtis et al. (2021), who found that virtual health advisers increase engagement via sympathetic interactions, resulting in higher user satisfaction. As a result, the current research confirms that perceived empathy in fitness applications may significantly improve well-being by promoting prolonged app use and creating a supportive environment for exercise involvement.

Anthropomorphism, or the attribution of human-like features to virtual coaches, is significant in user pleasure and engagement with fitness applications. The results of Schoeppe et al. (2016) are consistent with the current research, suggesting that anthropomorphic app features increase motivation for health-related behaviors. Similarly, Zhang et al. (2020) discovered that AI-powered, relational chatbots boost user involvement via persuasive behaviors. Kilic et al. (2023) found that anthropomorphic traits encourage behavior modification if tailored to individual requirements. However, Xie et al. (2023) discovered a possible drawback, stating that although emotional and aural cues increase attention, visual signals might sometimes interfere with perceived

privacy. Thus, anthropomorphic components in fitness applications promote user pleasure and well-being by generating interesting and realistic virtual interactions, although privacy concerns need caution in deployment.

6. Conclusion

In conclusion, particularly for young people who depend on virtual coaching to support their health paths, this research reveals a fascinating story about the influence of perceived privacy, anthropomorphism, and empathy in molding the well-being of fitness app consumers. The findings highlight the great importance of empathy and expose it as the most determining factor among the three factors, followed closely by anthropomorphism and privacy. Users feel understood and supported when virtual coaches go beyond simple functionality to provide emotional resonance, enhancing their general well-being and increasing their involvement with exercise technology. The soft, human-like features of humanoid design are also significant. People feel comfortable and connected with digital guides that look like helpful teachers. This link makes them trust each other more and feel like they have a friend, which can turn a simple app exchange into an exciting journey of self-improvement. Adding to more concern, privacy is an essential part of building trust. Knowing that personal information is being kept safe gives people the freedom to participate fully, which is good for their health. The results show that virtual teaching tools can completely change the digital health scene. By adding privacy, empathy, and anthropomorphism to fitness apps, developers can make experiences that help people live better lives and deeply connect with their needs for support, connection, and trust. This study shows that AI-driven teaching can become a real partner in the quest for health. It shows how technology is changing to become a friend and guide to better health in a world that is changing quickly.

7. Future Scope

This study makes it possible to look into how virtual coaches in exercise apps can be improved to make people healthier by learning more about how relationships and emotions work. In the future, researchers could look into other psychological factors, like drive and resiliency, to see how they affect users' happiness and involvement with privacy, empathy, and anthropomorphism. Including people of different ages and national backgrounds, not just young people, would help to understand how these traits affect a larger group of users. Longitudinal studies could also help to learn more about how AI-driven empathy and privacy perceptions change over time. This would help developers make fitness experiences that change based on user's needs and preferences in a world where healthcare is becoming more digital.

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