

健康疗愈导向下蓝色空间的研究进展

Research Progress of Blue Space Under the Guidance of Health Healing

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摘要：本文以中国知网及科学网核心合集数据库收录的有关“蓝色空间与健康”的研究文献为分析对象，基于科学知识图谱的可视化分析工具，对该领域的研究热点及进展进行分析解读，并在此基础上提出蓝色空间在我国研究发展的建议。研究结果显示：（1）蓝色空间的健康效益从 2017 年开始受到广泛关注，在随后的几年，发文数量急剧上升；（2）健康蓝色空间研究热点的演化进程可以分为三个阶段，即水污染带来的健康风险、蓝色空间与健康的关联机制、蓝色空间健康效益的量化评价，内容围绕蓝色空间的健康促进作用、作用机制和效果评价展开，热点依次涉及水疗干预、蓝色空间内的活动、蓝色空间的公共政策及环境评估；（3）根据国外蓝色空间的关键词贡献图谱的七个有效核心聚类，总结得到四大研究主线；（4）当前研究证据与效益的量化多集中在沿海区域，未来蓝色空间的研究方向有扩展到内陆淡水蓝色空间的趋势。

关键词：蓝色空间；水环境；健康；疗愈景观

Abstract: This article takes the research articles related to “Blue Space and Public Health” included in CNKI and WOS database as the analysis object, then analyzes and interprets the research hotspots and progress in this field based on the visual analysis tool of the scientific knowledge atlas, and on this basis, we put forward suggestions on the research and development of blue space in our country. The results of the study show: (1) The health benefits of blue space

have received widespread attention since 2017, and the number of publications has risen sharply in the following years; (2) The evolution of research hotspots in healthy blue space can be divided into three stages: health risks caused by water pollution, the connection between public health and blue space, and the quantitative evaluation of the health benefits of blue space. The content focuses on the health promotion effect, mechanism and effect evaluation of blue space. The hot spots in turn involve hydrotherapy interventions, activities in the blue space, public policies of the blue space, and blue space environmental assessment; (3) The four main research lines are summarized according to the 7 valid core clusters of the keyword contribution atlas for foreign blue space; (4) The current research evidence and quantification of benefits are mostly concentrated in the coastal area, and the research direction of blue space will expand to the inland freshwater blue space in the future.

Key words: blue space; water environment; health; healing landscape

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引言

2016 年发布的《“健康中国 2030”规划纲要》中明确提出建设健康环境是全面建成小康社会的重要基础。2020 年初,新冠疫情的肆虐更加凸显了研究健康环境的必要性。目前,国内景观、规划行业在健康环境建设领域的研究主要集中在绿地对健康的作用上,城市蓝色空间却鲜有提及。而众多来自北美、欧洲等发达国家的研究表明,城市蓝色空间具有显著的健康促进效益。在此背景下,健康蓝色空间的研究成为我国新兴的热点研究领域。本文对蓝色空间与健康相关的研究成果进行梳理整合,挖掘健康蓝色空间领域的研究热点和方向,从整体上把握其研究态势,研究成果将有助于为未来我国健康城市建设中蓝色空间的规划设计研究提供一定的理论基础和拓展方向。

1. 概念辨析与数据来源

1992 年,健康地理学家 Gesler WM 首次提出“疗愈景观”一词,将其定义为有益于恢复人们身心健康和保持健康快乐的设施、建筑、场所及周围环境等,包含自然或人工景观^[1],而在疗愈景观的研究中,水的存在及其健康效益备受重视。研究表明水环境具有生理和心理上的双重疗愈功能,是疗愈景观的重要组成部分^[2]。

2013 年,Volker S 提出“蓝色空间”一词是指“城市内所有有可见地表水的空间”^[3]。之后的研究中,国外学者们多将蓝色空间定义为天然或人造的室外水环境,主要以水为特征,并且是人类可以从近端(在水中、水上或附近)或从远端虚拟地(能够看到、听到或以其他方式感知)访问的空间^[4]。本文利用 JAVA 语言开发的一款信息可视化软件 Citespace,对中国知网及科学网核心合集数据库的数据进行格式转换,计量蓝色空间领域的主要研究路径,导出聚类视图、时区视图和时间线视图^[5],并对其进行分析解读,梳理出研究领域的知识结构、热点演变及前沿方向。

本文所研究的国内进展来源于中国知网数据库,将蓝色空间作为关键词进行检索,时间限定为 2000 年—2020 年,对检索到的内容进行逐个筛选,得到 204 篇相关文献。国外研究进展来源于科学网核心合集数据库,首先确定两大主题的相关检索关键词,其中与健康相关的关键词包括 health、healing、therapeutic landscape、rehabilitation;蓝色空间相关的关键词包括 blue space 和 water environment。为确保数据的完整性和准确性,检索时将文献类型设定为 Article 和 Review,语种设定为英语,时间跨度统一设置为 2000 年—

2020 年，首先分别以 blue space* 和 water NEAR/5 environment 为关键词，选择主题检索路径，共得到 25133 篇文献；第二步，分别以 health*、healing（由于关键词范围广，将检索路径设置为标题）、therapeutic landscape 和 rehabilitation*（主题检索路径）检索，共得到 554548 篇文献；第三步，将检索两个主题分别得到的 25133 篇和 554548 篇文献进行 AND 组配，精确筛选出 423 篇与健康蓝色空间相关的文献，形成所需的样本数据库，配合样本数据库中文献的阅读爬梳得出后续研究结论。

2. 健康疗愈视角下蓝色空间研究的演化进程与热点

近年来，有关蓝绿空间的研究开始与保健、健康、抑郁、住宅、老年人、体力活动、福利和政策等关键词建立联系，研究内容拓展到公共健康与公共政策领域。

2.1 国外健康疗愈视角下蓝色空间研究的演化进程与热点

以科学网核心合集数据库为文献搜索引擎的基础，运用 Citespace 科学知识图谱可视化软件，梳理国际蓝色空间与健康相关的研究热点与脉络，共检索到 423 篇相关文献。由于时间设定的终止节点为 2020 年年中，因此，2020 年的数据并不代表全年发文量数据。如图 1 所示，国外关于蓝色空间与健康的研究，从 2011 年起进入人们的视线，2017 年—2019 年间受到广泛关注，并取得突破性进展。

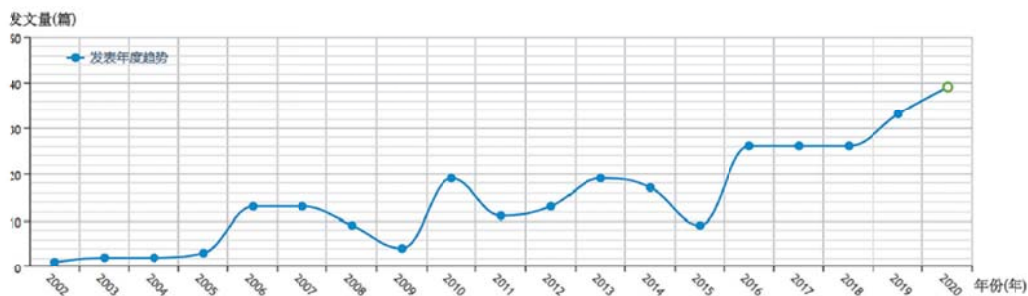
时区图谱显示了国外蓝色空间的研究趋势。根据 2009 年首次出现在关键词图谱中的“疗愈”节点，检索到 Lotan M 发表的关于为患有瑞特综合征的儿童进行水疗干预的研究，首次验证了水作为治疗 RS 病毒感染者的中介环境的重要性^[6]。2011 年—2018 年，图谱关键词依次显示为“儿童”“公共健康”“体力活动”“蓝色空间”“生态服务”“压力”“心理健康”“沿海附近”“气候调节”等，研究开始验证蓝色空间缓解温度调节气候的良好生态效益、缓解压力和焦虑的精神健康效益。

聚类图谱中聚类值 (Q) 反映聚类网络模块度，本文生成的聚类图谱 $Q = 0.54 > 0.5$ 表示聚类结果合理且较为显著。图谱显示节点 207 个，连线 698 条，密度为 0.0327，根据节点大小寻找到研究热点集中在水、康复、疗愈景观、环境、绿色空间、公共健康、蓝色空间、曝光度、感知、体力活动、心理健康等内容，这些关键词是连接不同研究热点及推动研究发展的重要脉络节点。机构聚类时间轴提供了领域内不同研究主题中成果突出的研究机构，包括 Galea S、Ministry F、Volker S、Wheeler BW、White MP、Bell S、Gascon M、Foley R、Van Den B、Markevych I、Helbich M 等。

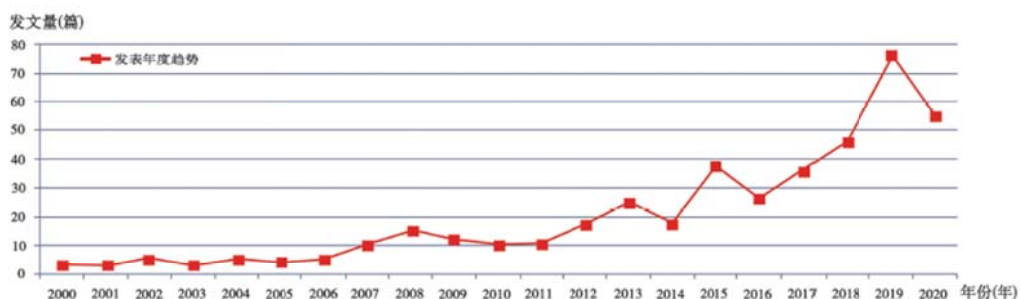
2.2 国内健康疗愈视角下蓝色空间研究的演化进程与热点

基于中国知网数据库，通过对检索内容的筛选，2000年—2020年间，国内共发表了204篇相关文献。国内发文量趋势的走向表明，有关健康蓝色空间的研究从2018年起发文量激增，到2020年，热度持续上升（图2）。国内有关蓝色空间与健康的研究大部分集中在河流自身的健康[7]。近年来，研究才开始延伸到健康导向的滨水区规划设计，并在此基础上展开对建设健康城市的研究。

将中国知网数据库中选取的204篇国内文献数据导入Citespace科学计量工具，对结果进行更精确的科学图谱分析。图谱中共25个节点，12条连线，连线较细且数量较低表明各节点之间的共现联系较低。结果显示，近年来相关研究开始注重人与自然的的关系、滨水区与城市的关系以及对市民健康行为的影响，并引入蓝色空间的概念，健康蓝色空间成为最新研究热点。但目前热点词间关联性较差，尚未形成相互融合的研究体系。



1
国外蓝色空间与健康相关研究的发文量趋势图
Trend Chart of Foreign Blue Space and Health-related Publications



2
国内蓝色空间与健康相关研究的发文量趋势图
Trend Chart of Domestic Blue Space and Health-related Publications

3. 研究主线分析

3.1 国外研究主线

国外蓝色空间与健康相关研究的热点词聚类图表显示，重点研究内容生成了八个聚类。笔者通过其中七个有效核心聚类，即水安全、心理健康、蓝色空间、绿色蓝色空间曝光度、公共健康、老年人健康、城市蓝色，并结合研究领域的热点（表 1）总结了国外有关蓝色空间与健康的四大研究主线：

（1）蓝色空间与心理健康：Nieuwenhuijsen MJ（2014）运用遥感和智能手机技术探索了蓝色空间与健康之间潜在的机制（包括减轻压力、提升恢复功能、体育活动、社会交往）^[8]；Gascon M（2017）首次系统地回顾了有关室外蓝色空间对人类健康和福祉益处的定量证据^[9]；Dzhambov AM（2018）研究了居家绿色、蓝色空间与焦虑、抑郁症状之间的中介机制、变量，结果表明蓝色空间有利于心理健康，但仅在横向分析中观察到体力活动的调节作用^[10]；Mizen A 等（2019）量化了接触和暴露于绿蓝空间对精神健康的有益影响^[11]；Britton（2020）对蓝色护理文献进行了首次系统综述，强调了蓝色空间的心理-社会福祉，提出未来研究的关键在于加深对蓝色护理可以改善人类健康的作用机制的理解^[12]。

（2）蓝色空间与身体健康、气候调节：美国的一项研究（2012）验证了水上运动是针对慢性阻塞性肺疾病患者（COPD）的新治疗方式^[13]；Volker S（2013）发现蓝色空间是缓解温度的可能因素^[14]；Schaefer SY（2016）提出水疗法，验证了水上运动在老年人中风后髋部骨折的康复作用^[15]；Grellier 等（2017）签订了 Blue Health 项目，汇集了不同学科领域的专家，研究城市蓝色空间、气候和健康之间的联系^[4]。

（3）蓝色空间与公共健康：Foley R（2015）探讨了在爱尔兰游泳是一种健康的身体与水在蓝色空间的互动方式，可以利用它来指导更广泛的公共卫生政策^[16]；Volker S（2016）通过对蓝色空间重要性的定性分析对与公共健康相关的拨款政策提出理论参考^[17]；Mcdougall CW（2019）将研究拓展到淡水蓝色空间的接触与实际健康结果联系起来的机制^[18]；Mishra HS 等（2020）开发了一种用于评估城市蓝色空间环境质量的工具——Blue Health 环境评估工具^[19]。

（4）蓝色空间与老年人健康：Kabisch N（2017）提出城市绿色和蓝色空间对儿童和老年人的健康具有普遍的保护作用^[20]；来自 Health & Place 的最新文献（2020）采用了多级线性回归模型、中介效应模型来研究促进生物心理、社会健康的途径，以及将蓝色空间和老年人个体健康之间联系起来的机制^[21]，研究发现减少环境危害、减轻压力和促进社会互动在调节暴露于蓝色空间对老年人心理健康的影响方面起着重要作用。其中，英国、美国、德

国等国家是健康蓝色空间研究的主要阵地：英国：提出了沿海学习和户外健康计划的初步研究^[22]；将内陆城市水道纳入具有疗愈潜力的蓝色空间范围，并拓展到以水质为中心的灰色、绿色和棕色区域^[23]；继德国后第二个关注沿海距离与心理健康的关联机制^[24]；发现内陆水域与健康的正向关联^[25]；利用低成本可穿戴技术量化蓝绿空间（湿地）曝光度对缓解压力的作用^[26]。美国：讨论了绿色和蓝色空间对老年人身体、心理和社会福祉的影响；区分了蓝绿空间的不同作用效果，即蓝色空间对心理健康尤为重要，而绿色空间对社区互动和社会福祉至关重要^[27]；验证了在蓝色空间内行走对心血管疾病的缓解作用^[28]；对淡水蓝色空间（内陆湖泊）曝光度进行更精确的测量^[29]。德国：研究了城市开放空间中蓝色空间增强健康的机制，即减少焦虑、抑郁和压力；城市蓝色空间的道路、设施、安全都是评价其质量的因子^[30]；提出蓝色空间使用频率与步行距离的关联及高度城市化地区使用蓝色空间的健康效益更明显^[31]。

3.2 国内研究主线

国内有关蓝色空间的研究突出了其维护生物多样性、吸尘、降噪、缓解热岛效应、净化环境、调节小气候、美化景观环境的作用^[32]。研究主线多集中在生态工程的规划设计^[33]，关注的重点是水体自身的健康。

2018年—2020年间有关蓝色空间与健康的发文量呈现快速上升趋势，在新冠疫情席卷全球之际，更多的研究人员开始关注水环境对健康行为影响的研究，并引入蓝色空间的概念。研究内容开始关注公众健康与幸福感^[34]、人类行为心理^[35]与蓝色空间的关联、蓝绿空间一体调控方法、健康导向的城市滨水空间活力评价等与健康密切相关的内容。

近年来，在蓝色空间对老年人心理健康的影响方面的研究成果颇为丰富^[21]。但目前还未形成体系化的多学科交叉研究趋势，缺乏符合国内蓝色空间现状的机制关联证据和相关量化指标，更没有蓝色空间相关的政策、法则和成体系化的设计方法，未来的研究应逐步完善上述空缺，并结合更新的技术实现蓝色空间健康效益的最大化。

表 1 蓝色空间与健康相关的研究热点

Table 1 Research Hotspots Related to Blue Space and Health

作者/年份	研究对象	研究方法	重要结果
Alkan RM 等 (2006)	伊斯坦布尔新的城市修复区中的所有利益相关者 (成年人)	GIS 数据、海岸带综合管理系统 (ICZM)	水环境中身体活动时的体重减轻和舒适度, 将有助于在康复方面做出贡献。
Araujo ZTD 等 (2012)	42 例中度至重度慢性阻塞性肺疾病 (COPD) 患者	肺活量测定法、问卷调查	水上运动是针对 COPD 患者的新治疗方式
Volker S 等 (2013)	各种类型的城市蓝色空间 (如池塘、湖泊、河流) 的气温	测温统计数据	认为蓝色空间是缓解温度的可能因素
Gascon M (2015)	有关住宅绿色和蓝色空间对精神健康有益影响的文献	遵循 PRISMA 声明准则来报告系统评价和分析	蓝色空间促进心理健康的机制和特性
Volker S 等 (2016)	德国 7 个具有不同类型蓝色城市开放空间的 211 名访客	标准化的定性访谈	与健康相关的拨款随蓝色城市开放空间的轮廓和蓝色空间覆盖的土地比例而变化。城市蓝色也能带来恢复性体验, 吸引城市居民进行体育锻炼
Gascon M (2017)	35 项有关室外蓝色空间的研究	按照 PRISMA 报告系统评价和分析, 使用观察性和实验性定量研究	审查有关室外蓝色空间对人类健康和福祉益处的定量证据, 结果存在较大异质性
Volker S 等 (2018)	2 个德国城市的居民上报的距离蓝色空间的步行距离	横向分析	蓝色空间使用频率与到蓝色空间的步行距离之间存在显著关联; 高度城市化地区使用蓝色空间会增加健康的可能性
Vert C 等 (2019)	西班牙巴塞罗那市区河滨公园访问者	Blue Active 蓝色空间健康结果评估工具	健康效益与在河滨公园进行的体力活动相关, 基础设施可以为人们提供与健康相关的经济利益
Mishra HS 等 (2020)	欧洲城市蓝色空间	Blue Health 环境评估工具	提供了用于提取与蓝色空间和健康决定因素相关的环境变量的框架

4. 结论与讨论

目前, 学术界对蓝色空间的研究处于繁荣发展阶段, 当前量化其健康效益的研究主要

集中在沿海区域。而早在 2011 年，Volker S 等人就强调了内陆水体与健康的联系^[36]，但目前还未有研究探讨淡水蓝色空间与心理健康之间具体关联机制。此外，现有研究普遍采用调查问卷、访谈等方式获取相对主观的健康指标数据，不具有客观普遍性。最新的研究成果正尝试通过环境评估工具加强量化评估在城市蓝色空间发展中的应用，但测量方法存在高度异质性，误差系数较高。

未来需要将定性分析与更加科学直观的定量分析相结合，进一步确定内陆淡水蓝色空间与健康的关联机制、影响效益发挥的因素及评价体系，在深入研究国外经验的基础上，结合中国的蓝色空间现状，探究基于量化评估的国内健康蓝色空间的规划设计体系。

Introduction

The Outline of “Healthy China 2030” Plan in 2016 clearly puts forward that the establishment of a healthy environment is an essential basis for constructing a well-off society in an all-round way. At the beginning of 2020, the outbreak of the covid-19 pandemic further highlighted the necessity of studying the healthy environment. At present, the research of domestic landscape and planning industries in the field of healthy environment construction mainly focuses on the influence of green space on health, and yet, the urban blue space is rarely investigated. A large number of studies from developed countries in North America and Europe however, indicate that urban blue space is capable of providing significant health promotion benefits. Under this context, the studies on healthy blue space have become an emerging research field in China. This paper sorts and integrates the research results related to blue space and health, explores the research hotspots and directions in the field of healthy blue space, and grasps its research trend as a whole. The research results will help to provide a certain theoretical basis and development direction for the planning and design research of blue space relevant to the construction of healthy cities in China in the future.

1. Concept Analysis and Data Source

In 1992, Gesler WM, a health geographer, first proposed the term “healing landscape”, which is defined as facilities, buildings, places and surrounding environment conducive to restoring people’s physical and mental health and maintaining health and happiness, including both natural

and artificial landscapes^[1]. In the studies on healing landscapes, the existence of water and its health benefits have received attention in a wide range. Such studies show that water environment has both physiological and psychological healing functions and is an important part of healing landscape^[2].

In 2013, Volker S proposed that the term “blue space” referred to “all spaces with visible surface water in urban”^[3]. In subsequent studies, foreign scholars mostly defined blue space as natural or man-made outdoor water environment, which is mainly characterized by water, and it is a space that enables humans to virtually access from the near-end (underwater, overwater or nearby) or the far-end (can be seen, heard or perceived in other ways)^[4].

In this paper, an information visualization software “Citespace” developed by JAVA language is used to convert the data adopted from CNKI and Web of Science core collection database, measure the main research paths in the field of blue space, and derive cluster view, time-zone view and timeline view^[5] with analysis and interpretation, and sort the knowledge structure, hotspot evolution and cutting-edge direction in regards with the research field.

The domestic progress studied in this paper adopts from CNKI database, in which blue space was used as keyword to search with a time range from 2000 to 2020. 204 relevant articles were obtained by filtering the retrieved contents in turn. Foreign research progress comes from Web of Science core collection database. Firstly, the relevant search keywords of two major topics were determined, among which the health-related keywords include health, healing, therapeutic landscape and rehabilitation; and keywords related to blue space include blue space and water environment. In order to ensure the integrity and accuracy of the data, the document type was set as Article and Review, the language was set to English, and the time span was uniformly set from 2000 to 2020. Firstly, the subject search path was selected with blue space* and water NEAR/5 environment as the keywords respectively, and a total of 25,133 articles were obtained; secondly, 554,548 articles were obtained by retrieving keywords including health*, healing (the search path was set as headings due to the wide range of keywords), therapeutic landscape and rehabilitation* (subject retrieval path); thirdly, 25,133 and 554,548 articles separately obtained via the retrieval of the two topics were matched with AND, and 423 articles related to health blue space were accurately filtered out to form the sample database required, and the follow-up research conclusions were drawn by reading and combing the articles in the sample database.

2. Evolution and Hotspots of Blue Space Research Under the Perspective of Health Healing

In recent years, the research on blue-green space has established links with key words such as health care, health, depression, housing, the elderly, physical activities, welfare and policies, and the research content has begun to expand to the field of public health and public policies.

2.1 Evolution and Hotspots of Blue Space Research Under the Perspective of Foreign Health Healing

Taking the Web of Science core collection database as literature search engine, the Citespace scientific knowledge atlas visualization software was used to sort out the research hotspots and context related to international blue space and health, and a total of 423 relevant articles were retrieved. Since the termination node of the time setting was the middle of 2020, the data in 2020 failed to represent the annual publications data. As shown in figure 1, foreign research on blue space and health has come into people's attention since 2011, and such research had attracted extensive attention and made breakthrough progress from 2017 to 2019.

The time-zone view shows the research trend of foreign blue space. According to the "healing" node first appeared in the keyword atlas in 2009, the research on hydrotherapy interventions for children with Rett syndrome published by Lotan M was retrieved, which verified the importance of water as an intermediary environment for the treatment of RS virus infected individuals for the first time^[6]. From 2011 to 2018, the atlas keywords of "children", "public health", "physical activity", "blue space", "ecological service", "stress", "mental health", "coast" and "climate regulation" were displayed successively. Relevant studies have begun to verify the good ecological benefits in alleviating temperature and regulating climate as well as mental health benefits in relieving stress and anxiety of blue space. The cluster value (Q) in the cluster atlas reflects the modularity of the clustering network. The cluster atlas $Q = 0.54 > 0.5$ generated in this paper indicates that the clustering result is reasonable and significant. The atlas shows 207 nodes, 698 connections and a density of 0.0327. According to the size of the node, we found that the research hotspots focus on water, rehabilitation, healing landscape, environment, green space, public health, blue space, exposure, perception, physical activities, mental health, etc. These keywords are important context nodes to connect different research hotspots and promote research and development. The institutional clustering timeline provides research institutions with

outstanding achievements regarding different research topics in this field, including Galea S, Ministry F, Volker S, Wheeler BW, White MP, Bell S, Gascon M, Foley R, Van Den B, Markevych I, Helbich M, etc.

2.2 Evolution and Hotspots of Blue Space Research Under the Perspective of Domestic Health Healing

By filtering the retrieval contents from the database of CNKI, the researchers found that 204 relevant articles were published in China from 2000 to 2020. The trend of domestic publications shows that the research on healthy blue space has seen a surge in publications since 2018, and the attention had continued to grow by 2020 (figure 2).

Most domestic studies on blue space and health focus on the health of rivers^[7]. In recent years, the research has begun to extend to the health-oriented waterfront planning and design, and on this basis, the research on constructing healthy cities has been carried out.

The 204 domestic articles selected from CNKI database were imported into Citespace scientific measuring tool to analyze the results more accurately. There are 25 nodes and 12 connections in the map. Among them, the thinner connections with lower number indicate that the co-occurrence relationship between nodes is relatively low. The results show that relevant research has also paid attention to the relationship between human and nature, the relationship between waterfront and city as well as its impact on citizens' health behavior, and also introduced the concept of blue space in recent years. Healthy blue space became the latest research hotspot. However, at present, the relevance among hot words is below average, and an integrated research system has not been formed.

3. Analysis on Principal Line of Research

3.1 Principal Line of Foreign Research

The clustering chart of hot words in foreign research on blue space and health shows that the key research contents have generated eight clusters. Through the seven effective core clusters of water safety, mental health, blue space, exposure of green blue space, public health, health of the elderly and urban blue, combining with the hotspots in the research field (table 1), the author summarized four major foreign research principle lines on blue space and health:

(1) Blue space and mental health: Nieuwenhuijsen MJ (2014) used remote sensing and smart

phone technologies to explore the potential mechanism between blue space and health (including reducing stress, improving recovery capability, physical activities and social communication)^[8]; Gascon M (2017) systematically reviewed the quantitative evidence on the benefits of outdoor blue space to human health and well-being for the first time^[9]; Dzhambov AM (2018) studied the mediating mechanism and variables between home green, blue space and symptoms of anxiety and depression, and the results showed that blue space was conducive to mental health, but the regulatory effect of physical activity was just observed in horizontal analysis^[10]; Mizzen A et al. (2019) quantified the beneficial effects of getting exposed to green blue space on mental health^[11]; Britton (2020) systematically reviewed the blue nursing articles for the first time, emphasized the psychosocial well-being provided by blue space, and proposed that the key to future research is to deepen the understanding of the mechanism by which blue nursing can improve humans' health^[12].

(2) Blue space, physical health and climate regulation: a study (2012) done in the United States verified that aquatic sports was a new treatment for patients with chronic obstructive pulmonary disease^[13]; Volker S (2013) found that blue space was a possible factor to alleviate temperature^[14]; Schaefer SY (2016) proposed hydrotherapy and verified the effect of aquatic sports on the elderly's rehabilitation of hip fracture after stroke^[15]; Grellier et al. (2017) signed the Blue Health project, bringing experts from different disciplines together to study the relationship between urban blue space, climate and health^[4].

(3) Blue space and public health: Foley R (2015) explored that swimming in Ireland was a way of interaction between healthy body and water in blue space, which can be used to guide broader public health policies^[16]; Volker S (2016) put forward a theoretical reference for the allocation policy related to public health through the qualitative analysis on the importance of blue space^[17]; McDougall CW (2019) extended the study to the mechanism of linking exposure to freshwater blue space with actual health outcomes^[18]; Mishra HS etc. (2020) developed a tool for assessing the environmental quality of urban blue space — Blue Health environmental assessment tool^[19].

(4) Blue space and the health of the elderly: Kabisch N (2017) proposed that urban green and blue space were generally capable of protecting the health of children and the elderly^[20]; the latest article (2020) from Health & Place adopted multi-level linear regression model and intermediary

effect model to study the way to promote biopsychology and community health, and the mechanism linking blue space and elderly individuals^[21], and the research found that reducing environmental hazards, relieving stress and promoting social interaction played an important role in regulating the impact of exposure to blue space on the mental health of the elderly. Among them, Britain, the United States, Germany and other countries are the main positions for healthy blue space research: Britain: a preliminary study on coastal learning and outdoor health plan was proposed^[22]; the waterways in inland city have been integrated into the blue space with healing potential and extended to the grey, green and brown areas, which are centered on water quality^[23]. It is the second country following Germany that focuses on the correlation mechanism between coastal distance and mental health^[24]. A positive correlation between inland waters and health was discovered^[25]. The effect of blue-green space (wetland) exposure on stress relief was quantified via low-cost wearable technology^[26].

United States: the impact of green and blue space on the physical, psychological and social well-being of the elderly was discussed. The different effects of bluegreen space were distinguished, that is, blue space was particularly important for mental health, while green space was crucial for community interaction and social well-being^[27]. The alleviating effect of walking in blue space on cardiovascular diseases was verified^[28]. More accurate measurement of exposure in freshwater blue space (inland lakes) was carried out^[29]. Germany: the mechanism of blue space in urban open space enhancing health was studied, which meant the reduction of anxiety, depression and stress. Roads, facilities and safety of urban blue space are the factors to evaluate its quality^[30]. It is proposed that the correlation between the use frequency of blue space and walking distance as well as the health benefits of using blue space in highly urbanized areas is more significant^[31].

3.2 Principal Line of Domestic Research

Domestic research on blue space has highlighted its role in maintaining biodiversity, absorbing dust, reducing noise, mitigating heat-island effect, purifying environment, regulating microclimate and beautifying landscape environment^[32]. The principal line of domestic research is mainly related to the planning and design of ecological engineering^[33] with its focus on the health of water.

From 2018 to 2020, the publications on blue space and health had shown a rapid upward trend.

Since covid-19 pandemic swept the world, more researchers have begun to pay attention to the study of the impact of water environment on health behavior and introduced the concept of blue space. The research contents have started to show solicitude for public health and well-being^[34], the relationship between human behavior psychology^[35] and blue space, the integrated regulation method of blue-green space, the health-oriented vitality evaluation of urban waterfront space and other aspects closely involved in health .

In recently years, the research results on the impact of blue space on the mental health of the elderly are in abundance^[21]. However, so far, the systematic interdisciplinary research trend has not yet been formed, mechanism correlation evidence and relevant quantitative indicators in line with the current situation of domestic blue space have still been insufficient, and there are no policies, rules and systematic design methods related to blue space even up to now. Future research should gradually improve the above vacancies and maximize the health benefits provided by blue space in combination with new technologies.

4.Conclusion and Discussion

At present, the academic research on blue space is in a booming stage. The current research that quantifies its health benefits mainly focuses on coastal areas. As early as 2011, Volker S et al. emphasized the relationship between inland water and health^[36], however, no studies have yet been done to explore the specific correlation mechanism between freshwater blue space and mental health. In addition, existing studies generally use questionnaires and interviews to obtain relatively subjective health index data, which is lack of objective universality. The latest research results are trying to strengthen the quantitative evaluation in the development of urban blue space with environmental assessment tools, and yet, there is high heterogeneity and error coefficients in regards with measurement methods.

In the future, it is necessary to combine qualitative analysis with more scientific and intuitive quantitative analysis to further determine the correlation mechanism between inland freshwater blue space and health, the factors affecting benefits and the evaluation system. Apart from that, the planning and design system of domestic health blue space based on quantitative evaluation should be investigated further based on in-depth studies of foreign experience and combined with the existing circumstances of China's blue space.

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