

EDITORIAL COMMENT

Moving Toward Global Primordial Prevention in Cardiovascular Disease



The Heart of the Matter*

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Over the past decade, incremental progress has been made in reducing mortality rates in patients with established cardiovascular disease (CVD) in the United States (1). These favorable trends largely reflect improved uptake of cardiovascular drug and device therapies, streamlined processes of care, and augmented access to effective disease management programs. Collectively, these *secondary prevention* approaches have improved the longevity of patients with CVD.

Despite encouraging trends, these data conceal relatively unaltered trajectories and alarmingly high rates of cardiovascular risk factors (e.g., dyslipidemia, hypertension, and diabetes) and adverse health behaviors (e.g., physical inactivity, high-calorie diets, smoking, and nonideal body weights) (1,2). Unfortunately, the proportion of adults and children meeting all ideal health metrics, as defined by the American Heart Association (AHA) (3), has not improved in recent years and is 1% or less in most contemporary series (4,5). Furthermore, CVD continues to be the major driver of deaths worldwide, disproportionately affecting low-income countries (6). As these countries experience continued transitions in economy, diet, and disease, it is expected that these patterns in CVD, risk factors, and health behaviors will continue to evolve.

PRIMORDIAL PREVENTION: A PARADIGM SHIFT

Delaying or preventing the development of CVD in at-risk persons (*primary prevention*) and reducing the onset of risk factors in otherwise healthy individuals (*primordial prevention*) have only recently become national and international priorities. The AHA's 2020 Impact Goal (3), the Institute of Medicine's report on "Promoting Cardiovascular Health in the Developing World" (6), and the Department of Health and Human Services' "Million Hearts" Initiative (7) are exemplary efforts in refocusing attention on early phases of prevention. However, the practicalities of meeting these goals are not prescriptive and open questions remain—who to target, when and where to intervene, and how to make these efforts sustainable.

High-quality, contemporary clinical trials have traditionally been limited to primary and secondary prevention settings. In this issue of the *Journal*,

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Peñalvo et al. (8) present key results from Preschool SI! (Evaluation of the Program SI! for Preschool Education: A School-Based Randomized Controlled Trial), a comprehensive school-based program intended to instill favorable health behaviors early in life.

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This was a cluster-randomized, parallel-group, controlled trial of 2,062 children 3 to 5 years of age enrolled in 24 public schools in Madrid, Spain, comparing the usual curriculum with a structured behavioral health program. The intervention provided educational materials to students, teachers, schools, and families and focused on multiple components of health. Intervention duration varied from 1 to 3 years, depending on the student age at entry. The primary endpoint of questionnaire-based domains capturing knowledge, attitudes, and habits improved with intervention, driven by changes in physical activity and diet. Behavioral improvements were especially prominent in children who were maintained in the program for 2 or 3 years. A reduction in the secondary outcome, triceps skinfold thickness, was seen in the 3-year intervention group.

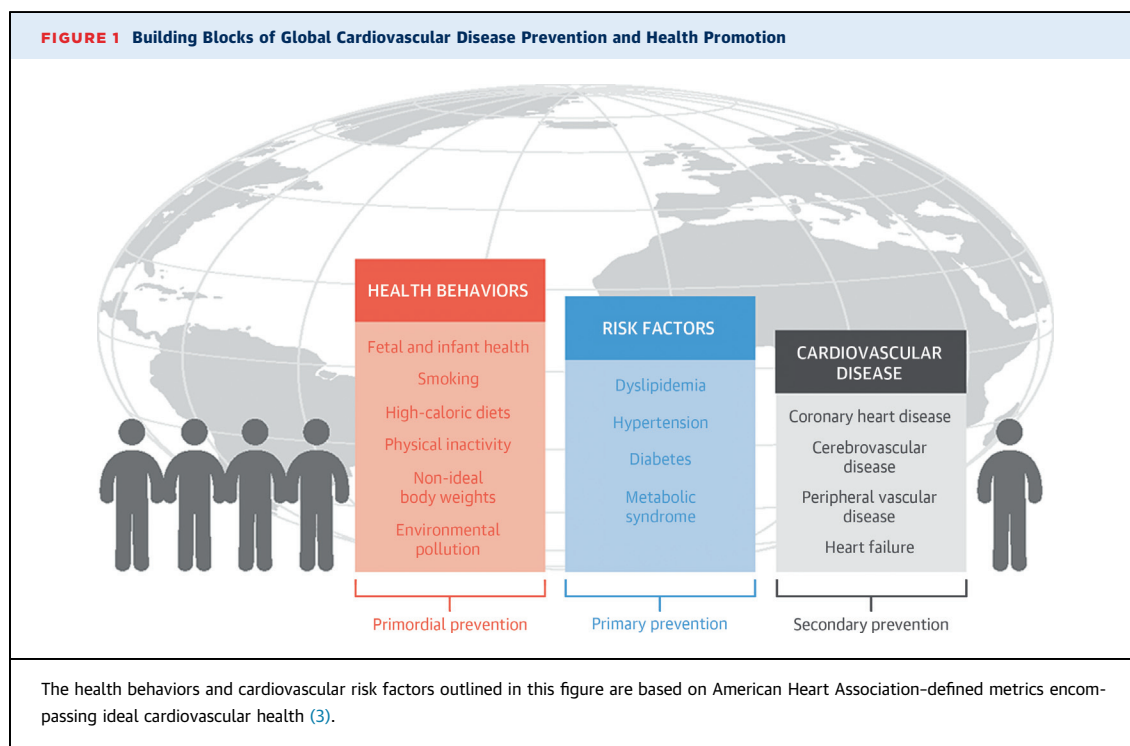
The Preschool SI! study (8) adds valuable new public health data on the benefits of early childhood intervention. This study uses an innovative design expanding the role of physicians to encompass

education and community leadership. Furthermore, it incorporates a structured protocol and evaluative framework, often lacking in community-based public health interventions. Finally, the program coordinates across students, families, and educators, potentially improving the sustainability of the intervention.

As recognized by the authors (8), a limitation of this trial is the reliance on self-reported outcomes without long-term data presented regarding the influence of this intervention on objective measures of health behaviors and risk factor development. It is unclear whether this program's early effects on health knowledge acquisition will translate into long-term (beyond the intervention period) effects on objective measures of physical activity, diet, anthropomorphic measurements, and cardiovascular risk factor profiles. Further study is needed of those aspects.

EARLY INTERVENTION: BIOLOGICAL OR BEHAVIORAL MODULATION?

Converging lines of evidence support the notion that CVD and the risk of CVD development are determined early in life (9,10). Although overt CVD often presents in adulthood, the development of atherosclerosis and adverse health behaviors begin in childhood. Preschool SI! targeted a critical age range not only for the biological underpinnings of CVD, but also for the



formation of traits that may influence CVD-related behaviors (11). The exact mechanism by which Preschool SI! achieved its beneficial effects on behavioral patterns is not entirely clear. How do children as young as 3 years of age not only assimilate knowledge related to their heart and health, but then in turn change their behavioral patterns favorably?

The observed benefits in Preschool SI! may be driven by behavioral modulation at the level of the student, school, or family. Understanding these behavioral changes will facilitate how this program can be scaled elsewhere and shed light on the exact mechanisms to inform the design of future global programs. One potential mechanism is through direct parental influence on student behavior. Because most children do not exert control over food choice, family members likely strongly shape any responses to targeted interventions. The benefits seen in Preschool SI! were greater in families with parents of higher economic and educational status. Consistent with these data (8), economically stable families may be able better to support healthy lifestyles espoused by the program. Another potentially fascinating mechanism involves the direct effects of the program on early formation of preferences in these children. Interventions targeted during a development period in childhood when preferences are formed may have powerful influences on behaviors later in life. This preference building may be reinforced through peer support in this school-based intervention.

Additionally, it is plausible that interventions targeting key sensitive periods in child development may fundamentally influence long-term programming of metabolic health. As suggested in the classic Abecedarian studies, high-quality preschool programs may strongly affect health and risk behaviors

later in life, especially in poor or at-risk families (12). Thus, it may not only be the cardiovascular health information itself that is helpful, but also the cognitive stimulation from and exposure to positive adult role models, which in turn influences personality traits such as delayed gratification and impulse control that are critical for health behavior and habit formation later in life.

This pioneering study represents an important step in exploring the intersection of child development, cardiovascular health promotion, and primordial prevention. We eagerly await longitudinal follow-up, data from other age groups, and outcomes related to families and schools from the Program SI!

NEXT STEPS IN GLOBAL CARDIOVASCULAR HEALTH PROMOTION

As improvements in CVD mortality plateau in the United States and the burden of CVD and its risk factors grow worldwide, new approaches targeting multiple levels of disease epidemiology need to be forged (Figure 1). The optimal balance between secondary, primary, and primordial prevention may depend largely on region-specific ecology of CVD, risk profiles, and national resources. Program SI!, standing for Salud Integral (or *comprehensive health*), is a groundbreaking public health program that has already transformed the delivery and study of high-impact, cost-effective interventions at the community level.

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