IJISEM
INTERNATIONAL JOURNAL OF INNOVATIONS IN SCIENCE ENGINEERING AND MANAGEMENT

International Journal of Innovations In Science Engineering And Management

Check for updates

OPEN ACCESS

Volume: 5

Issue: 4

Month: November

Year: 2026

ISSN: 2583-7117

Published: 16.11.2026

Citation:

K.Asanbekova, Altamas khan, Malik umar Abdullah, mohd Ajmal, Kabiraj Tomas "Association Between Somatotype, Body Composition, and Cardiovascular Functional Indicators in Healthy Young Men: A Review of Current Evidence" International Journal of Innovations In Science Engineering And Management, vol.5, no.4, 2026.

DOI:

10.69968/ijisem.2026v5i4279-288

This work is licensed under a Creative Commons Attribution-Share Alike 4.0 International License

Association Between Somatotype, Body Composition, and Cardiovascular Functional Indicators in Healthy Young Men: A Review of Current Evidence

K. Asanbekova[1], Altamas Khan[2], Malik Umar Abdullah[3], Mohd Ajmal[4], Kabiraj Tomas[5]

[1]*Senior Lecturer, International Medical Faculty, OSH State University*

[2,3,4,5]*Student, International Medical Faculty, OSH State University*

Abstract

Background: *Cardiovascular risk factors accumulate during young adulthood, yet body mass index (BMI) remains the default screening index even though it cannot separate fat from lean tissue. Somatotype, which describes physique through three components (endomorphy, mesomorphy, ectomorphy), and direct body-composition measures could refine risk description in healthy young men, but the relevant literature is fragmented: studies usually examine physique or body composition on one side and cardiovascular function on the other.*

Objective: *To synthesise evidence linking somatotype, body composition and cardiovascular functional indicators (blood pressure, heart rate and heart rate variability, arterial stiffness, and cardiorespiratory fitness) in healthy young men, to ask whether somatotype adds information beyond BMI, and to identify and prioritise research gaps.*

Methods: *Narrative review guided by the SANRA criteria. Primary studies, systematic reviews, consensus documents and foundational texts on somatotyping, adiposity assessment, and cardiovascular function were collected and appraised for design, measurement methods and population.*

Findings: *Somatotype components track body composition in expected directions, with endomorphy reflecting fatness and mesomorphy reflecting lean robustness. Observational studies in adults and young adults relate endomorphy to less favourable blood pressure, autonomic profile and aerobic fitness, and mesomorphy to higher aerobic capacity; effects are often modest and based on small cross-sectional samples. Studies of normal-weight obesity confirm that BMI misclassifies cardiometabolic risk. We found no study that formally tested the incremental value of somatotype over BMI, waist-to-height ratio or percentage body fat in healthy young men, none that combined somatotype, body composition and several cardiovascular domains in one cohort, and very little comparable data for South and Central Asian men. Twelve gaps are identified, spanning measurement standardisation, analytical handling of somatotype components, ancestry-specific evidence and longitudinal design.*

Conclusions: *Somatotype is a plausible but unproven complement to BMI. A priority-ordered research agenda, built around multi-domain cardiovascular phenotyping, standardised protocols and explicit incremental-value testing, is proposed.*

Keywords: *Heath-Carter Method; Body Composition; Body Mass Index; Heart Rate Variability; Arterial Stiffness; Cardiorespiratory Fitness.*

INTRODUCTION

Cardiovascular disease is increasingly recognised as a condition whose foundations are laid early. Atherosclerotic changes and clustered risk factors are already detectable in children and young adults [1], and blood pressure categories measured in young adulthood predict cardiovascular events decades later [2]. Epidemiological reviews emphasise that cardiovascular disease in young individuals is not rare and that prevention windows are widest before middle age [3]. Cardiovascular health frameworks now explicitly treat body weight, blood pressure and fitness-related behaviours as modifiable targets from early adulthood [4]. Even apparently healthy university-age men carry a substantial burden: in a small cohort of Australian men aged 18–25, 42.9% had body fat of at least 20% and one in five had systolic pressure of at least 130 mmHg [5].

BMI is the usual entry point for risk stratification and is strongly related to mortality at population level [6–8]. Its weakness is individual-level interpretation. BMI cannot distinguish fat from lean mass, ignores fat distribution, and relates to body fat differently across age, sex and ancestry [9–11]. Meta-analytic evidence shows that conventional BMI thresholds are specific but insensitive for excess adiposity [12,13].

The consequence is the normal-weight obesity phenotype, in which people with normal BMI but high body fat show adverse cardiometabolic profiles [14–17].

Somatotype offers a different lens. Originating in Sheldon's typology [18] and refined into the anthropometric method of Heath and Carter [19,20], it rates physique on three continuous components: endomorphy (relative fatness), mesomorphy (relative musculoskeletal robustness) and ectomorphy (relative linearity). Somatotyping has long been used in sport science, growth studies and anthropology, whereas its use for health and disease-risk assessment in non-athletes is comparatively uncommon [21]. Recent studies suggest that somatotype may differentiate blood pressure, aerobic fitness and obesity-related indices in healthy adults [21–23], and older work linked physique to disease prevalence [24].

Despite this, the literature on somatotype, body composition and cardiovascular function remains siloed. Body-composition papers rarely report physique type; somatotype papers frequently report only blood pressure; and few studies examine functional cardiovascular domains (autonomic regulation, arterial stiffness, fitness) alongside either. This review therefore asks three questions: (1) how are somatotype and body composition related in healthy young men; (2) what is known about their association with cardiovascular functional indicators; and (3) does somatotype provide information beyond BMI? It closes by identifying gaps and proposing a research agenda.

REVIEW APPROACH

This is a narrative review, structured and self-assessed against the SANRA criteria for narrative reviews [25]. It is not a systematic review and was not conducted according to PRISMA standards [26]. Therefore, statements of absence (e.g., "no study tested…") indicate that no relevant study was identified in the literature examined, rather than confirming that no such study exists. Literature was identified through searches of PubMed, Google Scholar, and Scopus using combinations of terms related to somatotype (Heath-Carter, endomorphy, mesomorphy, ectomorphy), body composition (DXA, bioimpedance, skinfolds, body fat, normal-weight obesity), and cardiovascular function (blood pressure, heart rate variability, pulse wave velocity, arterial stiffness, cardiorespiratory fitness, VO_2max), with emphasis on young adults and South and Central Asian populations. Additional foundational methodological texts, guidelines, and landmark cohort or meta-analytic studies were identified through citation tracking. Studies were retained if they provided primary data or authoritative methodological guidance relevant to healthy young adults or to the measurement concepts discussed..

CONCEPTUAL AND MEASUREMENT FOUNDATIONS

Somatotype

The Heath-Carter anthropometric somatotype expresses physique as three ratings, conventionally written endomorphy–mesomorphy–ectomorphy and typically ranging from 1 to 7 or more [19,27]. It is computed from height, body mass, four skinfolds (triceps, subscapular, supraspinale, medial calf), two bone breadths (humerus, femur) and two limb girths (flexed upper arm, calf), measured according to standardised landmarks [28]. The three components are interdependent, which has analytical consequences discussed in section 11. Ratings are often grouped into thirteen descriptive categories, such as "endomorphic mesomorph" or "balanced ectomorph" [20].

It is important to be precise about what somatotype is. It is a description of physique shape and relative composition, anchored to anthropometric landmarks, not a direct measurement of fat mass or lean mass. Endomorphy is dominated by skinfold thickness and therefore tracks subcutaneous adiposity; mesomorphy reflects bone breadth and muscle-related girths corrected for height; ectomorphy reflects the height–weight ratio. Because it integrates adiposity, robustness and linearity in one profile, it is conceptually positioned between a crude index such as BMI and compartmental body-composition measures.

Body Composition

Body composition can be organised in levels of increasing complexity, from atomic to whole-body [29]. In practice, young-adult studies use a two-compartment molecular model (fat mass and fat-free mass) obtained by dual-energy X-ray absorptiometry (DXA), bioelectrical impedance analysis (BIA) or skinfold equations, with DXA usually treated as the practical reference [30,31]. Fat distribution is captured with waist circumference and waist-to-height ratio, which are simple and, in meta-analysis, outperform BMI for cardiometabolic risk screening [32,33]. Visceral and ectopic fat are particularly relevant mechanistically [34,35], and abdominal obesity carries risk for myocardial infarction across regions [36].

Cardiovascular Functional Indicators

This review focuses on four functional domains that can be measured non-invasively in healthy young men. **Blood pressure** is the best standardised: protocols, device validation and classification thresholds are defined by guidelines [37–39]. **Heart rate and heart rate variability (HRV)** index autonomic regulation; time- and frequency-domain metrics have published conventions and normative ranges [40–42], with known sex effects [43]. **Arterial stiffness**, most commonly carotid–femoral pulse wave velocity, is an integrated marker of vascular ageing with

independent prognostic value [44–46]. **Cardiorespiratory fitness** (VO_2max) and muscular strength are strong predictors of mortality and are increasingly proposed as clinical vital signs [47–49], with roots in youth fitness as a health marker [50]. Clustering of these risk factors is conventionally summarised by metabolic syndrome definitions [51].

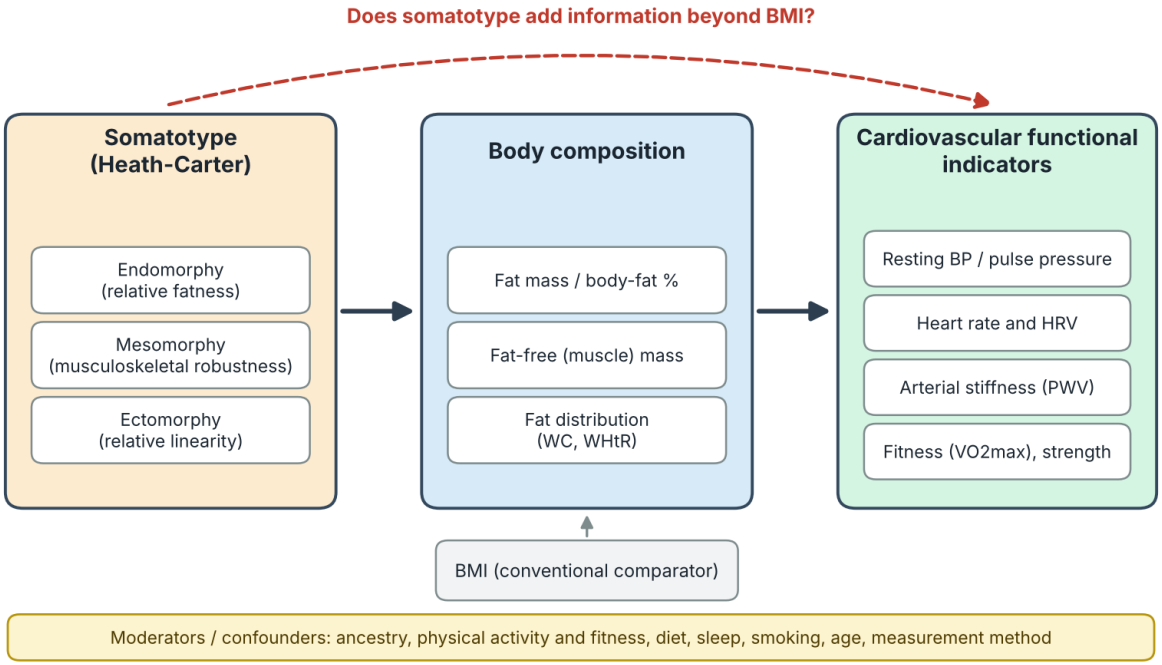


Figure 1. Conceptual framework. Somatotype components relate to body composition, which relates to cardiovascular functional indicators; the dashed arrow marks the central unanswered question of whether physique type adds information beyond BMI. Ancestry, activity, fitness and measurement method moderate or confound each link.

SOMATOTYPE AND BODY COMPOSITION

The relationship between physique type and composition was examined early. In college-aged women, the first Heath-Carter component was significantly related to body weight and body fatness, while the second component was related to lean body mass for a given height, explaining about 61% of its variance; Sheldon's original ratings were less closely tied to composition than the Heath-Carter ratings [52]. This established the logic still used today: endomorphy as an adiposity proxy, mesomorphy as a robustness-and-lean-mass proxy.

Contemporary data from healthy adults agree in direction. In a Polish study, body composition derived by bioimpedance was analysed together with somatotype and resting blood pressure, and the authors concluded that somatotype can add complementary information to individual measurements when describing biological risk, particularly in women [21]. In a large sample of adults from Xinjiang, which included Kyrgyz participants, somatotype distribution differed significantly across BMI-based obesity groups, with overweight and obesity concentrated in endomorphic-mesomorph categories [23]. Because both studies classify participants by BMI or use BIA, they show concordance rather than independence, a point taken up in section 5.

Measurement choice matters for any linkage. Fat-mass estimates from DXA, BIA and anthropometry in young adults do not always agree, and the interchangeability of methods remains a concern that motivated a recent validation study in 265 young adults [31]. Since somatotype itself is anthropometric, a study that pairs it with a BIA-derived fat percentage mixes two different measurement logics, whereas pairing it with DXA provides a more independent comparison [30].

Effect sizes linking physique to metabolic variables can be small. In non-obese women aged 25–40, endomorphy correlated with a continuous metabolic syndrome risk score only weakly ($r \approx 0.13$) [53], and in older adults somatotype has been explored in relation to lipids and glucose [54]. Such results are hypothesis-generating rather than decisive, and they come from groups very different from healthy young men.

DOES SOMATOTYPE ADD INFORMATION BEYOND BMI?

The Case Against Bmi As a Stand-alone Index

At the population level BMI has a J- or U-shaped relationship with mortality, with lowest risk in the range around 20–25 kg/m² [7,8], although the association of mild overweight with outcomes is debated [6]. At the individual

level, the percentage of body fat for a given BMI varies with age, sex and ancestry [11], and BMI classifies many people with excess fat as non-obese [12,13]. The normal-weight obesity literature quantifies the harm: in a large Colombian young-adult cohort, normal-weight obesity was associated with roughly threefold odds of an adverse cardiometabolic risk score, and with low HDL cholesterol, abdominal obesity and low muscular strength [17]. A meta-analysis confirms an association between normal-weight obesity and cardiometabolic risk factors [16], and a 2026 study of young adults undergoing occupational health assessments reported that the triglyceride-to-HDL ratio discriminated adiposity phenotypes despite normal BMI [55].

What Somatotype Could Add

Somatotype has two features BMI lacks. It separates fatness (endomorphy) from musculoskeletal robustness (mesomorphy) and linearity (ectomorphy), so that two men with the same BMI but different physiques receive different profiles. It also scales muscularity to bone size, which may help distinguish a muscular young man with a high BMI from an adipose one. Observational studies hint that this distinction is health-relevant. In healthy Polish adults, ectomorphic participants had the lowest BMI, waist circumference and waist-to-hip ratio; mesomorphy favoured higher aerobic capacity while endomorphy was associated with less favourable blood pressure and lower VO_2max [22]. In a large occupational sample, dominant mesomorphy with marked endomorphy characterised those with the highest prevalence of hypertension [24].

Why the Question Remains Open

The decisive test of added value has, to our knowledge, not been done in healthy young men. Existing studies compare somatotype groups, report correlations, or show that somatotype distribution varies across BMI categories [23]. None of the sources reviewed fitted models in which BMI (or waist-to-height ratio, or percentage body fat) is entered first and somatotype components second, with change in explained variance, discrimination or reclassification as the outcome. Without such tests, differences between somatotype groups may simply restate the adiposity that BMI already captures. The strongest competitors are not BMI alone but waist-to-height ratio and directly measured body fat, which already outperform BMI in screening [32,33]; any claim for somatotype should be tested against them. Because ancestry alters the BMI–fat relationship, the test must also be run within the ancestry group of interest [56,57].

BLOOD PRESSURE AND HEMODYNAMICS

Blood pressure is the cardiovascular variable most often paired with somatotype. Findings point to a positive association with endomorphy and, in several samples, with mesomorphy, and a negative association with ectomorphy; in the Polish sample resting blood pressure was associated with somatotype in women, whereas ectomorphy was associated with fewer risk factors in older men [21]. Young-adult evidence is thinner. In a small study of 29 men aged 18–22 who performed a treadmill step test to failure, ectomorphs showed higher functional capacity, a greater aerobic contribution to energy supply, smaller cardiovascular homeostatic shifts and lower post-exercise glucose and lactate than other types, especially endomorphs [58].

Body composition without somatotype shows a similar picture. In the Australian cohort of 35 young men, lean and overweight groups defined by body fat did not differ significantly in blood pressure, but the overweight group had lower HDL cholesterol, and risk factors clustered in men with high body fat and low monounsaturated fat intake [5]. Pooled together, these findings caution that in young men the signal in resting blood pressure can be small and that small samples may lack power.

Interpretation requires attention to thresholds and measurement. Blood pressure categories in young adults carry prognostic weight even below traditional hypertension cut-offs [2], and guideline definitions differ between US and European documents [38,39]. Between-study differences in cuff size, rest period, number of readings and device validation can be as large as the physique effect being sought [37]. A related concern is that in young adults waist-to-height ratio and blood pressure were independent determinants of aortic stiffness, so blood pressure should be analysed jointly with central adiposity rather than in isolation [59].

HEART RATE AND HEART RATE VARIABILITY

Autonomic imbalance, characterised by reduced vagal and relatively increased sympathetic activity, links adiposity to cardiovascular risk [60]. Obesity is associated with reduced HRV, and weight loss improves it [61]. A narrative review concluded that decreased HRV is associated with a higher percentage of body fat and lower muscle mass [62]. A cross-sectional study of 180 young-to-middle-aged men with high occupational physical activity found that higher fat mass and lower weight-adjusted muscle index went with weaker parasympathetic indicators, and suggested that activity and muscle mass may buffer the adverse effect of fat [63].

The relationship is not uniformly linear. In 24 lean, physically active men aged 18–30, weekly physical activity was positively related to vagal indices, and abdominal subcutaneous fat and waist-to-hip ratio showed a positive rather than negative relationship with high-frequency power [64]. This illustrates a recurrent difficulty: within low-risk,

active young men, the range of adiposity is narrow, and fat distribution, fitness and activity volume interact. HRV metrics also depend on recording length, posture, breathing and software, and normal values vary markedly between studies and by sex [40–43].

Direct links between Heath-Carter components and HRV in healthy young men are sparse in the English-language sources examined. Regional-language literature, notably from Eastern Europe, contains studies relating somatotype to HRV and hemodynamics in young adults; these were visible during searching but could not be fully catalogued here, and a systematic update should retrieve and appraise them.

ARTERIAL STIFFNESS

Pulse wave velocity predicts cardiovascular events and mortality independently of conventional risk factors [45,46], and consensus documents define methods and interpretation [44]. In the multiethnic DASH cohort of 666 young adults aged 21–23, unadjusted pulse wave velocity was similar in Black Caribbean and white UK young men and lower in other groups at comparable blood pressure and BMI; increased waist-to-height ratio, lower physical activity and higher blood pressure independently increased stiffness, and ancestry modified the relationships [59]. These findings show that arterial stiffness is sensitive to central adiposity and ancestry already in the early twenties, which is exactly where a physique descriptor could be useful.

Despite this, we did not identify any study relating Heath-Carter somatotype components to pulse wave velocity in healthy young men. In South Asian adults, adverse fat distribution is documented in young adults of Indian ancestry compared with African Creoles in Mauritius, who differed in visceral-to-peripheral adiposity and lipid profile [65], but vascular function was not the focus. Arterial stiffness therefore represents one of the clearest unexplored outcomes for somatotype research.

CARDIORESPIRATORY FITNESS AND FUNCTIONAL CAPACITY

Cardiorespiratory fitness is among the strongest modifiable predictors of cardiovascular and all-cause mortality [47,48], and muscular strength has independent prognostic value in men [49]. Fitness also modifies the consequences of excess fat: the metabolically healthy but obese phenotype carries a better prognosis when fitness is high, and fitness explains a large part of this protection [66,67]. Fitness is therefore both a cardiovascular outcome and a confounder or effect modifier for any body-composition analysis.

For somatotype, the most direct evidence comes from adults. In 276 Polish adults, somatotype differentiated anthropometric parameters and VO_2max, with higher aerobic capacity in mesomorphic individuals and lower VO_2max with endomorphy [22]. In young men, ectomorphs tolerated incremental exercise with smaller cardiovascular shifts [58]. A study of 304 young adults further showed that ACTN3 genotype may influence cardiorespiratory fitness, but its link to somatotype and body composition was not clear, underscoring genetic heterogeneity within physique categories [68].

ANCESTRY AND REGION: SOUTH AND CENTRAL ASIAN MEN

An expert consultation convened by the WHO concluded that Asian populations show different relationships between BMI, body fat and health risk than Europeans, with substantial risk of type 2 diabetes and cardiovascular disease at BMI values below 25 kg/m²; the proposed public-health action points were 23.0, 27.5, 32.5 and 37.5 kg/m², without a single universal Asian cut-off [56]. Chinese, Malay and Indian adults in Singapore had higher body fat at the same BMI than Europeans [57]. Related concepts include the thin-fat phenotype and the “Y-Y paradox” in Indians [69,70], and the adipose-tissue overflow hypothesis that explains susceptibility to central obesity in South Asians [71]. Comparative imaging shows that visceral adipose tissue accumulation differs by ancestry [72], and that South Asians in the United States have a higher prevalence of diabetes than other groups, partly explained by body composition and fat distribution [73]. Reviews of developing countries and an Indian consensus statement recommend lower thresholds and greater attention to abdominal adiposity [74,75].

For Central Asia the evidence is scarcer and methodologically distinct. Studies of ethnic Kyrgyz men in Osh used a constitutional typology (abdominal, thoracic, muscular and indefinite types) rather than Heath-Carter ratings; in 955 men, abdominal, muscular and indefinite types were each common and the thoracic type the rarest [76,77]. Because these categories are not interchangeable with endomorphy–mesomorphy–ectomorphy, results cannot be compared directly with Indian or European somatotype data. The Xinjiang study is a partial bridge, as it applied the Heath-Carter method in several Central Asian groups including Kyrgyz [23]. No study identified here compared Indian and Kyrgyz young men with the same somatotype, DXA-based body composition and cardiovascular protocol.

EVIDENCE SUMMARY AND METHODOLOGICAL ISSUES

Table 1 summarises the primary studies most relevant to the question. Several features recur: small or convenience samples, cross-sectional design, adjustment for few confounders, and outcome sets limited to one cardiovascular domain.

Table 1. Selected primary studies relevant to somatotype, body composition and cardiovascular indicators in young and adult populations.

Study	Population and design	Exposure / measures	Principal findings
Liberato et al. [5]	35 healthy men, 18–25 y; cross-sectional (Australia)	DXA body composition, BP, lipids, diet, fitness	Lean vs overweight groups differed in HDL cholesterol but not significantly in BP; 42.9% had body fat ≥20%; risk clustering with high fatness and low MUFA intake.
Prikhodko et al. [58]	29 healthy men, 18–22 y; exercise test to failure (Russia)	Heath-Carter somatotype, BP, HR, glucose and lactate	Ectomorphs showed higher functional capacity, smaller cardiovascular shifts and lower glucose and lactate after maximal effort than other types, especially endomorphs.
Cvijetić et al. [63]	180 men, young to middle age, high occupational activity	Multi-frequency BIA; photoplethysmographic HRV	Higher fat mass and lower muscle index accompanied weaker parasympathetic indices.
Avendaño et al. [64]	24 lean, physically active men, 18–30 y	Skinfolds, WHR, spectral HRV	Activity volume positively related to vagal indices; abdominal subcutaneous fat related positively to HF power.
Potocka et al. [68]	304 young healthy adults	Somatotype, directly measured VO_2max, ACTN3 genotype	Genotype may influence fitness; relation to somatotype and composition unclear.
Cruickshank et al. [59]	666 young adults, 21–23 y; multiethnic cohort	Arteriograph PWV, BP, anthropometry, activity	Waist-to-height ratio, BP and low activity independently increased PWV; ancestry modified associations.
Correa-Rodríguez et al. [17]	Large Colombian young-adult sample	BIA body fat, BMI, cardiometabolic Z-score	Normal-weight obesity: ~3-fold odds of adverse cardiometabolic score; low HDL, abdominal obesity, low strength.
Lipowicz et al. [22]	276 healthy adults (146 men), 18–72 y; Poland	Heath-Carter somatotype, VO_2max	Mesomorphy favoured aerobic capacity; endomorphy linked to less favourable BP and lower VO_2max; ectomorphs had lowest BMI, WC, WHR.
Lipowicz et al. [21]	Healthy adult men and women; Poland	Somatotype, bioimpedance body composition, resting BP	BP associated with somatotype in women; ectomorphy associated with fewer risk factors in older men.
Koleva et al. [24]	524 men and 250 women (workers)	Somatotype, clinical examination, disease prevalence	Dominant mesomorphy with marked endomorphy: highest hypertension prevalence.
Liu et al. [23]	3,438 adults incl. Kyrgyz; Xinjiang	Heath-Carter somatotype vs BMI groups	Somatotype distribution differed across obesity groups; overweight/obesity concentrated in endomorphic-mesomorph types.
Sakibaev et al. [76]	955 ethnic Kyrgyz men; Osh	Complex anthropometry, constitutional typology	Abdominal, muscular and indefinite types common; typology not Heath-Carter.

Heterogeneity of Somatotype Measurement

Somatotype can be obtained by the full anthropometric method, by photoscopic rating, by prediction from bioimpedance or body-composition indices, or by locally developed constitutional typologies, as seen in the Kyrgyz literature [19,27,76]. These approaches are not equivalent. Anthropometric somatotyping is sensitive to skinfold technique and landmarking, so inter-observer technical error should be reported [28]. Without a common protocol, pooled analysis is unreliable.

Heterogeneity of Body-composition Measurement

DXA, BIA and anthropometry give different fat-mass values and different error patterns, and device-, posture- and hydration-dependent bias is well documented [30,31]. Agreement between methods should be reported using limits-of-agreement analysis rather than correlation alone [78]. Body composition models also differ in the compartments they resolve [29].

Statistical Handling of Somatotype

Because the three components are constrained and correlated, using each as an independent predictor in the same regression model risks collinearity, and dichotomising into thirteen categories loses information and creates sparse cells. Recommended alternatives include modelling components as continuous variables with explicit diagnostics for collinearity, using somatotype attitudinal distances to compare groups, and prespecified multivariate or compositional approaches [20,27]. Incremental value should be reported with change in explained variance,

discrimination and reclassification, not only with significance tests.

Confounding and Effect Modification

Physical activity, fitness, diet, sleep, tobacco use and maturational timing influence both physique and cardiovascular function [66,79]. Many studies adjust for only age. Fitness in particular may mediate part of the association between physique and blood pressure or HRV, and should be handled explicitly rather than as an afterthought.

RESEARCH GAPS

Gap 1 is the one that motivated this review; the others emerge from the synthesis. They are ordered by the priority we would assign them. Table 2 pairs each with the evidence base and a concrete research response.

Table 2. Identified research gaps, supporting evidence and proposed responses.

	Gap	Current evidence	Proposed research response
1	Siloed literature: physique, body composition and cardiovascular function are rarely studied together in healthy young men	Body-composition papers report BP or HRV without physique [5,63,64]; somatotype papers report mostly BP or fitness [21,22,58].	Single cohort with somatotype, DXA composition and a multi-domain cardiovascular battery (BP, HRV, PWV, VO_2max).
2	No formal test of incremental value of somatotype beyond BMI, waist-to-height ratio or body fat	Evidence is group comparison and concordance with BMI [23,24]; competing indices already outperform BMI [12,33].	Hierarchical models: BMI → + WHtR/body fat → + somatotype; report ΔR^2, AUC, reclassification.
3	Narrow outcome coverage: BP dominates; arterial stiffness and HRV are almost absent for somatotype	No somatotype–PWV study identified; HRV evidence uses adiposity indices, not somatotype [62–64].	Include carotid–femoral PWV and standardised short-term HRV [40,44].
4	Non-standardised somatotype and body-composition methods	Anthropometric, BIA-derived and local typologies coexist [31,76].	Use ISAK-standard Heath-Carter protocol; report technical error of measurement; DXA as reference.
5	Limited ancestry-specific evidence for South and Central Asian men	WHO reports different BMI–fat–risk relations in Asians [56,57]; Kyrgyz data use a different typology [77].	Same-protocol comparison of Indian and Kyrgyz young men; ancestry-specific reference values.
6	Small, cross-sectional, single-site samples	Typical n=24–180 in young men [5,58,63,64].	A priori sample-size calculation for incremental-value endpoints; longitudinal follow-up.
7	No prospective data linking young-adult physique to later events or intermediate trajectories	Young-adult BP predicts later events [2]; physique trajectories untested.	Cohorts with repeat measures of somatotype and vascular function through the twenties.
8	Inadequate control of confounders and mediators	Fitness and activity modify obesity-related risk [66,67]; adjustment inconsistent.	Pre-specified covariates (activity, fitness, diet, sleep, smoking); mediation analysis.
9	Analytical handling of interdependent components	Components are correlated; categories are sparse [20].	Continuous modelling, attitudinal distance, compositional methods; pre-registered analysis plan.
10	Resting measures only; limited dynamic responses	Exercise responses differ by type in small samples [58].	Add BP and HR reactivity and recovery to standardised exercise.
11	Mechanistic and genetic heterogeneity unaddressed	ACTN3 genotype results unclear for physique [68].	Nested genetic or biomarker sub-studies in well-phenotyped cohorts.
12	Reporting and clinical translation: no thresholds or decision rules	Few studies translate findings into screening cut-offs [56,75].	Report effect sizes with CIs, ethnicity-specific thresholds; follow reporting guidelines.

PROPOSED RESEARCH AGENDA

A study capable of closing the principal gaps would share the following features.

- **Design:** Prospective cohort or well-powered cross-sectional study in healthy men aged 18–30, recruited with explicit sampling frames, with a pre-specified incremental-value hypothesis and a pre-registered analysis plan.
- **Exposure measurement:** Heath-Carter somatotype by trained, ISAK-credentialed anthropometrists with reported technical error [27,28]; DXA fat and lean mass as reference with BIA as a secondary field method [30,31]; waist circumference and waist-to-height ratio [32,33].
- **Outcome measurement:** Seated blood pressure with validated devices [37]; short-term HRV under controlled conditions [40,41]; carotid–femoral PWV

[44]; maximal or well-validated submaximal VO_2 and handgrip strength [48,49].

- **Comparators:** BMI-based classification using both standard and Asian-specific thresholds [56,75], waist-to-height ratio, and body-fat percentage, so that somatotype is judged against the strongest simple alternatives.
- **Analysis:** Continuous somatotype components and attitudinal distances; hierarchical models with ΔR^2, discrimination and reclassification; Bland–Altman agreement for any method comparison [78]; mediation by fitness; stratification by ancestry.
- **Populations:** Same-protocol recruitment of Indian and Kyrgyz men, with local typology (where used) reported alongside Heath-Carter ratings to allow bridging of the Central Asian literature [23,76].

LIMITATIONS OF THIS REVIEW

This is a narrative review. The search was not exhaustive and was not run through a pre-registered systematic protocol, so relevant studies, especially in regional-language journals, may be missing and statements of absence should be read cautiously. Several included studies had limited bibliographic detail available during searching and their citations should be completed before submission. Most primary evidence is cross-sectional, derived from small samples and from different somatotyping and body-composition methods, which prevents quantitative pooling. Sex and age were restricted to young men by design, although much of the supporting somatotype evidence comes from mixed-sex or older adult samples.

CONCLUSIONS

Somatotype describes physique in a way that tracks fatness and lean robustness and has been associated, in several modest studies, with blood pressure, autonomic profile and aerobic fitness. BMI misclassifies many young adults, and the burden of normal-weight obesity makes the case for richer descriptors. However, there is no direct evidence yet that somatotype improves explanation or prediction of cardiovascular function beyond BMI, waist-to-height ratio or measured body fat in healthy young men, and ancestry-specific evidence for South and Central Asian men is particularly thin. Closing these gaps requires multi-domain cardiovascular phenotyping, standardised somatotype and DXA protocols, careful handling of the interdependent components, and explicit incremental-value testing. Until then, somatotype should be regarded as a promising complement to, not a replacement for, BMI and central-adiposity measures.

REFERENCES

[1] Berenson GS, Srinivasan SR, Bao W, Newman WP 3rd, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults: the Bogalusa Heart Study. N Engl J Med. 1998;338(23):1650-1656

[2] Yano Y, Reis JP, Colangelo LA, Shimbo D, Viera AJ, Allen NB, et al. Association of blood pressure classification in young adults using the 2017 ACC/AHA blood pressure guideline with cardiovascular events later in life. JAMA. 2018;320(17):1774-1782

[3] Andersson C, Vasan RS. Epidemiology of cardiovascular disease in young individuals. Nat Rev Cardiol. 2018;15(4):230-240

[4] Lloyd-Jones DM, Allen NB, Anderson CAM, Black T, Brewer LC, Foraker RE, et al. Life's Essential 8: updating and enhancing the American Heart Association's construct of cardiovascular health. Circulation. 2022;146(5):e18-e43

[5] Liberato SC, Maple-Brown L, Bressan J, Hills AP. The relationships between body composition and cardiovascular risk factors in young Australian men. Nutr J. 2013;12:108. doi:10.1186/1475-2891-12-108

[6] Flegal KM, Kit BK, Orpana H, Graubard BI. Association of all-cause mortality with overweight and obesity using standard body mass index categories: a systematic review and meta-analysis. JAMA. 2013;309(1):71-82

[7] Berrington de Gonzalez A, Hartge P, Cerhan JR, Flint AJ, Hannan L, MacInnis RJ, et al. Body-mass index and mortality among 1.46 million white adults. N Engl J Med. 2010;363(23):2211-2219

[8] Global BMI Mortality Collaboration. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. Lancet. 2016;388(10046):776-786

[9] Prentice AM, Jebb SA. Beyond body mass index. Obes Rev. 2001;2(3):141-147

[10] Nevill AM, Stewart AD, Olds T, Holder R. Relationship between adiposity and body size reveals limitations of BMI. Am J Phys Anthropol. 2006;129(1):151-156

[11] Gallagher D, Heymsfield SB, Heo M, Jebb SA, Murgatroyd PR, Sakamoto Y. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. Am J Clin Nutr. 2000;72(3):694-701

[12] Okorodudu DO, Jumean MF, Montori VM, Romero-Corral A, Somers VK, Erwin PJ, Lopez-Jimenez F. Diagnostic performance of body mass index to identify obesity as defined by body adiposity: a systematic review and meta-analysis. Int J Obes. 2010;34(5):791-799

[13] Romero-Corral A, Somers VK, Sierra-Johnson J, Thomas RJ, Collazo-Clavell ML, Korinek J, et al. Accuracy of body mass index in diagnosing obesity in the adult general population. Int J Obes. 2008;32(6):959-966

[14] Romero-Corral A, Somers VK, Sierra-Johnson J, Korenfeld Y, Boarin S, Korinek J, et al. Normal weight obesity: a risk factor for cardiometabolic dysregulation and cardiovascular mortality. Eur Heart J. 2010;31(6):737-746

[15] Oliveros E, Somers VK, Sochor O, Goel K, Lopez-Jimenez F. The concept of normal weight obesity. Prog Cardiovasc Dis. 2014;56(4):426-433

[16] Mohammadian Khonsari N, Khashayar P, Shahrestanaki E, et al. Normal weight obesity and cardiometabolic risk factors: a systematic review and meta-analysis. Front Endocrinol. 2022;13:857930. doi:10.3389/fendo.2022.857930

[17] Correa-Rodriguez M, et al. Normal-weight obesity is associated with increased cardiometabolic risk in young adults. Nutrients. 2020. PMCID: PMC7230158

[18] Sheldon WH, Stevens SS, Tucker WB. The Varieties of Human Physique. New York: Harper & Brothers; 1940

[19] Heath BH, Carter JEL. A modified somatotype method. Am J Phys Anthropol. 1967;27(1):57-74

[20] Carter JEL, Heath BH. Somatotyping: Development and Applications. Cambridge: Cambridge University Press; 1990

[21] Lipowicz A, Pol A, Swierczynska K, Nierwinska K, Nowak Z, Mysliwiec A, Knapik A. Somatotype and body composition of healthy adult men and women and their contribution to civilization diseases risk. J Physiol Anthropol. 2025. doi:10.1186/s40101-025-00420-8

[22] Lipowicz A, Pol A, Swierczynska K, Knapik A, et al. Cardiorespiratory fitness of healthy Polish men and women with various somatotypes. BMC Cardiovasc Disord. 2025. doi:10.1186/s12872-025-05436-7

[23] Liu X, Li W, Wen Y, Xu G, Zhou G, Qu Q, et al. Obesity and Heath-Carter somatotyping of 3438 adults in the Xinjiang Uygur Autonomous Region of China by multivariate analysis. Diabetes Metab Syndr Obes. 2021;14:659-670

[24] Koleva M, Nacheva A, Boev M. Somatotype and disease prevalence in adults. Rev Environ Health. 2002;17(1):65-84. doi:10.1515/reveh.2002.17.1.65

[25] Baethge C, Goldbeck-Wood S, Mertens S. SANRA - a scale for the quality assessment of narrative review articles. Res Integr Peer Rev. 2019;4:5

[26] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71

[27] Carter JEL. The Heath-Carter Anthropometric Somatotype: Instruction Manual. San Diego: San Diego State University; 2002

[28] Marfell-Jones M, Olds T, Stewart A, Carter L. International Standards for Anthropometric Assessment. Potchefstroom: ISAK; 2006

[29] Wang ZM, Pierson RN Jr, Heymsfield SB. The five-level model: a new approach to organizing body-composition research. Am J Clin Nutr. 1992;56(1):19-28

[30] Kyle UG, Bosaeus I, De Lorenzo AD, Deurenberg P, Elia M, Gomez JM, et al. Bioelectrical impedance analysis - part I: review of principles and methods. Clin Nutr. 2004;23(5):1226-1243

[31] Mecherques-Carini M, Albaladejo-Saura M, Vaquero-Cristobal R, Baglietto N, Esparza-Ros F. Validity and agreement between dual-energy X-ray absorptiometry, anthropometry and bioelectrical impedance in the estimation of fat mass in young adults. Front Nutr. 2024;11:1421950. doi:10.3389/fnut.2024.1421950

[32] Lean MEJ, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. BMJ. 1995;311(6998):158-161

[33] Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obes Rev. 2012;13(3):275-286

[34] Despres JP. Body fat distribution and risk of cardiovascular disease: an update. Circulation. 2012;126(10):1301-1313

[35] Neeland IJ, Ross R, Despres JP, Matsuzawa Y, Yamashita S, Shai I, et al. Visceral and ectopic fat, atherosclerosis, and cardiometabolic disease: a position statement. Lancet Diabetes Endocrinol. 2019;7(9):715-725

[36] Yusuf S, Hawken S, Ounpuu S, Bautista L, Franzosi MG, Commerford P, et al. Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: a case-control study. Lancet. 2005;366(9497):1640-1649

[37] Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans. Circulation. 2005;111(5):697-716

[38] Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Hypertension. 2018;71(6):e13-e115

[39] Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, et al. 2018 ESC/ESH guidelines for the management of arterial hypertension. Eur Heart J. 2018;39(33):3021-3104

[40] Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability: standards of measurement, physiological interpretation, and clinical use. Circulation. 1996;93(5):1043-1065

[41] Shaffer F, Ginsberg JP. An overview of heart rate variability metrics and norms. Front Public Health. 2017;5:258

[42] Nunan D, Sandercock GRH, Brodie DA. A quantitative systematic review of normal values for short-term heart rate variability in healthy adults. Pacing Clin Electrophysiol. 2010;33(11):1407-1417

[43] Koenig J, Thayer JF. Sex differences in healthy human heart rate variability: a meta-analysis. Neurosci Biobehav Rev. 2016;64:288-310

[44] Laurent S, Cockcroft J, Van Bortel L, Boutouyrie P, Giannattasio C, Hayoz D, et al. Expert consensus document on arterial stiffness: methodological issues and clinical applications. Eur Heart J. 2006;27(21):2588-2605

[45] Vlachopoulos C, Aznaouridis K, Stefanadis C. Prediction of cardiovascular events and all-cause mortality with arterial stiffness: a systematic review and meta-analysis. J Am Coll Cardiol. 2010;55(13):1318-1327

[46] Ben-Shlomo Y, Spears M, Boustred C, May M, Anderson SG, Benjamin EJ, et al. Aortic pulse wave velocity improves cardiovascular event prediction: an individual participant meta-analysis of prospective observational data from 17,635 subjects. J Am Coll Cardiol. 2014;63(7):636-646

[47] Kodama S, Saito K, Tanaka S, Maki M, Yachi Y, Asumi M, et al. Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: a meta-analysis. JAMA. 2009;301(19):2024-2035

[48] Ross R, Blair SN, Arena R, Church TS, Despres JP, Franklin BA, et al. Importance of assessing cardiorespiratory fitness in clinical practice: a case for fitness as a clinical vital sign. Circulation. 2016;134(24):e653-e699

[49] Ruiz JR, Sui X, Lobelo F, Morrow JR Jr, Jackson AW, Sjostrom M, et al. Association between muscular strength and mortality in men: prospective cohort study. BMJ. 2008;337:a439

[50] Ortega FB, Ruiz JR, Castillo MJ, Sjostrom M. Physical fitness in childhood and adolescence: a powerful marker of health. Int J Obes. 2008;32(1):1-11

[51] Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, et al. Harmonizing the metabolic syndrome. Circulation. 2009;120(16):1640-1645

[52] Slaughter MH, Lohman TG. Relationship of body composition to somatotype. Am J Phys Anthropol. 1976;44(2):237-244. doi:10.1002/ajpa.1330440205

[53] Kusumaningnastiti B, Probosari E, Dieny FF, Fitranti DY. Tipe tubuh (somatotype) dengan sindrom metabolik pada wanita dewasa non-obesitas usia 25-40 tahun [Somatotype and metabolic syndrome in non-obese women aged 25-40 years]. J Gizi Klin Indones. 2019;16(2):72-80. doi:10.22146/ijcn.42345

[54] Reis Filho AD, Fett WCR, Voltarelli FA, Ferrari Junior J, Ravagnani FCP, Coelho-Ravagnani CF, et al. Somatotype in the elderly: prevalence and association with lipids and glucose levels. Geriatr Gerontol Aging. 2011;5:182-188

[55] [Authors to be completed from DOI.] Normal-weight obesity and hidden cardiometabolic risk in young adults: implications beyond BMI-based classification. Med Sci (Basel). 2026;14(3):354. doi:10.3390/medsci14030354

[56] WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363(9403):157-163

[57] Deurenberg-Yap M, Schmidt G, van Staveren WA, Deurenberg P. The paradox of low body mass index and high body fat percentage among Chinese, Malays and Indians in Singapore. Int J Obes Relat Metab Disord. 2000;24(8):1011-1017

[58] Prikhodko AYu, Golovin MS, Klimov VM, Krivoshchekov SG, Aizman RI. Assessment of functional and biochemical parameters in healthy young men with different somatotypes. J Med Biol Res. 2024;12(3):279-289. doi:10.37482/2687-1491-Z197

[59] Cruickshank JK, Silva MJ, Molaodi OR, Enayat ZE, Cassidy A, Karamanos A, et al. Ethnic differences in and childhood influences on early adult pulse wave velocity: the DASH study. Hypertension. 2016;67(6):1133-1141

[60] Thayer JF, Yamamoto SS, Brosschot JF. The relationship of autonomic imbalance, heart rate variability and cardiovascular disease risk factors. Int J Cardiol. 2010;141(2):122-131

[61] Karason K, Molgaard H, Wikstrand J, Sjostrom L. Heart rate variability in obesity and the effect of weight loss. Am J Cardiol. 1999;83(8):1242-1247

[62] Lopez Sanchez GF, Lopez Sanchez L, Diaz Suarez A. Body composition and heart rate variability: relations to age, sex, obesity and physical activity [in Spanish]. Sport TK. 2015

[63] Cvijetic S, Macan J, et al. Body fat and muscle in relation to heart rate variability in young-to-middle age men: a cross sectional study. Ann Hum Biol. 2023

[64] Avendano A, Rodriguez EA, Urbina A. Es la grasa abdominal subcutanea un predictor de la variabilidad cardiaca en hombres con bajo riesgo metabolico? [Is abdominal subcutaneous fat a predictor of heart rate variability in men with low metabolic risk?]. Rev Univ Ind Santander Salud. 2016;48(3):341-351

[65] [Authors to be completed from DOI.] Visceral-to-peripheral adiposity ratio: a critical determinant of sex and ethnic differences in cardiovascular risks among Asian Indians and African Creoles in Mauritius. Int J Obes. 2024. doi:10.1038/s41366-024-01517-3

[66] Ortega FB, Lee DC, Katzmarzyk PT, Ruiz JR, Sui X, Church TS, Blair SN. The intriguing metabolically healthy but obese phenotype: cardiovascular prognosis and role of fitness. Eur Heart J. 2013;34(5):389-397

[67] Stefan N, Haring HU, Hu FB, Schulze MB. Metabolically healthy obesity: epidemiology, mechanisms, and clinical implications. Lancet Diabetes Endocrinol. 2013;1(2):152-162

[68] Potocka N, Penar-Zadarko B, et al. Association of ACTN3 polymorphism with body somatotype and cardiorespiratory fitness in young healthy adults. Int J Environ Res Public Health. 2019;16(9):1489

[69] Yajnik CS, Fall CHD, Coyaji KJ, Hirve SS, Rao S, Barker DJP, et al. Neonatal anthropometry: the thin-fat Indian baby. The Pune Maternal Nutrition Study. Int J Obes Relat Metab Disord. 2003;27(2):173-180