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Review

The Adoption of Digital Technologies and Artificial Intelligence in Urban Health: A Scoping Review

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Abstract: As more people live in cities, the impact of urban settings on population health has been increasing. One of the main strategies to cope with urbanization is adopting artificial intelligence (AI) and new digital technologies to develop new urban services that improve citizens' health and well-being. The aim of this study is to review urban interventions and adopting digital technologies and AI-based algorithms to improve population health. A scoping review of the literature was conducted by querying MEDLINE, Web of Science, and Scopus databases. The included studies were categorized into one urban health area, suggested by the WHO, according to the type of intervention investigated. Out of 3733 records screened, 12 papers met all inclusion criteria. Four studies investigated the "outdoor and indoor pollution" area, one "climate change", one "housing", two "health and social services" and four "urban transport" areas. Only one article used a comprehensive approach to public health, investigating the use of AI and digital technologies both to characterize exposure conditions to health determinants and to monitor population health effects, while the others were limited to characterizing exposure conditions to health determinants, thus employing a preliminary public health perspective. From this point of view, countries should foster synergy for the development of research on digital technologies to address the determinants of health in the urban context. From a global health perspective, sharing results with the scientific community would also allow other countries to use those technologies that have been shown to be effective, paving the way for more sustainable living conditions worldwide.

Keywords: digital technologies; artificial intelligence; urban health

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1. Background

As more people live in cities and towns than in rural areas, the impact of urban settings on population health has been increasing. As reported by the United Nations, in 2018 about 55% of the world's population lived in urban areas, a proportion that is expected to increase to 68% by 2050. Urbanization, the progressive migration of human population from rural to urban areas, together with overall global population growth might potentially add another 2.5 billion people to urban areas by 2050, with almost 90 percent of this increase to happen in Asia and Africa [1].

Moreover, in the current era of climate change, urban settlements are of particular interest given their twofold role: in mitigation [2], since 52% of greenhouses gas emissions

derive from only 25 mega-cities, and in adaptation, as people living in cities are at higher risk from climate change [3].

Urban Health (UH) is the study of urban characteristics-including features related to the social and physical environment and to the urban resource infrastructure that can influence health and disease in an urban context [4]. Although UH did not become an officially recognized discipline until the mid-1980s, when it emerged as a subdiscipline of international public health, the linkage between urban life and population health has long been known [5]. Urban health matters, in critical ways, for more and more people. The World Health Organization (WHO) pointed out ten urban settings acting as health determinants: housing; water; sanitation; food; urban transport; noise exposure; outdoor and indoor air pollution; climate change; social environment; and health and social services. Indeed, when cities are well planned, managed, and governed, life flourishes and health outcomes surpass those seen in rural areas, and the way cities are built can change people's perception of their quality of life [6]. Currently, researchers are investigating the impact of several factors that may act as determinants of health, such as air pollution [7], soundscape experience [8,9], and the presence of urban parks [10]. But cities also concentrate risks and hazards for health. The current COVID-19 pandemic era is a sharp reminder that urbanization has transformed the way people and communities live, work, and interact, and that there is a crucial necessity of making local systems and capacities resilient to successfully prevent the spread of infectious diseases [11]. One of the main strategies to cope with challenges, such as urbanization, climate change, and infectious disease control, is adopting artificial intelligence (AI) and new digital technologies to revolutionize cities, creating opportunities to develop new urban services as a network that collects real-time and spatially dense environmental data to improve citizens' health and well-being [12].

In computer science, the field of AI research defines AI as the study of "intelligent agents" which are devices that "perceive their environment and take actions to maximize their chance of success at some goal" [13]. In the current age of rapidly progressing technology and exponential growth of massively huge data sets ("big data"), AI has gone from pure theory to concrete application on an unprecedented scale [14].

The paradigm shift to a new era of intelligent disease control and detection, virtual care, intelligent health management, intelligent monitoring, and decision making seems to be closer to the current health care system. In the monitoring of healthcare processes, sensors and other emerging technologies such as nanotechnology, 5G technologies, drone technology, blockchain, robotics, big data, internet of things, artificial intelligence, and cloud computing are enabling factors towards a transformative shift in patient-centered care. The so called "Healthcare 5.0" includes services such as remote patient monitoring, virtual tracking and clinics, ambient assisted living, smart self-management, smart treatment reminders, and personalized and connected health care [15]. Given the plummet of costs and dimensions, wearable sensor-based health monitoring devices as well as machine/deep learning applications have been increasingly used in healthcare [16–18]. By way of example, recent evidence showed the feasibility of these applications in early stroke prognostics and the rehabilitation management of post-stroke management.

According to McKinsey Global Institute, smart cities put data and digital technology to work, adding artificial intelligence to existing urban systems to make better decisions and improve people's quality of life. The report showed that using the current generation of smart city applications effectively could help cities making significant or moderate progress toward meeting most of the Sustainable Development Goals ranging from industry innovation and infrastructure (i.e., SDG 9) to partnerships for the goals (i.e., SDG 17) [19]. Moreover, Jain et al. found that adopting data is a functional tool for setting up strategies and actions aimed at localizing and achieving SDGs and also for increasing the local governments' accountability for outcomes [20]. In this perspective, a smart city could be considered a remarkable model in delineating a new frontier in urban governance that can be applied to achieve public health aims [21].

The objective of this study is to review urban interventions, adopting digital technologies and AI-based algorithms to improve population health.

2. Materials and Methods

2.1. Study Design and Search Strategy

A scoping review of the literature was conducted to review urban intervention based on digital technologies and AI, following the methodology developed by Arksey and O'Malley [22] and also informed by the Joanna Briggs Institute [23].

A comprehensive search strategy was developed, based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR), to query relevant electronic databases such as MEDLINE, ISI Web of Science, and Scopus. Eventual missing articles were retrieved by hand-searching. The following search terms were used: "algorithm"; "artificial intelligence"; "AI"; "technologies"; "machine learning"; "smart cities"; "urban health"; "citizen health"; "city health"; "decision making"; "city planning"; "urban planning"; "decision planning".

2.2. Study Selection

Eligibility criteria for the present scoping review were defined according to the population, concept, and context (PCC) framework. Particularly, the inclusion criteria were defined as articles explicitly involving any type of population living in urban contexts, describing interventions based on artificial intelligence (AI) and digital technologies, declaring public health purposes, and, if applicable, measuring the urban health areas suggested by the WHO classification (i.e., housing; water; sanitation; food; urban transport; noise exposure; outdoor and indoor air pollution; climate change; social environment; and health and social services) and/or the impact on population health.

The inclusion was also restricted by language (i.e., English, Spanish, French, Italian and Portuguese), availability of full texts published in peer-reviewed journals, and type of article (i.e., commentary, books, thesis, and conference proceedings). Three independent researchers conducted the first round of screening assessing the titles and abstract. Then, the full texts of each study included after the first round were screened to determine the final eligibility. In both rounds, any disagreements were solved by a fourth author.

2.3. Data Extraction

The data extraction was performed by three authors. A data charting form was developed including: study characteristics (i.e., authors' names, country, year of publication, title, and study design), type of intervention, scenario (i.e., real-world or simulation), beneficiary (i.e., decision makers, groups, individuals), and outcome-related aspects.

2.4. Data Synthesis

A descriptive analysis was initially conducted, adopting graphs and tables, to report basic summaries about the characteristics of each study.

In addition, a narrative synthesis of the included studies was conducted considering the scope of each study, the type of beneficiary, the urban health areas investigated according to the WHO classification, and, in this case, the impact on population health. Eventually, each study was connected to a specific urban setting and to the appropriate categories of digital health products and services [24].

3. Results

3.1. Study Selection and Characteristics

A total of 3733 articles have been retrieved, of which 31 were included for full-text screening. Twelve papers fulfilled all established inclusion criteria. The full selection process is illustrated in Figure 1.

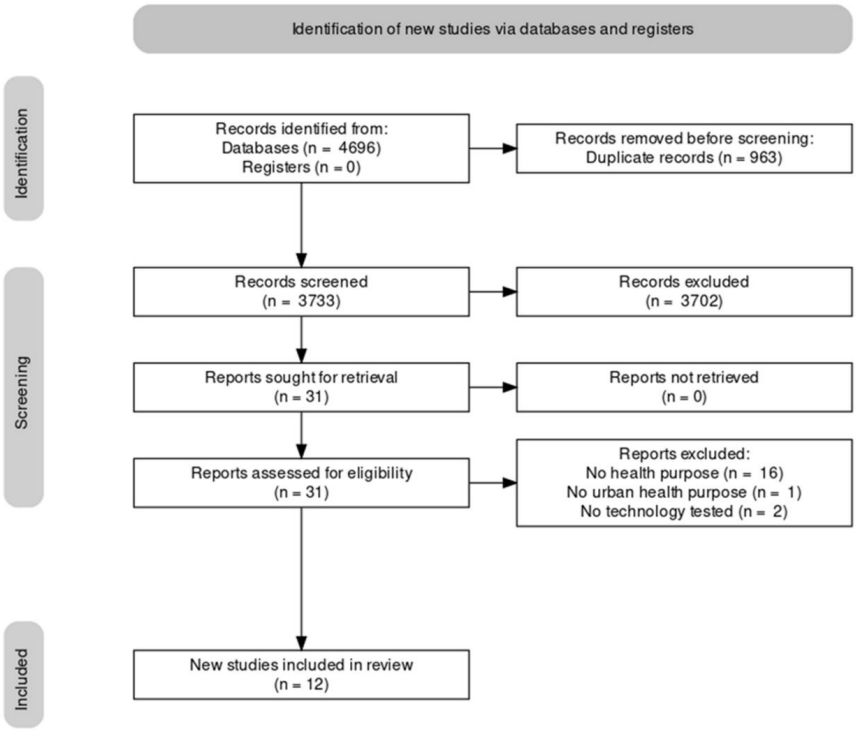

Figure 1. Flow diagram.

The scoping review highlighted that most of the included articles were published in the last five years, of which 33% were published in 2020 followed by 17% in 2021. The other studies were issued between 2016 and 2017. Only one study was published in 2013.

Europe was the most represented continent, with six studies, followed by Asia and North America (Figure 2).

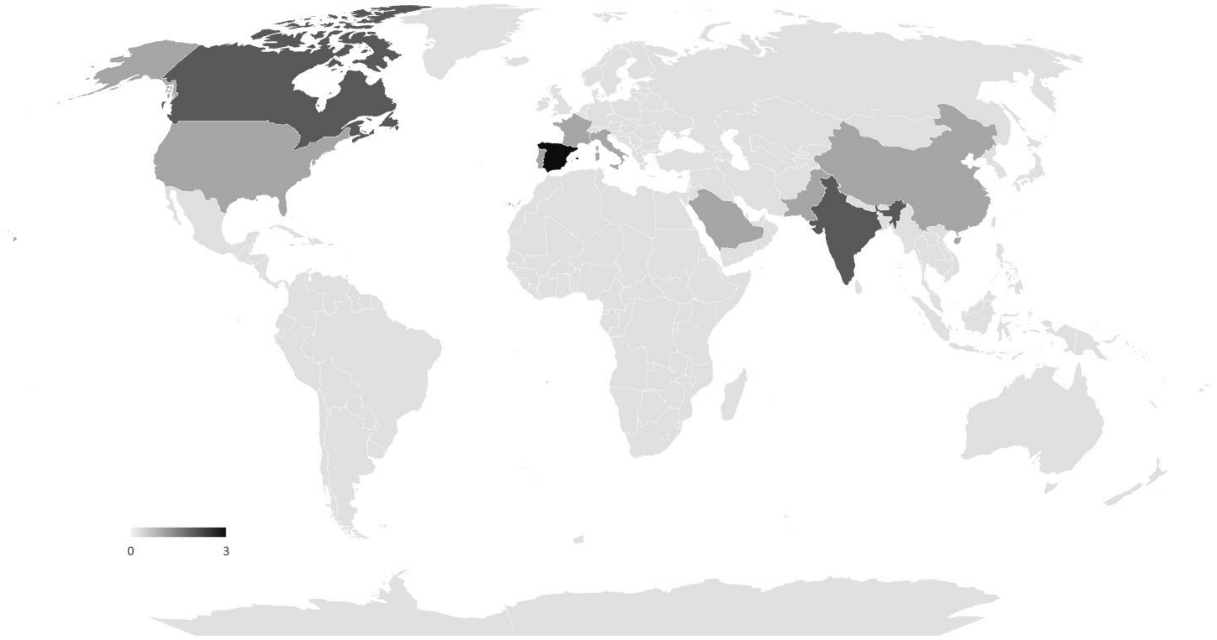

Figure 2. Geographical distribution of the included studies. Black countries: Spain, three articles. Dark gray: India and Canada, two articles. Light gray: USA, Italy, France, Portugal, China, Saudi Arabia, and Pakistan, one article.

Among those included, only one article out of twelve (Pala et al.) [25] investigated both the use of AI and digital technologies to enhance the exposure conditions to health determinants, through the analysis of prevention, clinical, and behavioral outcomes, and the related impact on population health, whereas the other eleven studies, out of twelve, focused on the adoption of AI and digital technologies to improve only the exposure conditions to health determinants, without putting direct attention to population health impact. The vast majority (75%) of the included articles were published in highly specific academic journals regarding science and technology of sensors and their applications. Three papers out of twelve were issued in an international journal focusing on promoting environmentally sustainable and socially resilient cities. No articles have been published in academic journals pertaining to the public health area. Summary characteristics of the selected manuscripts are reported in Table 1. Additional features can be found in Table S1 and Figure S1 in the Supplementary Materials.

Table 1. Summary characteristics of selected studies.

ACY	Urban Health Area	Citizen Involvement	Scenario	Scope	Beneficiary	Use of Health Data	Journal	Measured Population Health Impact
Candelieri A, Italy, 2013 [26]	Outdoor and indoor air pollution	No	Real world	Decision making and individual support	Decision maker, group and individual	No	WIT Transactions on Ecology and the Environment	No
Bravo Y, Spain, 2016 [27]	Urban transport	No	Real world	Decision making	Decision maker	No	Lecture Notes in Computer Science book series	No
Alhussein M, Saudi Arabia, 2017 [28]	Health and social services	Yes	Simulation	Individual support	Individual	Yes	IEEE Access	No
Mora H, Spain, 2017 [29]	Urban transport	Yes	Real world	Decision making and individual support	Decision maker, group and individual	Yes	Sensors (Basel)	No
Mihăiță AS, France, 2018 [30]	Urban transport	No	Real world	Decision making	Decision maker, group and individual	No	Simulation Modelling Practice and Theory (SIMUL MODEL PRACT TH)	No
Zaheer T, Pakistan, 2019 [31]	Urban transport	No	Simulation	Individual support	Individual	No	International Journal of distributed sensor networks	No
Bardhan R, India, 2020 [32]	Climate change	No	Simulation	Decision making	Group	No	Sustainable Cities and Society (SCS)	No
Jia J, China, 2020 [33]	Outdoor and indoor air pollution	No	Real world	Decision making	Decision maker	No	Sensors (Basel)	No
Morris E, Canada, 2020 [34]	Outdoor and indoor air pollution	No	Real world	Decision making	Decision maker	No	ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences	No
Pala D, USA, 2020 [25]	Outdoor and indoor air pollution	No	Real world	Decision making	Decision maker	Yes	Sensors (Basel)	Yes
Nagarajan SM, India, 2021 [35]	Health and social services	No	Real world	Decision making	Decision maker	Yes	Sustainable Cities and Society (SCS)	No
Valinejadshoubi M, Canada, 2021 [36]	Housing	No	Real world	Decision making	Group	No	Sustainable Cities and Society (SCS)	No

Abbreviations: ACY, Author, Country, Year.

3.2. Urban Health Areas

The included studies were classified and categorized into one urban health area according to the type of intervention investigated.

Four studies investigated the "outdoor and indoor pollution" area, one "climate change", one "housing", two "health and social services", and four "urban transport" areas.

Intervention in the "urban transport" area focused on reducing traffic congestion [27,31], planning urban transformation [30], or increasing cities' accessibility [29]. The management of traffic flows was possible by a smarter control of traffic lights [27] or by suggesting different individual routes exploiting real-time data [31].

Interestingly, the paper by Mora et al. [29] reported the possibility to discover and assess urban accessibility issues by integrating map data with individuals' urban mobility patterns.

Furthermore, Mihăiță et al. [30] considered the adoption of a simulation tool based on traffic management center inputs to forecast optimal traffic control plans during rush hours.

In relation to the "outdoor and indoor pollution" area, the main topics investigated were the integration of several sensors to monitor common pollutants and complex applications and the provision of practical solutions to the stakeholders as well as the assessment of the urban built environment. The studies by Morris et al. [34] and Jia et al. [33] reported that the deployment of specific sensors allowed the correct monitoring of the urban built environment. Additionally, in the perspective of decision-making support, the implemen-

tation of an integrated Internet of Service-based system can provide stakeholders with targeted applications aimed at assessing and dealing with water and air quality health challenges, as highlighted by the latest evidence in the scientific literature [26].

The paper by Pala et al. [25] demonstrated that a data analytic platform, based on a pre-learned deep Neural Network architecture, can provide policymakers with advanced approaches to analyze maps and geospatial information with healthcare and air pollution data and, therefore, can ease the urban planning process.

Surprisingly, only one paper [32] investigated the adoption of focused frameworks based on modeling approaches to identify and assess suitable solutions for the management of warming climate-induced energy in residential buildings.

Also for the "housing" area, only a single paper [36] evaluated the integration of a sensor-based alert system for the thermal comfort monitoring in buildings. The monitoring is ensured by Building Information Modeling platforms integrated with sensor data, detecting the optimal levels of thermal comfort/discomfort in the indoor environment.

For what concerns the "health and social services" area, interventions in both the two papers were focused on collecting and monitoring healthcare data from patients.

Nagarajan et al. [35] reported that an Internet of Things-based FoG-assisted cloud network architecture can collect, monitor, and analyze healthcare data from patients, also providing relief measures to the patients requiring immediate assistance. Similarly, the study by Alhussein et al. [28] showed that the cloud-based Parkinson's Disease framework can be a useful tool for the detection of that disease. The framework took advantage of speech signals from patients which were directly transmitted to the cloud and then to the registered physicians who then prescribed specific medications to the patients.

4. Discussion

The number of research papers related to digital technologies and AI-based algorithms applied in urban planning and management was found to be very impressive. The journal type of the included studies was found to be highly specialized in sensor science and technology and their applications.

Only one article adopted a complete public health approach, analyzing the use of AI and digital technologies both to characterize the exposure conditions to health determinants and to monitor the effects on population health, while the others merely addressed only the characterization of exposure conditions to health determinants, thus employing a preliminary public health perspective.

Although the COVID-19 pandemic has dramatically reconnected health with urban planning [37,38], it appears that to date public health is struggling to team up with urban decision makers in connecting data-driven algorithms with health outcomes [39].

In the face of an inexorable process of urbanization, the hope for sustainable growth depends closely on the proper management of urban development. This is even more true in low- and middle-income countries where the pace of urbanization is expected to be faster [40]. The present systematic scoping review highlights how research interest in digital technologies to support sustainable urban context has increased in recent years. However, few studies come from developing countries, which would most benefit from sustainable urban management. As reported by the World Health Organization (WHO), low- and middle- income countries can suffer from a high percentage of people who cannot access digital technologies, but decision-makers should use AI to implement new models of health-care delivery [41], integrating health data with urban data in order to improve health outcomes [41,42]. Only two papers [28,35] reported an innovative way to collect and monitor health data. It is expected that where Smart Cities are growing there will be public health leadership capable of promoting, implementing, and sharing a new agenda in which the collection of data from all possible sources is geared toward the well-being of the population [43].

Only one included article explicitly addressed the "climate change" area, although it is one of the current priorities for population health [44,45]. Even if a positive change in

one area is supposed to impact on all the others, it is striking that the development and application of new technologies do not consider among their key objectives the impact on climate change adaptation and mitigation strategies.

Furthermore, three included studies focused on urban transport, investigating the use of AI-based applications to optimize the traffic flow and obtain data about urban accessibility. Nonetheless, there is evidence highlighting the utility of algorithms to reduce road traffic injuries by designing cities supporting safer transport modes [46].

In support of the feasibility of digital technologies and AI applications, in all of the included studies different data formats were combined, those studies integrating data from users experienced a notable compliance, and most of the studies described real-word applications of digital technologies.

The present review should be read considering its strengths and limitations. The greatest limitation probably lies in the inclusion of only those articles that made explicit reference to population health, which has possibly resulted in the loss of interesting articles. Nonetheless, the aim of this study is to review the current evidence about the role of digital technologies and AI-based algorithms in decision-making in urban health, so it was deemed necessary to exclude those articles focused on a specific urban problem without considering its health impact. A further caveat is represented by the search strategy limited only to the scientific literature, thus missing evidence in the gray one. Nonetheless, the rationale behind the query from academic research databases lies in the choice to include peer-reviewed articles characterized by robust contents. Another limit may be the inadequate knowledge domain regarding the discussion of digital technologies and AI applications. However, the present review is firmly anchored to specific concepts of Public Health (and not to other technical fields of study) throughout its entire conduction.

Thus, further research is needed to investigate the urban health areas according to the WHO classifications, measuring, particularly, the impact on population health.

Among the ten urban settings proposed by WHO, no studies were found addressing the following: water, sanitation, food, noise exposure, and social environment even though urban living is defined as the result of a complex interaction across all the determinants of health. Scholars should consider the missing urban settings when implementing AI-based decision-making tools. Moreover, it is fundamental to address a combination of determinants in an integrated way since a partial innovation, focusing only on a single setting, could hardly be the solution to the challenges triggered by the whole urbanization process. The SDG agenda could be a useful integrated framework to chart the course establishing a direct relationship between the involved actors and the required tasks as well as making sure of considering all the connected goals [47].

5. Conclusions

In scientific literature, it is well established that urban context factors act as determinants of health. With the COVID-19 pandemic, this awareness has become even clearer. Digital technologies and AI-based algorithms offer an unprecedented opportunity to impact the urban context by using huge amounts of data in an integrated way. From a public health perspective, countries that experience a favorable coexistence of financial resources, technological infrastructure, and public health professionals, should promote a synergy for the development of research on digital technologies to address the determinants of health in the urban context. In addition, from a global health perspective, sharing results with the scientific community would also allow other countries to use those technologies that have been shown to be effective, paving the way for more sustainable living conditions worldwide.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14127480/s1, Table S1: Additional characteristics of the included interventions. Figure S1: Graphical representations of results in terms of Urban setting and categories of technology used in included studies.

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References

1. United Nations. World Urbanization Prospects: The 2018 Revision. United Nations Department of Economic and Social Affairs 2018. Available online: https://esa.un.org/unpd/wup (accessed on 15 January 2022).
2. Wei, T.; Wu, J.; Chen, S. Keeping Track of Greenhouse Gas Emission Reduction Progress and Targets in 167 Cities Worldwide. *Front. Sustain. Cities* **2021**, *3*, 381. [CrossRef]
3. World Health Organization. *Why Urban Health Matter*; World Health Organization: Geneva, Switzerland, 2010.
4. Ompad, D.C.; Galea, S.V.D. Urban Health Systems: Overview. *Int. Encycl. Public Health* **2008**, *6*, 463–470.
5. Sclar, E.D.; Volavka-Close, N. Urban Health: An Overview. *Encycl. Environ. Health* **2011**, 556–564. [CrossRef]
6. Mouratidis, K. Urban planning and quality of life: A review of pathways linking the built environment to subjective well-being. *Cities* **2021**, *115*, 103229. [CrossRef]
7. Kahn, M.E.; Lozano-Gracia, N.; Soppelsa, M.E. Pollution's role in reducing urban quality of life in the developing world. *J. Econ. Surv.* **2021**, *35*, 330–347. [CrossRef]
8. Aletta, F.; Oberman, T.; Mitchell, A.; Erfanian, M.; Lionello, M.; Kachlicka, M.; Kang, J. Associations between soundscape experience and self-reported wellbeing in open public urban spaces: A field study. *Lancet* **2019**, *394*, S17. [CrossRef]
9. Tong, H.; Kang, J. Relationship between noise complaints and urban density across cities of different levels of density: A crowd-sourced big data analysis. *Lancet* **2021**, *398*, S86. [CrossRef]
10. Chu, Y.-T.; Li, D.; Chang, P.-J. Effects of Urban Park Quality, Environmental Perception, and Leisure Activity on Well-Being among the Older Population. *Int. J. Environ. Res. Public Health* **2021**, *18*, 11402. [CrossRef]
11. Capolongo, S.; Rebecchi, A.; Buffoli, M.; Appolloni, L.; Signorelli, C.; Fara, G.M.; D'Alessandro, D. COVID-19 and Cities: From Urban Health strategies to the pandemic challenge. A Decalogue of Public Health opportunities. *Acta Biomed.* **2020**, *91*, 13–22. [CrossRef]
12. Gabrys, J. Planetary health in practice: Sensing air pollution and transforming urban environments. *Humanit. Soc. Sci. Commun.* **2020**, *7*, 35. [CrossRef]
13. Bini, S.A. Artificial Intelligence, Machine Learning, Deep Learning, and Cognitive Computing: What Do These Terms Mean and How Will They Impact Health Care? *J. Arthroplast.* **2018**, *33*, 2358–2361. [CrossRef] [PubMed]
14. Helm, J.M.; Swiergosz, A.M.; Haeberle, H.S.; Karnuta, J.M.; Schaffer, J.L.; Krebs, V.E.; Spitzer, A.I.; Ramkumar, P.N. Machine Learning and Artificial Intelligence: Definitions, Applications, and Future Directions. *Curr. Rev. Musculoskelet. Med.* **2020**, *13*, 69–76. [CrossRef] [PubMed]
15. Mbunge, E.; Muchemwa, B.; Jiyane, S.; Batani, J. Sensors and healthcare 5.0: Transformative shift in virtual care through emerging digital health technologies. *Glob. Health J.* **2021**, *5*, 169–177. [CrossRef]
16. Hussain, I.; Park, S.J. Big-ECG: Cardiographic Predictive Cyber-Physical System for Stroke Management. *IEEE Access* **2021**, *9*, 123146–123164. [CrossRef]
17. Hussain, I.; Park, S.J. HealthSOS: Real-Time Health Monitoring System for Stroke Prognostics. *IEEE Access* **2020**, *8*, 213574–213586. [CrossRef]
18. Jiang, F.; Jiang, Y.; Zhi, H.; Dong, Y.; Li, H.; Ma, S.; Wang, Y.; Dong, Q.; Shen, H.; Wang, Y. Artificial intelligence in healthcare: Past, present and future. *Stroke Vasc. Neurol.* **2017**, *2*, 230–243. [CrossRef]
19. McKinsey & Company. *Smart Cities: Digital Solutions for a More Livable Future*; McKinsey & Company: Seoul, Korea, 2018.
20. Jain, G.; Espey, J. Lessons from nine urban areas using data to drive local sustainable development. *NPJ Urban Sustain.* **2022**, *2*, 7. [CrossRef]
21. Buttazzoni, A.; Veenhof, M.; Minaker, M.L. Smart City and High-Tech Urban Interventions Targeting Human Health: An Equity-Focused Systematic Review. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2325. [CrossRef]
22. Arksey, H.; O'Malley, L. Scoping studies: Towards a methodological framework. *Int. J. Soc. Res. Methodol.* **2005**, *8*, 19–32. [CrossRef]
23. Peters, M.D.J.; Godfrey, C.M.; Khalil, H.; McInerney, P.; Parker, D.; Soares, C.B. Guidance for conducting systematic scoping reviews. *Int. J. Evid. Based Healthc.* **2015**, *13*, 141–146. [CrossRef]
24. Ronquillo, Y.; Meyers, A.; Scott, J.K. *Digital Health*; StatPearls: Orlando, FL, USA, 2022.
25. Pala, D.; Caldarone, A.A.; Franzini, M.; Malovini, A.; Larizza, C.; Casella, V.; Bellazzi, R. Deep Learning to Unveil Correlations between Urban Landscape and Population Health †. *Sensors* **2020**, *20*, 2105. [CrossRef] [PubMed]
26. Candelieri, A.; Archetti, F.; Giordani, I.; Arosio, G.; Sormani, R. Smart cities management by integrating sensors, models and user generated contents. *WIT Trans. Ecol. Environ.* **2013**, *179*, 719–730. [CrossRef]

27. Bravo, Y.; Ferrer, J.; Luque, G.; Alba, E. Smart mobility by optimizing the traffic lights: A new tool for traffic control centers. In *International Conference on Smart Cities*; Springer: Cham, Switzerland, 2016. [CrossRef]
28. Alhussein, M. Monitoring Parkinson's Disease in Smart Cities. *IEEE Access* **2017**, *5*, 19835–19841. [CrossRef]
29. Mora, H.; Gilart-Iglesias, V.; Hoyo, R.P.-D.; Andújar-Montoya, M.D. A Comprehensive System for Monitoring Urban Accessibility in Smart Cities. *Sensors* **2017**, *17*, 1834. [CrossRef] [PubMed]
30. Mihăiţă, A.S.; Dupont, L.; Camargo, M. Multi-objective traffic signal optimization using 3D mesoscopic simulation and evolutionary algorithms. *Simul. Model. Pract. Theory* **2018**, *86*, 120–138. [CrossRef]
31. Zaheer, T.; Malik, A.W.; Rahman, A.U.; Zahir, A.; Fraz, M.M. A vehicular network–based intelligent transport system for smart cities. *Int. J. Distrib. Sens. Netw.* **2019**, *15*, 845. [CrossRef]
32. Bardhan, R.; Debnath, R.; Gama, J.; Vijay, U. REST framework: A modelling approach towards cooling energy stress mitigation plans for future cities in warming Global South. *Sustain. Cities Soc.* **2020**, *61*, 102315. [CrossRef]
33. Jia, J.; Wu, X. A Multidimensional Assessment Model Using RE–3DSG Sensors on Net ES and GVR for Sustainable and Smart Cities. *Sensors* **2020**, *20*, 1259. [CrossRef]
34. Morris, E.; Liu, X.; Manwar, A.; Zang, D.Y.; Evans, G.; Brook, J.; Rousseau, B.; Clark, C.; MacIsaac, J. Application Of Distributed Urban Sensor Networks For Actionable Air Quality Data. *ISPRS Ann. Photogramm. Remote Sens. Spat. Inf. Sci.* **2020**, *VI-4/W2-20*, 119–126. [CrossRef]
35. Nagarajan, S.M.; Deverajan, G.G.; Chatterjee, P.; Alnumay, W.; Ghosh, U. Effective task scheduling algorithm with deep learning for Internet of Health Things (IoHT) in sustainable smart cities. *Sustain. Cities Soc.* **2021**, *71*, 102945. [CrossRef]
36. Valinejadshoubi, M.; Moselhi, O.; Bagchi, A.; Salem, A. Development of an IoT and BIM-based automated alert system for thermal comfort monitoring in buildings. *Sustain. Cities Soc.* **2020**, *66*, 102602. [CrossRef]
37. Junior, C.M.; Ribeiro, D.M.N.M.; Viana, A.B. NPublic Health in Times of Crisis: An Overlooked Variable in City Management Theories? *Sustain. Cities Soc.* **2021**, *66*, 102671.
38. Chigbu, U.E.; Onyebueke, V.U. The COVID-19 pandemic in informal settlements: (Re)considering urban planning interventions. *Town Plan. Rev.* **2021**, *92*, 115–121. [CrossRef]
39. Carmichael, L.; Prestwood, E.; Marsh, R.; Ige, J.; Williams, B.; Pilkington, P.; Michalec, A. Healthy Buildings for a Healthy City: Is the Public Health Evidence Base Informing Current Building Policies? *Sci. Total Environ.* **2020**, *719*, 137146. [CrossRef]
40. UN. 68% of the World Population Projected to Live in Urban Areas by 2050, Says UN. Available online: https://www.un.org/sw/desa/68-world-population-projected-live-urban-areas-2050-says-un (accessed on 20 January 2022).
41. WHO. *Ethics and Governance of Artificial Intelligence for Health*; WHO: Cham, Switzerland, 2021.
42. Singh, J.A. Artificial Intelligence and global health: Opportunities and challenges. *Emerg. Top. Life Sci.* **2019**, *3*, 741–746. [CrossRef]
43. Sharma, M.; Joshi, S.; Kannan, D.; Govindan, K.; Singh, R.; Purohit, H.C. Internet of Things (IoT) adoption barriers of smart cities' waste management: An Indian context. *J. Clean. Prod.* **2020**, *270*, 122047. [CrossRef]
44. Marten, R.; Yangchen, S.; Campbell-Lendrum, D.; Prats, E.V.; Neira, M.P.; Ghaffar, A. Climate change: An urgent priority for health policy and systems research. *Health Policy Plan.* **2021**, *36*, 218–220. [CrossRef]
45. Murray, V.; Chadborn, T. Climate change adaptation and societal transformation: What are the public health challenges? In *Climate Adaptation Modelling*; Springer: Cham, Switzerland, 2022; pp. 195–204. [CrossRef]
46. Thompson, J.; Stevenson, M.; Wijnands, J.S.; Nice, K.A.; Aschwanden, G.D.; Silver, J.; Nieuwenhuijsen, M.; Rayner, P.; Schofield, R.; Hariharan, R.; et al. A global analysis of urban design types and road transport injury: An image processing study. *Lancet Planet. Heal.* **2020**, *4*, e32–e42. [CrossRef]
47. Ramirez-Rubio, O.; Daher, C.; Fanjul, G.; Gascon, M.; Mueller, N.; Pajín, L.; Plasencia, A.; Rojas-Rueda, D.; Thondoo, M.; Nieuwenhuijsen, M.J. Urban health: An example of a "health in all policies" approach in the context of SDGs implementation. *Glob. Health* **2019**, *15*, 87. [CrossRef]