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The feasibility, engagement, and efficacy of personalised app-based exercise and dietary guidance based on salivary DNA analysis

Christopher McManus

cmcman@essex.ac.uk

University of Essex

Sally Waterworth

University of Essex

Richard Penney

University of Essex

Jenson Taylor

University of Essex

Henry Chung

University of Essex

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Full Title: **The feasibility, engagement, and efficacy of personalised app-based exercise and dietary guidance based on salivary DNA analysis**

Christopher McManus[1], Sally Waterworth[1], Richard Penney[1], Jenson Taylor[1], Henry Chung[1],

[1] School of Sport, Rehabilitation and Exercise Sciences, University of Essex, Colchester, UK

* Corresponding author: Christopher McManus, cmcman@essex.ac.uk
Christopher McManus: https://orcid.org/0000-0003-3871-3842

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KEY MESSAGES REGARDING FEASIBILITY

1) What uncertainties existed regarding the feasibility?
Whether we could recruit to capacity within the time window, the DNA assay failure rate relative to the ≤10% ceiling, adherence to baseline testing, retention through an unsupervised eight-week app phase, and the extent of participant engagement in the absence of research-grade telemetry.

2) What are the key feasibility findings?
Recruitment reached 41/45 (91.1%, green); adherence to Visit 2 was 40/41 (97.6%, green); retention to Visit 3 was 30/40 (75.0%, amber by point estimate but red by lower CI). DNA assay failure was 0% (0/41; Wilson 95% CI 0.0–8.6%, within the ≤10% ceiling). Engagement among completers was modest, 107/240 weekly surveys submitted (44.6%), median 4/8, with high engagement (≥6/8) in 20%.

3) What are the implications of the feasibility findings for the design of the main study?
Proceed with a definitive trial only with strengthened retention and engagement strategies during the app phase, and with embedded usage telemetry to verify exercise dose prescribed and exercise dose completed. Powering should account for ~25–35% post-baseline attrition under current conditions.

ABSTRACT

Background: Genotype-informed, app-delivered exercise and nutrition programmes offer a scalable route to personalisation, but their implementation in free-living adults is uncertain. This feasibility study evaluated recruitment, assay success, adherence, retention, and engagement over an eight-week programme, and generated estimation-focused parameters to inform a definitive trial.

Methods: Single-arm feasibility study with saliva DNA collection, laboratory baseline testing, and an eight-week app phase. The planned sample size was chosen to estimate key feasibility proportions with useful precision. Feasibility outcomes were prespecified with traffic-light progression rules. Proportions (recruitment, assay failure, adherence, retention, engagement) were summarised with Wilson 95% confidence intervals. Continuous outcomes (maximal oxygen uptake, resting metabolic rate, muscular performance, body composition including visceral adipose tissue, glycated haemoglobin, and blood lipids) were analysed as pre–post changes with 95% confidence intervals and interpreted against device precision. No formal hypothesis testing was undertaken for efficacy.

Results: Recruitment reached 41 of 45 available places (91.1%). Attendance at the baseline laboratory visit was 40 of 41 (97.6%). Retention to the post-intervention visit was 30 of 40 (75.0%). DNA assay failure was 0% (0/41; Wilson 95% CI 0.0% to 8.6%). Among post-intervention completers (n=30), 107 of 240 expected weekly surveys were submitted (44.6%). The median number of submissions was 4 of 8 (interquartile range 2–5), mean 3.6 ± 2.3. High engagement, defined a priori as at least 6 of 8 submissions, was observed in 6 participants (20.0%). Most participants submitted at least 1 survey (25/30, 83.3%), while 5 submitted 0 (16.7%). Exploratory outcome estimates for fitness, muscular performance, body composition, and biomarkers were small on average with wide confidence intervals and heterogeneous individual responses; these estimates, together with observed standard deviations, will inform sample-size and measurement plans for a future main trial.

Conclusions: The delivery pipeline was technically feasible with acceptable recruitment and baseline adherence, including zero assay failures. Retention and week-to-week engagement during the unsupervised app phase were below target and will require strengthened support and embedded usage telemetry. These feasibility findings support progression to a definitive evaluation contingent on retention and engagement mitigation, confirming the design parameters needed for sample-size calculation alongside outcome measurement.

KEYWORDS

Feasibility, Nutrigenetics, Mobile app, Adherence, Saliva DNA, Aerobic fitness

BACKGROUND

Digital programmes that pair saliva DNA profiling with app-delivered exercise and nutrition advice offer a plausible route to scalable personalisation in free-living adults. Yet before a definitive effectiveness trial is warranted, several practical uncertainties require resolution in our context: (i) can we recruit to capacity within realistic operational limits; (ii) will participants adhere to laboratory visits and remain engaged through an unsupervised app-only phase; and (iii) given an eight-week exposure, do objective health and performance markers change beyond device-specific measurement error? Contemporary guidance for pilot/feasibility work emphasises that these questions and the prespecified progression criteria used to answer them should be foregrounded to inform a future definitive trial (1).

Personalisation is attractive because population-average responses to standardised exercise prescriptions can be modest and highly variable. Higher cardiorespiratory fitness (CRF) is consistently associated with lower all-cause, cardiovascular, and cancer mortality (2,3); exercise helps preserve lean mass, reduce visceral adipose tissue (VAT), and support weight-loss maintenance (4,5), but mean weight change with exercise-only programmes is typically small over 8–52 weeks, and individual responses vary widely owing to metabolic and behavioural compensation, baseline phenotype, and adherence (6). Collectively, these observations support the mortality relevance of CRF (7,8), the limited average effect of generic exercise-only prescriptions (13,14), and the case for more personalised approaches (9,10).

A biologically grounded basis for personalisation exists. Inherited genomic variation contributes to between-person differences in weight regulation and trainability, and meta-analytical studies have also shown associations between specific single-nucleotide polymorphisms (SNPs) and modifiable changes in both health and fitness markers in the presence of targeted exercise training programmes (11–13). Twin/family studies such as HERITAGE show familial aggregation of CRF gains with standardised endurance training, consistent with an appreciable genetic component (14–16). Candidate-locus and meta-analytic work implicates pathways for mitochondrial biogenesis and substrate utilisation; for example, variants in PPARGC1A (PGC-1α) have been associated with endurance/power phenotypes and may modulate adaptation to training (17–20).

However, translating genotype into actionable improvements in free-living adults is non-trivial. In the Food4Me randomised trials (21,22), personalised nutrition improved dietary

behaviours relative to generic advice, yet adding genotype to phenotype-based tailoring delivered little or no incremental benefit on key outcomes, underscoring the need for cautious, empirical evaluation of genotype-guided behavioural interventions on clinically relevant endpoints (23).

At the same time, digital delivery is susceptible to engagement decay and adherence challenges outside supervised settings. Evidence suggests that app-supported exercise can increase short-term adherence and functional outcomes, but durability beyond the near term is uncertain, making engagement a central feasibility parameter for any app-only phase (24).

Scalable, non-invasive pipelines now allow saliva-based DNA collection, external ISO-accredited laboratory analysis, and app-based delivery of algorithm-derived, genetically personalised exercise and nutrition guidance. The present study leverages such a pipeline to evaluate whether an eight-week, genotype-informed programme in adults with varied baseline fitness and adiposity, focusing on feasibility, safety, adherence, and inter-individual variability to inform a future definitive trial.

The primary objective was to assess feasibility, with pre-specified progression thresholds for recruitment, adherence, and retention, while engagement was quantified through submission-level and participant-aggregated app-use metrics. A secondary objective was to provide preliminary, measurement-error-adjusted estimates of change (means, standard deviations, 95% confidence intervals, and effect sizes) in key physiological outcomes related to health and fitness assessments, including cardiorespiratory fitness ($\dot{V}O_2max$), resting metabolic rate (RMR), muscular performance (press-ups, plank, handgrip, countermovement jump), body composition including visceral adipose tissue, and cardiometabolic biomarkers (HbA1c, blood lipids). We hypothesised that the protocol would be feasible and acceptable, meeting the progression criteria for recruitment, adherence and achieving retention within an acceptable range. Efficacy outcomes were analysed as exploratory, estimation-focused endpoints rather than for hypothesis testing.

METHODS

Study Design

A single-arm, observational feasibility and engagement cohort study with exploratory efficacy endpoints was conducted.

Ethical approval

Ethical approval was granted by the Institutional Ethics Board, subcommittee one (Code: ETH2425-0154).

Participants

The study was constrained by the number of available DNA testing kits (*n*=50). Allowing for up to five technical failures or repeat collections, we planned to recruit 45 participants. Because the primary aim was to assess feasibility rather than intervention efficacy, the planned sample size was justified in relation to the precision with which key feasibility parameters could be estimated, specifically recruitment to planned capacity, adherence to Visit 2, retention to Visit 3, and technical assay failure. This approach is consistent with methodological recommendations that pilot and feasibility study sample sizes should be justified according to the precision of key feasibility or design parameters, rather than formal power for efficacy outcomes (25,26). With $n = 45$, the approximate half-width of a 95% confidence interval for a single proportion is about 12 percentage points for a proportion near 0.80 and about 9 percentage points for proportions near 0.90 or 0.10, which was judged sufficient to support interpretation of these feasibility estimates alongside the prespecified traffic light progression criteria. This level of precision was considered appropriate for a single-arm feasibility study conducted within the practical constraints imposed by kit availability (26). Efficacy outcomes were therefore treated as exploratory and estimation-focused, rather than powered for hypothesis testing (1).

Adult volunteers were recruited via convenience and snowball sampling from the University's staff and student body, the surrounding community, and local sports clubs. Recruitment materials were disseminated through posts on university research participation boards, social-media channels, and printed flyers placed in community settings (e.g., noticeboards in local shops and sports clubs). Interested individuals accessed a study link directing them to a customised Qualtrics survey (Qualtrics, Seattle, USA), which presented the participant information sheet and captured initial eligibility screening responses. Participants were encouraged to share the invitation with eligible peers to support snowball recruitment.

Inclusion criteria were adults aged 18–65 years who were healthy, physically active, comfortable and competent in attempting the efficacy assessments described in the participant information sheet. Screening was conducted using a Physical Activity Readiness Questionnaire (PAR-Q), with responses reviewed by a member of the research team before scheduling. Written informed consent was obtained before any testing commenced. Individuals were excluded if they self-reported type 1 diabetes mellitus, pregnancy,

physician-diagnosed cardiovascular disease, hypertension (resting blood pressure > 140/90 mmHg), cancer, eating disorders, cognitive disorders, or use of medications for which physical activity was not advised. Any affirmative PAR-Q response indicating a contraindication to exercise resulted in non-enrolment, in line with the study's safety protocol.

Protocol

Participants attended three laboratory visits. Visit 1 (~40 min), included eligibility confirmation, familiarisation with study procedures and equipment, and salivary sample collection. Visits 2 (~90 min) were scheduled 2 weeks after Visit 1, and Visit 3 (~90 min) eight weeks after Visit 2, at similar times of day with standardised pre-visit instructions (diet, caffeine, and exercise in the preceding 24 h) to reduce diurnal and pre-analytical variability. Procedures at Visits 2 and 3 were identical to permit within-participant comparisons across the eight-week intervention period.

After arrival and a brief seated rest, resting blood pressure was measured using an oscillometric monitor (HEM-7188 Omron Healthcare Co., Ltd., Kyoto, Japan), followed by assessment of whole-body composition and lumbar bone health by dual-energy X-ray absorptiometry (DEXA). Capillary blood samples were collected for biomarker analysis. Resting metabolic rate (RMR) was assessed by online breath-by-breath gas exchange. Neuromuscular performance was evaluated using a countermovement jump, maximal-repetition press-ups, a forearm plank hold, and handgrip dynamometry, administered in a fixed order with standardised recovery periods. Each visit concluded with a submaximal, incremental treadmill protocol on a motorised treadmill. To respect participant autonomy and minimise undue burden, all efficacy assessments were optional. Participants could decline any individual test while remaining enrolled in the study and completing other measures. Declines were recorded, and analyses followed an available-case approach without imputation. Between visits 2 and 3, participants completed an eight-week app-based programme delivering genotype-informed, personalised exercise and dietary guidance. Intervention fidelity and engagement were monitored via a brief weekly email survey in which participants reported their use of the app and the extent to which it influenced their exercise and dietary choices over the preceding week.

Intervention

During Visit 1, participants provided a 2 mL passive saliva sample in a uniquely coded plastic tube (GeneFiX™ Saliva DNA/RNA Collection), prefilled with nontoxic stabilisation buffer via the DNA testing kit provided by Bio-Synergy Ltd (London, England). Participants were

instructed to do this seated, resting over a table, with their mouth around the included screw-on funnel attachment and not to chew gum, drink, eat or brush their teeth 3 hours before this collection. Participants were also instructed not to spit and only drool into the tube. This ensured maximum quality of the sample. All samples were immediately packaged and sent via pre-paid tracked delivery service to Eurofins Global Laboratory (Certification: ISO 17025 and ISO 14001) for analysis. DNA extract using phosphate-buffered saline was mixed to prevent any premature cell rupture, and cell recovery was accomplished using standard extraction procedures. Recovered cells and assay medium (Cell Lysis Solution Infinium, GoldenGate) were loaded into chip wells for Illumina multiplex sequencing. Custom chips (Illumina® EPIC BeadChip) with bound DNA sequences were used for the determination of gene variants, and genotype calls with an accuracy report of 99%. Within two weeks, results were completed, and participants were then informed to attend their laboratory Visit 2.

Following this, the intervention comprised an eight-week, app-mediated, genotype-informed programme delivered in free-living conditions between the second and third laboratory visits. Participants installed the Bio-Synergy mobile application (version 1.0.12; iOS and Android app stores), and all guidance during the intervention was delivered through this version by the company. The build used in the study had last been updated in December 2024; the app version remained stable throughout participants' active period. On first use, the app required basic anthropometric and demographic inputs (age, sex, height, weight) to initialise profiling. Personalisation was driven by a combination of each participant's genomic summary and the self-reported profile fields noted above. Specifically, the app consumed an externally derived DNA report that aggregated ~900,000 loci into polygenic domain scores, which were then used, together with age, sex, height, and weight, to tailor both exercise and nutrition recommendations. The genetic domains informing recommendations (e.g., physical, diet, vitamin, health) are listed in a study Appendix 1 with gene mapping; no proprietary model weights or code is disclosed.

Exercise programming consisted of goal-aligned resistance-training and conditioning sessions assembled from configurable templates that the app customised to the individual's genetic domain scores and user-specified weekly training availability. Typical prescribed sessions lasted 45–60 minutes. Progression across the eight weeks followed the app's rule-based templates and was contingent on user-directed adjustments (e.g., changing goals or the number of sessions per week); no supervised modification was applied by the research team. Nutrition guidance provided qualitative recommendations and macronutrient ranges aligned to participants' genetic profile, stated goals (e.g., weight gain or loss), and dietary

preferences (e.g., vegan or vegetarian). Guidance also included prompts on meal frequency and genetics-informed suggestions to meet macro- and micronutrient targets.

Participants were instructed to engage with the app throughout the eight weeks and to follow the personalised advice as closely as possible. Intervention fidelity and engagement were monitored independently of the app via a weekly email survey in which participants reported their usage and described how the programme influenced their exercise and dietary choices over the preceding week.

Feasibility outcomes

Feasibility outcomes were pre-specified before enrolment and focused on recruitment, adherence, retention, and technical performance. The primary recruitment outcome was capacity-constrained target attainment, defined as the proportion of the 45 planned enrolment slots filled, set by the availability of 50 DNA kits with five reserved for contingency. We used rolling recruitment concurrent with data collection from 20th October 2024, and scheduled completion of all study procedures by 30 March 2025. Progression criteria followed a traffic light framework with point estimate and confidence interval requirements: green if the recruitment point estimate was ≥ 90% and the Wilson 95% confidence interval lower limit was ≥ 75%. The 75% lower-limit guardrail reflects the capacity-constrained question, namely, whether the trial can reliably fill at least three quarters of planned slots even after accounting for sampling uncertainty; it also sits within ranges used in published feasibility work (1,27). Amber and red bands were set one tier lower on both the point estimate and the lower limit to signal amend versus do-not-proceed decisions (Table 1). As contextual, non-primary recruitment information, we also evaluated eligibility conversion as the proportion of eligible volunteers who attended Visit 1 and provided consent. Reasons for non-attendance were not recorded, as most eligible, non-attending individuals did not engage further after completing the online form. No progression threshold was attached to eligibility conversion because enrolment was capped by capacity.

Adherence was defined as completion of Visit 2 among participants who attended Visit 1. Progression criteria were green if the point estimate was ≥ 80% and the Wilson 95% lower limit was ≥ 70%; amber if the point estimate was 70% to < 80%, or the lower limit was 60% to < 70%; red if the point estimate was < 70%, or the lower limit was < 60%. Retention was defined as completion of Visit 3 among participants who completed Visit 2, following the eight-week app-based programme. Progression criteria mirrored those for adherence. The traffic light rules are summarised in Table 1.

Technical feasibility was indexed by the DNA assay failure, defined as the proportion of kits yielding failed or unusable results. The a priori ceiling was ≤ 10%. Screening and scheduling logs, laboratory attendance records, and assay results were the source documents for all feasibility metrics.

Engagement outcomes

Engagement during the eight-week app period was monitored using a brief weekly online survey, with submission of a completed survey constituting an engagement event. The Bio-synergy app did not provide research-grade usage telemetry, and discontinuation points for non-completers could not be verified; engagement analyses were prespecified for participants retained to Visit 3 only. For these completers, the expected number of entries was eight (one per week). Engagement was operationalised as the absolute count of submitted surveys (range 0–8) and the proportion of expected surveys submitted. “High engagement” was defined as submission of six of eight surveys (≥75%). Non-submission in any week was treated as non-engagement. Survey timestamps and submission records exported from the survey platform were the sole source of data, and metrics were summarised descriptively.

Table 1. Prespecified feasibility outcomes and traffic light progression criteria

Outcome	Numerator	Denominator	Primary point threshold	CI based Green rule (95% LL)	Amber rule	Red rule
Recruitment	Consented and attended Visit 1	Planned capacity, 45 slots	≥ 90%	Lower limit ≥ 75%	Point 75 to < 90% **or** lower limit 65 to < 75%	Point < 75% **or** lower limit < 65%
Adherence to Visit 2	Attended Visit 2	Attended Visit 1	≥ 80%	Lower limit ≥ 70%	Point 70 to < 80% **or** lower limit 60 to < 70%	Point < 70% **or** lower limit < 60%
Retention to Visit 3	Completed Visit 3	Completed Visit 2	≥ 80%	Lower limit ≥ 70%	Point 70 to < 80% **or** lower limit 60 to < 70%	Point < 70% **or** lower limit < 60%

Questionnaire

The weekly survey (Qualtrics, Seattle, USA) referenced the preceding seven days and included items spanning exposure, interaction intensity, perceived influence, feature use, and satisfaction, with parallel coverage of diet and exercise. Exposure was recorded as the number of days the app was opened (0–7). Interaction intensity was assessed via average openings per day (once, twice, three times, more than three) and typical total use per day (<5, 5–10, 10–20, >20 min). Perceived influence on behaviour was captured with 0–100 numeric rating scales anchored at 0 (“not at all”) and 100 (“completely”) for both dietary influence and exercise influence. Satisfaction with changes attributable to the app was assessed separately for diet and exercise using 0–100 numeric rating scales with identical anchors. Participants provided their name and the survey date to enable linkage with study records; prior to analysis, names were replaced with unique study identifiers, and all personally identifiable information was removed.

Efficacy Outcomes

Anthropometry

Stature was measured to the nearest 0.1 cm using a portable stadiometer (Seca 213, Hamburg, Germany). Participants stood with heels, buttocks, and upper back in contact with the stadiometer, head positioned in the Frankfort plane; a gentle upward traction at the mastoid processes ensured full erect posture, and the vertex was recorded at end-inspiration. Body mass was measured to the nearest 0.1 kg on a calibrated electronic scale (Seca 813).

Body composition and bone health

Whole-body composition (fat mass, lean mass, visceral adipose tissue estimate) and lumbar spine bone mineral density (BMD) were assessed by dual-energy X-ray absorptiometry on a fan-beam scanner (Hologic Horizon W; APEX software v5.6.0.5, Marlborough, MA). Daily phantom quality control and device warm-up were completed before data collection, and participants removed metal objects and wore light clothing/gowns. Two trained DXA operators acquired and analysed scans throughout the study; for each participant, the same operator conducted both pre- and post-intervention scans to preserve within-participant consistency.

For the whole-body scan, participants lay supine and were aligned to the table mid-line with arms alongside the torso, palms facing down, legs hip-width apart and gently internally

rotated; the feet were secured together at the metatarsophalangeal joints to minimise movement for the duration of the scan, following established positioning standards (28). Automated region segmentation was reviewed and, where necessary, manually corrected by the operator to ensure anatomical separation of the upper limbs at the acromio-humeral joints and of the lower limbs at the pelvic-femoral joints (29). Outcomes included total lean mass, total fat mass and visceral adipose tissue.

The lumbar-spine scan (L1–L4) was acquired with standard Hologic positioning. Previous precision testing established a least significant change (LSC) for L1–L4 spine BMD of 0.0196 $g \cdot cm^2$ at the 95% confidence level. For whole-body composition, prior precision work at the host site yielded a root-mean-square coefficient of variation (RMS-CV) and corresponding 95% LSC of 0.94% and 1.44 kg, respectively, for total lean tissue mass, and 1.83% and 1.21 kg for total fat mass. These values were used to interpret within-participant changes relative to measurement error. Visceral adipose tissue reliability is also reported to be between ~6.4-7.1% for overweight and healthy weight individuals, respectively (30).

Resting metabolic rate (RMR)

RMR was measured by indirect calorimetry using a ventilated hood (canopy) connected to a metabolic cart (Vyntus CPX; Vyaire, Höchberg, Germany). The canopy measurement lasted 20 min; the final 10 min were used to compute RMR (31) via the Weir equation (32) after verifying steady state (discarding the initial 5 min and confirming ≤ 10% CV for $\dot{V}O_2$ and $\dot{V}CO_2$ in a stable window). Gas analysers were two-point calibrated with certified span gases immediately before testing; flow was verified per manufacturer procedures. Test–retest reliability for Vyntus CPX RMR is excellent in healthy adults (ICC 0.92) with between-day typical error of measurement (TEM) reports as 4.5% (33).

Glycaemic control (Hb1Ac)

Capillary blood (1.5 µL) was collected from a warmed finger (middle or ring) using single-use, auto-retracting lancets. The sample was applied to an Afinion™ HbA1c cartridge and analysed immediately on an Afinion™ 2 point-of-care analyser (Abbott Diagnostics, Abbott Park, USA). Peer-reviewed comparisons indicate analytical precision with a CV of 2% and close agreement with HPLC methods in non-diabetic ranges (34).

Blood lipid status

Capillary blood (40 µL) was analysed on an Alere Cholestech LDX™ analyser (Abbott Technologies) for total cholesterol, HDL-cholesterol, and triglycerides; LDL-cholesterol was calculated by the device algorithm. Quality control followed manufacturer guidance. Point-of-

care performance of the Cholestech LDX shows between-day CVs of 2.2-3.5%, 2.4-6.3%, 2.3-3.4% and 4.3-5.9% for total cholesterol, HDL-cholesterol, and triglycerides; LDL-cholesterol, respectively (35), and acceptable accuracy relative to reference laboratory methods (36).

Countermovement jump (CMJ)

Lower-limb neuromuscular performance was assessed on dual uniaxial force plates (FD4000 ForceDecks; VALD Performance, Australia; ≥ 1000 Hz). Participants performed CMJs with hands on hips (no arm-swing), starting from quiet standing (1–3 s). Trials with excessive pre-movement, tucking, or off-plate landings were repeated. Jump height was derived from take-off velocity via impulse–momentum. ForceDecks demonstrates good-to-excellent validity versus embedded laboratory plates and excellent test–retest reliability for CMJ height metrics (ICC 0.97) and minimal detectable change of 3.4 cm (37).

Maximal-repetition press-ups

Upper-body muscular endurance was assessed as the maximum number of technically valid press-ups completed in one bout. Participants could choose either the standard press-up or a modified version with knees resting on the floor; the chosen variant was documented and repeated at the follow-up visit to ensure within-participant comparability. For both variants, hands were placed at shoulder width, the torso kept in a straight line, and each repetition required ~90° elbow flexion (chest depth verified by the assessor) and full elbow extension; violations were not counted, and termination occurred at volitional failure or loss of form. Body-weight push-up endurance tests show excellent repeatability under fixed technique rules in healthy adults (ICC 0.98; CV 3.8%), supporting use as a reliable field measure (38).

Forearm plank hold

Trunk endurance was measured with a timed forearm plank. From a prone start, participants supported body mass on forearms and toes with elbows under shoulders and a neutral spine. Timing began upon stable lockout and ceased at loss of posture (pelvic drop/raise, foot displacement, or head contact) as judged by the assessor. One familiarisation hold (≤ 20 s) preceded the maximal trial. The prone bridge (plank) test demonstrates good-to-excellent test–retest reliability in adults (ICC 0.90), and between-day standard error of measurement (SEM) reported as 2.4-2.9% when termination criteria are standardised (39).

Handgrip dynamometry

Maximal isometric grip strength was assessed with a Takei handgrip dynamometer (Takei Scientific Instruments Co., Tokyo, Japan). Participants stood with the tested arm (self-

selected dominant) alongside the body, elbow extended, forearm in neutral, and wrist in slight extension. After one submaximal familiarisation, three 3-s maximal efforts were performed, separated by 2 min, with the highest value retained. Takei devices show excellent reliability for maximal grip in healthy individuals (ICC 0.95-0.97; SEM 1.96-2.5 kg) (40)

Cardiorespiratory fitness

Participants were offered an incremental treadmill test to volitional exhaustion. Pulmonary gas exchange was measured using a calibrated metabolic cart (Vyntus CPX, Vyaire, Höchberg, Germany) while participants completed an incremental treadmill protocol. After a three-minute warm-up at 7 $km \cdot h^{-1}$ and 1% grade, participants stood on the side rails for 30 s. The test then comprised three-minute stages from 9 $km \cdot h^{-1}$ at 1% grade, increasing by 1.0 $km \cdot h^{-1}$ in females and 1.5 $km \cdot h^{-1}$ in males per stage, each separated by 30 s passive recovery on the rails. The test ended at voluntary termination. The Vyntus CPX was two-point gas calibrated with certified span gases and volume verified before every session according to manufacturer guidance.

Breath-by-breath $\dot{V}O_2$ time series were processed in Matlab version R2025a (The MathWorks, USA) as follows. Missing samples were linearly interpolated. Obvious spikes were removed using a moving window of 10 samples, with values above the local mean plus three standard deviations set to missing and then linearly interpolated. $\dot{V}O_2$ was low-pass filtered with a third-order Butterworth filter (zero phase, 0.04 Hz cut-off; normalised to the sampling frequency estimated from time stamps). $\dot{V}O_2max$ was identified as the peak of the filtered $\dot{V}O_2$ trace. Previously reported test–retest reliability for $\dot{V}O_2max$ in similar treadmill protocols indicates a coefficient of variation of 2.6% and a smallest worthwhile change of 1.1 $ml \cdot kg^{-1} \cdot min^{-1}$ **(41)**.

Statistical analysis

Engagement with the app was analysed using two complementary approaches. In the per-submission view, each completed survey was treated as an independent observation. In the aggregated within-participant view, repeated surveys were first collapsed within each individual participant. For continuous 0–100 scales, a within-participant mean was calculated before summarising the distribution across participants as mean ± SD. For ordered categorical variables, the within-participant median category was calculated and subsequently tabulated as counts and percentages across participants. Percentages in the per-submission view used the number of non-missing responses as the denominator,

whereas percentages in the aggregated view used the number of participants with a non-missing median category as the denominator. No imputation of missing values was undertaken. The adoption of this dual approach ensured that frequent submitters did not disproportionately influence the descriptive statistics, while still capturing the distribution of responses at the submission level.

Efficacy outcomes were analysed descriptively in line with the feasibility design. Formal hypothesis testing using associated p-values was deliberately avoided to mitigate the risk of type II error and to prevent over-interpretation of findings as confirmatory. Instead, interpretation focused on mean change values and their precision, with reference to established measurement error thresholds for each outcome. For body composition variables derived from DEXA, changes between baseline and follow-up were compared with the least significant change (LSC) at the 95% confidence level to determine whether observed differences exceeded device noise. For resting metabolic rate, mean change values were considered against the previously reported typical error of measurement for the Vyntus CPX system. Biomarkers, including HbA1c and blood lipid concentrations, were interpreted relative to the coefficients of variation established for the Afinion™ and Cholestech LDX™ point-of-care analysers. Muscular endurance assessed via maximal-repetition press-ups was compared with published coefficients of variation for bodyweight push-up tests, while changes in countermovement jump height were evaluated against the minimal detectable change for this measure. For cardiorespiratory fitness, changes in $\dot{V}O_2$max were examined in the context of the smallest worthwhile change threshold to establish their potential practical significance.

Across all efficacy outcomes, change scores (follow-up minus baseline) were tested for normality using the Shapiro–Wilk test. Results are reported as mean change, associated standard deviation (SD), and 95% confidence intervals (CIs), following recommended practice (42). Confidence intervals that did not cross zero were interpreted as indicative of a potential true change rather than random variation, with the extent of the change further evaluated against the known measurement error of each variable (e.g., LSC, coefficient of variation, typical error of measurement, or minimal detectable change). Effect sizes were also calculated using Cohen's *d* and interpreted according to conventional thresholds, with values <0.2 considered trivial, 0.2–0.49 small, 0.5–0.79 medium, and ≥0.8 large (42). All analyses of efficacy outcomes were conducted using SPSS Statistics, version 29 (IBM Corporation, Armonk, New York).

RESULTS

Feasibility outcomes

Recruitment

Recruitment ran from 20 October 2024 to 14 January 2025 and was capacity-constrained to 45 enrolment slots and time-constrained to ensure data collection was completed by 30th March 2025. We filled 41/45 slots (91.1%; Wilson 95% CI 79.3–96.5) for Visit 1, meeting the a priori green rule (point estimate ≥90% and lower bound ≥75%). Twenty-eight additional volunteers signed up during this period, but did not progress to Visit 1 due to withdrawal, scheduling failure or no communication after initial email contact. This is outlined in full in Figure 1.

Adherence

Defined as completion of Visit 2 among those who attended Visit 1, was 40 of 41 participants, corresponding to 97.6% (Wilson 95% confidence interval 87.4–99.6). This exceeded the a priori green threshold.

Retention

Retention, defined as completion of Visit 3 among those who completed Visit 2 following the eight-week app period, was 30 of 40 participants, corresponding to 75.0% (Wilson 95% confidence interval 59.8–85.8). The point estimate lay within the amber band (70% to <80%), while the lower confidence bound was <60%, classifying retention as red under the prespecified progression rules. For context, expressed against planned capacity, attendance was 41/45 at Visit 1 (91.1%), 40/45 at Visit 2 (88.9%), and 30/45 at Visit 3 (66.7%).

Technical feasibility

DNA assay failure was 0% (0 failed or unusable kits among those issued at Visit 1), meeting the prespecified ceiling of ≤10%. The Wilson 95% confidence interval for the failure proportion was 0.0% to 8.6%, confirming adequate technical feasibility.

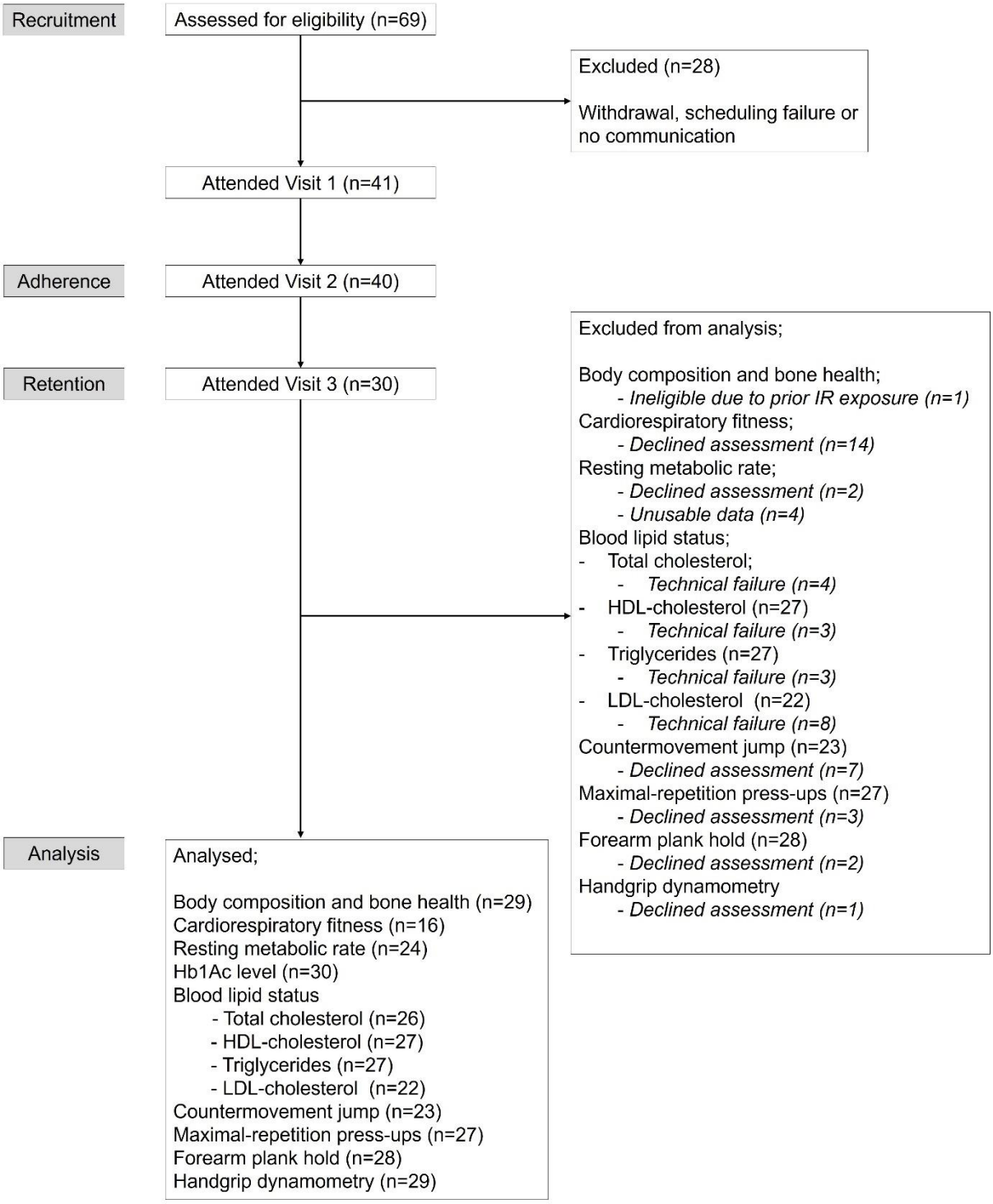


Figure 1. CONSORT flow diagram showing participant recruitment, adherence, retention and analysis. *Abbreviations: IR, ionising radiation (e.g., prior diagnostic/therapeutic exposure).*

Engagement

Engagement was analysed among participants who completed Visit 3 (n = 30). Across these completers, 107 of 240 expected weekly surveys were submitted, yielding an overall submission rate of 44.6%. The median number of submissions was 4 of 8 (50.0%) with an

interquartile range of 2–5 of 8 (25.0–62.5%); the mean was 3.6 ± 2.3. High engagement, defined a priori as at least six submissions, was observed in 6 participants (20.0%). Most participants submitted at least one survey (25/30, 83.3%), whereas 5 participants submitted none (16.7%). The distribution of submissions among completers was: 8 (n = 1), 7 (n = 2), 6 (n = 3), 5 (n = 5), 4 (n = 5), 3 (n = 5), 2 (n = 3), 1 (n = 1), and 0 (n = 5).

Questionnaire

Across the study period, 107 weekly submissions were provided by 25 participants. Engagement was summarised in two ways: a submission-level view, which treats each survey as an independent observation, and a participant-aggregated view, which first collapses repeated surveys within participant, using the mean for continuous scales and the median for ordered categories (Table 2). Overall engagement was modest and characterised by brief interactions with the app. Participants typically opened the app on only a few days each week and, most often, once per day and for less than ten minutes. Exercise-related influence scores were consistently higher than diet-related influence scores, but absolute ratings were low in both domains. As expected, participant-aggregated estimates were slightly attenuated compared with submission-level estimates, reflecting the removal of overweighting from frequent submitters.

Table 2. In-app engagement and perceived impact, shown per submission and aggregated within participant.

	Per submission (n=107)	Aggregated within participant (n=25)
App Engagement		
Days the app was opened (of 7)	2.26 ± 1.73	2.11 ± 1.28
Opens per day	Once = 81 (75.7%)	Once = 19 (76%)
	Twice = 19 (17.8%)	Twice = 6 (24%)
	Three = 7 (6.5%)	
Time spent per day	<5 minutes = 55 (51.4%)	<5 minutes = 14 (56%)
	5–10 minutes = 38 (35.5%)	5–10 minutes = 10 (40%)
	10–20 minutes = 13 (12.1%)	10–20 minutes = 1 (4%)
	>20 minutes = 1 (0.9%).	
Exercise-related responses		
Exercise advice influence (0–100)	33.19 ± 35.99	25.93 ± 28.51
Exercise sessions guided by the app	None = 51 (47.7%)	None = 12 (48%)
	1 session = 25 (23.4%)	1 session = 8 (32%)
	2–3 sessions = 21 (19.6%)	2–3 sessions = 3 (12%)
	>3 sessions = 10 (9.3%).	>3 sessions = 2 (8%)
Satisfaction with exercise changes (0–100)	24.22 ± 28.05	19.13 ± 22.48
Diet-related responses		
Dietary advice influence (0–100)	11.91 ± 19.78	10.15 ± 16.25
Meals planned using the app	None = 86 (80.4%)	None 21 (84%)
	1–2 meals = 17 (15.9%)	1–2 meals 4 (16%)

	3–5 meals = 1 (0.9%) >5 meals = 3 (2.8%)	
Satisfaction with diet changes (0–100)	14.10 ± 24.29	12.02 ± 16.25

Efficacy outcomes

Those who completed Visit 3 comprised 30 adults (21 males, 9 females). Participants were of normal-to-overweight status (BMI 25.1 ± 2.9 kg/m²), with males being taller and heavier than females (1.79 ± 0.07 m, 81.3 ± 9.4 kg vs. 1.67 ± 0.06 m, 68.5 ± 12.2 kg, respectively). Full descriptive data for the overall sample and stratified by sex are provided in Table 3.

Table 3. Participant descriptive data

	All (n=30)		Males (n=21)		Females (n=9)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Age (yr)	40	(12)	42	(12)	37	(10)
Height (m)	1.75	(0.08)	1.79	(0.07)	1.67	(0.06)
Body mass (kg)	77.4	(11.9)	81.3	(9.4)	68.5	(12.2)
BMI (kg/m^2)	25.1	(2.9)	25.4	(2.8)	24.5	(3.3)

Body composition and bone health

DXA-derived indices of body composition and lumbar spine bone mineral density (BMD) showed no meaningful changes over the intervention period (Table 4). Confidence intervals for all outcomes crossed zero, and mean differences were smaller than the respective thresholds for measurement error, including the least significant change for fat and lean mass, the reliability range for visceral adipose tissue, and the least significant change for lumbar spine BMD. Effect sizes were uniformly trivial to small. Collectively, these findings indicate that any observed differences are most likely attributable to measurement variability rather than true biological change.

Table 4. Whole-body composition, visceral adipose tissue, and lumbar spine BMD pre-post values, mean change with 95% CI, and effect size (n = 29).

	Pre mean (SD)	Post mean (SD)	Mean change (SD)	Mean change 95% CI	Effect size
Fat mass (kg)	21.36 (5.34)	21.49 (5.31)	0.13 (1.13)	-0.31, 0.57	0.11
Lean mass + BMC (kg)	54.37 (9.37)	54.30 (9.15)	-0.06 (0.97)	-0.44, 0.31	-0.07

Body fat (%)	28.13 (5.06)	28.24 (4.88)	0.11 (1.22)	-0.36, 0.59	0.09
VAT mass (g)	422.76 (192.77)	410.61 (179.74)	-12.16 (54.01)	-33.06, 8.75	-0.22
Lumbar BMD (g/cm^2)	1.07 (0.12)	1.07 (0.13)	0.002 (0.033)	-0.011, 0.014	0.05

VAT: visceral adipose tissue, BMC: bone mineral content, BMD: bone mineral density

Blood biomarkers

Blood biomarker analyses showed no evidence of systematic change over the intervention period (Table 5). For HbA1c, both IFCC and DCCT units remained stable, with mean changes well within the established coefficient of variation. Similarly, lipid fractions, including total cholesterol, HDL-cholesterol, triglycerides, and LDL-cholesterol, did not demonstrate consistent shifts. All 95% confidence intervals crossed zero, and the magnitude of observed differences was smaller than the respective coefficients of variation for each analyte. Effect sizes were trivial across outcomes. Taken together, these findings suggest that fluctuations in blood biomarker values are most plausibly attributable to measurement variability rather than intervention-related biological change.

Table 5. Blood biomarkers pre-post values, mean change with 95% CI, and effect size.

	Pre mean (SD)	Post mean (SD)	Mean change (SD)	Mean change 95% CI	Effect size
HbA1c IFCC (mmol/mol) (n=30)	33.50 (2.55)	33.23 (2.42)	-0.27 (1.24)	-0.74, 0.20	-0.21
-0.29H-bA1c DCCT (%) (n=30)	5.23 (0.23)	5.20 (0.22)	-0.03 (0.10)	-0.07, 0.01	-0.29
Total cholesterol (mg/dL) (n=26)	5.31 (1.15)	5.16 (1.10)	-0.11 (0.97)	-0.51, 0.29	-0.11
HDL (mg/dL) (n=27)	1.43 (0.45)	1.51 (0.43)	0.03 (0.48)	-0.16, 0.23	0.07
Triglycerides (mg/dL) (n=27)	1.13 (0.51)	1.31 (0.87)	0.13 (0.81)	-0.19, 0.46	0.16

LDL (mg/dL) (n=22)	3.43 (1.15)	3.27 (0.98)	-0.21 (1.12)	-0.72, 0.30	-0.19

High-Density Lipoprotein (HDL) Cholesterol; Triglycerides (TG); Low-Density Lipoprotein (LDL) Cholesterol

Performance and physiological outcomes

Changes in performance and physiological measures are summarised in Table 6. Cardiorespiratory fitness showed a small mean increase that did not exceed the pre-specified smallest worthwhile change, and the 95% confidence interval crossed zero, indicating no clear improvement beyond expected variability. Resting metabolic rate fluctuated within the typical error of measurement for the device, with wide confidence intervals consistent with measurement noise rather than a systematic shift. Lower-limb power (countermovement jump height) exhibited a small mean decrease whose magnitude remained within the minimal detectable change, and the confidence interval included zero. By contrast, upper-body muscular endurance (press-ups) and trunk endurance (plank hold) both improved: for each, the 95% confidence interval did not cross zero, and the observed mean changes exceeded their respective measurement-error thresholds (press-ups beyond the reported CV; plank beyond the SEM), supporting genuine performance gains over the intervention period. Maximal handgrip strength showed a trivial mean decrease with a confidence interval spanning zero and a magnitude within the SEM, consistent with no meaningful change.

Table 6. Performance and physiological outcomes pre-post values, mean change with 95% CI, and effect size.

	Pre mean (SD)	Post mean (SD)	Mean change (SD)	Mean change 95% CI	Effect size
$\dot{V}O_2max$ ($ml \cdot kg^{-1} \cdot min^{-1}$)	44.67 (5.02)	45.34 (5.62)	0.7 (3.3)	-1.1, 2.5	0.20
RMR (kcal/day)	1564.47 (317.78)	1572.70 (431.40)	-62.6 (495.6)	-276.4, 151.2	-0.12
CMJ (cm)	28.24 (5.78)	27.12 (5.82)	-1.1 (2.5)	-2.2, 0.0	-0.44
Press-ups (n)	27.00 (12.69)	30.59 (13.48)	3.6 (4.4)	1.8, 5.4	0.80
Plank hold (s)	106.79 (38.49)	117.09 (41.82)	10.3 (24.2)	0.8, 19.8	0.42

Handgrip strength (kg)	45.36 (9.16)	43.91 (9.88)	-1.4 (4.0)	-3.0, 0.1	-0.35

RMR: resting metabolic rate.

DISCUSSION

This study examined the feasibility, engagement, and preliminary efficacy of an eight-week, genotype-informed exercise and nutrition programme delivered via a mobile application. In line with the primary objective, we observed strong feasibility for recruitment and adherence within capacity constraints, but mixed evidence for retention. Engagement with the app over the eight weeks was modest, characterised by brief, infrequent interactions. Regarding the secondary objective, efficacy signals were limited: most physiological and biomarker outcomes did not exceed measurement-error thresholds, although upper-body muscular endurance and trunk endurance improved beyond their respective noise bands. Collectively, these findings indicate that a larger, definitive trial is feasible with targeted refinements to retention strategies, engagement levers, and intervention delivery.

Feasibility

Recruitment met the a priori “green” criterion, with 91% of planned slots filled within the target window, confirming that sufficient interest can be generated under capacity limits. Adherence to Visit 2 was excellent and comfortably exceeded the progression threshold, suggesting that the pre-intervention and baseline testing workflow is acceptable and implementable at scale. Retention to Visit 3, however, was more challenging: while the point estimate reached the “amber” band, the lower 95% confidence bound fell in the “red” zone. This suggests that, as implemented, the eight-week, unsupervised app phase carries a non-trivial risk of attrition that would need to be mitigated before a definitive trial. In our study, we provided a light-touch incentive by informing participants that they would receive a personalised results report covering all laboratory variables upon completing Visit 3. However, participants also received automated access to their DNA report shortly after Visit 1 (to enable in-app personalisation), which may have diluted the motivational value of the end-of-study report and thereby affected retention and adherence dynamics. Evidence supports several low-burden options to bolster retention, including personalised SMS reminders (43) or similar proactive re-contact protocols, small fixed incentives, and light-

touch accountability (e.g., brief check-ins), each of which has improved follow-up or adherence in randomised evaluations (44).

Engagement

Among completers, survey submissions averaged fewer than half of the expected weekly entries, with most interactions occurring on only a few days per week and typically lasting <10 minutes. Exercise-related influence scores were consistently higher than diet-related scores, yet absolute ratings were low across domains. The dual analytic approach (per-submission and participant-aggregated views) confirmed that these patterns were not an artefact of frequent submitters. Taken together with anecdotal feedback, these data point to a need for clearer personalisation, simplified user journeys, and robust logging/integration features to sustain engagement.

Efficacy

Interpreting pre–post changes against measurement-error thresholds, we observed targeted improvements in specific performance tasks alongside largely unchanged systemic markers over eight weeks, consistent with recent app-based trials. In an 8-week RCT of a mobile app, push-up endurance improved while countermovement jump and $\dot{V}O_2$max were maintained relative to control (45), closely mirroring our press-up and plank improvements with unchanged CMJ and sub-threshold $\dot{V}O_2$max movement. By contrast, $\dot{V}O_2$max increases emerge when the digital prescription is highly protocolised and high-intensity (46). For example, a two-group randomised trial of smartphone-guided 4×4-min HIIT produced $\dot{V}O_2$max gains comparable to supervised HIIT (47), underscoring that intensity and structure, not app delivery per se, drive aerobic adaptation over ~8–10 weeks. For body composition, detectable DXA/VAT change typically requires longer exposure or stronger behavioural dosing. A randomised trial (3 months; app + smart band) reported modest improvements in body mass and selected composition variables versus control (48), whereas shorter interventions commonly show minimal change, consistent with our null DXA/VAT findings at eight weeks. Biomarkers such as HbA1c and lipids likewise tend to remain stable over short durations in generally healthy cohorts; robust reductions are more characteristic of digital therapeutics in type 2 diabetes populations, further contextualising our stable values within device CVs (49).

Interpretation and future research

Taken together, our feasibility outcomes support progression, with targeted attention to retention during the unsupervised app phase. The modest engagement profile and limited efficacy signals across most outcomes are consistent with an intervention that, in its current form, lacks sufficient personalisation, accountability, and objective fidelity checks to shift physiological markers beyond measurement noise over eight weeks. Large, multi-country trials of personalised nutrition indicate that tailored advice can improve behaviours, but genotype-augmented advice adds little without robust behavioural supports. This underscores the need for transparent, phenotype (and where appropriate genotype) linked prescriptions coupled with behaviour-change scaffolding (21). To strengthen adherence and dose delivery, brief human support based on the “supportive accountability” model can be layered in (e.g., short credibility-anchored check-ins), which has been shown to enhance adherence to eHealth interventions (50). In parallel, embedding research-grade telemetry, time-stamped app opens, feature use, notification delivery and taps, and wearables integration should strengthen both intervention fidelity and the capacity to deliver timely engagement prompts. This approach aligns with best-practice trial-reporting guidance (46), which explicitly recommends systematic capture and reporting of usage metrics for digital interventions. Moreover, telemetry enables just-in-time adaptive intervention (JITAI) designs that tailor prompts to the individual’s context (47), and micro-randomised trials demonstrate that well-timed, tailored push notifications can increase proximal app engagement (48). Integrating wearable sensors can also enhance adherence monitoring and support activity-focused interventions, as evidenced by recent systematic reviews of wearable-based programmes (49). Accordingly, a definitive evaluation should adopt a pragmatic randomised design with an active comparator, extend intervention duration, and implement telemetry-enabled personalisation plus light-touch human support to improve dose delivered and dose received, thereby increasing the likelihood of moving key outcomes beyond the smallest worthwhile change and device-specific error thresholds (21,51).

Strengths and limitations

Strengths include prespecified feasibility criteria with Wilson intervals, conservative interpretation of efficacy against measurement error thresholds, and comprehensive laboratory phenotyping anchored to device precision metrics. Limitations include the single-arm design, capacity- and time-constrained recruitment, reliance on self-reported engagement without full telemetry, and an eight-week exposure that is likely insufficient for meaningful change in DXA and glycaemic/lipid biomarkers. Learning effects cannot be excluded for some performance tasks despite standardised procedures, and external

training/dietary behaviours were not controlled. Generalisability may be limited by self-selection and the study setting.

Conclusion

Within a capacity-limited, real-world setting, a genotype-informed, app-delivered programme was recruitable and implementable with high early-phase adherence but required improvements to sustain retention and engagement over eight weeks. Efficacy signals were confined to measures of muscular and trunk endurance, with most outcomes remaining within measurement noise. These results justify a refined, telemetry-enabled, and behaviourally enhanced trial to test the incremental value of genetically informed personalisation on clinically relevant endpoints.

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Appendix 1.

Category	Trait	Genes of Interest
Physical	Muscle Power	AMPD1, IL-6, ACTN3, NOS3, ACE, VEGFA, AGT, PPARA, TRHR, LEPR, INS-IGF2, COMT
Physical	Muscle Stamina	ADRB2, COL5A1, ACTN3, PPARA, ACE, ADRB3, PPARGC1A, AMPD1, ADRB1, VEGFA, GABPB1, IGF2
Physical	Oxygen Usage	ADRB1, VEGFA, GABPB1, ACE
Physical	Anaerobic Threshold	PPARGC1A, ACTN3
Physical	Recovery Rate	AMPD1, IGF2, INS-IGF2, NOS3
Physical	Muscle Mass	AMPD1, LEPR, INS-IGF2, MSTN
Physical	Injury Risk	COL5A1, GDF5, COL1A1
Physical	Soft Tissue Inflammation	AMPD1, GDF5, INS-IGF2

Physical	Lean Body Mass	LEPR, TRHR
Physical	Power-to-weight ratio	LEPR, TRHR, AMPD1, ACE, INS-IGF2
Physical	Exercise Effect on Weight	ADRB2, FTO, LOC
Diet	Carbohydrate Response	ADRB2, PPARG
Diet	Saturated Fats Response	FTO, TCF7L2
Diet	Unsaturated Fats Benefit	APOA5, ADIPOQ
Diet	Protein Response	FTO, TFAP2B
Diet	Sugar Response	ADRB2, PPARG
Diet	Overeating Sweet Foods	TAS1R3, TAS1R2
Diet	Bitter Taste	TAS1R3, TAS2R38
Diet	Snacking Risk	MC4R, FTO
Diet	Metabolic Rate	IL-6, UCP1
Diet	Fat Distribution	ADRB2, UCP2
Diet	Yo-Yo Diet Response	ADRB2, IL6
Diet	Lactase Persistence	LCT (MCM6)
Vitamins	Vitamin D Deficiency	CYP2R1, NADSYN1, GC
Vitamins	Vitamin A Deficiency	BCO1
Vitamins	Iron Deficiency	TF, TMPRSS6
Vitamins	Magnesium Deficiency	MUC1, ATP2B1
Vitamins	Potassium Deficiency	MUC1, ATP2B1
Vitamins	Sodium Deficiency	MUC1, ATP2B1
Vitamins	Vitamin B6 Deficiency	NBPF3
Vitamins	Vitamin B12 Deficiency	MTHFR
Vitamins	Folate Deficiency	MTHFR, SLC19A1, MTRR
Vitamins	Selenium Deficiency	GPX4
Vitamins	Omega-3 Benefit	APOA5, ADIPOQ, PPARG, FTO
Vitamins	Calcium Deficiency	VDR
Vitamins	BCAA’s Benefit	FTO, TFAP2B
Vitamins	Choline Benefit	FADS1
Vitamins	Glutamine Benefit	COL5A1, GDF5, COL1A1
Vitamins	Creatine Benefit	AMPD1, IL-6, ACTN3, NOS3, ACE, VEGFA, AGT, PPARA, TRHR, LEPR, INS-IGF2, COMT
Vitamins	Beta-Alanine Benefit	ADRB2, COL5A1, ACTN3, PPARA, ACE, ADRB3, PPARGC1A, AMPD1, ADRB1, VEGFA, GABPB1, IGF2
Vitamins	Arginine Benefit	ADRB1, VEGFA, GABPB1, ACE
Health	Caffeine Sensitivity	CPLX3, CYP1A2
Health	Genetic Bone Mineral Density	VDR, CYP2R1, NADSYN1, GC
Health	Genetic Obesity Risk	FTO, MC4R, TNF, APOA2, ADIPOQ

Health	Genetic Type 2 Diabetes Risk	
Health	Genetic Infection Risk (Colds/Flu)	FUT2, GPX1