

Artificial intelligence in sport: Exploring the potential of using ChatGPT in resistance training prescription

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ABSTRACT: OpenAI's Chat Generative Pre-trained Transformer (ChatGPT) technology enables conversational interactions with applications across various fields, including sport. Here, ChatGPT's proficiency in designing a 12-week resistance training programme, following specific prompts, was investigated. GPT3.5 and GPT4.0 versions were requested to design 12-week resistance training programmes for male and female hypothetical subjects (20-years-old, no injury, and 'intermediate' resistance training experience). Subsequently, GPT4.0 was requested to design an 'advanced' training programme for the same profiles. The proposed training programmes were compared with established guidelines and literature (e.g., National Strength and Conditioning Association textbook), and discussed. ChatGPT suggested 12-week training programmes comprising three, 4-week phases, each with different objectives (e.g., hypertrophy/strength). GPT3.5 proposed a weekly frequency of ~3 sessions, load intensity of 70-85% of one repetition-maximum, repetition range of 4-8 (2-4 sets), and tempo of 2/0/2 (eccentric/pause/concentric/'pause'). GPT4.0 proposed intermediate- and advanced programme, with a frequency of 5 or 4 sessions, 60-90% or 70-95% intensity, 3-5 sets or 3-6 sets, 5-12 or 3-12 repetitions, respectively. GPT3.5 proposed rest intervals of 90-120 s, and exercise tempo of 2/0/2. GPT4.0 proposed 60-180 (intermediate) or 60-300 s (advanced), with exercise tempo of 2/1/2 for intermediates, and 3/0/1/0, 2/0/1/0, and 1/0/1/0 for advanced programmes. All derived programmes were objectively similar regardless of sex. ChatGPT generated training programmes which likely require additional fine-tuning before application. GPT4.0 synthesised more information than GPT3.5 in response to the prompt, and demonstrated recognition awareness of training experience (intermediate vs advanced). ChatGPT may serve as a complementary tool for writing 'draft' programme, but likely requires human expertise to maximise training programme effectiveness.

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INTRODUCTION

Generative Pre-training Transformer (GPT) from OpenAI is a language model that attracted 1 million users within 5 days of launching the free model 3.5 (GPT3.5) on November 30, 2022 (<https://openai.com/>). Its paid successor, GPT4.0, launched on March 14, 2023 (<https://openai.com/>), enhanced its suitability for tasks requiring advanced reasoning. Based on Natural Language Processing, GPT generates human-like conversations through applications (chatbots or ChatGPT), providing contextually accurate responses to users' inputs [1]. As such, ChatGPT has the potential to offer support in various fields, including academia and sport [2].

In academia, chatbots may serve as a "research assistant" to generate ideas, receive feedback, and summarise literature [2, 3, 4]. In

sports, ChatGPT can produce training prescriptions, including plans, suggestions, and performance feedback based on specified information [2]. This is particularly useful in situations like Coronavirus disease 2019, where training support may be scarce [5]. In preparing training programmes, coaches utilise books, scholarly articles, and online resources [6]. Yet, the wealth of information, coupled with biases inherent in diverse data sources (e.g., erroneous conclusions or perceptions), remains challenging and time consuming to navigate. Globally, GPT technologies appear to offer an increasingly popular approach to streamlining such information gathering and synthesis. However, reported examples of its use in sport and exercise are scarce [2, 3].

Pre-trained on a large corpus of online data, the accuracy of ChatGPT in exercise prescription is not fully understood [7]. Such limitations must be recognised before the replacement of human intelligence can be countenanced in this area, through widespread adoption across the general population. Thus, this ‘short communication’ aimed to (i) explore and inform readers about ChatGPT technology in sports and exercise, (ii) highlight the potential use of ChatGPT for exercise prescription in resistance training, and (iii) compare the resistance training programmes designed by GPT3.5 and GPT4.0 in a hypothetical male and female participant.

MATERIALS AND METHODS

In this study, we assessed ChatGPT’s ability to prescribe training for hypothetical individuals characterised as either intermediate (moderately resistance-trained) or advanced (well resistance-trained) via a series of prompts. The training programmes proposed by ChatGPT were carefully compared with authoritative literature, including the textbook of the National Strength and Conditioning Association (NSCA) and various review papers. The authors had expertise in sports science and exercise prescription; possessed strength and conditioning

qualifications; and had 10–20 years of experience in designing and assessing resistance training programmes for athletes of varying experience levels, ranging from adolescent to Olympic. These backgrounds may add a valuable perspective to the appraisal (Table 1).

Exercise prescription using ChatGPT

Separately, we requested GPT3.5 and GPT4.0 (July 20, 2023 versions; OpenAI, L.L.C., San Francisco, CA, USA) to provide a 12-week resistance training programme to develop muscular strength, i.e., intermediate-level training programmes (abbreviated as GPT3.5 and GPT4.0_{INT} for each version, respectively). Technologies auto-generated texts based on three prompts (Figure 1). The texts (training programmes) generated by ChatGPT were transformed or condensed (manually) into table format to facilitate review and appraisal (supplementary file 1 [S1], and supplementary file 2 [S2]). Our preliminary prompts yielded comparable recommendations for both the male and female; therefore, we only report male responses in this brief report. Subsequently, we asked GPT4.0 to create an advanced training programme (GPT4.0_{ADV}) for the same participants, using the same prompts except for the training level (Figure 1).

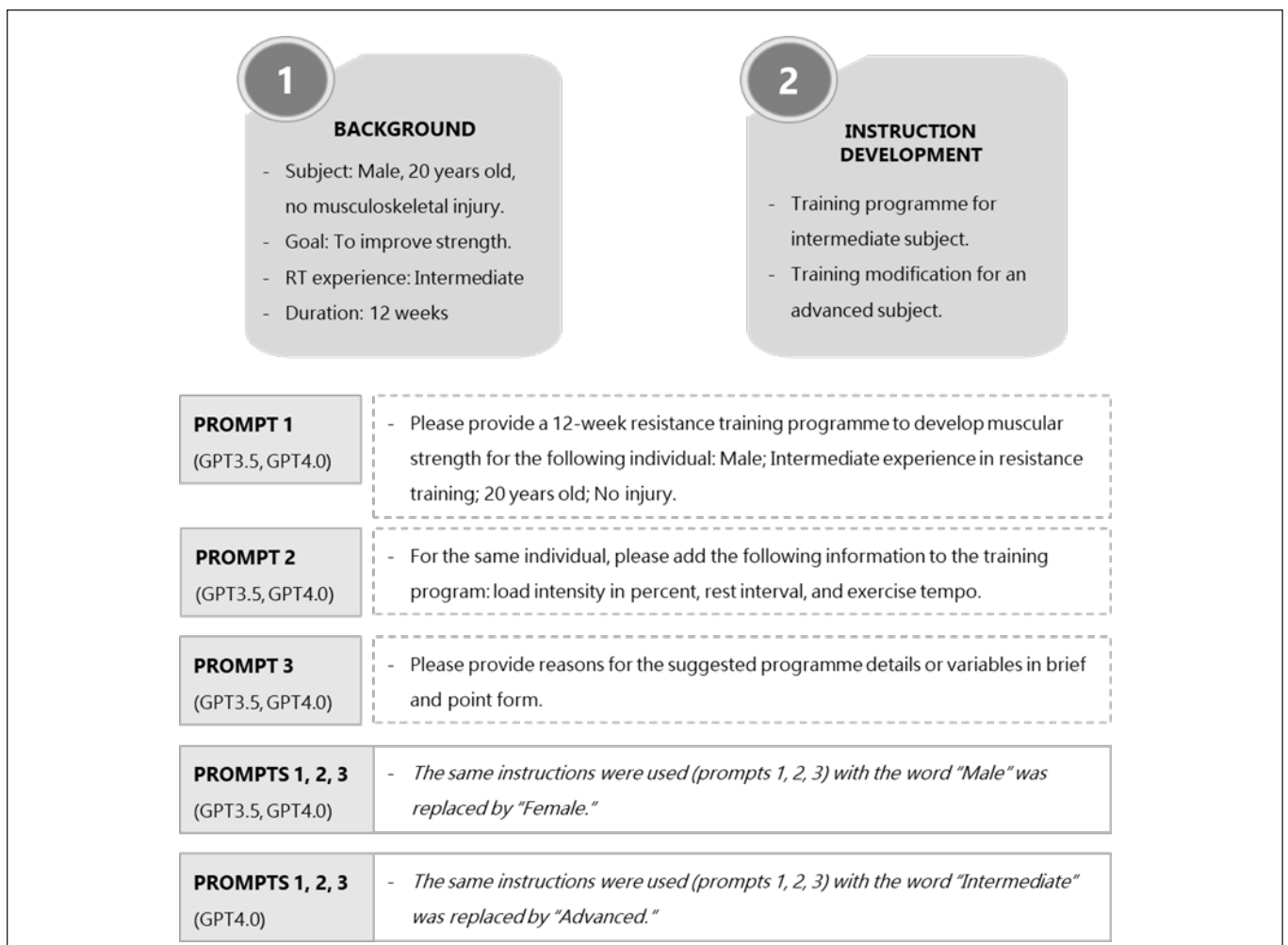





FIG. 1. Prompts or instructions used to generate training programmes for intermediate (GPT3.5 and GPT4.0_{INT}) and advanced (GPT4.0_{ADV}) resistance training in male and female subjects.

TABLE 1. Summary of the appraisal between and ChatGPT generated training programmes and scientific literature

	 GPT 3.5 INTERMEDIATE	 GPT 4.0 INTERMEDIATE	 GPT 4.0 ADVANCED
Programming			
Exercise selection	Moderate	Moderate	Moderate
Weekly frequency	Strong	Strong	Strong
Load intensity	Strong	Strong	Strong
Set and repetition	Moderate	Strong	Strong
Tempo	Moderate	Moderate	Moderate
Rest interval	Weak	Strong	Strong
Principles			
Progressive overload	Strong	Strong	Strong
Variation	Strong	Strong	Strong
Specificity	Moderate	Moderate	Moderate
Recovery	Moderate	Moderate	Strong
Strategies			
Weekly routines	Strong	Strong	Strong
Contemporary practices	Weak	Weak	Weak

Note: Ratings are classified as ‘strong’, ‘moderate’, or ‘weak’, which are assigned by considering the appropriateness and completeness of how particular variables are integrated within the overall programme, including the degree to which the variables align with established scientific standards and practices.

RESULTS

A summary of ChatGPT’s responses (Table 1), the requested 12-week resistance training programmes (S1) and reasoning (S2), are provided. Briefly, both GPT3.5 and GPT4.0 proposed three periodised phases of training (foundation *and* high volume; strength building *and* moderate volume/high intensity; and intensification *and* low volume/very high intensity) lasting 4 weeks. The advanced programme

also utilised 4-week phases, but proposed block periodisation (accumulation, intensification, and realisation). Preliminary analysis specific to “female prompts” revealed objectively similar training recommendations for both male and female participants.

For (i) *exercise selection and structure*, ChatGPT recommended exercises in two (GPT3.5 and GPT4.0_{ADV}) or three (GPT4.0_{INT}) exercise groups, using a split-routine approach. For (ii) *training*

frequency, ~3 sessions/week (GPT3.5), 4 sessions/week (GPT4.0_{ADV}), and 5 sessions/week (GPT4.0_{INT}), were proposed. For (iii) load intensity, GPT3.5 (70–75% to 75–80% to 80–85%), GPT4.0_{INT} (60–70% to 70–80% to 80–90%), and GPT4.0_{ADV} (70–80% to 80–90% to 90–95%) provided subtly different progressions. For (iv) sets and repetitions, GPT3.5 proposed 2–4 sets and 4–8 repetitions for most exercises, while GPT4.0_{INT} and GPT4.0_{ADV} proposed 3–5 sets and 5–12 repetitions, and 3–6 sets and 3–12 repetitions, respectively. For (v) exercise tempo, the ‘pause’ duration between eccentric and concentric phases differed in GPT3.5 (2/0/2), GPT4.0_{INT} (2/1/2), and GPT4.0_{ADV} (3/0/1/0, 2/0/1/0, and 1/0/1/0, in each phase). For (vi) rest interval, GPT3.5 proposed predominantly between 90–120-s, while GPT4.0_{INT} proposed 60–90-s (for high repetition exercise), 90–120-s (medium repetition), and 2–3-min (low-medium repetitions). In comparison, GPT4.0_{ADV} proposed 60–300-s rest intervals depending on training phase and exercise (main vs supplementary).

DISCUSSION

ChatGPT generated relevant content for resistance training programming (Table 1). GPT3.5, GPT4.0_{INT} and GPT4.0_{ADV} proposed three 4-week phases (S1). Some subtle differences were observed between the responses in terms of exercise variables such as exercise selection, frequency, repetitions, and intensities. GPT4.0 (intermediate and advanced) provided additional information, reflecting a better understanding of training prescription. Furthermore, GPT4.0 was adept in tailoring training programmes to accommodate different resistance training competency levels. The generated training programmes generally considered training principles (e.g., progressive overload and variation), comparable with information contained within established guidelines and peer-reviewed resources, and articulated using standard academic language. These outputs indicated some degree of appropriate prioritisation by the technology, in terms of sourcing information.

Manipulation of volume and load intensity are key considerations in designing resistance training programmes [8] and exercise volume-induced changes in steroid hormones like testosterone and cortisol also influence strength gains [9, 10]. It is encouraging that both ChatGPT versions proposed three training phases with varying foci regarding training variables to facilitate strength development [11]. ChatGPT also incorporated both ‘main’ and ‘supplementary’ exercises, while proposing appropriate exercises that targeted major muscle groups, such as upper and lower body push-pull variations, which can stimulate hormonal responses that in turn facilitate muscular growth and strength [12]. ChatGPT also employed a split-routine to target specific muscle groups on separate days, a common practice in strength training [12]. The advanced programme proposed a block periodisation, which is common practice for well-trained individuals [12] and included unilateral (for engagement of stabilising muscles) and loaded bodyweight exercises. These routines and strategies adhere to the training principles (e.g., progressive overload,

variation, specificity) that allows a training stimulus to remain optimal over time [12]. This prescription offers end-user more comprehensive and relevant information when prompted appropriately.

ChatGPT generally recommended 3–5 sessions of resistance training in a week (S1). GPT4.0_{ADV} stated that “four training sessions provides a balance between training volume and recovery for an advanced trainee” (S2). Higher training frequency (≥ 3 sessions/week) augments total weekly training volume, and positively impacts muscular strength [13]. The NSCA recommends 3–4 sessions/week for intermediate and 4–7 sessions/week for advanced trainers [12]. This frequency provides sufficient time for recovery and adaptation, whilst optimising hypertrophy and strength [14, 15]. Interestingly, only GPT4.0_{ADV} considered “active recovery” sessions, citing the promotion of blood flow and removal of waste products (S2). GPT models showed variable load intensity prescriptions, ranging from 60–95% (S1) to allow “proper progressive overload” (S2), with loads varied in main/supplementary exercises. These recommendations are aligned with conventional resistance training [12] but omit emerging trends like low-load prescriptions ($< 60\%$) or blood flow restriction for muscle hypertrophy [8]. Varying repetition ranges for exercises were recommended by different versions of GPT, which generally, aligned with established research on muscle hypertrophy and strength development [12]. For example, the proposed heavy loads ($> 85\%$) with fewer repetitions were specific to achieve training goals (e.g., maximal strength) (S1). Depending on the stated objective, GPT4.0_{ADV} proposed medium repetitions during the initial training period (accumulation), reducing to low-medium during “intensification”, and low during “realisation” phase. GPT3.5 proposed low-medium range repetitions (4–8 reps) for most exercises, while GPT4.0_{INT} proposed a relatively medium range (5–12 reps). Medium repetition ranges (e.g., 6–12 reps) may facilitate hypertrophy, and lower repetitions (e.g., 1–6 reps) enhance strength [12]. ChatGPT proposed a multiple-set system tailored to an individual’s training level for optimal strength gains (S1). Indeed, intermediate-level individuals benefit from a medium weekly dosage of 5–9 sets, while advanced individuals benefit from both medium and high (≥ 10 sets) weekly sets [14].

GPT4.0_{ADV} recommended additional volume and eccentric loading to enhance hypertrophy and prepare muscle tissues for heavier loads. Indeed, muscular strength can be optimised through training volume and “time under tension” or tempo [13, 16, 17]. As exercise tempo can affect training volume [14], differences in total time under tension, [e.g., 2/0/2 (GPT3.5) and 3/0/3/0 (e.g., GPT4.0_{ADV})] can possibly impact movement and influence training adaptation. Even though both eccentric and concentric training are necessary to optimise hypertrophy [8], current evidence supports strength training protocols with medium eccentric and fast concentric actions (e.g., 2-4/0/1/0) for optimising dynamic strength development in trained and untrained individuals [18]. ChatGPT did provide a debatable assertion that “muscle damage is a key driver for hypertrophy” (S2). These responses again reinforce the importance of human interpretation of responses, prior to application.

Prescribed rest intervals reflected the specific training goals (S1). For example, GPT4.0 (intermediate and advanced) contained appropriate rest interval durations of 60–300 s dependent on exercise repetitions, phase, and exercise types (S1). GPT3.5 proposed 90–120 s for all three phases, even when the training focus was strength development. This prescription deviates from the specificity concept to enhance training gains, which is likely suboptimal, given short rest intervals (e.g., 60–90 s) are usually applied to enhance hypertrophic responses [12] while longer rest intervals (2–5 min) facilitate greater recovery and enable heavier loads to be lifted [12]. Therefore, this indicates a more appropriate prescription from the latest GPT model, compared with earlier iterations.

Currently, ChatGPT supports autodidactic self-learning, but responses need to be carefully appraised. ChatGPT's justifications such as "efficient" use of training time, as well as considerations of active recovery, nutrition, and hydration are noteworthy (S2), as these elements were not outlined in the prompts. This detail indicates a broader awareness of the subject matter than what was detailed in the prompt. A weekly routine that encompasses a well-rounded approach (including proper exercises, structured routines, adequate recovery etc.) is essential for optimising training effectiveness. Furthermore, ChatGPT delivered information in a language comparable to academic sources. However, the suggested guidelines (S1) and rationales (S2) appear to have overlooked some alternative training methods, loading strategies, and set configurations [19]. For example, the potential to induce substantial strength gains through cluster sets, variable resistance training, and blood flow restriction. Other methods, such as supersets and drop sets, which are time-efficient and effective to induce strength gains, were also omitted. This exclusion indicates a possible lack of alignment with contemporary, evolving training methodologies. Future prompts may need to be refined to consider emerging research and suggested programmes should be scrutinised by a topic expert. While only male responses are reported, the prompts for a female subject received comparable recommendations to the male subject regarding training phases, weekly structure, and session routines. This lack of distinction may be due to the disproportionately low number of female training studies and source material available for ChatGPT to draw upon. We strongly support future research focused on female training programmes and acknowledge that females may require different prescription needs to males [20].

In this article, we exclusively examined artificial intelligence-generated training programmes, while thoroughly considering literature and guidelines, leaving the potential impact of personal trainer's recommendations and supervisions unassessed. Also, we did not explore whether ChatGPT can synthesise contextual information, for example, modifying training based on physical readiness. Nevertheless, ChatGPT offered no potential real-time adjustments, or revisions to training protocols, based on feedback or individual progression. Intuitively, practitioners with a sound understanding of resistance training remain best suited to adjusting these variables. Currently, we propose that ChatGPT cannot replace the judgement and empathy of a human practitioner and gaps in acknowledging recent advancements in related research are evident.

CONCLUSIONS

ChatGPT generated realistic information for resistance training, guided by user prompts. However, the suggested programme may require modification. GPT4.0_{ADV} provided greater detail and consideration of training status when prescribing training. As artificial intelligence technologies develop over time, future versions may enhance the user experience. Further exploration and validation of ChatGPT-generated training programmes in real-world settings and with actual athletes is warranted to ascertain their practical utility.

Practical Applications

- ChatGPT can accelerate idea generation and detailed resistance training prescription.
- ChatGPT produced credible information, which may be suitable for general exercise guidance. However, additional professional assistance appears necessary for optimal outcomes.
- During isolating circumstances such as the COVID-19 pandemic, the use of a ChatGPT 'chatbot' for training prescription may help bridge information gaps.
- ChatGPT should be used as a supplementary tool (not a replacement) and combining artificial intelligence with human expertise may optimise exercise prescription effectiveness.

Conflict of interest declaration

The authors declare no conflict of interest.

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SUPPLEMENTARY FILE 1. ChatGPT generated texts for the 12 weeks intermediate and advanced resistance training programmes.

GPT3.5	GPT4.0	GPT4.0
Intermediate programme	Intermediate programme	Advanced programme
PROMPT 1	PROMPT 1	PROMPT 1
<p>Weeks 1–4: Foundation Phase</p> <p>Day 1: Upper Body Bench Press: 3 sets of 6–8 reps Bent-over Rows: 3 sets of 6–8 reps Overhead Shoulder Press: 3 sets of 6–8 reps Bicep Curls: 2 sets of 10 reps Tricep Dips: 2 sets of 10 reps</p> <p>Day 2: Lower Body Squats: 3 sets of 6–8 reps Deadlifts: 3 sets of 6–8 reps Leg Press: 3 sets of 8–10 reps Leg Curls: 2 sets of 10 reps Calf Raises: 2 sets of 12 reps</p> <p>PROMPT 2</p> <p>Day 1: Upper Body Load: 70–75%; Rest: 2 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 2 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 2 mins; Tempo: 2:0:2 Load: 60–65%; Rest: 1.5 mins; Tempo: 2:0:2 Load: Bodyweight; Rest: 1.5 mins; Tempo: 2:0:2</p> <p>Day 2: Lower Body Load: 70–75%; Rest: 2 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 2 mins; Tempo: 2:0:2 Load: 65–70%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 60–65%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 60–65%; Rest: 1 min; Tempo: 2:0:2</p>	<p>Weeks 1–4 (High Volume)</p> <p>Day 1 (Chest, Shoulders, Triceps): Bench Press: 3 sets of 12 reps Overhead Press: 3 sets of 12 reps Dumbbell Fly: 3 sets of 12 reps Lateral Raise: 3 sets of 12 reps Tricep Pushdown: 3 sets of 12 reps</p> <p>Day 2 (Legs, Abs): Squat: 3 sets of 12 reps Deadlift: 3 sets of 12 reps Leg Press: 3 sets of 12 reps Calf Raises: 3 sets of 12 reps Plank: 3 sets of 60 seconds</p> <p>Day 3 (Rest)</p> <p>Day 4 (Back, Biceps): Pull-up: 3 sets of 12 reps Bent Over Row: 3 sets of 12 reps Lat Pulldown: 3 sets of 12 reps Barbell Curl: 3 sets of 12 reps Hammer Curl: 3 sets of 12 reps</p> <p>Day 5 (Rest)</p> <p>Day 6 & 7 (Repeat Day 1 & 2)</p> <p>PROMPT 2</p> <p>Load intensity: 60–70% of one-rep max (1RM) Rest interval: 60–90 seconds between sets Exercise tempo: 2–1–2 (2 seconds for the eccentric or lowering phase, 1 second pause, 2 seconds for the concentric or lifting phase)</p> <p>Day 1 (Chest, Shoulders, Triceps): Bench Press: 3 sets of 12 reps Overhead Press: 3 sets of 12 reps Dumbbell Fly: 3 sets of 12 reps Lateral Raise: 3 sets of 12 reps Tricep Pushdown: 3 sets of 12 reps</p> <p>Repeat for days 2–7 as above.</p>	<p>Weeks 1–4 (Accumulation Phase) (Increasing volume) Frequency: 4 days a week.</p> <p>Day 1: Lower Body Squat – 4 sets × 8 reps Deadlift – 3 sets × 8 reps Bulgarian Split Squats – 3 sets × 10 reps per leg Romanian Deadlifts – 3 sets × 10 reps Calf Raises – 4 sets × 12 reps</p> <p>Day 2: Upper Body Bench Press – 4 sets × 8 reps Barbell Rows – 4 sets × 8 reps Overhead Press – 3 sets × 10 reps Pull-Ups – 3 sets × 8 reps (add weight if necessary) Dips – 3 sets × 10 reps (add weight if necessary)</p> <p>Day 3: Rest or Active Recovery (e.g., light cardio, stretching)</p> <p>Day 4: Lower Body Front Squat – 3 sets × 8 reps Sumo Deadlift – 3 sets × 8 reps Lunges – 3 sets × 10 reps per leg Glute Bridge – 3 sets × 12 reps Seated Calf Raise – 4 sets × 12 reps</p> <p>Day 5: Upper Body Incline Bench Press – 4 sets × 8 reps Pull-Ups (wide grip) – 4 sets × 8 reps Dumbbell Shoulder Press – 3 sets × 10 reps Barbell Curl – 3 sets × 10 reps Skull Crushers – 3 sets × 10 reps</p> <p>Day 6 & 7: Rest or Active Recovery</p> <p>PROMPT 2</p> <p>Intensity: ~70–80% of 1RM</p> <p>Rest Interval: 60–90 seconds between sets</p> <p>Tempo: 3–0–1–0 (3 seconds eccentric, 0 pause at the bottom, 1 second concentric, 0 pause at the top)</p>

SUPPLEMENTARY FILE 1. Continue.

GPT3.5	GPT4.0	GPT4.0
Intermediate programme	Intermediate programme	Advanced programme
<i>Cont. PROMPT 1</i>	<i>Cont. PROMPT 1</i>	<i>Cont. PROMPT 1</i>
Weeks 5–8: Strength Building Phase	Weeks 5–8 (Moderate Volume/High Intensity)	Weeks 5–8: Intensification Phase (Increasing intensity)
Day 1: Upper Body Bench Press: 4 sets of 5–6 reps Pull-Ups/Assisted Pull-Ups: 4 sets of 6–8 reps Seated Shoulder Press: 4 sets of 5–6 reps Barbell Bicep Curls: 3 sets of 8 reps Skull Crushers: 3 sets of 8 reps	Increase weights and lower reps to focus on strength. Day 1 (Chest, Shoulders, Triceps): Bench Press: 4 sets of 8 reps Overhead Press: 4 sets of 8 reps Dumbbell Fly: 4 sets of 8 reps Lateral Raise: 4 sets of 8 reps Tricep Pushdown: 4 sets of 8 reps	Frequency: 4 days a week. Day 1: Lower Body Squat – 5 sets × 5 reps Deadlift – 4 sets × 5 reps Bulgarian Split Squats – 4 sets × 8 reps per leg Romanian Deadlifts – 4 sets × 8 reps Calf Raises – 5 sets × 10 reps
Day 2: Lower Body Back Squats: 4 sets of 5–6 reps Romanian Deadlifts: 4 sets of 5–6 reps Leg Press: 3 sets of 6–8 reps Leg Extensions: 3 sets of 8 reps Standing Calf Raises: 3 sets of 10 reps	Day 2 (Legs, Abs): Squat: 4 sets of 8 reps Deadlift: 4 sets of 8 reps Leg Press: 4 sets of 8 reps Calf Raises: 4 sets of 8 reps Plank: 4 sets of 60 seconds	Day 2: Upper Body Bench Press – 5 sets × 5 reps Barbell Rows – 5 sets × 5 reps Overhead Press – 4 sets × 6 reps Weighted Pull-Ups – 4 sets × 6 reps Weighted Dips – 4 sets × 8 reps
<i>Cont. PROMPT 2</i>	Day 3 (Rest)	Day 3: Rest or Active Recovery
Day 1: Upper Body Load: 75–80%; Rest: 2 mins; Tempo: 2:0:2 Load: Bodyweight; Rest: 2 mins; Tempo: 2:0:2 Load: 75–80%; Rest: 2 mins; Tempo: 2:0:2 Load: 65–70%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 65–70%; Rest: 1.5 mins; Tempo: 2:0:2	Day 4 (Back, Biceps): Pull-up: 4 sets of 8 reps Bent Over Row: 4 sets of 8 reps Lat Pulldown: 4 sets of 8 reps Barbell Curl: 4 sets of 8 reps Hammer Curl: 4 sets of 8 reps	Day 4: Lower Body Front Squat – 4 sets × 6 reps Sumo Deadlift – 4 sets × 6 reps Lunges – 4 sets × 8 reps per leg Glute Bridge – 4 sets × 10 reps Seated Calf Raise – 5 sets × 10 reps
Day 2: Lower Body Load: 75–80%; Rest: 2 mins; Tempo: 2:0:2 Load: 75–80%; Rest: 2 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 65–70%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 65–70%; Rest: 1 min; Tempo: 2:0:2	Day 5 (Rest)	Day 5: Upper Body Incline Bench Press – 5 sets × 5 reps Pull-Ups (wide grip) – 5 sets × 6 reps Dumbbell Shoulder Press – 4 sets × 6 reps Barbell Curl – 4 sets × 8 reps Skull Crushers – 4 sets × 8 reps
	Day 6 & 7 (Repeat Day 1 & 2)	Day 6 & 7: Rest or Active Recovery
	<i>Cont. PROMPT 2</i>	<i>Cont. PROMPT 2</i>
	Load intensity: 70–80% of 1RM Rest interval: 90–120 seconds between sets Exercise tempo: 2–0–2	Intensity: ~80–90% of 1RM Rest Interval: 2–3 minutes between sets Tempo: 2–0–1–0
	Day 1 (Chest, Shoulders, Triceps): Bench Press: 4 sets of 8 reps Overhead Press: 4 sets of 8 reps Dumbbell Fly: 4 sets of 8 reps Lateral Raise: 4 sets of 8 reps Tricep Pushdown: 4 sets of 8 reps	
	Repeat for days 2–7 as above.	

SUPPLEMENTARY FILE 1. Continue.

GPT3.5	GPT4.0	GPT4.0
Intermediate programme	Intermediate programme	Advanced programme
Cont. PROMPT 1	Cont. PROMPT 1	Cont. PROMPT 1
<p>Weeks 9–12: Intensification Phase</p> <p>Day 1: Upper Body Incline Bench Press: 4 sets of 4–5 reps Bent-over Rows (Barbell/D'bell): 4 sets of 4–5 reps Arnold Press: 3 sets of 6 reps Barbell Curls: 3 sets of 6 reps Tricep Rope Pushdowns: 3 sets of 6 reps</p> <p>Day 2: Lower Body Front Squats: 4 sets of 4–5 reps Sumo Deadlifts: 4 sets of 4–5 reps Bulgarian Split Squats: 3 sets of 6 reps per leg Hamstring Curls: 3 sets of 6 reps Seated Calf Raises: 3 sets of 8 reps</p> <p>Cont. PROMPT 2</p> <p>Day 1: Upper Body Load: 80–85%; Rest: 2 mins; Tempo: 2:0:2 Load: 80–85%; Rest: 2 minutes; Tempo: 2:0:2 Load: 70–75%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 1.5 mins; Tempo: 2:0:2</p> <p>Day 2: Lower Body Load: 80–85%; Rest: 2 mins; Tempo: 2:0:2 Load: 80–85%; Rest: 2 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 70–75%; Rest: 1.5 mins; Tempo: 2:0:2 Load: 65–70%; Rest: 1 min; Tempo: 2:0:2</p>	<p>Weeks 9–12 (Low Volume/Very High Intensity)</p> <p>Further increase weights and decrease reps to peak strength.</p> <p>Day 1 (Chest, Shoulders, Triceps): Bench Press: 5 sets of 5 reps Overhead Press: 5 sets of 5 reps Dumbbell Fly: 5 sets of 5 reps Lateral Raise: 5 sets of 5 reps Tricep Pushdown: 5 sets of 5 reps</p> <p>Day 2 (Legs, Abs): Squat: 5 sets of 5 reps Deadlift: 5 sets of 5 reps Leg Press: 5 sets of 5 reps Calf Raises: 5 sets of 5 reps Plank: 5 sets of 60 seconds</p> <p>Day 3 (Rest)</p> <p>Day 4 (Back, Biceps): Pull-up: 5 sets of 5 reps Bent Over Row: 5 sets of 5 reps Lat Pulldown: 5 sets of 5 reps Barbell Curl: 5 sets of 5 reps Hammer Curl: 5 sets of 5 reps</p> <p>Day 5 (Rest)</p> <p>Day 6 & 7 (Repeat Day 1 & 2)</p> <p>Cont. PROMPT 2</p> <p>Load intensity: 80–90% of 1RM Rest interval: 2–3 minutes between sets Exercise tempo: 1–0–1</p> <p>Day 1 (Chest, Shoulders, Triceps): Bench Press: 5 sets of 5 reps Overhead Press: 5 sets of 5 reps Dumbbell Fly: 5 sets of 5 reps Lateral Raise: 5 sets of 5 reps Tricep Pushdown: 5 sets of 5 reps Repeat for days 2–7 as above.</p>	<p>Weeks 9–12: Realization Phase (Testing new strength levels)</p> <p>Frequency: 4 days a week.</p> <p>Day 1: Lower Body Squat – 6 sets × 3 reps Deadlift – 5 sets × 3 reps Bulgarian Split Squats – 4 sets × 6 reps per leg Romanian Deadlifts – 4 sets × 6 reps Calf Raises – 5 sets × 8 reps</p> <p>Day 2: Upper Body Bench Press – 6 sets × 3 reps Barbell Rows – 6 sets × 3 reps Overhead Press – 5 sets × 4 reps Weighted Pull-Ups – 5 sets × 4 reps Weighted Dips – 5 sets × 6 reps</p> <p>Day 3: Rest or Active Recovery</p> <p>Day 4: Lower Body Front Squat – 5 sets × 4 reps Sumo Deadlift – 5 sets × 4 reps Lunges – 4 sets × 6 reps per leg Glute Bridge – 4 sets × 8 reps Seated Calf Raise – 5 sets × 8 reps</p> <p>Day 5: Upper Body Incline Bench Press – 6 sets × 3 reps Pull-Ups (wide grip) – 6 sets × 4 reps Dumbbell Shoulder Press – 5 sets × 4 reps Barbell Curl – 5 sets × 6 reps Skull Crushers – 5 sets × 6 reps</p> <p>Day 6 & 7: Rest or Active Recovery</p> <p>Cont. PROMPT 2</p> <p>Intensity: ~90–95% of 1RM for main lifts, ~80–85% for accessory lifts</p> <p>Rest Interval: 3–5 minutes for main lifts, 2–3 minutes for accessory lifts</p> <p>Tempo: 1–0–1–0</p>
Remarks	Remarks	Remarks

SUPPLEMENTARY FILE 1. Continue.

GPT3.5	GPT4.0	GPT4.0
Intermediate programme	Intermediate programme	Advanced programme
<i>Cont. PROMPT 1 & 2</i>	<i>Cont. PROMPT 1</i>	<i>Cont. PROMPT 1</i>
<p>General Guidelines:</p> <ul style="list-style-type: none"> – Perform the program 3 days a week, with at least one rest day between sessions. – Increase the weight when you can complete the recommended reps and sets with proper form. – Rest 2–3 minutes between sets of compound exercises and 1–2 minutes for isolation exercises. – Focus on proper form and technique to prevent injuries and maximize gains. – Incorporate a 5–10 minute warm-up and cool-down routine before and after each workout. <p>Track your progress to monitor improvements and make necessary adjustments.</p> <p>Remember, adequate nutrition and sufficient rest are essential for recovery and muscle growth. Listen to your body, and if you ever experience pain or discomfort, consult with a fitness professional or healthcare provider.</p>	<p>Note:</p> <p>Always start each workout with a good warm-up, and finish the workout with a cool-down. Adjust weights as needed to ensure they’re challenging but don’t compromise form. Ensure rest days are taken to promote muscle recovery and growth.</p> <p>Lastly, it’s essential to pair this program with a balanced diet that supports your training goals. Please consult with a fitness professional to ensure that these exercises and the program are suitable for your particular circumstances.</p> <p>Before starting any new exercise program, it’s always a good idea to consult with a healthcare professional.</p> <p>Cont. PROMPT 2</p> <p>Note: The 1RM should be updated periodically, possibly every 4 weeks, to account for strength increases. Exercise tempo should be adjusted according to individual comfort and safety. Always ensure proper form to prevent injury. Remember that recovery is crucial – do not skip rest days. Consult a professional for individual advice.</p> <p>Again, ensure that you’re using proper form and technique throughout the program, and if you have any concerns or questions, consult with a certified fitness professional or healthcare provider.</p>	<p>Note:</p> <p>Warm-up appropriately before each session. Increase the weight if the prescribed reps feel easy. Ensure proper form and technique. Consider adding in supplemental work (abdominal exercises, rotator cuff exercises) and stretching/mobility work on active recovery days. Ensure adequate nutrition and sleep to support recovery. After this 12-week program, you may want to consider taking a deload week, where volume and intensity are reduced to allow for optimal recovery before starting another program or cycle.</p> <p>Cont. PROMPT 2</p> <p>These percentages are starting points. It’s essential to listen to one’s body and adjust based on how the training feels. If someone finds that a set at a particular percentage feels too easy or hard, adjusting the weight accordingly is important. Proper warm-up, form, and technique are paramount, especially when working with higher intensity loads.</p>

Note: All the texts within this table were generated by ChatGPT. During prompt 2, GPT-3.5 provided the same training programme as prompt 1, which we removed to improve readability, and only the additional variables were shown. GPT-3.5 also provided the same “general guidelines” in prompt 1 and prompt 2. *Training tempo*: a sequence 3:1:2:0 (or 3/1/2/0 or 3-1-2-0) reflects an exercise performed as 3 seconds eccentric, 1 second pause before the next motion, 2 seconds concentric, and 0 or no pause before the next repetition. *Abbreviations*: GPT: Generative Pre-trained Transformer; rep/reps: repetition(s); mins: minutes.

SUPPLEMENTARY FILE 2. GPT3.5 and GPT4.0 generated text specifying reasons of the suggested programme variables.

Intermediate training programme	Intermediate training programme	Advanced training programme
GPT3.5	GPT4.0	GPT4.0
<p>Foundation Phase (Weeks 1–4)</p> <ul style="list-style-type: none"> – 6–8 reps: Moderate rep range to build a foundation of strength and muscular endurance. – 70–75% Load Intensity: A balance between challenging the muscles and allowing for proper progression. – 2 minutes Rest Interval: Sufficient time to recover between sets and perform the exercises with adequate intensity. – Tempo: 2:0:2 (2 seconds eccentric, 0-second pause, 2 seconds concentric): Emphasizes controlled movements and muscle tension. <p>Strength Building Phase (Weeks 5–8)</p> <ul style="list-style-type: none"> – 5–6 reps: Lower rep range for increased intensity to promote strength gains. – 75–80% Load Intensity: Higher intensity to challenge the muscles further as strength improves. – 2 minutes Rest Interval: Sufficient rest for heavy lifting and recovery between sets. – Tempo: 2:0:2: Slower eccentric phase enhances time under tension for greater strength development. <p>Intensification Phase (Weeks 9–12)</p> <ul style="list-style-type: none"> – 4–5 reps: Lower rep range to focus on maximal strength development. – 80–85% Load Intensity: High intensity to stimulate strength gains in the intermediate lifter. – 2 minutes Rest Interval: Allows for proper recovery between heavy sets. Tempo: 2:0:2: Controlled tempo to maintain muscle tension during the challenging lifts. 	<p>1. Periodisation</p> <p>Periodisation is used to structure training into different phases over the course of the 12 weeks. Each phase focuses on different aspects of strength training (high volume, moderate intensity, and high intensity), allowing for gradual adaptation and reducing the risk of overtraining.</p> <p>2. High Volume (Weeks 1–4)</p> <p>Lower intensity (60–70% 1RM) and higher volume (more repetitions) is used initially to build muscular endurance, improve technique, and prepare the body for the higher intensities to come.</p> <p>3. Moderate Volume/High Intensity (Weeks 5–8)</p> <p>The intensity is increased to 70–80% of 1RM and volume is reduced to allow for greater strength and muscle size gains, and to further prepare the body for the very high intensity in the final phase.</p> <p>4. Low Volume/Very High Intensity (Weeks 9–12)</p> <p>In this phase, intensity is further increased to 80–90% of 1RM and volume is further reduced. This focuses on maximizing muscle strength.</p> <p>5. Rest Intervals:</p> <p>Shorter rest intervals are used during the high-volume phase to keep the intensity moderate and ensure the body is adequately stressed by the higher number of reps.</p> <p>As the program transitions to higher intensity, the rest periods between sets are extended to allow for sufficient recovery and enable the individual to lift more weight.</p>	<p>1. Periodization:</p> <p>Reason: Allows for systematic programming to avoid plateaus and manage fatigue.</p> <p>Benefits: Maximizes adaptation, minimizes overtraining, and allows for targeted training outcomes (e.g., hypertrophy, strength, power).</p> <p>2. Load Intensity (% of 1RM):</p> <p>Weeks 1–4 (70–80%):</p> <p>Reason: Focus on moderate weight to allow for higher volume and focus on technique.</p> <p>Benefits: Lays a foundation, promoting hypertrophy and preparing tissues for heavier loads.</p> <p>Weeks 5–8 (80–90%):</p> <p>Reason: Increase in weight to shift focus towards pure strength adaptations.</p> <p>Benefits: Neuromuscular adaptations, increased motor unit recruitment.</p> <p>Weeks 9–12 (90–95%):</p> <p>Reason: Heavy weights to realize strength gains and test new strength levels.</p> <p>Benefits: Peak strength adaptation and increased CNS efficiency.</p> <p>3. Rest Intervals:</p> <p>Weeks 1–4 (60–90 seconds):</p> <p>Reason: Shorter rest due to moderate loads; sufficient for ATP-PCr energy system recovery.</p> <p>Benefits: Enhances hypertrophic adaptations and keeps workout duration reasonable.</p> <p>Weeks 5–8 & 9–12 (2–5 minutes):</p> <p>Reason: As intensity increases, more recovery time is needed between sets.</p> <p>Benefits: Allows for full recovery and maximal effort in subsequent sets, optimizing strength gains.</p>

SUPPLEMENTARY FILE 2. Continue.

Intermediate training programme	Intermediate training programme	Advanced training programme
GPT3.5	GPT4.0	GPT4.0
	<p>6. Exercise Tempo:</p> <p>A slower tempo (2–1–2) is used during the high volume phase to increase time under tension, improving muscular endurance and promoting technique.</p> <p>As the program progresses to higher intensities, the tempo is increased slightly to allow for heavier weights to be lifted.</p>	<p>4. Tempo (eccentric-pause-concentric-pause):</p> <p>Weeks 1–4 (3–0–1–0):</p> <p>Reason: Emphasis on eccentric phase promotes muscle damage, a key driver for hypertrophy.</p> <p>Benefits: Maximizes time under tension (TUT) and promotes hypertrophy.</p>
	<p>7. Exercise Selection:</p> <p>The program includes compound movements, which work multiple muscle groups at once. This is efficient and effective for improving overall strength.</p> <p>Exercise order is arranged in a way that larger muscle groups are worked before smaller ones.</p>	<p>Weeks 5–8 & 9–12 (2–0–1–0 & 1–0–1–0):</p> <p>Reason: As weight increases, it’s challenging to maintain a slow eccentric; focus shifts to moving the weight effectively.</p> <p>Benefits: Allows for handling of heavier loads and optimal force production.</p>
	<p>8. 1RM Updates:</p> <p>Regularly updating the 1RM ensures the training load is adjusted as strength increases. This keeps the intensity appropriate for the desired training effect.</p>	<p>5. Exercise Selection:</p> <p>Reason: Compound movements are prioritized as they recruit multiple muscle groups, allowing for heavier loads and maximizing strength adaptations.</p> <p>Benefits: Functional strength gains, comprehensive muscle development, and efficient use of training time.</p>
	<p>9. Rest and Recovery:</p> <p>Rest days are crucial for muscle recovery and growth. They also prevent overtraining and reduce the risk of injuries.</p> <p>Remember, while this plan provides a general guideline, it should be individualized to meet specific needs and goals. The person should also consider their diet, hydration, and sleep as these factors greatly affect the outcome of the training program. Always consult a professional to ensure a safe and effective training plan.</p>	<p>6. Frequency (4 days a week):</p> <p>Reason: Provides a balance between training volume and recovery for an advanced trainee.</p> <p>Benefits: Allows sufficient stimuli for adaptation while ensuring adequate recovery, reducing the risk of overtraining.</p>
		<p>7. Active Recovery Days:</p> <p>Reason: Active recovery can promote blood flow and aid in the removal of waste products.</p> <p>Benefits: Speeds up recovery, mitigates soreness, and reduces the risk of overuse injuries.</p> <p>These variables, when combined systematically, aim to provide an effective platform for advanced strength adaptations while managing fatigue and injury risk.</p>

Note: All the texts within this table were generated by ChatGPT. *Training tempo*: a sequence 3:1:2:0 (or 3/1/2/0 or 3-1-2-0) reflects an exercise performed as 3 seconds eccentric, 1 second pause before the next motion, 2 seconds concentric, and 0 or no pause before the next repetition. *Abbreviations*: GPT: Generative Pre-trained Transformer; rep/reps: repetition(s); mins: minutes;