Original Article

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Digital coaches: an alternative to expert coaches for men's fitness goals

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Abstract: This study compares the impact of training programs developed by an AI-supported application and those designed by personal trainers on specific health-related physical fitness parameters. Male individuals with similar health conditions and fitness goals were randomly assigned to two groups: one that utilized personalized exercise programs generated by OpenAI's GPT-4 model (n=10; age=21.7 years; height=174.45 cm) and another that engaged in training with a personal trainer. The first group (n=10) was trained using an AI-supported application (body weight=77.16 kg), while the second group (n=10) underwent training with a personal trainer (body weight=70.60 kg). Training programsThe training programmes were generated by inputting the subjects' information and commands into the OpenAI GPT-4 model. The personal trainers were provided with the personal information of the other group in order to plan their training sessions. The training programmes for both groups were designed to enhance upper extremity muscle strength and hypertrophy, with sessions lasting 90 minutes, three times a week for 12 weeks. Significant statistical changes ($p < 0.05$) were observed in muscle resistance values (right arm, left arm, right shoulder, left shoulder), body weight, lean body mass, and total body fluid parameters as a result of training with a personal trainer. However, the OpenAI GPT-4 recommendation indicated that the only significant improvement observed in the training group was in left arm muscle resistance ($p < 0.05$), with no significant changes in other parameters ($p > 0.05$). It was therefore concluded that strength and hypertrophy training under the supervision of a personal trainer might be more efficient than individually conducted training supported by artificial intelligence. However, further research with larger sample sizes is needed to establish a definitive conclusion..

Keywords: Artificial Intelligence, ChatGPT, Digital Health, Exercise Optimization, Personal Training

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INTRODUCTION

The significance of physical activity has been more fully appreciated recently as a consequence of the chronic ailments that are increasingly being attributed to lifestyles that are characterised by a lack of physical exertion [1-4]. Technological tools and advancements are frequently employed to facilitate the adoption of an active lifestyle at any time and in any location. The application of science and technology has grown in significance over time, exerting a profound influence on human existence across a multitude of domains. One such advancement is that of artificial intelligence (AI) technology [5]. Artificial intelligence (AI) is a technology that is increasingly being utilised in the sports sector, as it is in many other areas. The AI assistants in use include applications such as Chat GPT, Copilot AI, Google Bard, Jasper, Cortana, and IBM Watson [6-14]. The utilisation of AI and computational intelligence (CI) algorithms in the domain of sports presents considerable potential, particularly in the context of training session planning and analysis [15]. The objective of AI-powered exercise applications is to assist users in exercising in a healthy and effective manner. Some of the applications powered by AI that are currently in use in this field include those that provide personalised workout plans, offer real-time feedback, track progress, provide adaptive training, act as virtual personal trainers, offer AI-powered yoga and Pilates, provide HIIT workouts, offer strength training programmes, provide cardio workouts, and offer flexibility and stretching programmes [16]. In the field of sports, AI applications are employed in a number of areas, including performance analysis, data processing and prediction, training programmes, game analysis and strategy development, injury prevention, and referee decisions. Artificial intelligence has the potential to design personalised training programmes that are tailored to the specific characteristics and abilities of individual athletes, with the objective of aligning their training with their personal goals. The analysis of data allows for the organisation of training sessions that are more effective and efficient, enabling the identification of athletes' strengths and weaknesses [17-21]. However, it should be noted that there are also potential disadvantages associated with the use of artificial intelligence applications. The overuse of artificial intelligence gives rise to concerns about the diminishing role of educators and coaches.

The role of the human factor in any given situation is always of critical importance. In the context of sports education, it is of paramount importance to verify information through the utilisation of the guidance and experience of coaches and experts. The inappropriate application of artificial intelligence in certain processes has the potential to negatively impact the health and careers of individuals engaged in sports [22,23]. A study reported that while GPT-4 has a wealth of online information when designing exercises, it may prefer newer, updated methodologies over more reliable and valid traditional practices, which can lead to negative outcomes [25].

Based on this background, our research investigates the impact of AI-generated exercise programs, such as those derived from ChatGPT-4, compared to those designed and supervised by personal trainers on participants' physical fitness. This study aims to evaluate the potential of ChatGPT-4 in daily exercise routines, providing a concrete comparison of its advantages and limitations in improving fitness outcomes.

MATERIAL AND METHODS

Characteristics of the studied groups

Prior to the commencement of the study, the participants were provided with the requisite information regarding the exercises and test protocols, and the informed consent forms were duly completed and submitted. The study population was defined as male, aged between 18 and 25 years, with no chronic illnesses or musculoskeletal disorders, a normal resting heart rate, no medical conditions that would prevent participation in exercise, similar baseline body composition values (height and body weight), a balanced level of initial muscle strength and endurance, and the goal of improving upper extremity muscle strength and hypertrophy. Additionally, participants were required to have not participated in a regular exercise program within the last three months. Individuals with comparable baseline health parameters (i.e., no chronic illnesses, normal resting heart rate, and similar body composition) and aligned fitness objectives (i.e., improving upper extremity muscle strength and hypertrophy) were randomly divided into two groups: one using personalized exercise programs generated by OpenAI's GPT-4 model (n = 10; age = 21. The first group comprised individuals aged 18 to 25 years (mean age ± standard deviation: 21.34 ± 1.34 years), with a mean height of 174.45 ± 8.29 cm and a mean body weight of 77.16 ± 19.86 kg. The second group trained with a personal trainer (mean age ± standard deviation: 21.61 ± 1.43 years), with a mean height of 176.81 ± 6.26 cm and a mean body weight of 70.60 ± 12.91 kg.

Ethics

The study was conducted in accordance with the ethical standards of the Helsinki Declaration and was approved by the Ethics Committee at Bartın University (protocol number 2024-SBB-035).

A general description of training protocols

Prior to the commencement of the study, both groups underwent a series of assessments to determine their maximal muscle strength and individual characteristics. These assessments were conducted using standardised strength testing protocols, which included one-repetition maximum (1RM) tests for key upper extremity exercises, such as the bench press and shoulder press. The training programme for the GPT-4 group was generated by inputting specific participant information into the OpenAI GPT-4 model. The data set comprised the following variables: age, height, body weight, baseline maximal strength values, and fitness goals focused on enhancing upper extremity muscle strength and hypertrophy. The model was prompted to create a progressive overload-based 12-week programme with consistent weekly progression through the use of commands.

In the case of the personal training group, the trainer was furnished with the same participant information in order to devise bespoke exercise routines. The training programmes for both groups were designed to enhance upper extremity muscle strength and hypertrophy, with each session lasting 90 minutes, three times a week. Over the course of the 12-week study period, the GPT-4 group adhered to the same training programme without any modifications to the maximal values. In contrast, the personal training group underwent reassessment of their maximal values at four-week intervals, with the training programme adjusted accordingly to ensure continued progression.

Tests and measurements of maximal muscle groups force

The measurements of the upper extremity muscle groups (dorsal, chest, forearm, arm, scapula) were recorded twice for each participant, once prior to the commencement of the study and again after a 12-week period. Maximal strength (1RM) was assessed using a standard incremental loading protocol, as described by [26]. At the outset of the exercise, the participants engaged in a series of preparatory sets. The warm-up set commences with eight to ten repetitions at 50% of the participant's estimated one-repetition maximum (1RM). Subsequently, the participants performed three to five repetitions at an intensity of 70 to 80% of their estimated one-repetition maximum (1RM). Subsequently, the weights were incrementally increased until the maximum weight that the participant could lift for a single repetition was reached. A rest interval of between three and five minutes was permitted between each attempt, allowing for muscle recovery [27]. Muscle resistance was assessed using the Lafayette manual muscle testing device

[28,29], while body fat and muscle percentages were determined with the TANITA BC410 [30]. Height and weight were measured with a SECA stadiometer-integrated scale [31].

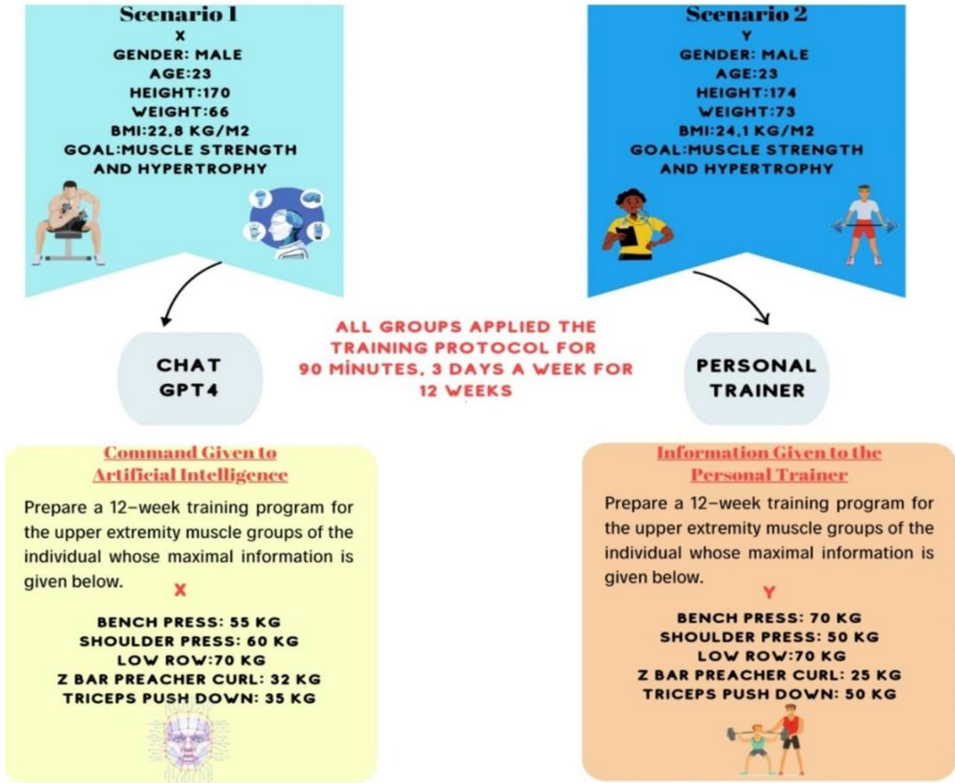

Figure 1. Information used in the preparation of the training program of artificial intelligence and personal trainer [designed by the authors].

Table 1. Upper Extremity Training Program Designed by OpenAI-GPT-4.

Day 1	Day 2	Day 3
Chest and Triceps Machine Bench Press (1 Rm 55 kg) Set 1: 70% x 8 (385 kg) Set 2: 75% x 6 (41 kg) Set 3: 80% x 5 (44 kg) Set 4: 85% x 4 (47 kg) Set 5: 90% x 3 (495 kg)	Shoulder and Back Machine Shoulder Press (1 Rm 60 kg) Set 1: 70% x 8 (42 kg) Set 2: 75% x 6 (45 kg) Set 3: 80% x 5 (48 kg) Set 4: 85% x 4 (51 kg) Set 5: 90% x 3 (54 kg)	Biceps ve Triceps Barbell Curl (1 Rm 40 kg) Set 1: 70% x 10 (28 kg) Set 2: 75% x 8 (30 kg) Set 3: 80% x 6 (32 kg) Set 4: 85% x 4 (34 kg) Set 5: 90% x 3 (36 kg)
Triceps Pushdown (1 Rm 35 kg) Set 1: 70% x 10 (245 kg) Set 2: 75% x 8 (26 kg) Set 3: 80% x 6 (28 kg) Set 4: 85% x 4 (30 kg) Set 5: 90% x 3 (315 kg)	Machine Low Row (1Rm 70 kg) Set 1: 70% x 10 (49 kg) Set 2: 75% x 8 (525 kg) Set 3: 80% x 6 (56 kg) Set 4: 85% x 4 (595 kg) Set 5: 90% x 3 (63 kg)	Triceps Dips (1Rm 70 kg) Set 1: 70% x 10 (49 kg) Set 2: 75% x 8 (525 kg) Set 3: 80% x 6 (56 kg) Set 4: 85% x 4 (595 kg) Set 5: 90% x 3 (63 kg)
Z Bar Preacher Curl (1 Rm 32 kg) Set 1: 70% x 10 (225 kg) Set 2: 75% x 8 (24 kg) Set 3: 80% x 6 (255 kg) Set 4: 85% x 4 (27 kg) Set 5: 90% x 3 (29 kg)	Dumbbell Lateral Raises (1Rm 20) Set 1: 70% x 10 (14 kg) Set 2: 75% x 8 (15 kg) Set 3: 80 % x 6 (16 kg)	Lying Crunches (own body weight) 3 set x 12-15 repetitions 2-3 minutes rest between each set

1Rm: one-repetition maximum; OpenAI. [25]

Table 2. Training program implemented by a personal trainer (Maximal strength was measured twice, at four-week intervals, and the training programs were revised accordingly; Rest between sets: 45 sn./Rest between series: 2 dk./cool douwn: 10 dk.)

Workout exercises	general warm-up	special warm-up	Set 1 (%70)	Set 2 (%80)	Set 3 (%85)	Set 4 (%90)	Set 5 (%100)
Barbell Bench Press (1Rm 70 kg)	Jogging 10 minutes Stretching 5 minutes	20kg x12	49kg x10	56kg x8	59.5kg x6	63kg x4	70kg x1
Low Row Machine (1Rm 70 kg)		20kg x12	49kg x10	56kg x8	59.5kg x6	63kg x4	70kg x1
Z Bar Preac. Curl (1 Rm 25 kg)		10kg x12	17.5kg x10	20kg x8	21kg x6	22.5kg x4	25kg x1
D. Shoulder Press (1Rm 50 kg)		5kg x16	35kg x10	40kg x8	42.5kg x6	45kg x4	50kg x1
Triceps Push Down (1 Rm 50 kg)		20kg x12	35kg x10	40kg x8	42.5kg x6	45kg x4	50kg x1

Training Program Derived from OpenAI's GPT-4 Model

A strength and hypertrophy training plan was devised in accordance with the instructions provided to OpenAI's GPT-4 model, with due consideration of the distinctive attributes of the participants. To ensure consistency across all participants, key parameters were defined. The GPT-4 model was instructed to define the variables pertinent to the training programme, including the type, intensity and progression of the training. The commands provided to the GPT-4 model, along with the parameters and the structure of the training plan, are presented in detail in Figure 1. The following table presents a one-week training programme designed for subject X.

Personal Training

The training programme has been developed by a certified fitness trainer with expertise in the field of training programmes. In the design of the training programmes, consideration was given to the individual characteristics of the participants in order to create a plan that would result in the desired outcomes of muscle strength and hypertrophy. The following table presents a one-week training programme designed for subject Y. Prior to the commencement of the training sessions, participants were required by the trainer to provide a document attesting to the fact that they had undergone a medical examination and to sign consent forms indicating their agreement to participate in the training sessions. Moreover, the participants were informed by the trainer that they should refrain from engaging in any physical activity other than the programme designed for them for a period of 12 weeks.

Statistical Analysis

The data obtained in the course of the research were subjected to analysis using the SPSS 26.0 package program. The initial step involved examining the skewness and kurtosis values to ascertain whether the data exhibited a normal distribution. As the values fell within the range of +2 and -2 [32], it was concluded that the data exhibited a normal distribution. A paired sample t-test was employed to examine the pre-test and post-test values of the groups.

RESULTS

The results from both groups in the study are presented in the tables below. Table 3 presents the pre-test and post-test values of individuals who underwent an AI-assisted training plan. The results demonstrated a statistically significant improvement in the left arm muscle resistance strength parameter ($p < 0.05$), while no significant changes were observed in the other parameters ($p > 0.05$).

Table 4 presents the pre-test and post-test values of individuals following a training plan with personal training. The results demonstrate statistically significant differences in the values of participants for muscle resistance (right-left arm, right-left shoulder), body weight, lean body mass, and total body fluid. The effect size of this significance over time is considered large (Cohen's d: >0.8).

Table 3. Paired Sample T-Test Results for the Comparison of Pre-Test and Post-Test of the AI-Supported Training Plan (n=10)

Variable	Pre-Test	Post-Test	t	p	*d*
	Mean ± sd	Mean ± sd			
Body Weight (kg)	77.16 ± 19.86	79.19 ± 22.54	-1.700	0.123	-
General Fat Percentage (%)	13.30 ± 6.23	13.97 ± 7.11	-0.588	0.571	-
Body Mass Index (kg/m^2)	24.81 ± 4.53	25.19 ± 5.29	-0.952	0.366	-
Fat Mass (kg)	11.18 ± 8.75	12.33 ± 10.92	-1.011	0.338	-
Lean Body Mass (kg)	65.66±12.02	66.83±12.83	-1.054	0.319	-
Total Body Fluid (kg)	48.06±8.80	48.94±9.39	-1.083	0.307	-
Right Arm Fat Percentage (%)	12.92±4.09	13.54±4.90	-0.604	0.561	-
Left Arm Fat Percentage (%)	14.06±4.40	14.77±5.53	-0.522	0.615	-
Trunk Fat Percentage (%)	12.80±7.09	14.15±8.18	-1.223	0.252	-
Right Arm Muscle Strength (kg)	20.83±4.28	22.05±3.77	-1.609	0.142	-
Left Arm Muscle Strength (kg)	20.31±3.80	22.99±4.05	-5.843	<0.001	-1.84
Right Shoulder Muscle Strength (kg)	24.12±4.57	26.96±4.35	-1.833	0.100	-
Left Shoulder Muscle Strength (kg)	23.47±4.39	25.76±3.29	-1.532	0.160	-
Right Hand Grip Strength (kg)	48.62±12.22	48.94±9.18	-0.157	0.879	-
Left Hand Grip Strength (kg)	46.08±9.54	51.90±9.93	-1.879	0.093	-
Back Strength (kg)	138.25±20.82	137.51±17.36	0.215	0.834	-

d - Cohen effect size; $p<0.05$

Table 4. Paired Sample T-Test Results for Pre-Test and Post-Test Comparison of Training Conducted by Personal Trainers (n=10)

Variable	Pre-Test	Post-Test	t	p	d
	Mean ± sd	Mean ± sd			
Body Weight (kg)	70.60± 12.91	73.36±14.84	-3.672	0.004	-1.10
General Fat Percentage (%)	13.72± 6.03	13.30± 6.13	0.540	0.601	-
Body Mass Index (kg/m^2)	21.70±5.69	22.85± 3.98	-1.190	0.261	-
Fat Mass (kg)	10.36± 6.45	10.36± 6.89	0.000	1.000	-
Lean Body Mass (kg)	61.10± 8.00	63.00± 8.85	-2.770	0.020	-0.83
Total Body Fluid (kg)	44.72± 5.87	46.10± 6.48	-2.732	0.021	-0.80
Right Arm Fat Percentage (%)	14.86± 4.25	14.17± 3.75	0.890	0.395	-
Left Arm Fat Percentage (%)	15.71± 4.98	14.70±4.02	1.157	0.274	-
Trunk Fat Percentage (%)	13.86± 6.40	13.28± 6.67	0.609	0.556	-
Right Arm Muscle Strength (kg)	18.08± 3.24	22.15± 3.78	-3.615	0.005	-1.09
Left Arm Muscle Strength (kg)	18.60± 3.24	22.21± 3.38	-5.149	0.000	-1.04
Right Shoulder Muscle Strength (kg)	24.85± 3,25	30.54± 3.27	-4.890	0.001	-1.55
Left Shoulder Muscle Strength (kg)	24.38± 3.70	29.83± 5.80	-2.501	0.031	-1.49
Right Hand Grip Strength (kg)	44.37± 5.88	43.53± 6.60	0.498	0.629	-
Left Hand Grip Strength (kg)	42.31± 7.42	43.56± 7.69	0.821	0.431	-
Back Strength (kg)	118.09± 27.85	123.86± 23.09	-1.155	0.275	-

d - Cohen effect size; $p<0.05$

DISCUSSION

The question of whether AI-based applications can supplant the role of personal trainers and fitness coaches has recently been the subject of debate. There is currently insufficient experimental research to ascertain whether fitness programmes generated by AI (such as OpenAI's GPT-4) and applied individually can provide benefits comparable to those achieved through guided training with a personal trainer.

In the present study, the 12-week results of the group that underwent individualised training using the OpenAI GPT-4 model, which was entered with subject information and requests, were evaluated. It was observed that only the left arm muscle resistance strength exhibited a significant improvement ($p < 0.05$). Significant statistical changes ($p < 0.05$) were observed in the parameters of muscle resistance (right-left arm, right-left shoulder), body weight, lean body mass, and total body fluid among participants who completed the entire process with a personal fitness trainer. In a related study, Dergaa et al. [24] asserted that fitness trainers possess a distinct advantage over contemporary artificial intelligence technology in facilitating substantial physiological adaptations and health benefits, largely due to their capacity to adapt and personalise exercise regimens in real-time. The same study highlighted that exercise prescriptions developed by GPT-4 could support individuals with average fitness levels in maintaining their current health status. However, it was found that these were insufficient to provide the necessary stimuli for significant improvements in health or fitness. Furthermore, it was concluded that they could not replace expert experience in exercise prescription. Similarly, another study reported that while ChatGPT could generate AI-created training protocols for beginner and intermediate exercise programming, minor manual adjustments by experts were necessary for high-quality training protocols [33]. Another study has proposed that exercise programmes generated by artificial intelligence must undergo comprehensive review to ensure their validity and reliability, and be aligned with established exercise science principles and individual health requirements [34]. Similarly, the necessity of integrating artificial intelligence with experts such as doctors and trainers has been emphasised in order to further optimise its use in fitness [35].

It has also been observed that individuals lacking prior experience in performing squats or bench presses should be instructed in these movements under the guidance of an experienced personal trainer [36]. In a separate study, it was demonstrated that hybrid exercise programs developed by artificial intelligence and experts had a beneficial impact on muscle mass and function in adults [37]. Another study reached the conclusion that multi-component activities (such as mobile applications, expert trainers, etc.) were more effective in promoting physical activity than mobile application-based exercise activities alone [38]. The results of the studies were found to be consistent with our findings, indicating that training conducted with the guidance of a personal trainer yielded more successful outcomes. The findings of the literature review and the results of the present study indicate that although fitness programs generated by artificial intelligence generally offer safe recommendations, they lack the personalisation, creativity, and variability that a fitness expert can provide [24].

Despite the considerable advances in technology, it appears that it is not yet possible to entirely supplant human expertise in exercise prescription with artificial intelligence systems. To illustrate, a fitness expert can take into account an individual's fluctuating energy levels and modify the intensity of exercises accordingly to maintain motivation and prevent burnout. This comprehensive approach enables trainers to implement modifications specific to each individual's requirements, a capability that is not currently available in artificial intelligence. Therefore, personal training provides a level of personalisation and creativity that is not achievable with the plans generated by artificial intelligence [24].

Furthermore, the pre-test and post-test results of the programme generated by artificial intelligence were not statistically significant, with the exception of one parameter. Nevertheless, the results indicated a numerical upward trend. In accordance with the aforementioned findings, a study has demonstrated that a 12-week AI-driven lifestyle modification programme, comprising physical activity and dietary alterations, has resulted in quantifiable enhancements in body composition [39]. Another study indicated that AI-assisted interventions, such as mobile applications, recommendation systems, and chatbots, had a positive impact on physical activity and fitness levels. The results of the researchers' studies are in alignment with our findings.

It has been proposed that greater standardisation and consistency are required in the context of applications such as ChatGPT [41,42]. While AI can facilitate the planning of exercise routines, it is imperative that training programmes are subject to review by qualified fitness professionals and that exercises are conducted under their guidance.

In conclusion, the evidence suggests that strength and hypertrophy training conducted under the supervision of personal trainers may be more efficacious than individually conducted training supported by artificial intelligence. Nevertheless, further extensive research involving larger participant groups is required to establish a definitive conclusion.

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