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# Taoist way of a balanced exercise training cocktail for the management of primary hypertension in older persons

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High blood pressure is the world's leading risk factor for mortality, affecting nearly half of the global population aged 50–79 years. Physical inactivity is one factor contributing to the prevalence of hypertension. This paper discusses a new concept for the management of hypertension in older persons. We are inclined to fade the current guidelines used in China, the United States, and Europe. Although demonstrating irrefutable benefits for blood pressure regulation, the guidelines fail to address the need to incorporate balance exercises, which are crucial for mitigating the risk of falling. We address three pressing questions regarding the efficacy of various combinations of exercise modes for blood pressure regulation, alongside providing an overview of balance exercises. At the core of our concept, we explicate the challenges inherent in addressing the global pandemic of physical inactivity and hypertension in regular socioeconomic people. No guidelines could change the state of inactivity by jumping between zero and all things, where “zero” symbolizes conditions such as physical inactivity and hypertension, and the concept of “all things” encompasses the ideals of an active lifestyle and healthy aging. We advocate a Taoist way, “zero–one—all things,” where “one” in this context refers to an inclusive and culturally diverse exercise training cocktail. The Tao guides us to illuminate an ancient way of overcoming physical inactivity-associated diseases in the present day.

## KEYWORDS

balance, blood pressure, falls, physical activity, meta-analysis, Tai Chi, Tao

## 1 Introduction

Dating back to the Warring States Period, the Esoteric Scripture of the Yellow Emperor made observations regarding the impact of an irregular pulse on human health (1). The scripture noted that over-consumption of salt might lead to impaired blood circulation and subsequently impact one's facial complexion (“多食鹹則脈凝泣而變色”), and that those who consume excessive amounts of salt and experience heart failure may exhibit an increased and hardened pulse (“[脈]盛而緊曰脹”). These vivid writings may constitute the earliest documentation of primary hypertension (hereafter, hypertension), suggesting that hypertension is not a recent ailment. Nevertheless, as we learn from the oracle bone script and beyond, securing a sufficient calorie intake was the paramount daily concern for the ancient Chinese, and the population halved every few hundred years as a result of famine and revolt (2). Obesity, insulin resistance, high alcohol intake, aging, or sedentary lifestyles are all recent “luxury” causes of hypertension

(3) that have emerged in industrial societies, making hypertension a modern disease.

In 2019, approximately 1.3 billion of the global population aged 30–79 years were living with hypertension (4). Hypertension has emerged as the primary risk factor for early mortality on a global scale, resulting in an estimated annual count of 10.8 million avoidable deaths (5). During the 78th Session of the United Nations General Assembly, the World Health Organization officially launched global efforts to prevent and cure this global disease, which it has referred to as “the race against a silent killer” (6). The worldwide hypertensive population will continually trend higher in the absence of lifestyle modifications, among which the level of physical activity plays a crucial role in the prevention–development–management nexus of high blood pressure (BP).

To date, there is conclusive evidence that physical inactivity is an etiology of hypertension and, conversely, regular physical activity (hereafter, exercise training) is an important adjuvant to standard pharmacological treatments (7). Despite its exceptional preventive and therapeutic values, the global level of physical activity has been on a downward trend and accelerated throughout the height of the COVID-19 pandemic (8). Should the existing prevalence of physical inactivity remain unchanged, a staggering 240 million new cases of preventable hypertension are projected to emerge worldwide between 2020 and 2030, which will impose a more than 115 billion US dollar burden on public healthcare systems (9). This polarization between evidence and action can be ascribed to myriad problems (10), but the elephant in the room is the lack of an all-round exercise training recommendation considered for regular socioeconomic people.

In this perspective, we first provide an overview of the existing exercise training guidelines for treating hypertension, with a focus on older persons. Old age is an independent risk factor of hypertension. On a global scale, the prevalence of hypertension among adults aged 30–79 years is estimated to be 33%, with a notable rise to 49% among those aged 50 to 79 (11). With the global demographic shift towards an aging society, hypertension will impose an even greater burden on healthcare systems. The aim of this discussion is to illuminate a way towards all-round exercise training guidelines for regular socioeconomic people with hypertension.

## 2 Exercise guidelines

The lack of policy emphasis on physical activity has been subject to criticism for impeding the successful implementation of evidence-based exercise training programs (10). But it is also important to be honest about the scale of the challenge. Part of the reason for hypertensive patients' current condition is a lack of exercise training. This further exacerbates the difficulties associated with engaging in exercise training when they are well past the stage of developing habitual active living habits, from both a physiological and psychological perspective. Meanwhile, individuals diagnosed with hypertension tend to have an increased susceptibility to comorbidities, such as the progressive development of cardiovascular diseases, diabetes mellitus, and renal diseases (12, 13). Sub-optimal health circumstances considerably limit options for participating in highly structured exercise training programs. Furthermore, the effectiveness of exercise training is significantly influenced by exercise adherence, with ample evidence confirming that acceptable adherence rates are achieved only in short-term, supervised clinical settings (14).

With the aforementioned practical barriers in mind, we will examine three exercise training guidelines that are currently recommended for hypertensive patients in China, the United States, and Europe (15–17). The guidelines, illustrated in Figure 1, all advocate the inclusion of both aerobic and resistance exercises on a regular basis, typically spanning most days of the week, as an effective approach to reducing BP. American institutions value both aerobic and resistance exercise equally, while Chinese and European institutions prioritize aerobic exercise, with additional benefits derived from incorporating resistance exercise. In addition, the American guidelines suggest adding isometric resistance, which is a well-founded recommendation given that there is a significant correlation between a reduction in handgrip strength and the occurrence of old-age disabilities (18). These guidelines are backed by strong clinical evidence; therefore, it is not unexpected that they share similarities. In the meantime, we are inclined to suggest that they also reflect the trend of following the academic zeitgeist.

In the current context, domain-theory-driven guidelines demonstrate conceptual rigor but are somewhat impractical in real-life situations—it is as if we expect conscientious hypertensive patients to constantly evaluate their health status and activity requirements, and then factor in this information to their daily decision-making process. In everyday life, regular socioeconomic people often do not grasp the concept of periodic exercise training (19) and they may struggle to understand scientific methodology explained in specialized terminology. Indeed, there are even academic debates surrounding the technical language used in the assessment and prescription of exercise intensity, prompting the European Association of Preventive Cardiology to provide clarification and standardization of the terminology used (20). Moreover, as numerous experiences have indicated, once individuals transition from in-person supervised exercise training to the home environment, long-term exercise adherence cannot be maintained. All of these factors leave a practical gap between knowledge of the benefits of exercise and the behavioral changes required for maintaining exercise training among the hypertensive population.

The above critique is not a new point of view. The current physical activity guidelines of the World Health Organization recommend that all persons aged over 65 years engage in multi-component physical activity that prioritizes functional balance and strength training (21). Our recent meta-analysis further reviews evidence of the cellular advantages associated with multi-component exercise training and its implications for extending the healthspan (22). Therefore, the true deficiency in the existing guidelines for the management of hypertension is the lack of specific multi-component exercise training, as well as the absence of any reference to an exercise countermeasure to address a significant risk factor for premature mortality—accidental falls among older persons. The resultant gap is a small deficiency in exercise training modes, and a seemingly “little” accident can lead to a much higher probability of older persons losing their ability to live independently or may even lead to them dying.

Falls represent the leading cause of injuries among older persons in China (23) and the United States (24), with the resulting injuries strongly contributing to complications and death within this population globally (25). Aging and hypertension often coexist, leading to a higher incidence of falls. Inconveniently, the use of anti-hypertensive medication in older persons may amplify the risk of falling. A cautious interpretation of longitudinal studies points to hypertension exacerbating age-associated fall risks, the initiation of

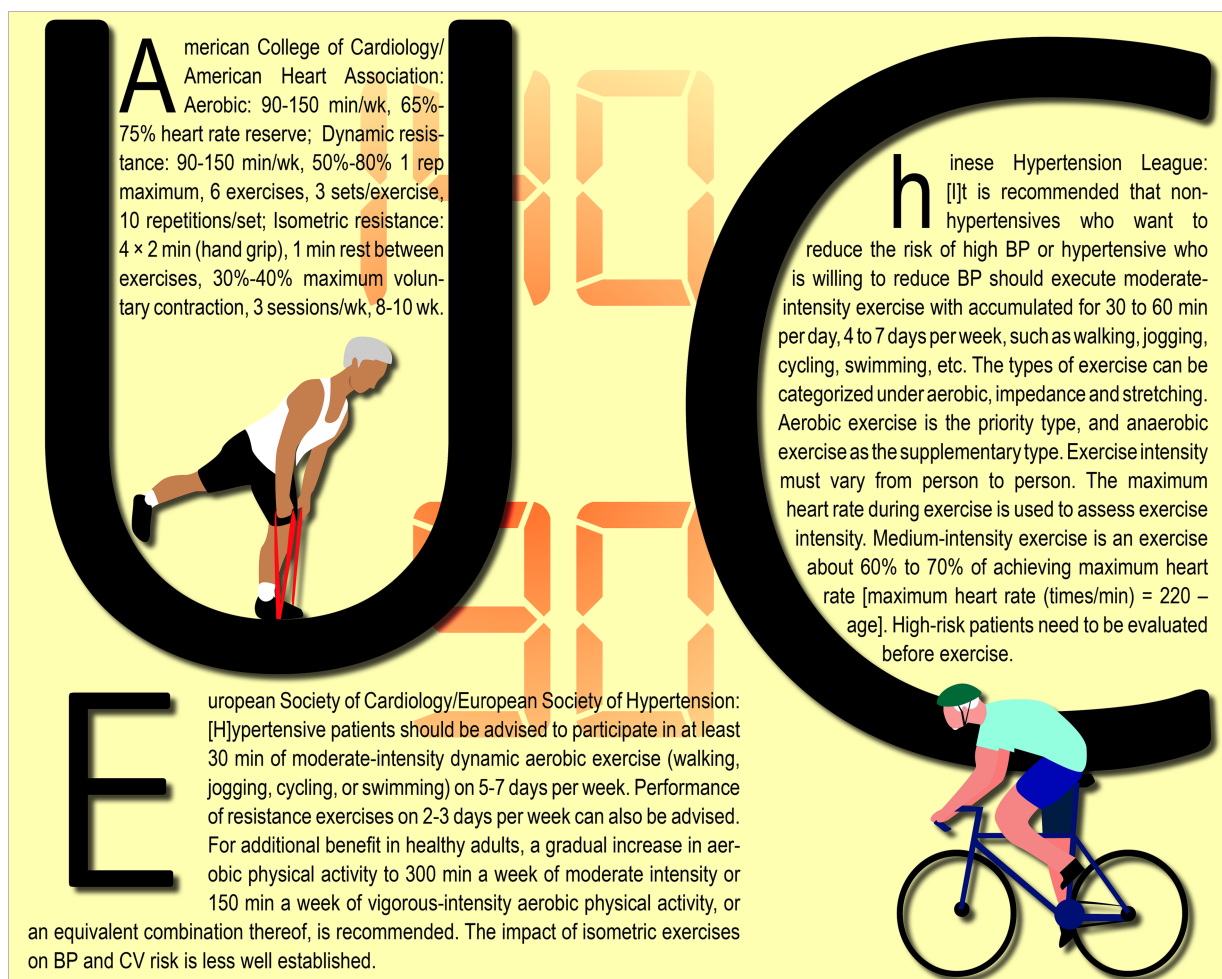


FIGURE 1  
Featured exercise training guidelines for the management of hypertension.

anti-hypertensive drugs (26, 27) may further expose individuals to such risks, and the intensification of anti-hypertensive drug usage (26, 28) may heighten the long-term risk of falling in older patients. While exercise-induced reduction in BP is reported to reduce all-cause mortality by 4% (29), which is a welcome development, the obvious concern is that a single severe fall could end many efforts at staying healthy, if not an older person's life. From a practical perspective, none of the aforementioned exercise training guidelines for hypertension provide a complete recipe for success in the pursuit of healthy aging. To our knowledge, only the recent revision of the International Society of Hypertension's guideline mentions the need for additional flexibility and balance exercise (30). Nevertheless, neither the infographic intended for public consumption nor the technical description provide an evidence-based approach toward balance exercise. Consequently, there is an enormous gap in existing anti-hypertensive exercise training guidelines, necessitating the inclusion of multi-component activities with special consideration to balance exercise for older persons.

### 3 Remixing meta-analyses

According to the World Health Organization (21), multi-component exercise training involves "combinations of balance,

strength, endurance, gait, and physical function training." When expressed in strict, straightforward terms, whether the existing guidelines (15–17, 30) can achieve comparable BP benefits to concurrent aerobic and resistance exercise is in some respects debatable, but the overarching point is that these guidelines do not explicitly mention the inclusion of multi-component exercise modes within the same session, and nor do they address the aspect of balance exercise. Hence, multi-component exercise training in this perspective can be operationally defined as a structured exercise session that integrates aerobic, resistance, and balance exercises with the aim of reducing BP and enhancing balance. Ideally, multi-component activities could concurrently improve flexibility. To provide a concise overview of scientific evidence on exercise training outcomes, we examined updated meta-analyses and will present a few representative studies published by leading academic societies. Three research questions are retrospectively examined.

Question 1: Which type of exercise training is better in terms of BP control? When combined with hypertension medication, aerobic exercise could significantly reduce daytime systolic and diastolic BP by  $-5$  and  $-3.5$  mmHg, respectively (31); resistance exercise could significantly reduce daytime systolic and diastolic BP by  $-4.7$  and  $-3.5$  mmHg, respectively (32); and isometric resistance exercise could significantly reduce daytime systolic and diastolic BP by  $-7.5$  and

−3.2 mmHg, respectively (33). Since previous meta-analyses of multi-component exercise training for the treatment of hypertension only covered a small amount of the available literature ( $n=2$ ) (31) or examined its effect on systolic BP only (34), we conducted an updated one ( $n=7$ ) and present the results here (see also the Supplementary Material for detailed methods: <https://doi.org/10.6084/m9.figshare.24247861.v1>). Based on empirical evidence from older persons with hypertension, multi-component exercise training could significantly reduce daytime systolic and diastolic BP by −9.5 and −6.7 mmHg, respectively (35–41). Of note, high-intensity interval training is not taken into consideration in our perspective due to the lack of evidence supporting its long-term adherence among older persons. Taken collectively, multi-component exercise training appears to offer additional benefits in controlling BP compared to aerobic or resistance exercise training alone.

**Question 2: Does exercise training improve balance or reduce the risk of falling in older persons with hypertension?** This question is difficult to answer for two reasons. First, the current guidelines (15–17) overlook the need of including balance exercise in exercise training programs for older hypertensive patients, and it is evident that balance assessment was seldom included as an outcome measure in the relevant literature. Second, there is no universally accepted diagnostic criterion for assessing the risk of falling. Several assessments, such as the one-leg standing test (42) and the timed up and go test (43), have acceptable discriminatory ability in identifying the risk of falling among low-functioning older persons. With these shortcomings in mind, we undertook a subsequent meta-analysis, specifically addressing multi-component exercise training (see also Supplementary Material). Based on the available evidence ( $n=4$ ) (35, 39, 40, 44), the results of the timed up and go test indicate a difference of −0.26 s (95% CI −0.66 to 0.14) between the multi-component exercise training group and the no exercise training group. In simpler terms, a combination of aerobic and resistance exercise (39, 40), or aerobic and functional exercise (35, 44), did not improve balance or reduce fall risks. Our cautious takeaway is that multi-component exercise training, in the absence of a dedicated balance exercise, is unable to effectively achieve both BP control and balance improvement simultaneously.

**Question 3: What do empirical data suggest about the efficacy of exercise modes in enhancing balance among older persons in general?** To ease the promotion of balance exercises, we introduce approaches with the potential to serve as a feasible framework transcending ethnoses and socioeconomic boundaries, and we interpret the academic literature using the common-language effect size (45). The simplest form of linear movement approach—Nordic walking—has been shown to have a 58.4% chance of improving dynamic balance (timed up and go test) in healthy older persons (46). Backward walking has been found to enhance static balance (one-leg standing test) by 0.91 s in healthy older persons (47), equivalent to an approximate 5% decrease in the likelihood of experiencing hip fractures (48). Although such odds seem like a coin toss, it is important to note that walking has the potential to be the most widely practiced activity for preventing falls in an unsupervised home environment (49). Stepping exercises can be implemented to enhance the complexity of gait training in a two-dimensional manner, and this approach has been found to have a 61.4% chance of enhancing dynamic balance (timed up and go test) in older persons (50). When it comes to 3D-type balance exercises, Pilates and yoga are popular exercises among women. Pilates training has been found to have a

70.2% chance of enhancing dynamic balance (timed up and go test) (51), while yoga has been found to have a 67.5% chance of enhancing overall balance (52) in healthy older persons. In the last two decades, the health and therapeutic benefits of Taijiquan (commonly known as Tai Chi) has garnered more acknowledgment beyond China (53, 54). Research conducted on older persons found that engaging in Taijiquan practice improved static balance (one-leg standing test) by an average of 5.33 s (55), and has been found to be associated with a 20 and 31% reduction in the risk of falling and rate of falls, respectively (56). It is worth mentioning that Taijiquan practice as a part of anti-hypertensive intervention could significantly reduce daytime systolic and diastolic BP by −12.5 and −6.5 mmHg, respectively (57), which highlights its origins as a martial art. It is said that “They do not hurt each other, and the virtue in each one refreshes both” (Tao Te Ching, Chapter 60). We believe that practicing any of the aforementioned balance exercises will be beneficial for older persons in the long term and two is greater than one.

## 4 Zero, one, then all things

In 485 BCE, prior to Lao Tzu embarking on his final journey into the wilderness, he composed Tao Te Ching, wherein he articulated the Tao ideas: “The Tao begot one. One begot two. Two begot three. And three begot the ten thousand things.” More than a decade ago, when I asked my mentor (Phil Bishop, Emeritus Professor of the University of Alabama) for his advice on recommended exercise for weight loss, his response was succinct: “move first.” By combining contemporary insight with ancient wisdom, we advocate for a holistic approach to promote physical activity — “zero, one, then all things”. Esoteric though it may be, this is the natural sequence, especially now, as academics ponder the growing contrast between their sound scientific exercise prescriptions and the pandemic of physical inactivity (10). Too often, overly prescribed exercise intensity has actually been a source of muted positive affective responses (58), particularly among sedentary individuals (59)—indeed, it has been a sponsor of low exercise adherence.

With apologies to the billions of wonderful people on Earth, let the authors portray the realities facing regular socioeconomic people. These people are usually not inspired by academic jargon. They are often exposed to cheap, low-nutrient dense calories (60) and are often engaged in physically light duties. They have the highest marginal propensity to essential consumption. Moreover, they are mostly insulated from fiscal largesse. These factors are all ominous for the race against physical inactivity.

For the Taoists, such a non-movement, abstract being state can be referred to as zero, the formless essence of the Universe at the beginning. In contrast, exercise training can be viewed as a formed state. The current guidelines on one step fixing the “zero” overlook the natural developmental process where “infants” learn to walk before they can run.

The Tao begot one, the change leading to order and then forming all things. One in Tao is seen as a symbol of water, with the ability to exhibit both gentle and gradual movements, as well as the capacity to erode even the most resilient of rocks over time. Above all, water is esteemed for its greatest virtue of fostering life and sustaining the existence of all things. The sooner people accept that the one is the missing force for differentiation between undifferentiated



non-movement and differentiated being, the sooner the world can begin to bridge the deep divisions between zero and all things.

Although the emphasis in the current guidelines on effective BP-reducing workouts is sound, albeit incomplete in our view, society is not ready for the swift adoption of the structured exercises prescribed in academic jargon. There must be a clearly defined equilibrium status between the present state and the ideal level of physical activity. In Figure 2, we describe the essential “one,” a cocktail of walking, balance exercises, and upper-body exercise as a life-awakening program for hypertensive patients. To begin with, walking serves as the fundamental basis for all-round exercise training. Walking is the most convenient form of aerobic exercise for older persons who do not have severe physical limitations. Walking not only decreases BP (61, 62) but also enhances lower limb strength (63), hence reducing the risk of falling (64) and all-cause mortality (65). Thus, it functions as a holistic means of managing hypertension, balance, and lifespan for older persons.

Modern medicine has demonstrated the excellent efficacy and low toxicity of drugs used in the management of high BP (66). From a therapeutic standpoint, exercise intervention is arguably an adjuvant endeavor. Put differently, hypertensive patients can live with this medical condition without engaging in exercise training, notwithstanding the myriad of physiological and financial benefits obtained from exercise. Nevertheless, the fact that there is no pill targeting age-associated decline in balance control underscores the significance of the balance exercise component in our way. As mentioned above, there are various culturally diverse exercises for developing balance control. Our recent randomized controlled experiment demonstrated that a multi-component exercise

training program, comprising walking and Taijiquan, can enhance static balance, as well as improve flexibility, handgrip strength, and lower limb endurance in normotensive older persons (67). Hypertensive patients within the Chinese cultural radius thus can choose to practice a simplified form of Taijiquan, which typically lasts for approximately 15 min, to improve their balance control. Although new work is necessary to validate the effectiveness of a multi-component exercise training program that includes walking and yoga, Pilates, or stepping exercises for controlling BP and balance control, our assertion of the importance of balance exercise within a comprehensive BP management strategy is hard to ignore. Thus, incorporating diverse balance exercises is the essence of a balanced exercise training program for hypertensive patients as they age.

Incorporating a resistance exercise component not only contributes to the hierarchical nature of BP-reducing exercise training, but also adds to the prospects of improved lifespan outcomes. A previous cohort study compared various forms of exercise and sports, concluding that engagement in racquet sports exhibited the most significant reduction in all-cause and cardiovascular diseases mortality (68). A potential explanation may be that racquet sports incorporate whole-body movements, aligning with the conclusions of our recent meta-analysis (22). Briefly, training a wide range of muscle groups can enhance the expression of intracellular nicotinamide phosphoribosyltransferase, leading to increased levels of nicotinamide adenine dinucleotide during the aging process. This in turn could aid older persons in protecting themselves against environmental insults and enhance BP management in people with hypertension (69). Nevertheless, we do not explicitly recommend hypertensive patients



FIGURE 2 Taoist's exercise training concept — zero, one, then all things. Note: Texts should be read from top to bottom and from right to left.

to engage in racquet sports as a form of upper-body exercise. From our perspective, regular socioeconomic people lack the necessary resources, such as finances and time, to participate in racquet sports on a daily basis. As a feasible alternative, we suggest incorporating straightforward yet effective upper-body exercises to encourage and establish exercise adherence.

None of the existing guidelines (15–17, 30) include targeted exercise recommendations for individuals with impaired lower limb function or disability, which is another critical deficiency. Our way first seeks to extend the boundaries of exercise training guidelines and includes special sociodemographic populations. Although exercise equipment such as an arm crank ergometer could address the mobility dilemma, we explicitly recommend using a sports wheelchair as an optimal choice for exercise training. Despite both the arm crank ergometer and sports wheelchair having the potential to provide similar physiological benefits when handled correctly, the key distinction lies in the exercise environment. Engaging in exercise training in calm outdoor environments, such as walking, using a sports wheelchair, or practicing Taijiquan in a park, can enhance sensations of vigor, which in turn have a positive impact on mental wellbeing and exercise attendance and adherence (70). Finally, although poor mobility or disability should not be used as a justification for physical inactivity, it is important to acknowledge the lack of awareness, knowledge, and financial challenges experienced by regular socioeconomic people. To address this issue, it is necessary to establish a collaborative governance system where the government takes the lead in providing fiscal support and mobilizing society forces (71). This would enable the dissemination of instructional materials and the co-funding of affordable products to fulfill the specific market demands.

One notable feature of the Taoist way is its potential to achieve a harmonious blend of scientific principles and sustainability. Using walking as a focal point, our way does not specify the pace of walking, as empirical data align with the hedonic theory and support the use of self-paced intensity to promote exercise adherence, especially if individuals are not used to being physically active (72). While it may seem that engaging in a 45-min self-paced walking activity may not meet the recommended thresholds for reducing the risk of falling (5,000 steps per day) (64) and all-cause mortality (6,000–8,000 steps per day) (65), it is essential to not lose the sight of the fact that our way aims to cultivate a disciplined active lifestyle among sedentary individuals in the later stages of life. After following the “one” for at least a year, hypertensive patients are advised to progressively incorporate additional scientific guidelines (15–17) as needed, which represents the second stage of the formed state. Ultimately, Tao resists objectification yet is immanent in the way cultivated people spontaneously engage in physical activity and generate health benefits.

## 5 Conclusion

Tao is the way and science is the light, from which we project ourselves into the global situation and form this guide. It will serve as

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an impetus for further discussion of the early prevention of noncommunicable diseases and robust systems of governance for population fitness (71). It is said that “Under heaven nothing is more soft and yielding than water. Yet for attacking the solid and strong, nothing is better.” Overall, we salute the ancient wisdom by orienting a multi-component exercise training cocktail, featuring inclusive sociodemographic populations and culturally diverse balance exercises for the management of hypertension.

“The ten thousand things carry yin and embrace yang. They achieve harmony by combining these forces.” — Lao Tzu, Chapter 42 of Tao Te Ching

## Data availability statement

The original contributions presented in the study are included in the article/supplementary materials, further inquiries can be directed to the corresponding author.

## Author contributions

WX: Data curation, Formal analysis, Writing – original draft. BW: Validation, Writing – original draft. XB: Data curation, Formal analysis, Writing – original draft. ST: Writing – original draft. YZ: Conceptualization, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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