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Commentary

Assessing athletes beyond routine screening: Incorporating essential factors to optimize cardiovascular health and performance

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ABSTRACT

The American Heart Association (AHA) has devised Life's Essential 8, a set of eight evidence-based health behaviors that play a crucial role in optimizing cardiovascular health and overall well-being. In addition to Life's Essential 8, enhanced screening for Cardiovascular-Kidney-Metabolic (CKM) Syndrome risk factors into routine athlete screening also provides a more comprehensive approach for ensuring athlete safety and long-term health. Incorporating Life's Essential 8 and CKM Syndrome metrics into athlete health evaluations will improve the sports performance of athletes and help optimize their long-term health.

1. Introduction

Athletes of all levels require comprehensive health assessments prior to engaging in rigorous practice or competition [1]. In order to achieve peak performance and minimize injury risk, maintaining optimal physical condition, nutrition and recovery is required. Traditionally, evaluation of athletes has focused on pre-participation physicals and screenings to evaluate physical and psychological health [1]. In addition to baseline measures of fitness, the American Heart Association (AHA) has defined key measures for improving and maintaining cardiovascular health, namely Life's Essential 8 and the newly defined Cardiovascular-Kidney-Metabolic (CKM) syndrome [2–4].

Life's Essential 8 expands the clinical context by focusing on the following 8 facets of overall health: 1) Healthy eating and its effects on overall health, 2) Optimizing physical activity, 3) Tobacco cessation, 4) Healthy sleep habits, 5) Maintaining a healthy weight, 6) Controlling cholesterol, 7) Managing blood sugar, and 8) Managing blood pressure. All of these elements – when optimized – improve overall cardiovascular health. Furthermore, the advent of the new PREVENT equations (Predicting Risk of cardiovascular disease EVENTS), along with the newly defined CKM Syndrome allow clinicians to predict cardiovascular disease (CVD) risk when someone is younger, thereby enabling a more

holistic cardiovascular risk assessment of athletes throughout their life span. This is important, because as many athletes age, the athlete and their providers may underestimate CVD risk as they may perceive exercise as making one immune to the development of CVD. As such, in addition to conventional evaluation by a physician, incorporating Life's Essential 8 along with assessment of CKM risk factors during routine health screening would result in improved pre-participation evaluations and risk assessment for athletes [4].

2. Current paradigm

Given the risk of sudden cardiac death in those with undiagnosed or undertreated cardiovascular disease, in 1996, an AHA expert consensus panel recommended pre-participation screening for competitive athletes to identify conditions associated with sudden cardiac arrest [5,6]. However, the best method for cardiovascular screening of young athletes remains controversial. The AHA currently recommends a 14-point history and physical exam for preparticipation screening. These guidelines do not recommend universal ECG screening due to a lack of evidence, false positives and negatives, and strain on the health system, although this differs from European guidelines.

While a screening visit increases the chance of detecting a

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predisposing condition, it is also an opportunity to assess an athlete's overall health in detail, including how to develop sustainable and advantageous healthy behaviors while also controlling underlying health factors that could predispose to early CVD risk [7,8]. It also provides an opening to highlight that athletes are not immune to CVD and may in some cases be at higher risk of developing pathophysiologic changes to the cardiovascular system such as coronary calcification, atrial arrhythmias, and myocardial fibrosis [9,10].

Currently, several pre-participation physical evaluation (PPE) questionnaires do screen beyond CV risk; however, integrating Life's Essential 8 may allow for better standardization. For example, in addition to cardiac questions, screening questions typically include those pertaining to female/male athlete triad, diet and menstrual history, as well as mood and fatigue, concussions/other neurologic conditions, and joint, tendon, bone or muscle issues. Importantly, optimizing healthy BMI and weight management have been shown to contribute to decreased joint pain and improved mobility.

Furthermore, there remains no consensus on the ideal PPE environment. While some argue that mass physicals should be conducted by physicians and specialists who best understand risk factors and the optimal screening approach for athletic participation, still others state that a pediatrician or PCP who knows the patient the best should perform the PPE to allow for a more personal approach that could get lost in a mass event. Different settings may also afford varying amounts of time for these patient encounters.

Although a primary goal of PPEs is to screen athletes at risk of sudden cardiac arrest and death, they have evolved overtime to become a more comprehensive evaluation of athlete well-being. Primary care sports medicine physicians are concerned for the athlete as a whole person, and providing referrals and resources to aid their entire well-being beyond their athletic abilities is meaningful. While some of the components of Life's Essential 8 are vaguely included in most screening questionnaires –including questions about mental health and stress, relative energy deficiency, or weight, and joint issues – this can and often varies among institutions or between states. Incorporating Life's Essential 8 and CKM guidelines could help standardize these questions for more effective and streamlined counseling.

3. Life's Essential 8 and their relation to health

Life's Essential 8 could be integrated into a well-athlete visit for maximum impact to help transform athlete screenings. During routine physicals, athletes could be inspired to optimize their performance and simultaneously cultivate lifelong health. For example, short, targeted questions during the visit may uncover potential nutritional gaps, hidden sleep struggles, or undisclosed tobacco use. Moreover, personalized feedback based on questionnaire responses, exam findings, and even fitness tracker data could help assess latent health issues [4]. As such, athletes would leave empowered, armed with actionable plans tailored to their needs, whether it is a customized meal plan to fuel their energy levels or a stress-management toolkit to combat training anxieties. This streamlined approach elevates athlete assessments beyond a perfunctory screening, prioritizing the interplay of physical and metabolic well-being. Athletes can then build sustainable health habits for a thriving athletic career and a flourishing life beyond the arena.

Life's 8 Essential factors have been further stratified into 4 health behaviors and 4 health factors. The health behaviors include: 1) Optimizing nutrition, as establishing healthy eating earlier in an athlete's career ensures a greater chance of long-term health, enabling longevity. 2) Healthy levels of physical activity, which for athletes goes beyond the basics of regular fitness and may include the frequency of exercise, the establishment of safe limits, optimal timing for workouts and recovery, as well as strategies to avoid injury. 3) Avoiding tobacco, where the intermediate-term health risks of smoking and vaping should be stressed early, in addition to longer-term increased risk of stroke and CVD. 4) Getting healthy sleep, as the majority of athletes get insufficient sleep for

a number of reasons including, anxiety, late workouts, and travel. Establishing sleep hygiene practices that help mitigate stress and improve mental health while also enabling healing and repair of blood vessels and tissues is crucial for athletes [11].

In addition to the 4 health behaviors, the 4 health factors are: 1) Managing weight, as maintaining a healthy weight and BMI are essential to reduce the long-term risk of diabetes, high blood pressure, asthma, sleep apnea, psychosocial stressors and CVD for athletes during and after their competitive years. 2) Controlling cholesterol by optimizing LDL-C and triglyceride levels and evaluating genetics early if indicated, and providing early intervention if needed. 3) Managing blood sugar and knowing early warning signs of diabetes such as increased fatigue, urination, and thirst, and preventing hypo or hyperglycemic events for athletes with diabetes. 4) Monitoring blood pressure, which is critical for detecting high blood pressure since it is usually asymptomatic. Athletes with high blood pressure should be counseled early and followed regularly [4,12]. Lastly, though not specifically mentioned in Life's Essential 8, alcohol and substance use and moderation should also be discussed and counseled appropriately.

4. Strategies for integrating Life's Essential 8 into screening athletes

Several strategies can be implemented to integrate Life's Essential 8 into athlete screening programs effectively. For example, screening questionnaires can be developed to assess an athlete's adherence to each of the Life's Essential 8 behaviors, while identifying areas for improvement. For those with increased risk, more comprehensive health assessments can evaluate athletes for cardiovascular disease and provide a baseline for monitoring progress. The benefits of this approach must be weighed against the cost of any downstream testing that will be generated, and evidence of benefit must be provided prior to its introduction. Technology is rapidly developing, and the optimal use of mobile apps and wearable devices can track and monitor progress towards Life's Essential 8 goals, thereby promoting self-management and accountability. For example, novel applications such as the Corrie Health digital health platform have demonstrated that self-management tools can have a direct impact on improving patients' understanding of their own health while improving overall outcomes [13].

An oft-neglected aspect of athlete health is nutritional counseling if resources allow, whereby athletes would receive personalized nutritional counseling to develop a dietary plan specific to their sport aligned with Life's Essential 8 principles. Physical activity coaching for athletes in organized sports is usually managed by coaches and athletic trainers, although individual athletes may benefit from designing an exercise program that meets their needs and preferences, ensuring adherence to the Life's Essential 8 recommendations. Tobacco cessation support would improve athlete health, as resources and support services can be provided to athletes struggling with tobacco use. Sleep hygiene education is an area where significant improvements can be made, as athletes can be educated on healthy sleep habits and strategies to improve sleep quality and duration [14]. A schematic representation of the Life's Essential 8 factors to be integrated within athlete screening is highlighted in Fig. 1.

5. Integrating CKM risk factors

A recent scientific statement from the American Heart Association (AHA) outlines how the pathophysiological interrelatedness of cardiovascular disease, chronic kidney disease, obesity, and diabetes has led to the conceptualization of Cardiovascular-Kidney-Metabolic (CKM) syndrome. The interplay between these conditions provides valuable insights that can be integrated into athletes' medical encounters to promote long-term health and safety [2,3].

The intersection between athletes and metabolic risk factors presents a fascinating paradox. While athletes are often lauded for their physical

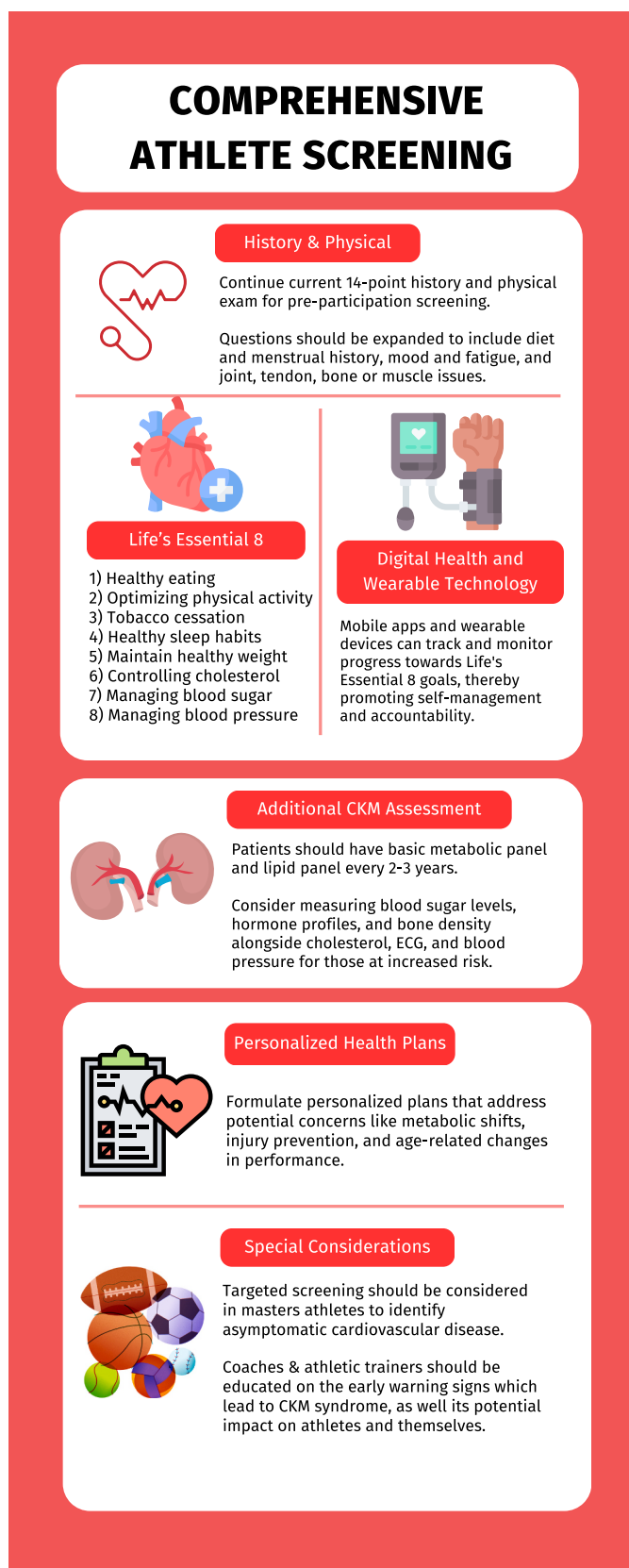


Fig. 1. Integrating Life's Essential 8 and CKM Risk Factors into Comprehensive Athlete Screening.

conditioning, a significant number may harbor the underlying risk factors of metabolic syndrome, a cluster of conditions associated with increased cardiovascular and diabetes risk, particularly among sports that tend to favor higher body mass index [15,16]. While exercise improves some metabolic markers, certain factors such as intense training, genetics, and body composition can contribute to insulin resistance and other hallmark features of metabolic syndrome. By incorporating holistic approaches that address both physical and metabolic well-being such as balancing healthy diets and adequate sleep with heavy training loads, athletes can maximize both on-field success and long-term health.

The CKM framework enables providers to expand the traditional screening components, with targeted assessments to identify potential risks for cardiovascular, kidney, and metabolic complications in athletes. Based on CKM-related risk of long-term complications, athletes can be stratified into CKM stages based on their individual CKM risk profile. Tiered screening can then be performed, with more intensive assessments for athletes in higher CKM stages. This approach facilitates more systematic identification of risk factors, which can then be addressed holistically through a combination of lifestyle change and pharmacotherapy as needed.

Given the varying physical profiles required for different sports, personalized management of an athlete's health has become increasingly important. Within the new CKM framework, individualized plans may be developed, as based on each individual's CKM risk profile. If necessary, higher risk athletes may also be referred to cardiologists, nephrologists, endocrinologists or other specialists for further evaluation and management. It is also important for athletes to be monitored periodically for changes in CKM risk factors and their management plans adjusted accordingly. A schematic representation of the CKM factors to be integrated within athlete screening is highlighted in Fig. 1.

6. Potential benefits of enhanced cardiovascular risk assessment

There are many potential benefits for integrating Life's Essential 8 and CKM Screening when counseling athletes. Enhanced performance can be achieved by optimizing cardiovascular health and overall well-being, and athletes may experience improved endurance, strength, recovery, and resilience as a result. Greater adherence to healthy lifestyle habits may contribute to better musculoskeletal function and reduced risk of injuries. The long-term health benefits from establishing healthy behaviors early in athletes' careers also include lowering their risk of developing chronic diseases in the future, thereby promoting long-term health and well-being. This comprehensive approach to athlete health addresses not only physical fitness but also mental and emotional well-being. For example, results from the HUDDLE study demonstrate a remarkably high rate of hypertension among former NFL athletes, with 9 out of 10 were diagnosed with hypertension and approximately 84 % of participants screened having a blood pressure in excess of 130/80. Both results from studies like HUDDLE and subsequent analyses high highlighted the need for improved screening and more structured frameworks when screening, so as to help identify CVD early in athletes' careers and prevent long term progression [17,18].

7. Counseling younger athletes

Understanding the distinct characteristics of both young and older athletes is imperative for effective health counseling. Younger athletes, typically defined as adolescents and teenagers, are still in crucial developmental stages. As such, their bodies are undergoing rapid growth and change, requiring specific nutritional focus for bone health, muscle development, and optimal energy levels. Additionally, navigating the pressures of competition and social dynamics at this age demands mental health support and guidance in building healthy coping mechanisms.

Importantly, in the young athlete such as high school and collegiate

athletes, there are many personal and life stressors that frequently contribute to impaired health and performance. Screening for all components of Life's Essential 8 during the PPE can help identify those with risk factors and serve to provide education and resources for seeking care and optimizing one's overall well-being. PPE data can be collected to identify areas of intervention for an individual and patterns where more resources and education could be beneficial for the group or team including often overlooked sleep hygiene and nutrition.

There is also a need for baseline health studies to ensure athletes are counseled at the start of their sports careers and through college. For example, the new CKM health guidance, in alignment with the American Academy of Pediatrics Guidelines, recommends lipid panels around ages 9–11 and again at 21, which represents a significant step towards proactive health management [19]. Early intervention can include lifestyle changes for healthier eating, such as reducing saturated fats and fried foods as well as increasing fruits and vegetables, which would benefit young athletes regardless of their cholesterol levels. Additionally, identifying those at higher risk allows for closer monitoring and potential medication initiation and adjustments, further reducing the risk of cardiovascular complications. This proactive approach empowers young athletes and their families to make informed decisions about their health.

8. Special considerations in masters athletes and tactical athletes

Older athletes, on the other hand, might face increasing injury risks, require adjustments to training regimens to accommodate aches and pains, and contend with age-related changes in metabolism and energy expenditure. This group includes endurance athletes, such as marathon runners and triathletes, and tactical athletes whose professions require a high degree of athleticism, such as police officers, military, and firefighters, among many others. Their health counseling needs may include managing chronic conditions and more traditional cardiovascular risk factors. Clearly, a “one-size-fits-all” approach to health counseling simply is not sufficient. Longer discussions and expanded laboratory testing can offer crucial insights to inform established athletes on their long-term well-being.

Many middle-aged, older, and retired athletes already have existing chronic conditions that elevate cardiovascular risk such as high blood pressure or diabetes. Managing and identifying chronic conditions is as important for athletes as for non-athletes to ensure that they receive specialized support for managing their health. Older athletes may believe that they are “immune” to standard cardiovascular risk factors and diseases due to their active lifestyle.

Delving deeper into their medical history, training routines, and lifestyle habits during extended consultations allows for a more nuanced understanding of potential risks and areas for improvement. Additionally, analyzing blood sugar levels, hormone profiles, and bone density alongside cholesterol, ECG, and blood pressure, paints a holistic picture of their internal health. With this comprehensive data, healthcare professionals can create personalized plans that address potential concerns like metabolic shifts, injury prevention, and age-related changes in performance. In addition to maximizing current performance, we can empower established athletes to make informed choices and actively engage in preventive measures, setting them on a path towards a continued healthy and active future.

A recent study published in the *European Journal of Preventive Cardiology* challenges the effectiveness of only conducting yearly heart screenings for preventing major adverse cardiovascular events (MACEs) in masters athletes. While the study monitored 798 athletes over five years with regular screenings, only 10 MACEs occurred, and all affected individuals had abnormal screening results. However, most athletes with abnormal screenings didn't experience a MACE during the follow-up period, suggesting screening alone – especially as presently conducted – might not be the best strategy for long-term prevention [20].

This highlights the need for further research to determine optimal health management strategies for this active population and emphasizes the importance of considering other factors beyond those identified with routine screening for cardiovascular risk assessment among older athletes. Furthermore, as previously mentioned, masters athletes are often diagnosed with CVD later in life, despite being asymptomatic. This suggests that targeted comprehensive screening with Life's Essential 8 and CKM risk factors, which take into account existing risk factors and baseline health status, could be used more effectively to diagnose, treat, and counsel older athletes much earlier.

9. Expanding counseling to coaches and athletic trainers (ATCs)

While athletes rightfully receive a spotlight on health and performance, coaches/ATCs often undergo health screening alongside their athlete as well. Coaches/ATCs may have a wider variety of health risks compared to their athletes. Health screening and education for coaches/ATCs can help foster a culture of improved nutrition for themselves and their athletes, establish healthy eating principles, and importantly, also facilitate recognition of the red flags of disordered eating in their athletes. Resources and guidance on portion sizes, nutrient balance, and the impact of food on performance can empower them to make informed choices for their teams.

In addition, coaches/ATCs should be trained to identify signs of stress, anxiety, or depression in their athletes. They should be provided with tools and resources to build a supportive and inclusive environment, foster open communication, and direct athletes towards professional help when needed. Coaches/ATCs should also be educated as to the early warning signs which lead to CKM syndrome, as well its potential impact on athletes and themselves. They should be challenged to lead by example by prioritizing their own health and modeling healthy behaviors. This sets the tone for a team culture that values well-being alongside performance, creating a ripple effect of positive choices. By empowering coaches/ATCs with knowledge and resources to take charge of their own health, we create a collaborative environment where athletes can thrive.

10. Challenges and considerations

While incorporating Life's Essential 8 and CKM screening may be more resource intensive and time-consuming, it is essential that athletes are evaluated beyond cardiovascular risk to ensure a comprehensive approach to their overall health and wellness. Implementing these strategies and the possible downstream testing that will follow requires resources and expertise in the field of sports cardiology, including trained personnel and access to healthcare services. Programs must be designed to be culturally sensitive and accessible to athletes of all backgrounds and socioeconomic levels. Careful consideration should also be paid to sustainability, as long-term commitment and ongoing support are necessary for maintaining successful integration of Life's Essential 8 and CKM risk factors into athlete health programs over time. Balancing the long-term benefits of CKM screening with the associated costs of some simple lab work, *i.e.*, basic metabolic panel and lipid panel every 2–3 years, is important to ensure optimal resource allocation. Lastly, the enhanced screening could be seen as potentially overburdening athletes, and care should be taken to streamline the process and prevent potential psychological strain or negative impacts on athlete's overall health experience.

11. Conclusion

Integrating CKM risk factors alongside Life's Essential 8 into athlete screening fosters a holistic approach to safeguarding health during sports participation and beyond. By identifying potential risks and implementing appropriate preventive measures early, athletes can participate in their chosen sports with greater confidence and reduced

risk of adverse events. This approach requires planning, resource allocation, and a focus on maximizing benefits while minimizing potential drawbacks. Ultimately, the goal is to create a safe and supportive environment for athletes to excel, while prioritizing their long-term health. By adopting a comprehensive approach that addresses physical, mental, and emotional well-being, athletes can achieve their full potential while laying the foundation for a healthy and fulfilling life.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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