健康城市：
论城市绿色景观对大众健康的影响机制及重要研究问题

HEALTHY CITIES:
MECHANISMS AND RESEARCH QUESTIONS REGARDING THE IMPACTS OF URBAN GREEN LANDSCAPES ON PUBLIC HEALTH AND WELL-BEING

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摘要

本文针对目前中国突出的城市环境问题及其所导致的大众健康问题，从促进身体锻炼、舒缓精神压力、减轻精神疲劳、提供生态产品与服务、提升社会资本5个理论机制来解释城市绿色景观对公众健康及福祉的影响，并据此提出了一个简明的理论框架和一系列有待研究的重要问题。

关键词
公众健康；城市绿色景观；影响机制；理论框架；研究问题

ABSTRACT

The paper presents a summary of critical environmental problems in Chinese cities and serious public health crisis resulting from those environmental problems. The paper explains five theoretical pathways through which urban natural landscape influences human health and well-being: promoting physical exercises, relieving stress, reducing mental fatigue, providing ecological products or services, and enhancing social capital. A theoretical framework connecting urban natural landscape with health outcomes is established and a set of important research questions are presented.

KEY WORDS

Public Health; Urban Green Landscape; Mechanism; Theoretical Framework, Research Questions

城市化在中国已成燎原之势，据中国国家统计局数据，中国城镇人口占总人口比率从1982年的21%剧增至2012年的53%。无论是在西方还是中国，城市发展在创造巨大价值的同时，也产生了诸多的负面效应。人与自然环境的疏离隔阂、都市生活带来的压力与焦虑、市民居住工作环境的嘈杂逼仄、层出不穷的环境污染已经对公众健康产生了显著威胁[1]-[3]。

1 警钟：中国城市环境恶化所引发的严重健康危机

中国城市环境恶化已引发多方面的健康危机。首先，快节奏、高压力、远离自然的城市生活所导致的精神疲劳和压力可能诱发多种健康和社会问题，包括心血管疾病、糖尿病、部分类型的癌症、操作失误事故、自杀、暴力犯罪等[4]。疲劳、压力、抑郁和焦虑会导致不健康的生活方式，例如缺乏运动、吸烟、酗酒、毒品或药物依赖等[5]。据世界卫生组织2005年报告，全球范围内31.5%的健康生命损失年可归因于精神健康问题[5]。据2013年的一项研究预测，中国罹患抑郁症的人数超过3 000万人，其中约90%不能得到及时诊断和治疗。抑郁与焦虑在中国城市人群中普遍存在[6]。

静态的生活方式、公共绿色景观不足和分配不均、日趋依赖机动车通行的城市环境是导致市民体重超重和肥胖并诱发多种致死疾病的重要原因[7]。2010年中国成年人体重超重率为30.6%，肥胖率为12.0%。中国未成年人超重率和肥胖率分别从1981年至1985年的1.8%和0.4%上升到2006~2010年的13.1%和7.5%[8]。缺乏身体锻炼已经给社会带来沉重经济负担：2002年因缺乏身体锻炼导致的疾患造成的经济损失为211.1亿元，2007年则达509.9亿元[9][10]。

此外，中国城市的空气污染已经到了极其严重的程度。据中国国家气象局报告，2013年在城市较为密集的华中及华东部地区年平均霾日数达到35.9天。机动车辆的增加和交通拥挤被认为是近年来中国城市空气质量恶化的重要原因[11]。在中国，平均每年约有35~50万例死亡可归因于室外空气污染[12]。早在2005年，空气污染在中国造成的劳动力损失和医疗负担已达9 050亿；根据近10年的发展态势，近年空气污染造成的

Urbanization in China has become rampant. China's urban population has increased drastically, from 21% in 1982 to 53% in 2012, according to the National Bureau of Statistics of China's survey data. In both the West and China, urban development has brought many negative effects while also creating some considerable benefits. The alienation of humans to nature, the stress and anxiety of urban life, the noise and crowdedness in residential and working environment, and constantly emerging pollution problems all significantly threaten public health[1]-[3].

1 Alarm: Severe Health Crisis Induced by China's Urban Environment

The deterioration of China's urban environment has created health crisis in a variety of dimensions. Fast-paced, high-pressure urban living that is disconnected from nature result in mental fatigue and high levels of mental stress. This can cause many health and social problems, including cardiovascular disease, diabetes, some types of cancer, operational blunders and accidents, suicide, and violent crimes[4]. Fatigue, stress, depression and anxiety will stimulate an increasingly unhealthy lifestyle, such as lack of exercises, smoking, drinking, drug addiction or drug dependence, etc.[5] According to a 2005 report by the World Health Organization, 31.5% of all years lived-with-disability worldwide stems from mental health problems[5]. A 2013 study estimated that there are more than 30 million people in China who suffer from depression, 90% of whom could not get timely diagnosis and treatment. Depression and anxiety are prevalent in the urban population of China[6].

Inactive urban lifestyles, a lack and uneven distribution of public green landscapes, and an urban environment increasingly relied on vehicles have helped create the current crisis in obesity — which leads to a variety of fatal diseases[7]. In 2010, 30.6% of adults in China were overweight, while 12.0% were classified as obese. The trend for minors is just as striking: compared to the mid 1980s, by 2010, minors who were overweight went from 1.8% to 13.1% of the population while those who were obese went from 0.4% to 7.5%[8]. Lack of physical exercises has brought heavy health and economic burdens to the society: in 2002, the financial loss due to diseases brought by lack of physical exercises was 21.11 billion RMB, and in 2007 it was 50.99 billion RMB.[9][10]

In addition, air pollution in Chinese cities has reached severe levels. According to China's Meteorological Administration, in 2013, the average number of haze days reached 35.9 annually in middle and eastern areas, where there are relatively high population densities in cities[11]. In China, on average there are about 350,000 to 500,000 deaths each year ascribed to outdoor air pollution[12]. As early as in 2005, the labor losses and medical burdens caused by air pollution reached 905 billion RMB. Based

健康损失极有可能远超2005年的水平[13]。

城市环境的工业污染已经成为城市居民的另一大健康杀手。过去半个世纪，中国有超过800家国有矿产公司和23万家私人矿产公司共计产生了约200万公顷被重金属严重污染的荒地；采矿和熔炼处理带来的重金属大气污染问题亦十分严重[14]。此外，中国已经成为全球电子垃圾的重要倾泄和处理基地。恶劣的作业环境和无处理排放使人们很容易接触到有害化学物质。这些物质继而通过污染河流、土壤和食品加剧和扩散危害。

2 本文目的

面对这一系列复杂而紧迫的问题，虽然我国的规划设计专业人士已经提出了一些对策，但数量和内容仍较为有限，大部分成果都集中于园艺疗养及城市管理领域，缺乏对城市绿色景观健康效应的全面而深入的考量。我们仍过分依赖经验和常识，缺乏进行理论和实证研究的耐心，也缺乏跨专业合作的意识和经验。应对这一问题，本文将通过梳理近30年来全球范围内的、来自多个相关专业的重要研究成果，概括出5种城市绿色景观影响健康的理论机制和对应支持每一种理论机制的科学证据，并由此发展出一个总体理论框架和一系列可供研究的重要议题。我们希望通过本文为我国的城市管理者、学者和规划设计师提供一些基本线索，围绕这一重大话题开展研究与实践。

3 健康、福祉、城市绿色景观的概念

人们常将“健康”狭义地理解为身体器质性的健康，而忽视心理健康和社会关系的健康。世界卫生组织对健康做出了全面的定义：“健康不仅是消除疾病或赢弱，也是体格、精神与社会的完全健康。”广义的健康还可以用“福祉”这一概念来表达。根据《新千年生态系统评估》的定义，福祉除了包括身心健康以外，还包括满足基本物质需求，安全、良好的社会关系，以及个人选择和行动的自由[15]。因此，健康应该不仅包含身心健康的平衡，也包含个人及社会的平等与和谐[16]。

本文的城市绿色景观是指公共或私有的、主要被植物所覆盖的城市空间，能够直接（例如作为休闲、社交或健身场所或审美的对象）或间接（例如对城市空气、水、噪音环境的积极影响）地为市民服务。

4 理论机制：城市绿色景观对健康和福祉的影响

那么，城市绿色景观究竟是通过何种机制影响市民健康和福祉的呢？总体而言，可以概括为5个主要理论机制：促进身体锻炼、舒缓精神压力、减轻精神疲劳、提供生态产品与服务、提升社会资本。

4.1 促进身体锻炼

相对于那些缺乏植被、以硬质空间为主的城市景观，绿色景观更能鼓励人们进行身体锻炼。在有更多绿色植被的场所，儿童或成人均倾向于更积极的身体锻炼[17][18]。绿色景观能使锻炼者的锻炼时间更长[19]，亦能更大程度提升认知能力[20]和缓解精神压力[21]。研究发现在绿色景观中进行5分钟低强度的身体锻炼（如散步）即可产生显著的整体情绪和自尊感提升效应（分别提升60%和70%）[22]。在绿色景观中进行锻炼还能有效预防器质性疾病。森林散步能显著增加成人自然杀伤细胞的活动度和抗癌活性蛋白的数量，降低肾上腺素的分泌，而在缺乏植被的城市环境散步则无类似的效应[23]。社区周边的绿色景观覆盖率差异越小，社区间由收入差距引起的健康状况（循环系统患病率及死亡率）差距越小[24]。此外，有研究发现城市老年居民的寿命和其所居住社区可供锻炼的绿色景观的数量存在显著正相关性[25]。

4.2 舒缓精神压力

1991年，罗杰·乌尔里希提出了接触绿色景观可产生压力舒缓效应的理论，他指出人类在长达数百万年的进化中都与自然环境有着密切的联系，这种进化历程可部分解释为何现代人在接触自然或城市绿色景观可得到精神压力的舒缓。他强调这种舒缓是“立即的、潜意识的应激反应”[26]，只需要动用非常低水平的意识活动即可促使人体生理性的变化或者产生迅速的身体动作来应对威胁和适应环境。人通常会选择安全的

on development trends of the past decade, the health losses caused by air pollution will likely far exceed levels measured in 2005[13]. Industrial pollution in the urban settings has become another major threat to city dwellers. Over the past 50 years, there have been over 800 state-owned and 230,000 privately-owned mining companies in China that, together, have generated 2 million hectares of wasteland that are polluted by heavy metals. Heavy metal air pollution brought by mining and smelting is also severe[14]. In addition, China has become a significant dumping and disposal ground for worldwide electronic wastes. The poor working environment and no-treatment emission process has exposed citizens to harmful chemicals. These chemicals threaten even individuals who live far from the origins of the pollution as the pollutants spread via rivers, soils and food.

2 Purpose of This Article

In response to these complex and pressing issues, planning and design professionals have proposed a variety of strategies but their effectiveness has been limited. Most achievements have been related to therapeutic gardens and city management. Still, most cities lack a comprehensive and in-depth plan for how urban green landscapes might improve the health and well-being of citizens. As designers and planners, we are highly dependent on practice experience or common sense, not having enough patience on conducting theoretical or empirical research, and lacking awareness and experiences in interdisciplinary collaboration. In order to begin to address this problem, this article proposes five mechanisms of how urban green landscape impacts human health. For each mechanism, we provide supporting scientific evidence. We draw on research results over the past 30 years from a wide variety of disciplines and present a theoretical framework and a series of research questions. We hope this article can provide some basic clues for our city managers, scholars, planners and designers.

3 Definition of Health, Well-being and Urban Green Landscapes

People often narrowly understand health as related to the physical body, while neglecting health for mental and social relations. The World Health Organization has made a comprehensive definition of health: “Health does not only mean eliminating illness or frailty, but also means full physical, mental and social health.” A broader definition can be described as well-being. According to the definition from Millennium Ecosystem Assessment, in addition to physical and mental health, well-being includes meeting basic material needs, safety and positive social relations, as well as freedom for personal choices and actions[15]. Therefore, health should not only include the balance of physical and mental health, but also the equality and harmony of individuals and the society[16].

Urban green landscape in this article refers to public or private urban space, mainly covered by vegetation, having direct (such as used for recreation, social, exercises and aesthetics) or indirect (such as positive impact to air, water and noise of urban environment) functions to serve the citizens.

4 Theoretical Mechanisms: The Impact of Urban Green Landscape on Health and Well-Being

What mechanisms do urban green landscapes influence health and well-being? Here, we summarize five main mechanisms: promoting physical exercises, relieving stress, reducing mental fatigue, providing ecological products or services, and enhancing social capital.

4.1 Promoting Physical Exercises

Compared with urban landscapes that lack vegetation and are dominated by hard-paving materials, green landscapes seem to encourage people to exercise more. When urban settings have higher level of greenness, children and adults are more active[17][18]. Green landscapes are also associated with people exercising for longer periods[19], and have been shown to promote cognitive functioning[20], and relieve stress[21]. A study found 5 minutes of light physical exercises (such as walking) in green landscapes can significantly improve the overall positive emotion and self-esteem (increased by 60% and 70% respectively)[22]. Exercise in green landscapes may also prevent organic diseases. Compared to walking in an urban setting where without vegetion, walking in a forest has been shown to significantly increase the number of natural killer cells and anti-cancer active proteins and also reduce secretion of adrenaline in adults[23]. When the difference in green landscape coverage near the communities is smaller, disparity in health status (morbidity and mortality caused by circulatory system diseases) associated with income disparity among citizens is smaller[24]. In addition, studies have found that longevity of elderly individuals is associated with the quantity of the green spaces in their neighbourhood[25].

4.2 Relieving Mental Stress

In 1991, Roger Ulrich suggested that exposure to green landscapes could help recover from stressful experiences. Ulrich reasoned that through millions of years in which modern humans evolved in tremendously close contact to nature, which can partly explain why exposure to nature would help modern humans address mental stress, which emphasizes “immediate, subconscious stress reaction” in responding to stressful situations[26]. These reactions need only a low level of cognitive effort to spur human physiological changes or produce rapid action to deal with threats

自然环境来舒缓精神压力。根据关于绿色景观的生理学和心理学研究，精神压力的舒缓既体现在心率、皮肤收缩水平、皮质醇水平、血压的降低，也体现在乐观情绪的提升和焦躁程度的降低。[26]-[28]

研究发现许多类型的城市绿色景观均能起到舒缓压力的作用。绿色景观可以减少居民的精神压力：与完全缺乏树木的居住环境相比，具有中等林冠覆盖率（约30%）的居住环境能使人的压力舒缓效应提升约3倍[27]。同时绿色景观可以缓解城市噪音对居民所产生的精神压力和负面情绪[29]，经比较实验发现，缺乏植被的城市景观则没有类似的效应[30][31]。更多的绿色景观有助于降低员工的精神压力[32][33]。学生在学校与绿色景观的接触频率和精神压力水平存在反向相关[34]。在医疗场所，与绿色景观接触更多的患者术后住院时间更短，自控镇痛剂的使用量更少[35][36]，血压更趋于正常[37]，情绪也更为积极[38]。综合而言，目前掌握的科学证据可清楚地证明绿色景观有助于缓解精神压力。

4.3 减轻精神疲劳

史蒂芬·卡普兰和雷切尔·卡普兰提出的“注意力恢复理论”指出接触绿色景观能使人们从精神疲劳中得到恢复[39][40]。卡普兰夫妇认为接触自然，即使是城市空间里的绿色景观也可因休息和恢复主动性注意力而强化人们的专注力。一些场所（例如观赏拥有树木和草地的绿色空间或观赏水景），只消耗人的非主动性注意力而让直接注意力得到恢复[39]——人具有不需动用主动性注意力即可快速阅读和适应自然环境的内在能力；相反，在缺乏绿色、充满强制性的人造刺激的城市环境里，人们需要消耗大量的主动性注意力才能得以关注他们正在做的事情。

研究发现许多不同类型的城市绿色景观均有恢复自主性注意力的作用。在工作环境通过各种方式来接触绿色景观，不论是观赏窗外景色[41]，还是在其中坐憩或锻炼身体，都能减少精神疲劳和恢复注意力[42]。研究发现，学生与学校户外绿色景观的视觉接触和多项学业表现有着显著的正相关性[34]。居住环境的绿色景观有利于提升居民的注意力和认知能力，这一影响对成人和儿童均成立。居住环境的绿色景观的增加亦与儿童的认知能力的提升显著相关[43]。儿童在更多绿色景观的环境中表现出更高的创造性[44]、更高的自律性及更集中的注意力[45][46]。

4.4 提供生态产品或服务

健康的生态系统中可提供多种有益于人类生存和发展的产品或服务[15]。其一，城市绿地可以起到改善城市温室效应、减少高温危害的作用。其中自然湿地和乔木林地的效应最为显著[47]。研究发现自然湿地形状越完整，其降温效应越显著；距离城市中心越近，其降温效应越显著[48]。其二，城市绿地能有效降低城市空气污染，从而降低呼吸道疾病病发率。据研究，每公顷的屋顶花园每年可吸收85.60kg的空气污染物[49]。一棵成熟乔木每年可产生价值1.52~2.38美元的改善空气污染的效益[50]。每棵乔木每年所提供的生态服务价值在21~159美元之间[51]。其三，城市绿地可以提供开展城市农业的场所，鼓励市民参与建设生产性景观，在城市内部充分利用空地、阳台、墙体、屋顶种植作物，或将城市开放空间的观赏性景观置换为生产性景观，可减少因长途运输产生的大气污染，增加对绿色食品的摄入，减少对快餐垃圾食品的依赖和提高食品安全程度，这对于保障市民，特别是低收入市民的健康起到重要的作用[52][53]。此外，随着城市化进程的推进，不渗水地面大量增加，地表水下渗受阻，在降雨时短时间内可形成大量的地表径流，增加洪涝灾害的发生几率，同时径流会裹携和溶解大量的危害健康的污染物质。城市绿色景观还可以通过调节城市水文过程来提升市民健康。俞孔坚建议以河流、湿地、绿道等为主要脉络将生态斑块联系起来，建立生态安全格局，是净化空气和水源、减少洪涝灾害风险、创造休闲游憩机会、保障城市居民健康的有效途径[54]。

4.5 提升社会资本

社会资本的分配和发展可显著地影响身心健康[55]。皮埃尔·布尔迪厄提出社会资本就是在社会网络中被分享的资源[56]。罗伯特·帕特南对社会资本的概念作了进一步的诠释[57]。他认为社会资本是“包括例如信

as well as to adapt to the environment. People normally tend to choose a safe natural environment to relieve stress. According to physiological and psychological researches on green landscapes, relieving stress is reflected not only in heart rate, skin contraction levels, cortisol levels, lower blood pressure, but also in improved level of optimistic emotions and reduced level of anxiety[26]-[28].

Studies have found that different types of urban green landscapes help people relieve stress. Compared to urban settings with a complete absence of trees, one with a moderate canopy cover (approximately 30%) enables people to obtain about three times the stress relief[27]. People also benefit from having more access to green landscapes which could relif stress and negative emotions caused by urban noise[29], that could not be provided by places where lack of greenery[30][31]. There are consistent evidences that green views from one's work place can reduce employee's mental stress[32][33]. Green school landscapes have also been shown to impact the speed at which students recover from stressful experiences[34]. In medical facilities, patients with more contact with green landscape stayed in the hospital for less time, used less self-administered pain medicine[35][36], had healthier blood pressure levels[37], and higher levels of positive emotion[38]. The body of evidence is clear, green landscapes help people recover from stress.

4.3 Reducing Mental Fatigue

Stephan Kaplan and Rachel Kaplan proposed “Attention Restoration Theory”, suggesting that green landscapes can help people recover from mental fatigue[39][40]. The Kaplans argued that contact with nature, even green landscapes in urban spaces, enhances our ability to pay attention by resting and restoring voluntary attention that helps us focus. Green landscapes only consume indirect attention while let voluntary attention restore (for example, a view of green space with trees and grass, or watching water), allowing individuals to recover from mental fatigue[39]. Green settings seem to effortlessly engage our attention, allowing us to be in such settings without focusing attention — people have inherent ability to read and adapt to the natural environment without the need to use the voluntary attention. As a contrast, they have to consume a great level of voluntary attention to concentrate when they are in barren urban environments full of artificial, mandatory stimuli.

Studies have found that many urban landscapes have an effect on restoring our capacity to pay attention. For people at work, contact with green landscapes that comes from looking out the window[41], or by exercising or sitting in such spaces has been shown to reduce mental fatigue and restore a person’s capacity to pay attention[42]. At school, students who have a view of a green landscape from windows have been shown to perform more effectively on their studies[34]. At home, green landscapes in the residential environment is helpful in enhancing residents’ attention and cognitive abilities, for both adults and children[43]. Children who have easy access to green landscapes demonstrate higher levels of creativity[44], self-discipline, and focused attention[45][46].

4.4 Providing Ecological Products or Services

Healthy ecosystems produce a variety of products or services that are beneficial for the survival and development of humans[15]. For instance, urban green spaces can contribute to mitigating urban greenhouse effects and reducing high temperatures associated with the urban heat island effect. Natural wetlands and woodlands have the most significant cooling effect[47]. Studies have found that the more integrative the natural wetland form is, more significant the cooling effect is; the closer the wetland or woodland is to city center, the more significant the cooling effect is[48]. Another ecosystem benefit is that urban green spaces can reduce urban air pollution, so as to reduce incidences of respiratory diseases. According to a study, every hectare of roof garden can absorb 85.60 kg of air pollutants annually[49]. One mature tree can reduce air pollution at a value of 1.52 to 2.38 dollars annually[50]. The total ecological service per tree provides a value of 21~159 dollars annually[51]. A third ecosystem benefit that urban green spaces can provide concerns urban agriculture. Community gardens encourage people to make productive use of their local landscape. Taking advantage of vacant spaces in the inner city, such as neglected plots, balconies, walls, and roofs to plant fruits and vegetables, or transforming the decorative landscape of urban open spaces into productive landscapes, can reduce air pollution, increase the intake of fruits and vegetables, reduce dependency on fast food and junk food, and improve food safety. This is important for protecting the health of the citizens, especially low-income people[52][53]. In addition, with increased urbanization, there has been a substantial increase in impervious surfaces. Buildings, roads, parking lots and other impervious surfaces that prevent rain water from infiltrating into the ground, increase storm runoff, and increases the likelihood of floods. The runoff from rainfall also carries with pollutants that are harmful to health. Finally, urban green landscapes also improve public health by adjusting urban hydrology. Kongjian Yu has proposed that cities connect different levels of ecological patches through a network of rivers, wetlands, greenways and so on, to establish a healthy ecological system[54]. Following this suggestion will be an effective way to improve air and water quality, reduce flooding risks, offer recreation opportunities and protect the health of urban residents.

4.5 Enhancing Social Capital

Distribution and development of social capital can significantly impact physical and mental health[55]. Pierre Bourdieu referred to social capital as shared resources in the social network[56]. Robert Putnam explained the concept of social

任、规范和网络等能够通过促进协同合作来提升社会效率的社会组织特征”。

增强市民、社会群体之间的社会纽带是城市绿色景观影响市民健康的一条重要途径[58]。绿色开放空间可吸引人们前往，从而帮助享用相同居住或工作环境的人们变得相互熟悉。经过一段时间，这些人之间即可发展出社会纽带。诸多研究指出更多的城市绿色景观与更多的户外聚集、更多的社会交往及邻里之间更强的社会纽带相关[18][59]。最近一项研究发现，增加10%的林冠覆盖率与减少12%的犯罪率存在显著正相关性[60]。此外，有研究发现城市社区的林冠覆盖率与社会资本成正相关性，林冠覆盖率这一环境因素为衡量社会资本的水平增加了22.72%的解释力[61]。经常接触绿色景观可帮助邻里或从业者发展社会纽带。这些社会纽带继而有助于人们预防疾病和更快地从疾患中痊愈。因此，绿色景观对创造健康社区起到重要的作用。绿色景观对那些弱势群体，如贫困、患疾或残疾人士，可起到尤为重要的作用[62][63]。

5 理论框架及研究方向

基于前文的论述，我们可以用一个简明的理论模型来概括城市绿色景观对公众健康的影响机制（图1），同时，在此提出可以在中国展开深入研究的7个重要领域：

5.1 身心健康

关注城市绿色景观对个体的心理及器质性健康的影响，我们应该更好地理解以下问题：

1）城市绿色景观的设计如何提升心理安全感、抑制侵略性或暴力行为冲动、提升身体锻炼的意愿？

2）城市绿色景观量与其对健康的影响：绿色景观的密度，人与绿色景观接触的时间、频次、强度与身心健康之间有何关系？

3）城市绿色景观的文化和精神意蕴与提升身心健康有何关系？绿色景观所激发的归属感、崇高感、神圣感是否在某种程度上对健康具有影响？

4）城市绿色景观的物种、色彩、气味、材质、形态、空间构成、密度等特征与人的环境感知或行为方式有何关系？

5）景观与城市设计对预防和治疗重要疾病能做出何种程度的贡献？这些疾病包括心血管疾病、糖尿病、肥胖症、肺癌、哮喘等。

5.2 生活方式与行为习惯

关注改变人们的生活理念与生活习惯，我们需要理解下列问题在何种程度可以通过城市绿色景观设计得到改善：

1）鼓励人们参与户外健身活动。

2）帮助人们摆脱对私家车的依赖，鼓励他们选择步行、自行车或公共交通。

3）使市民有机会使用健康的、本地的食物。

4）提升市民的环境保护意识和为其创造参与环境保护的机会。

capital further[57], pointing out that social capital is “features of social organization, such as trusts, norms and networks that can improve the efficiency of society by facilitating coordinated actions”.

Enhancing social ties among individuals and communities is an important way that urban green landscapes impacts citizens’ health[58]. Green open space help people who live or work near one another to become acquainted because green spaces attract people. Over time, after people have recurring visual contact with one another in an urban green space, social ties would be developed. Multiple studies have shown that greener urban landscapes are associated with more people gathering outside, more social contact and stronger social ties among neighbors[18][59]. A recent study found that increasing canopy cover by 10% has a significantly positive associated with the 12% decrease of crimes[60]. Another study discovered that urban communities’ canopy cover is associated with the social capital — the environmental factor of canopy coverage added 22.7% explanation power for measuring the level of social capital[61]. Regular contact with green landscape can help neighbors or nearby workers form social ties. These social ties, in turn, provide a level of support that is significant to help people better prevent disease and recover from illness faster. Thus, green landscapes play an important role in creating a healthy community. These findings may be most important for the most vulnerable among us, people who are poor or who already have some kind of illness or disability[62][63].

5 Theoretical Framework and Research Fields

Based on the findings present above, we propose a simple theoretical model that summarizes the ways in which urban green landscape impact public health and well-being (Fig. 1). We also identify seven pressing research fiedls that can be addressed and further studied in China.

5.1 Physical and Mental Health

Focus on the impact of urban green landscape on individuals’ psychological and physical health. We need to better understand:

1) How we might design urban landscapes that promote positive psychological states, such as improving people’s sense of safety, inhibiting impulses toward aggression and violence, and enhancing their willingness to participate in physical exercise.

2) The impact of varying quantity of urban green landscape on health. How does varying quantity of green landscape (such as varying durations of exposure, frequence of exposure, and varying concentrations of nature) impact physical and mental health?

3) The cultural and spiritual meaning of urban green landscape and the improvement of physical and mental health. To what extent does a sense of belonging, a sense of sublime or a sense of the sacred inspired by urban green landscape influence health?

4) The relationships among environmental perception or behaviors and urban green landscape’s species, colors, smell, texture, shape, spatial composition, density, and other physical characteristics.

5) The extent to which design can contribute to the prevention and treatment of major diseases. These diseases include cardiovascular disease, diabetes, obesity, cancers, asthma, etc.

5.2 Lifestyle and Behavior

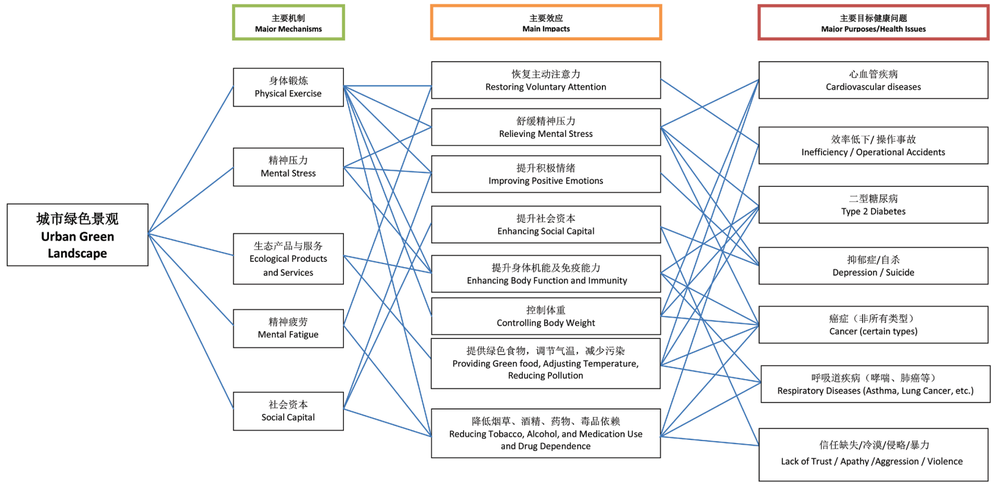
Focus on creating the conditions that help support healthy behaviors and habits. We need to know better the extent to which:

1) Landscape design can encourage more people to participate in outdoor exercise.

2) Design can help people reduce their dependency on private vehicles, and encourage them to walk, bike, or take public transit.

3) We can improve the accessibility of healthy local food through design.

4) We can raise public awareness of environmental protection and create opportunities for participation in environmental protection through landscape design.



1. 理论框架：城市绿色景观影响大众健康的理论机制

1. Theoretical framework: mechanisms of impacts of urban green landscapes on public health

5.3 社会群体健康

关注对社群关系、社会融合度、社会资本的影响，我们应该更好地理解以下问题：

1）城市环境对积极通行方式（步行、自行车等）的友好程度如何影响社会资本的发展？

2）城市绿色景观的数量、品质、空间结构与社会资本的发展有何关系？

3）集体性的景观体验与社会群体健康有何关系？

4）景观与城市设计如何对预防和解决社会问题做出贡献？这些社会问题包括社会信任感缺失、社群疏离与冲突、吸毒、自杀、及暴力犯罪等。

5.4 关注特殊或易感人群

关注社会弱势群体或身心较为脆弱敏感的人群的健康，我们应该更好地理解以下问题：

1）在城市绿色景观与公众健康的关系中，性别、年龄、职业、城乡差异、收入、教育程度、婚姻状况、成长经历等因素扮演何种角色？

2）城市绿色景观与儿童以及青少年身心的健康发展有何关系？与青少年肥胖问题有何关系？

3）城市景观设计如何关照特殊或弱势人群（如自闭症患者、抑郁症患者、灾难幸存者、绝症患者、残疾人士、老年人、失业人士等）的身心健康？

4） 针对居住于城市的外来流动人口，文化差异、城乡差异如何影响到城市景观与公众健康的关系？

5）景观和城市设计如何为城市白领、流水线工人、危险工种从业者普遍存在的过度疲劳问题、精神压力问题、抑郁问题和免疫能力低下等问题作出贡献？

5.5 景观、污染治理与健康

关注绿色景观对污染问题的贡献及产生的健康效应，我们应该更好地理解以下问题：

1）景观和城市设计如何为解决工业污染、农业污染、电子垃圾污染、生活垃圾污染做出贡献？

2）污染源周边的绿色景观设计如何对处理水、空气、噪音、土壤污染，减少健康危害做出贡献？

3）城市绿色景观的物种、结构、面积与其处理各种类型污染的能力有何关系？

5.3 Community Health

Focus on creating social cohesion and social capital. We need to better understand:

1) How to design transportation systems — from walking, cycling, and mass transit — increase social capital.

2) How to create urban green landscapes that foster the development of social capital.

3) The relationships between collective landscape experience and community health.

4) The extent to which urban design contributes to the prevention of social issues, including the lack of social trust, social alienation and conflict, drug abuse, suicide, violent crime, etc.

5.4 Focus on Vulnerable Populations

Focus on the health of individuals and groups who are in some way disadvantaged because of their economic, health, or minority status. We need to better understand:

1) What role do sex, age, occupation, urban and rural differences, income, education level, marital status, growing up experiences and other factors influnce on the benefits that people gain from their exposure to urban green landscapes.

2) To what extent do children and especially tennagers benefit from urban green landscapes? In what ways can urban green landscapes help prevent childhood obesity and promote the mental health of young people?

3) The extent to which urban landscape design can promote the physical and mental health of vulnerable populations (for example, people with autism, depression, post-traumatic disorder, disabilities, the elderly, or people who are unemployed).

4) The extent to which cultural differences impact the health benefits of urban landscape for migrating population who now live in urban areas.

5) The extent to which landscape and urban design can alleviate mental fatigue, stress, depression, low immunity and others widespreaded health problems among workers, such as office workers, assembly line workers, and hazardous work practitioners.

5.5 Landscapes, Pollution Management, and Health

Focus on the health benefits associated with reductions in pollutions by green landscapes. We need to better understand:

1) The extent to which landscape and urban design help solve industrial pollution, agricultural pollution, electronic waste pollution, and garbage pollution issues.

2) The extent to which design of green landscapes can alleviate water, air, noise, and soil pollution.

3) Best practices in the selection of plant species, and the structural design of urban green landscape that reduce pollutants in the environment.

5.6 重要规划与设计专题

关注重要或迫切需要研究的课题，我们应该更好地理解以下问题：

1）中国政府如何在制定城市绿地设计规范时将绿色景观的健康效应纳入考量？

2）不同内容、形式和面积的城市绿色景观对改善城市热岛效应有何种程度的影响？

3）如何建立完善的测量指标系统来衡量城市绿色景观对大众健康的影响？

5.7 跨学科合作

关注如何实现重要跨学科评价体系和概念的联系，我们应该更好地理解以下问题：

1）城市绿色景观的生态健康与该环境对大众健康的影响有何关系？

2）城市绿色景观的景观生态结构与城市居民的身心健康有何关系？

3） 如何利用诸如“风水”或“气”等东方传统知识来探究城市绿色景观与公众健康的关系？

4）景观审美评价与景观的健康效应评价有何关系？

6 结语

本文针对中国城市环境恶化导致的公众健康危机，对相关理论和研究成果进行了梳理。我们的结论是非常清楚的：精心设计的城市绿色景观能通过不同的途径提升健康，包括促进身体锻炼、舒缓精神压力、减轻精神疲劳、提供生态产品与服务、提升社会资本。希望本文能对我国城市管理者、学者、规划师和设计师在这一领域的工作有所助益。诚然，城市自然景观对健康有着显著的、全方位的提升作用，但在实践中，我们应重点关注以下三个原则问题：

1）城市绿色景观作为生态基础设施的先行原则：西方城市走过的弯路告诉我们，城市自然资源一旦遭受破坏则需要付出极大的代价和漫长的时间才能得以恢复。对城市生态基础设施的投资将持续提供数十年甚至上百年的生态服务并改变无数人的生活方式。中国应当抓住目前城市化和新城镇建设的契机，把保护和修复既有绿色景观、优化绿色景观的生态服务功能、建立生态基础设施作为城市建设的第一步[64]。

2）城市绿色景观对污染物质的处理能力存在一定的局限性。当环境

5.6 Planning and Design Strategies at a Larger Scale

We need to understand:

1) How does the Chinese government consider the health effects of urban green landscape while formulating regulations of urban green space?

2) How can urban green landscapes with distinctive content, shape, and size alleviate the urban heat island effect?

3) How to develop and establish a comprehensive health assessment tool for assessing the impact of urban green landscape on public health?

5.7 Interdisciplinary Collaboration

We will likely make better progress in solving the challenges identified above by interdisciplinary collaboration rather by trying to solve them within the confines of landscape architecture. We need to better understand:

1) How do ecologically healthy places promote public health.

2) How do ecological structures of urban green landscape impact the physical and mental health of urban residents.

3) How could the knowledge from Chinese traditions such as “Feng Shui” or “Qi” help us understand the impact of urban green landscape on public health.

4) Relationship between aesthetic values of urban green landscapes and their impacts on public health.

6 Conclusions

In this article, we have presented theories and research findings describing the impact of urban green settings on the health and well-being of people. The findings are clear. Careful design of urban green landscapes promote heath in various ways: by promoting physical activity, recovering from stressful experiences, reducing mental fatigue, increasing social capital, and enhancing ecological services. We hope this article is helpful for city managers, scholars, planners, and designers working to create healty places. Indeed, we should specially pay attention to the following three principles in order to maximize of health benefits:

1) Preceding principle of urban green landscape as ecological infrastructure: lessons learned from the development of Western cities let us know that once the city’s natural resources are destroyed, a great price and a long time are necessary to recover. An investment in urban green infrastructure will last many decades or even hundreds of years and will help shape the lifes of countless people. Given the current pace of urban development, China should seize this opportunity to protect and restore existing green landscapes, optimize their ecological functions, and proactively enhance the development of new urban green landscapes that protect the environment and enhance human health and well-being[64].

2) Urban green landscape has certain limitations on the

污染超过一定的阀值，城市绿色景观对环境质量和身心健康的提升效应会大打折扣[65]。西方国家亦走过从通过环境工程手段治理有害污染到利用城市绿色景观进一步改善健康的道路[66]。因此，控制污染排放、减少资源浪费、杜绝非理性城市建设是城市绿色景观能显著提升健康的重要前提。

3）大数据系统及公众参与的重要性：城市景观质量和公共健康的评估都涉及到动态和海量的数据的采集、管理和处理。以美国为例，研究者能够方便地建立人口普查、公众健康普查、污染排放普查、土地利用方式普查、城市绿地普查等多种数据的联系，并在国家、城市、社区等多个尺度上进行分析。

过去数十年间，我们已经为城市的粗放发展付出了沉重的代价，如今警钟已经在耳畔响起：环境与健康问题关乎个人、家庭、国家的命运，只有大家勠力同心，才能为数亿国人以及未来后世创造健康的生活环境。**LAF**

treatment of pollutants. When pollution exceeds a certain threshold, the promotion of human health brought by urban green landscape might significantly diminish[65]. Western countries have gone through a history from treating toxic pollution through environmental engeering solutions to further improving public health through urban green landscapes[66]. Therefore, controlling pollutions, reducing waste of resources, and avoiding immoderate urban development are important prerequisites for this.

3) Importance of the big data systems and public participation: assessment of the urban landscape quality and public health are both related to the dynamic and vast amounts of data collection, management, and processing. In the United States, researchers have access to connect survey data from census survey, public health survey, pollution survey, land use survey, urban open space survey, etc., and can analyze the data across national, city and community scales.

Over the past few decades, we have sacrificed too much for rampant urban grwoth. Environmental and health issues are relevant to the fate of every individual, every family, and the entire country. We call for everyone to work together in order to create healthy living environments for hundreds of millions of Chinese citizens and our future generations. **LAF**

致谢

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注释

本文所涉及的货币数据均为当年货币实际数目。

NOTE

All currency amounts presented in this article are actual numbers reported by then.

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