

# What evidence is available to translate into planning strategies for healthy higher density living?

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# What Evidence is Available to Translate into Planning Strategies for Healthy Higher Density Living?


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An evidence review undertaken as part of the Healthy Higher Density Living collaborative research project involving the University of Technology, Sydney, University of Sydney, University of New South Wales, and conducted in partnership with Landcom.

## Context of this Evidence Review


les, and in partnership with Landcom, New South Wales. The project seeks to advance knowledge of ways to plan higher density precinct developments to improve health by enabling industry to identify how health and wellbeing can be integrated into higher density precinct development policies and practice.

## Acknowledgements

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## Disclaimer

The authors have used all due care and skill to ensure the material is accurate as at the date of this report, however, UTS, UNSW, University of Sydney, Landcom, and the authors do not accept any responsibility for any losses that may arise by anyone relying upon its contents.

The findings outlined in the reports executive summary are to be read in the context of the entire report and its appendices.

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## List of Key Terms and Definitions

| | |
|---|---|
| Built Environment | Refers to elements of the physical environment situated in space that have been modified into buildings and infrastructure by people for functional use (Macaulay et al., 2011, in Haigh et al. 2011: 9) |
| Co-benefits | The term is used widely in the climate literature to describe primary or secondary integrated benefits |
| Density | Definitions vary and there is no consensus on which variant is most appropriate. However, it is used as a quantitative or qualitative measure of a particular activity or a geographic area |
| Determinant of Health | Influencer of health outcomes and includes factors such as access to safety or access to open spaces |
| ERA 2015 | Abbreviation for *Excellence in Research Australia* 2015, published by the Australian Research Council |
| Global Health | An area of study that focuses on the health of populations and prioritises improving health for all people worldwide |
| HHD | Healthy Higher Density. Used as an abbreviation for the Healthy Higher Density Living research project |
| Higher Density | There is no consensus on what constitutes a higher density Environment; however, the term can be used as a quantitative or qualitative measurement of space and is most commonly used to refer to refer to a heavily populated area or area characterised by high rise apartments that stand in contrast to the low rise dwellings that characterise low density environments |
| Interdisciplinary | Interdisciplinary studies and activities involve the combining of two or more academic disciplines into one activity |
| Inter-institutional | Activities that take place between different institutions |
| Land Use | Refers to location and type of activity within a geographic area, such as residential, commercial or recreational |
| Liveability | A term used to describe factors associated with overall quality of life |
| Multidisciplinary | A study or activity that involves combines several academic disciplines |

| | |
|---|---|
| Place | Refers to the historical and social (community) relationships that exist within an area or space |
| Planetary Health | Conceptual framework of health that frames the health of human civilisation on the state of the natural systems upon which it depends (see McMichael et al., 2009) |
| Planning Strategies | Refers to a range of activities involving the development of plans, tools and actions by planning professionals |
| Socio-Ecological Determinants of Health | A coherent system of physical and social environmental factors that interact. The term is used as a conceptual framework for understanding the links between elements of a social system (factors) and the physical environment within this system. |
| Space | Physical nature of an area and infrastructure available |
| Transdisciplinary | Transdisciplinary research or activity involves researchers from multiple disciplines and people from multiple institutions to solve a problem in way that takes a shared approach to defining and resolving the problems |
| Urban Form | Refers to the quality of the built environment and related to the density and use of land within urban areas |

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# Executive Summary

This document provides the findings of a systematic literature review of 141 academic journal articles in response to the question:

***What Evidence is Available to Translate into Planning Strategies for Healthy Higher Density Living?***

## Background:

This literature review was undertaken as part of the *Healthy Higher Density Living: Translating Evidence to Support Planning Strategies for Healthy Higher Density Living* (HHDL) research project, which seeks to advance knowledge of ways to plan for creating healthier higher density urban precinct developments by enabling industry to identify how health and wellbeing can be integrated into planning policy and practice.

This literature review forms the second of two reviews of the multi-disciplinary academic literature that focuses on health and density in the urban planning context. This report will be followed by a review of government, industry and policy literature, which was not included within the scope of this study, and which will focus on two New South Wales higher density urban developments that were chosen as case study sites for the Healthy Higher Density Living research project – Victoria Park and Green Square

## Aims and purpose:

The aim of this review is to provide a detailed overview of the types of evidence discussed within the existing body of academic scholarship focusing on health and planning for higher density living. This review focused on answering the question: ***What Evidence is Available to Translate into Planning Strategies for Healthy Higher Density Living?***

This question was broken down into four sub-level questions in order to fully answer the question:

1. *What is understood by the term health evidence?*
2. *What evidence is being used in the literature to link health to higher density living?*
3. *What types of evidence are currently translated into planning strategies for healthy higher density living?*
4. *What types of evidence are proposed for translation into planning strategies for healthy higher density living?*

The purpose of this literature review is to inform the research project by providing recommendations on how health evidence can be applied to the development of planning strategies for healthy higher density, and by providing suggestions about how these recommendations will be actioned within the context of the case study sites and the research project plan.

## Methods:

A combined systematic and narrative content-analysis inductive approach was used to conduct the review. A total of 141 papers were identified as relevant for the purposes of the

study. The 141 relevant articles were sourced from a broad range of journals, which evidences the transdisciplinary nature of the research themes. The journals that the articles were sourced from included multidisciplinary journals and journals pertaining to a wide variety of diverse academic disciplines, including: Urban and Regional Planning, Human Geography, Public Health and Health Services, Engineering, Environmental Engineering, Chemical Science, Sociology, Environmental Science, Design and Management Studies, Medicine and Health, Sociology, Sports Science, Pediatric Studies, and other studies in Human Sciences.

## Summary of Findings:

### What is understood by the term health evidence?

The findings reveal considerable differences in understanding of the term health evidence. These differences depend upon which of the theoretical perspectives of health – Global Public and Population Health, Social-Ecological Determinants of Health, and Planetary Health – which each article is framed upon.

Research underpinned by approaches characteristic of traditional Global Public and Population Health are primarily concerned with individual health issues, specifically infectious disease, child health, and more recently, the growth of chronic disease in the developed world context (Beaglehole and Bonita, 2010). The research is characterised by: a predominant biomedical understanding of what constitutes human health outcomes in relation to the built environment context (Beaglehole and Bonita, ibid). Social-Ecological Determinants of Health perspectives differ from traditional Global Public and Population Health-focused approaches and are characterised by their emphasis on the significance of the inter-relationship between social and environmental determinants of health (Atkinson and Joyce, 2011; Beresford, 2002; Crommelin et al., 2017), and the interrelationship between social, economic, cultural and political factors in influencing health outcomes (Graham and White, 2016; Kjellstrom and Mercado, 2008). The Planetary Health perspective recognises that social factors are the key anthropogenic drivers of global climate change and focus on both human and environmental health and the complex, multi-directional relationships between human health, environmental health and the built environment; and the health threats associated with anthropogenic climate change (Acunzo et al., 2018; Black et al., 2015; Guitton, 2017; Janko et al., 2018).

While articles grouped within the Global Public and Population Health domain focus largely on data pertaining to human health outcomes and behaviours within the context of the urban environment, articles within the Social-Ecological Determinants of Health domain focus more on human health outcomes and behaviours in relation to key features of the built environment. In contrast, articles embedded within Planetary Health give an equal predominant focus to both human and environmental health outcomes and their relationship to the built environment. Articles framed within each of the three theoretical health domains also differ considerably in terms of their use of empirical data in relation to the development of theory, with articles in Global Public and Population Health mostly utilising deductive approaches to scientific inquiry, and with articles framed upon a Social-Ecological Determinants and Planetary Health perspective tending to adopt both deductive and inductive approaches. Articles framed upon a Global Public and Population Health perspective place more emphasis on the generalisability of research findings for the regional and global levels, while articles grouped within the Social-Ecological Determinants placing greater emphasis on

case studies and the importance of determinants of health within specific local contexts. Planetary Health-focused articles adopt a multi-scale approach, highlighting the importance of local level health evidence for impact at the wider global and planetary health scales.

**Recommendations:**

Given the observable differences between articles embedded upon each of the different theoretical domains of health as to what is considered to amount to ‘health evidence’, as well as the different ways that this evidence can be utilized, the following recommendations for the HHD project can be made:

- To examine how health evidence has been understood within the development of Victoria Park and Green Square case study sites by both health and planning professionals who were involved in the development;

- To explore through discussions with senior academics from a wide range of academic disciplines with an interest in urban health and planning how health evidence has been understood within each academic discipline and in relation to healthy planning in order to advance new, transdisciplinary understandings of health evidence for mobilisation in research and practice for improving human and planetary health outcomes.

**Actions:**

The following actions will be undertaken to develop these recommendations within the scope of the project:

• To undertake a review of government, industry and policy literature focusing on health in higher density urban development within the New South Wales context to explore how health evidence has been understood within planning policy documents and to examine if this understanding varies across different institutions and whether it has changed over time;

• To examine government, industry and policy documents pertaining to the development of Victoria Park and Green Square Town Centre to find out how health evidence has been understood within the development of two New South Wales local case study site areas;

• Through interviews and discussions with planning professionals involved in the development of Victoria Park and Green Square, identify and explore how planning professionals understand and apply the term ‘health evidence; and analyse how this aligns with the different theoretical conceptualizations of health found in the academic literature;

• Discuss with members of the project team how health evidence has been understood within the context of the different academic disciplines and work together to advance new transdisciplinary approaches to solving human health dilemmas by thinking about how different theoretical understandings of health evidence can be better aligned in both academic and applied-action research.

**What evidence is being used in the literature to link health to higher density living?**

While only one article provides a specific definition of healthy higher density (Giles-Corti et al., 2012), 26 articles present evidence of attributes of the built environment associated with indicators of positive or negative health outcomes to link health indirectly to the higher density built environment. The limited number of articles defining density or linking health to conceptualisations of higher density suggests that little attention has been given to defining what exactly a healthy higher density environment consists of. Articles that link health to higher density through evidence of features of the built environment and evidence of health outcomes embedded upon each theoretical perspective of health all draw on evidence from reviewing existing academic literature or by drawing on secondary empirical data. However, the most commonly utilised type of evidence found in the Global Public and Population health articles used to link higher density to health was epidemiological cross-sectional human health research data. This type of evidence was also used in the articles embedded upon a Socio-Ecological Determinants of Health perspective, however evidence from reviews of secondary empirical data presented within existing academic literature was the most commonly utilised evidence within articles within this category. In contrast, the most common type of evidence used to link health to features of the higher density built environment in articles embedded upon a Planetary Health perspective was research data from modelling and simulation techniques.

Greater emphasis is placed on qualitative forms of evidence in articles embedded within a Social-Ecological Determinants perspective compared to articles framed upon a Global Public and Population Health perspective (i.e. qualitative open-ended questionnaires, reviews of policy documents, resident self-reported data, site observations, evidence from interviews, and recorded video diaries). However, while articles grouped within this perspective utilised qualitative evidence, a greater number of articles within this same category drew upon quantifiable and measurable forms of evidence, including demographic health statistics, suicide statistics, crime statistics, evidence of walking behavior, and spatial GIS data rather than qualitative forms of evidence. Articles located with planetary health focus on both quantitative and qualitative forms of evidence, including narratives of social collective memories, soil sampling data, evidence from mapping, modeling and simulation techniques, energy use statistics, policy intervention review, and measurements of indoor and outdoor temperature. Articles located within a Global Public and Population Health perspective primarily focus on quantifiable, measureable forms of evidence.

**Recommendations:**

- To develop a comprehensive understanding of a healthy higher density living environments that aligns existing quantitative and qualitative indicators and descriptors of the built environment to human and environmental health as holistically conceptualised by utilising and aligning the different foci of health emphasised by each of the different theoretical understandings of health highlighted in the literature;

- To identify which specific features of the built environment are linked to evidence of positive health outcomes in higher density living environments and consider how these may be applied within the specific New South Wales context in future planning strategy developments.

- To examine planning documents for the Victoria Park and Green Square Town Centre case study sites to identify what types of health evidence planning professionals have drawn on and whether this changed over time in order to link health to higher density in practice;

- To compare and contrast the types of evidence used in the case study site literature with the types of evidence discussed in the literature and consider what other types of evidence from the articles could potentially be applied at the case study sites to link health to the higher density built environment;

- To identify current gaps and evidence in the academic evidence base and consider how future studies may involve collection of new types of health evidence. For example, at present, little qualitative evidence is available. In addition, with the majority of existing articles drawing on secondary quantitative research data, opportunities for conducting primary data collection on different aspects of human and environmental health should be identified for future research projects and research funding applications.

**Actions:**

- To undertake a transdisciplinary, collaborative problem-solving workshop with academics from a wide range of disciplines and professionals from a range of government and private sector organisations to develop an integrated definition of a healthy higher density living environment and to identify specific indicators of health evidence appropriate to the higher density urban environment for mobilisation in a project toolkit used to inform future planning strategy developments

- To undertake a context study of evidence obtained from Landcom and City of Sydney planning documents for the Victoria Park and Green Square case study sites to see how health has been linked higher density within specific local case study sites;

- To develop a conceptual framework for linking health evidence and attributes to higher density built environment drawing on evidence from all three theoretical domains of health;

- To critically analyse existing uses of health evidence at the project site by comparing these to the types of health evidence discussed in the literature and used to form the conceptual framework as part of an evidence mapping exercise;

- To conduct interviews and workshop activities with health professionals and planning professionals to find out what types of health evidence have been prioritised in planning and the reasons for this, as well as to discuss what other types of evidence could be considered for linking health to the higher density built environment in future development strategies;

- To discuss with health experts from the Project Reference Group what types of data sources, existing epidemiological datasets and other types of datasets are available for the NSW and for the city of Sydney contexts, which the project could draw upon and find out if it would be possible to access and examine these datasets;

- To work collaboratively with members of the academic project team to identify opportunities for future research and develop research proposals and funding applications accordingly.

**What types of evidence are currently translated into planning strategies for healthy higher density living?**

These findings from this review of the literature indicate that very little evidence is currently available that details how health evidence has been incorporated into planning practice to date. The majority of the 141 documents reviewed did not discuss how different types of evidence have been already translated into planning strategies for improving health outcomes in the higher density urban built environment. Instead, the majority of articles drew on health evidence to critique existing approaches to planning and existing higher density urban developments. However, the actual implementation of health evidence in planning development - transferred from idea to enactment ('translation') - was not reported. This suggests that although health evidence has been deployed in the analysis of higher density urban planning, at present there is a paucity of evidence being used or translated prior to the actual construction of higher density developments or in the planning stages of development. This strongly indicates that there is a need to improve integration of research and evidence at the planning stages of development.

**Recommendations:**

- Given the limited research examining how health evidence has been integrated into planning development, this suggests a need for further case study research into how health evidence has been implemented in order to advance understandings of how health evidence can mobilised in planning policy and practice to improve health-related outcomes. On the basis of this, one recommendation would be to examine what types of health evidence have been incorporated into or used to influence planning developments at the case study sites and how this has/may have differed over time;

- To consider how the types of evidence that may have been implemented at the case study sites reflects the foci of the different theoretical domains of health to showcase how different understandings of health in planning may have influenced current health outcomes and the current challenges to health that are evident in higher density urban living environments today;

- To draw upon criticisms outlined in the literature about the lack of integration between planning and health experts at the early stages of planning developments by establishing a trans-disciplinary and inter-institutional focus group to collaborate on devising new strategies for the implementation of health evidence in planning policy and practice at the development stage;

- The lack of evidence in the articles relating to the actual implementation of health evidence in practice presents opportunities for further research, both in terms of evaluating existing strategies, as well as for devising new developments. Another recommendation would therefore be to work with members of the academic project team to identify and discuss opportunities for future research projects and grant applications.

- Given the lack of evidence focusing on evidence translation for the higher density urban context, consider how health evidence has been translated into urban planning strategies more broadly and for other densities and work with health and planning academics and professionals to discuss whether these strategies: a) can be appropriated for a higher density context, and b) what considerations would need to be made to apply them within a high density context.

**Actions:**

- Identify and analyse what health evidence has been implemented into existing policy and practice at the case study sites and in the New South Wales context more broadly by reviewing Landcom and relevant government documents pertaining to Green Square Town Centre and Victoria Park;

- Through interviews and discussions with planning professionals find out more about what health evidence was used to develop and/or influence planning decision-making and to gather their opinions about: a) the effectiveness of interaction levels between health and planning professionals in the planning development field to date, b) what evidence was not included, but which they think should have been included, c) what was deliberately excluded and why, and d) at what stages do they think different types of evidence can potentially be included;

- To conduct interviews and discussions with health professionals to gather their opinions about a) the effectiveness of interaction levels between health and planning professionals in the planning development field to date, b) what evidence was not included, but which they think should have been included, and c) at what stages do they think different types of evidence can be included;

- To compare the findings from the discussions and interviews with the two groups of professionals to identify similarities and differences in ideas for improving the integration of health evidence in planning strategies; and work with professionals from both groups to devise a framework for implementation of health evidence in future planning policy and practice specific to the higher density context;

- To publish 4-6 collaborative academic journal articles over the next year in order to advance knowledge in this field of academic research;

- To set up a workshop meeting with all members of the academic project team to devise future research projects and develop research grant and funding applications;

- To consult health and planning experts and work with all members of the academic project team to find out more about how health evidence has been mobilised in other planning development contexts and for other densities and consider how these strategies, approaches and techniques may be appropriated for application in planning strategies for higher density contexts.

**What types of health evidence are proposed for translation into planning strategies for healthy higher density living?**

A number of articles grouped within each of the three theoretical domains of health suggest how health evidence may be incorporated into planning policy and practice. Articles grouped within the Global Public and Population Health perspective and the Social-Ecological Determinants of Health perspective both stress the need to base planning developments upon evidence of chronic disease morbidity and mortality and existing health inequity in order to design solutions appropriate for reducing identified risks and inequities. However, articles embedded upon a Social-Ecological Determinants perspective place greater emphasis on the need to include evidence over time and at multiple scales. Both domains include articles that propose the need to include evidence linking health to the design of the built environment. Articles grouped within Planetary Health recommend incorporation of evidence of both the human and environmental health impacts associated with anthropogenic climate change in planning strategies, as well as evidence of the known challenges and barriers to addressing both the causes and impacts of anthropogenic climate change through urban planning policy and practice.

**Recommendations:**

- Given the difference between the numbers of articles discussing what types of evidence should be included in planning strategy development versus what has actually already been implemented in existing planning strategy, one recommendation would be to examine to what extent suggestions made by articles framed upon each of the three domains of health have actually been implemented at the case study site;

- From this, identify gaps in terms of the application of proposed types of health evidence in planning strategies at the case study site;

- To identify appropriate suggestions which have not already been implemented at the case study sites for possible embedding within the proposed toolkit of recommendations to be produced as a final outcome of the HHD project;

- To test and evaluate the implementation of these suggestions within the specific case study site context;

- To devise student projects and course assignments to test and evaluate the implementation of these suggestions;

- To gather feedback from the testing phase and revise suggestions and implementations accordingly;

- To record the challenges, barriers and limitations to implementation;

- To contribute to the scholarship of health and the built environment by writing collaborative journal articles that look at: a) how suggestions for implementing evidence within planning have been included at the case study site, and b) how new strategies were tested and implemented at the case study site, and c) what the challenges faced translating and implemented health evidence into planning strategies at the case study site were;

- To work collaboratively with health and planning professionals and other academic experts from a wide range of scholarly disciplines to produce the toolkit for guidance

on decision-making for embedding health evidence in planning strategies for higher density development.

**Actions:**

- To plan and conduct interviews with planning professionals to examine what suggestions have already been included in planning development at the case study sites;

- To review existing planning documentation for the case study site context to identify what suggestions have been included and to identify areas where suggestions could be applied to improve future planning developments;

- To undertake collaborative workshops with planning and health professionals and academic experts from a wider variety of disciplines to explore how suggestions can be implemented;

- To embed strategy testing within existing undergraduate and postgraduate student coursework and assessment and to development new postgraduate and undergraduate modules that the strategy testing phase could link to;

- To contact the course coordinators of the relevant existing modules to discuss how student projects can align with the proposed project activities;

- To create a collaborative working document that all project team members can contribute to in order to record evidence of barriers, challenges and limitations to translating evidence at the project case study sites;

- To hold academic writing workshops as part of the project team meetings to identify the focus of academic articles for publication in high ranking academic journals and to work collaboratively with project team members to co-author the journal articles;

- To identify dates for workshop meetings focused on production of the guidance toolkit.

## Conclusion:

The recommendations and points for action developed from the findings of this review contribute to the development of the *Healthy Higher Density Living* research project, wherein the project will develop and implement a framework designed to promote strategies for improving health in higher density urban development. Development of the recommendations derived from this research into specific tangible actions should not only help to develop new understandings of how health evidence can be effectively translated into planning strategy developments that can then be used to great a Guidance Toolkit for implementing health-evidence and research in higher density planning strategy development, but will also help to create a collaborative inter-institutional, action-oriented transdisciplinary learning partnership between researchers and professionals from a wide range of disciplines and institutions with interests in supporting innovation in healthy planning for higher density urban development.

# 1.0: Introduction

## 1.1: Background

This literature review is the second in a series of reports which form part of the *Healthy Higher Density Living: Translating evidence to support planning strategies for healthier higher density living* project (HHD Project). The aims of the overarching project are to:

a). Understand how health evidence can be used to plan higher density precinct developments to enhance health, so that;

b). Planning strategies can be developed that apply health evidence within planning policy and practice for higher density development.

This two-year collaborative research project is being carried out by a team of urban planning and public health scholars at the University of Technology Sydney ("UTS"), the University of Sydney ("USyd"), and the University of NSW ("UNSW"). These academic institutions have partnered with Landcom – a state development agency in New South Wales ("NSW"), Australia ("Landcom"). The Project has its focus on two recently constructed higher density sites in inner-urban Sydney (Green Square Town Centre and Victoria Park).

At the outset of the Project, a literature review was undertaken to understand what is currently meant by the concept of healthy higher density, and planning for healthy higher density (Connon et al., 2018). This was a narrative content analysis of 141 academic journal papers related to health and the higher density urban environment. It provided a comprehensive insight into what is meant by the term healthy higher density living, and developed a conceptual framework for the various theoretical understandings of health in relation to higher density living. This conceptual framework is known as the theoretical perspectives of health. The review reported in this document supplements this previous initial review by providing a specific focus on the way evidence is and can be translated for planning for healthy higher density living. The theoretical perspectives of health developed in the first review are used as a structure to provide consistency of understanding and a way to order a vast body of literature.

## 1.2: Aims and Purpose of the Review

This Evidence Review provides an overview of what is understood by the term ‘evidence’, what types of evidence is used in scholarly research to define and link health to higher density urban development, and what evidence has: a) been translated into planning strategies and, b) what could be proposed for translation into future planning strategies. It aims to inform the overarching HHD project by providing succinct recommendations on how health evidence can be best used to influence planning strategy development for improving health in higher density living environments.

In light of the aim outlined above, this Evidence Review is guided by a key research question:

*What Evidence is Available to Translate into Planning Strategies for Healthy Higher Density Living?*

The following sub-questions are used to explore first, the concept of health evidence, and second, the ways evidence is and can be translated to planning strategies:

1. *What is understood by the term ‘health evidence’?*

2. *What evidence is being used in the literature to link health to higher density living?*

3. *What types of evidence are currently translated into planning strategies for healthy higher density living?*

4. *What types of evidence are proposed for translation into planning strategies for healthy higher density living?*

## 1.3: Structure of this Review

The Evidence Review is structured as follows:

- Methodology;
- Findings (structured against the five key questions above);
- Conclusion;
- References;
- Appendices.

## 1.4: An Important Note on the Terms 'Evidence', 'Evidence-Based Practice' and 'Translational Research'

It is important to note that evidence means different things to different people, professions and practices. It is a slippery concept which is noted to be 'highly contestable', 'socially constructed' and can reflect 'vested interests' (Krieger, 1992; Chan and Chan, 2000, in Davis and Parkin, 2015: 115; and Juntti et al., 2009, in Davis and Parkin, 2015: 116). Indeed, evidence is a 'value-based label attached to particular types of knowledge' which is political and reflects the 'perceptions' and 'priorities' of those in power (Nutley et al., 2007: 23, 25). Whilst evidence is used by a range of professions, including lawyers, medical staff and managers, what counts as evidence changes across professions and disciplines (Rychetnik and Wise, 2004: 248, in Davis and Parkin, 2015: 115). Nutley et al., (2007: 13) endorse a broader view of what constitutes evidence than merely academic research and clinical studies, to include evidence from a wide range of research methods, which they place alongside 'routine monitoring data, expert knowledge and information from stakeholder consultations'.

Within Public Health and Medicine, the term 'evidence-based practice' is often used to refer to the explicit inclusion of epistemological methods in decision-making (Parkhurst and Abeysinghe, 2016; Sackett, 2000). The use of evidence is considered by Public Health as highly significant for decision-making processes, and current approaches to the use of evidence can be regarded to be based upon the principles of Evidence-Based Medicine (Sackett, 2000; 2006). According to Evidence-Based Medicine, only the strongest types of health research evidence, such as the types of evidence stemming from meta-analyses, systematic reviews and randomized control trials, should be considered for forming recommendations for application in decision-making and practice (Parkhurst and

Abeysinghe, 2016). According to Evidence-Based Medicine, subjective and other forms of evidence make it less reliable owing to risks of bias, imprecision, and inconsistency (Schunemann et al., 2013). Objective forms of evidence that are large scale are considered to be even more reliable and high quality evidence can be determined according to confidence that can be attributed to the data in providing the true value (Balshem et al., 2011; Eddy 1990; Schunemann et al., 2013).

Like Public Health researchers and professionals, Urban Planning also recognises the value of the use of evidence in the design of guidelines and policies. With a wealth of recent health-based research examining the health of urban populations highlighting a number of challenges to human health that are characteristic of the 21st century urban environment in the developed world context (e.g. rise in chronic diseases such as diabetes and heart disease, as well as the threats posed to human health that result from anthropogenic climate change including risks of vector-borne disease and risks to life and well-being resulting from increasing intensity of environmental disasters such as earthquakes and floods), questions are now being asked as to how urban settlements can be better planned to promote health and well-being by creating the conditions for healthy behaviour, equitable communities and resilience to the health impacts associated with anthropogenic climate change (Barton et al., 2015; Harris, 2018). This requires urban planning researchers and professionals to gather evidence about how spatial place-making and design principles can be better orientated towards improving health (Lawrence, 2015; 2017), and an increase in research examining the links between health and urban planning has ensured scholars and professionals are increasingly knowledgeable about the features of the built environment that promote positive human health outcomes (Barton et al., 2015; Kent et al., 2017; Wheeler et al., 2011).

However, despite abundant available knowledge and research highlighting the significance of urban planning for improving health outcomes, it is currently not clear how health-related evidence obtained can be effectively translated and mobilised in planning policy and practice for higher density urban development (Kent et al., 2017; Harris et al., 2017), including ways to foster inter and transdisciplinary collaborations between the often disparate practices of health and urban planning. The translational approach, as a research paradigm, has emerged in recent years and is applicable to the issues faced by the health and urban planning scholarship and practice. It has an emphasis on understanding how evidence can be transferred effectively between a variety of contexts: between disciplines such as public

health (which include community health through to planetary health) and urban planning; from context to context; and from research to policy (Rychetnik, et al., 2012; Milat, et al., 2014; Nutbeam and Milat, 2017). This approach complements recent debates in urban planning on tensions between urban research and policy impact (Dai and de Vries, 2018; Gurran and Phibbs, 2017), including barriers to the integration of health and planning (Lowe et al., 2018).

Understanding how health-evidence can be translated and used to improve planning strategy developments forms the fundamental core of the HHD project. This Evidence Review therefore looks at how health-related evidence is understood, used to link health to urban planning in the higher density urban environment, translated into planning policy and practice, and proposed for translation into future planning developments in order to understand how health-related evidence can be advanced within future urban planning developments for creating the conditions that constitute healthy higher density living.

# 2.0: Methodology

This review followed Bryman's (2012) steps for conducting a systematic review. These steps are:

1. Defining the purpose and scope of the review;
1. Seeking out refereed journal articles relevant to the scope and purpose of the review ;
2. Assessing the relevance of each refereed journal article for each of the research questions;
3. Appraising the quality of the studies; and
4. Extracting the results and synthesising the findings.

The review was conducted in a systematic manner using a narrative and inductive approach (Snilsveit et al., 2012). This was considered to be most appropriate as it enabled adherence to the key principles of systematic reviewing, including transparent, comprehensive and systematic practices throughout the search, while simultaneously allowing for subjective evaluations of the literature to determine relevance, and enable dominant themes to be deduced (Snilsveit et al., 2012).

## 2.1: Defining the Scope of the Review

The purpose of the review was to ascertain the extent to which existing academic literature answered the five sub-level questions listed in the introduction. The review's scope is therefore limited to health and higher density in the developed world context only. Journal articles published in peer reviewed outlets presenting empirical research and case studies form the bulk of literature reviewed, however some relevant reports, commentaries, and opinion pieces are also included.

## 2.2: Seeking Out Relevant Literature

The search process, including the selection of databases and search terms, was undertaken between September 2018 and March 2019. It was a two-step process. First, a more traditional search of scholarly databases was performed. This was then complemented by a more purposeful-sampling approach.

For the first step, a total of 12 databases were selected to reflect the transdisciplinary nature and translational dimension of the research problem. These were:

1) Scopus (Social Science, Environment, Health, Planning);
2) Medline (Health and Medicine);
3) Science Direct (Environment, Health);
4) Sociological Abstracts (Social Science, Urban Studies);
5) Health Collection Database (Health, Medicine);
6) Web of Science (Health, Environment);
7) Wiley Journals Database (Planning, Urban Society, Architecture, Urban Planning, Social Science, Inter-institutional Research, Inter-disciplinary Research);
8) APAIS Health and Australian Public Affairs Database (Policy-relevant Research, Health, Public Health, Translational Research, Planning, Legislation);
9) ATRI Transport Database (Transport, Planning, Urban Planning);
10) Health and Society collection (Health, Social Science);
11) Humanities and Social Science Index (Social Science, Urban Planning, Design, Humanities);
12) Urban Studies (Social Science, Built Environment, Urban Planning, Urban Society, Transport Planning).

Given the transdisciplinary nature of the project, it was important to access a broad, multidisciplinary list of databases. As such, the list of databases used include those that focus on health and medicine, and others that focus on the social dimensions of health, particularly urban planning and transport. Databases with a focus on the environment and health were also included.

In searching the databases, five key themes were used to identify relevant conceptual domains:

- Higher density development

Higher Density Development was used as the primary focus of the research, with the following four themes cascading from this focus:

- Planning;
- Health;
- Environmental Sustainability;
- Methods (incorporating translational research).

Specific keywords were drawn up for each of these themes. These were:

- High Density Development;
- High Density Development and Planning and Health;
- High Density Development and Environmental Sustainability;
- High Density Development and Environmental Sustainability and Planning and Health;
- High Density Development and Methods; and
- High Density Development and Methods and Health and Planning

The specific focus on Higher Density within each thematic domain helped to limit the scope of the search. A second set of keywords were then drawn up to reflect thematic subdomains that did one or more of the following: 1) enabled specifying of the topic context and/or geographic area, e.g. ‘Urban’ and ‘Metropolitan’, 2) related to institutional or bureaucratic actions, processes and outcomes, e.g. ‘Research’, ‘Policy’, ‘Strategy’, ‘Tool’, ‘Legislation, or 3) referred to actions and processes relevant to individuals and/or groups, e.g. ‘Walking’, ‘Cycling’, and ‘Gardening’. Subdomain keywords could apply to one or more of the key domains. 119 subdomains were identified. A complete list of the domains and subdomains used to develop the keywords are listed in **Appendix 1 (Section 6.1)**.

The databases were divided between members of the project team for conducting the keyword searches. Databases were accessed via the University of Technology Sydney and The University of Sydney online libraries. The search was conducted using the broad domain keywords and using each of the subdomain keywords with each of the broad domain keywords: (“High density development” OR “High density development health and planning” OR “High density development environmental sustainability” OR “High density development environmental sustainability planning and health” OR “High density development methods planning and health” OR “High density development methods”) AND (“Australia”, “Metropolitan”, “Policy”) (as examples of the 119 subdomain keywords).

A total of 714 keyword searches were performed for each of the remaining 11 databases ("6 domains" AND "119 subdomains"). The total number of keyword searches completed was 7845. Each database was searched using the same list of search terms. Tables were drawn up to record the number of hits for each of the searches per domain and subdomain for each individual database. These are included in **Appendix 2 (Section 6.2).** Keyword searches were saved and recorded in instances where databases permitted it possible to do so. The results indicated the spread of the literature in different topic areas.

## 2.3: Assessing the Relevance of Each Article and Appraising the Quality of the Articles

Articles identified using the method described above were first scanned to ensure relevance. This included checking for inclusion of key terms in the abstract, introduction and keywords, with any articles failing to include key terms in these components scanned to check if they addressed the topic but used other words to do so. Any remaining articles where the relevance remained uncertain was read for review and included or excluded based on this reading. Relevant articles were saved into a project Endnote database. Duplicates were removed.

A specific inclusion/exclusionary criteria was developed drawing on Weaver et al.,'s (2002) methodology for conducting a systematic review. Selection of articles for inclusion into the pool of relevant articles was made on the basis of:

1) Geographic context of the articles;
2) The extent and relevance of their focus on themes of a) health, b) environment, c) subsistence, d) education, e) human values, actions, beliefs and emotions, f) population, and g) governance;
3) The relevance of an article's a) methods and b) tools, within the context and scope of the *Healthy Higher Density Living* research project;
4) The year of publication and its relevance to the contemporary context and scope of the project.

Full details of the criteria that was applied to limit the inclusion pool to the articles most relevant for the purposes of the study are listed in **Table 1, Appendix 3 (Section 6.3).** Fifty three articles were selected for inclusion using this method.

Following the database search described above, several 'purposeful sampling' methods were used to identify other useful literature sources. First, a previously published report considered to be highly relevant to the Project (Giles-Corti et al., 2012) was reviewed, with relevant literature extracted and included in this Evidence Review using a 'Reverse snowball' (backwards snowball) method (Carlson et al., 2015; Kazmi 2013; Sayers, 2007). This was then followed by a more detailed search of the way this seminal report has been cited and used by other scholars. This involved conducting a citation search via Google Scholar to obtain a list of articles and reports that refer to the Giles-Corti et al., (2012) report. Thirty-five citations were listed. The abstracts and titles of these documents were then read to assess for relevance and inclusion. Twenty-six sources were added to this Evidence Review using this method. Second, the bibliographies of two other highly relevant publications were review - Easthope and Judd (2010) and Haigh et al. (2011). Each article referred to in these publications was checked for relevance and 45 sources were added to this Evidence Review using this method. The reference list of these 45 sources were then checked for relevance resulting in an addition 17 sources to this Evidence Review. In total, 88 sources were added to this Evidence Review using this purposeful sampling method.

Using this combination of systematic database and purposeful sampling, 141 articles in total were included in this Evidence Review.

## 2.4: Extracting and Synthesising the Results

Each article was initially coded against the aims and purpose of the first literature review (Connon et al., 2018). As the first report focused on answering two principal questions: 1) What is meant by healthy higher density living, and 2) How can planning strategies support healthy higher density living, and each article was coded according to the theoretical perspective of health that the article was framed upon. Three specific theoretical conceptualisations were identified from the sample literature. These were:

- Global, public and population health
- Social-ecological determinants of health
- Planetary health.

Research underpinned by approaches characteristic of traditional Global Public and Population Health are primarily concerned with individual health issues, specifically infectious disease, child health, and more recently, the growth of chronic disease in the developed world context (Beaglehole and Bonita, 2010). The research is characterised by: a predominantly biomedical understanding of what constitutes human health outcomes in relation to the built environment context; linear, one-directional deductive use of data pertaining to single health outcomes; and predominant focus on global rather than local governance for health (Beaglehole and Bonita, ibid). Social-Ecological Determinants of Health perspectives differ from traditional Global Public and Population Health-focused approaches and are characterised by their emphasis on: the significance of the inter-relationship between social and environmental determinants of health (Atkinson and Joyce, 2011; Beresford, 2002; Crommelin et al., 2017); the interrelationship between social, economic, cultural and political factors in influencing health outcomes (Graham and White, 2016; Kjellstrom and Mercado, 2008); emphasis on indirect as well as direct influencers of health; significant acknowledgement of the importance of the specific local context for influencing health outcomes; and focus on positive health outcomes, including mental wellness, human happiness, and quality of life, rather than solely concentrating on evidence of ill-health (Schulz and Northridge, 2006). In addition, they emphasise a probabilistic view of the influencers of health, place greater emphasis on the values that shape the relationship between vulnerability and resistance to disease, and raise more questions about for whom the built environment matters more or less and under what conditions is the health impact larger or smaller (Giles-Corti et al., 2013; Hernandez and Blaser, 2006). Understandings shaped by a Social-Ecological Determinants perspective also acknowledge the broad level influence of the natural and global ecosystem for influencing human health outcomes through their impact on the form of the local built environment context (Bambra et al. 2010; Watts et al., 2015), however they place less emphasis on the role of the natural environmental conditions on contributing to individual and population health outcomes than the more relational ecological approaches to health that characterises the Planetary Health perspective.

The Planetary Health perspective recognises that social factors are the key anthropogenic drivers of global climate change. These approaches to health are characterised by a focus on: both human and environmental health and the complex, multi-directional relationships between human health, environmental health and the built environment; emphasis on the importance of urban and greening and bluing for human and environmental sustainability; focus on enhancing the biodiversity of the supporting environment; non-linear use of descriptive data to discuss relationships between human, environmental and built environmental health factors; and emphasis on the health threats associated with anthropogenic climate change (Acunzo et al., 2018; Black et al., 2015; Guitton, 2017; Janko et al., 2018). In particular, they recognise that the ecological health of the planet is the core driver of the potential for human health (Grant et al., 2017). Tait (2018) argues that the approach is founded upon the principles of human ecology and political ecology and values that posit attunement to bio sensitivity, which refers to the idea that we live respectfully in tune with the natural world and other species and the ecosystem upon which our well-being depends. This approach recognises the primacy of nature and humans as part of nature, thus departing from the human-centric ideological underpinnings that characterise traditional global public health perspectives and social-environmental determinants of health perspectives (Girardet, 2015; Prescott and Logan, 2018). It approaches health from a perspective of wider cultural transformation: of transforming assumptions and beliefs about the taken-for-granted dominance of humans over nature (Lerner and Berg, 2017; Whitmee et al., 2015).

A total of 14 articles within the sample were grouped within the Global, Public and Population health category, 109 within the Social-Environmental determinants of health perspective category, and 20 within the Planetary health category (See **Table 2, Appendix 4, Section 6.4**). Two articles were given more than one code, and were therefore grouped within more than one category (see **Appendix 5, Section 6.5** for a list of documents by health domain). This is because they contained evidence and discussion focusing on both the Global Public and Population Health perspective and the Socio-Ecological Determinants perspectives.

Further, within each of the three health dimensions, subcategories were developed to produce a synthesis framework for thematically consolidating this broad and complex literature. For this, each article was given a set of secondary codes according to specific broad

types/categories of factors, attributes and characteristics identified as necessary for enhancing health in a high-density living environment (See Snilsveit et al., 2012: 420, for further information about constructing a framework synthesis approach). Details of these secondary codes under each of the health dimensions categories were as follows:

1. **Global, Public and Population Health**
    - Responsive to urbanisation challenges
    - Focus on improving physical health
    - Focus on improving mental health outcomes
    - Concentrates on long term human health outcomes

1. **Social-Environmental Determinants of Health**
    - Liveability
    - Focus on physical health outcomes
    - Focus on mental health outcomes and impacts
    - Health equity oriented

2. **Planetary Health (relational ecological approaches to health)**
    - Co-benefits approaches to human and environmental health
    - Holistic and complex understanding of the relationship between human physical and mental health
    - Climate change responsive
    - Promotes environmental sustainability in design of the built environment.

Articles grouped within each category were then scanned for specific attributes associated with health in higher density living contexts. A summary of the specific attributes pertaining to each of the sub-categories for each of the three theoretical domains of health, as well as details of the numbers of articles coded within each of the sub-categories for each theoretical domain of health is detailed in **Tables 3, 4 and 5** in **Appendix 6 (Section 6.6).**

Articles were coded again this time in relation to the second research question that was covered in the first literature review; in order to identify and extract information and ideas as to how health can be incorporated into planning strategies. Reading and assessing each article in relation to the second research question revealed that information relating to how health

can be incorporated into planning strategies can be broken down into two main categories: 1) suggestions for improving approaches to planning at the bureaucratic level, and 2) specific suggestions for action at the design and implementation level that can be undertaken to enhance healthy higher density living. Each article within each of the conceptual framework categories was therefore given one or two secondary codes: 1) Approaches to Planning at the Bureaucratic Level, and 2) Actions for Design and Implementation, depending on the type of suggestions made within each article. Articles were given more than one code if the evidence included in pertained to more than one category. A comparative summary of the suggestions made at: a) the bureaucratic level, and b) the design and action-intervention level, for each of the three theoretical health domains was drawn up in two tables (see **Tables 6 and 7 in Appendices 7 and 8, Sections 6.7 and 6.8**).

For the purposes of this evidence review, several additional steps were then taken that build on the findings reported in the previous literature review report (see Connon et al., 2018). These additional steps were undertaken in order to answer the main research question of this Evidence Review, 'What evidence may be translated into planning strategies for healthy higher density living, and its four associated sub-questions.

The first step involved:

> 1) Examination and inductive thematic coding of understandings of what constitutes health evidence for each article as grouped within each of the thematic sub-categories of the three wider theoretical domains of health

This enabled the first research question of the evidence review to be answered: *What is meant by the term 'health evidence'?*

The second step involved:

> 2) Identification and inductive coding of evidence used to: a) directly define healthy higher density living and b) the types of evidence used to directly and indirectly link health to the higher density urban built environment'.

This allowed the second research question to be answered: *What types of health evidence are being used in the literature to link health to higher density living?*

The next two steps involved:

> 3) Examination and inductive coding of the types of health evidence that has been deployed within existing planning strategies at both the bureaucratic and action-intervention levels for articles grouped within each of the three theoretical health domains.

And:

> 4) Identification and coding of what health evidence is proposed for translation into planning strategies at both the bureaucratic and action-intervention stages for articles grouped within each of the three theoretical health domains

This enabled a differentiation to be made between how health evidence is actually being utilised in planning strategies and what suggestions have been made to how it could be used in future planning strategies in order to answer the third and fourth research questions: *What types of evidence are currently translated into planning strategies for healthy higher density living? And, what types of evidence are being proposed for translation into planning strategies?*

The findings were then drawn to concluding discussion about their applicability in the development of future planning strategies within the Victoria Park and Green Square HHD project case study site context.

# 3.0: Findings

## 3.1: What is Meant by the Term ‘Health Evidence?

This part considers the various types of health evidence presented in the 141 articles included in this Evidence Review. It is organised according to the three broad conceptualisations of health, and the subdomains as previously explained in the methodology section.

### *3.1.1: Global public and population health*

Fourteen out of 141 articles reviewed fell into the theoretical domain “Global Public and Population Health”. While none of the fourteen articles provide a specific definition of the term ‘health evidence’, indications of what is meant by the term could be deciphered from examining how health evidence was used and understood within each article. According to these 14 articles, health evidence can be said to refer to the following:

- Empirical data pertaining to human health outcomes (14 out of 14 articles)
- Empirical Data pertaining to quantifiable, measureable indicators of acute and chronic disease and health behaviour (13 out of 14 articles)
- Predominantly deductive use of primary and secondary evidence in scientific inquiry (12 out of 14 articles)
- Empirical evidence drawn from one or more academic research disciplines, but predominately from medical and public health-related research (12 out of 14 articles)
- Linear, one-directional use of data in conceptualizing the relationship between empirical data and theory (7 out of 14 articles)
- Empirical Data that can be used to validate indicators of healthy populations (6 out of 14 articles)

- Empirical data that can be used to strengthen arguments for improving public services to improve population health (3 out of 14 articles)

- Empirical data that can be used to support arguments for improving governance for improving health outcomes (3 out of 14 articles)

- Empirical data used to promote critical approaches to scientific inquiry in public health (2 out of 14 articles)

A breakdown of these key indicators revealing what is understood as 'health evidence' for articles embedded upon a Global, Public and Population Health theoretical perspective is presented below:

- ***Empirical data pertaining to human health outcomes (14 out of 14 articles)***

All 14 out the 14 articles embedded upon a Global Public and Population Health perspective use the term 'evidence' to refer to indicators and incidences of disease, such as obesity rates, admissions to hospital for asthma, rates of diabetes, and rates of heart disease. These health indicators are used to support or contrast against various theoretical understandings of the relationship between health and the environment (Barton, 2009; Bunker and Holloway, 2005; Giles-Corti et al., 2012; Giles-Corti et al., 2016; Grant et al., 2017; Hanlon et al., 2012; King 2018; Wells et al., 2010).

- ***Empirical Data pertaining to quantifiable, measureable indicators of acute and chronic disease and health behaviours (13 out of 14 articles)***

Thirteen out of 14 articles use the term 'evidence' to refer specifically to quantifiable indicators of disease, including numbers of people living with diabetes and heart disease (Barton, 2009; Bunker and Holloway, 2005; Giles-Corti et al., 2012; Giles-Corti et al., 2016; Grant et al., 2017; Hanlon et al., 2012; King, 2018; Wells et al., 2010). For example, (Giles-Corti et al., 2012: 7) refers to evidence as data that can be isolated and categorized to encourage healthy behavior. Added to these health indicators are other indicators of built-environment characteristics such as population density and personal practices, such as rates of physical activity. This evidence is used deductively to test existing hypotheses and

understandings and to support existing arguments regarding the relationship between human health and environment (Easthope and Judd, 2010; Giles-Corti et al., 2012; Giles-Corti et al., 2016; Grant et al., 2017; Redman and Jones, 2005; Wells et al., 2010). The outcomes of hypotheses testing can then be used to evaluate existing theory and to develop new understandings.

- ***Empirical data that is used and applied deductively in accordance with a scientific paradigm (12 out of 14 articles)***

Twelve out of 14 articles take a deductive approach to using health evidence in relation to the development of theory.

- ***Empirical evidence drawn from one or more academic research disciplines (12 out of 14 articles)***

Twelve out of the 14 articles draw primarily on empirical, epidemiological data pertaining to public health and medicine. However, one out of these articles moves beyond thinking of health evidence in terms of quantifiable epidemiological data and linear relationships between data and theoretical argument, by looking at evidence from different academic disciplines to illustrate the relevance of planning for health (Wells et al., 2010: 125). Although Wells et al., (2010) focuses on quantifiable evidence, they acknowledge the importance of drawing on evidence pertaining to sociology, psychology and planning in addition to health and medicine in order to fully understand the different dimensions of human health.

- ***Linear use of empirical data in deductive scientific inquiry (7 out of 14 articles)***

Seven out of the 14 articles that discuss the relationship between human health and the built environment take simple, deductive, linear, one-directional approach to understanding the relationship between empirical health evidence and theoretical understandings of the relationship between the different factors involved. For example, both Flood (1997) and Redman and Jones (2005) understand the term health evidence to refer to empirical data that can be used in a linear fashion to support or contrast existing theoretical understandings through the testing of specific hypotheses.

- ***Empirical Data that can be used to validate indicators of healthy populations (6 out of 14 articles)***

Six articles present evidence as empirical data, which can then be used to validate indicators of healthy populations (Bunker and Holloway, 2002; Flood, 1997; Giles-Corti et al., 2014; King, 2018; Redman and Jones, 2005; and Wells et al., 2010). For example, Giles-Corti et al., (2014) refers to evidence empirical data which can be used to validate indicators of healthy communities. Similarly, Bunker and Holloway (2002) refer to evidence as empirical data that can be used to provide measurable indicators for evaluating housing policy, whereas King (2018) and Wells et al., (2010) use the term evidence to refer to empirical data focused on human health that can indicate population health in more generalizable terms. Redman and Jones (2005) argue that empirical epidemiological data can be used to spot particular problems associated with urbanization. One of the articles, Flood (1997), identified 46 key indicators that can be used to report on the status of cities for future monitoring of a Global Plan of Action and national action plans for examining the health problems associated with urban living.

- ***Empirical data that can be used to strengthen arguments for improving public services to improve population health (3 out of 14 articles)***

Three articles discuss how empirical data on human morbidity, mortality and health behavior can be mobilized to strengthen arguments aimed towards improving public services to improve population health (Barton, 2009; Giles-Corti et al., 2012: 6; Grant et al., 2017). For example, Grant et al., (2017), discuss evidence as research data that can be used to strengthen existing arguments for policy change and reform towards healthier populations by exposing the range of current human health problems associated with urbanization and globalization. Similarly, Barton (2009) uses the term evidence to refer to the collection of data that can be used to review the effectiveness of current planning strategies in relation to evidence of the determinants of health outcomes.

- ***Empirical data that can be used to support arguments for improving governance for improving health outcomes (3 out of 14 articles)***

Three out of the 14 articles use the term evidence to specifically refer to how empirical data can be used to improve governance for improving health outcomes in dense urban areas (Easthope and Randolph, 2009; Flood, 1997; Randolph and Holloway, 2005). Easthope and Randolph (2009) discuss how data can be used to argue for particular approaches to governance, while Randolph and Holloway (2005) refer to evidence in the context of the use of research data that can be used to inform policy debates and answer key questions about population health. Flood (1997) uses the term evidence to refer to data that can be used to generate indicators of health, which can then be used to form health action plans and policies.

- ***Empirical data used to promote critical approaches to scientific inquiry in public health (1 out of 14 articles)***

One out of the 14 articles take a more critical approach in discussing the relationship between the uses of evidence in relation to the generation of theoretical understandings. Hanlon et al., (2012) uses the term 'evidence' to refer to current approaches to empirical inquiry that involve the application of data to analyse existing understandings and arguments put forward to explain health-related outcomes. According to Hanlon et al., (ibid), empirical data forms the evidence required to examine the feasibility of existing understandings of health outcomes and approaches to improving health outcomes. This article also emphasizes that the current use and application of evidence in public health is a product of modernist thinking and suggests that a paradigm shift is required in how current empirical inquiries are undertaken in order to improve health outcomes. Specifically, it discusses the need to move beyond using data as evidence in order to test existing theory and hypotheses and instead look towards using evidence of existing problems in order to develop new theories and understandings by taking a more grounded approach.

### *3.1.2: Social-Ecological Determinants of Health*

109 out of 141 documents reviewed fell into the Social Environmental Determinants of health category. Social-Ecological determinants of Health approaches differ from approaches embedded in a Global Health perspective in their emphasis on the interplay between the social and environmental factors in determining human health outcomes.

For articles grouped within this health domain, the term health evidence can be taken to refer to:

- Use of objective as well as subjective empirical data pertaining to human wellbeing (30 out of 109 articles)

- Data examining the relationship between health outcomes, socio-economic factors and the built environment (29 out of 109 articles)

- Use of data to emphasise a multi-directional relationship between the built environment and multiple factors linked to human well-being (24 out of 109 articles)

- Quantifiable, measureable empirical data on access to public transport (18 out of 109 articles)

- Data pertaining to socio-cultural contextual factors, health behaviours and features of the built environment (14 out of 109 articles)

- Data pertaining to social interaction levels, including at different stages of the life course (13 out of 109 articles)

- Objective and subjective data on thermal comfort measured against objective, measureable empirical data human health outcomes associated with heat exposure (13 out of 109 articles)

- Correlations between data pertaining to social interaction levels, data on mental health outcomes, and empirical data on the design of the built environment (12 out of 109 articles)

- Data pertaining to age, health outcomes and the built environment context (10 out of 109 articles)

- Empirical data on resident access to fresh food and predicted human health outcomes (9 out of 109 articles)

- Empirical data pertaining on observable features of building design and quantifiable data on access to space to promote positive behaviour change (8 out of 109 articles)

- Correlations between objective and subjective empirical data on noise levels and mental health outcomes (6 out of 109 articles)

- Objective data pertaining to human exposure to air pollution (5 out of 109 articles)

- Data linking gender, health outcomes, and the built environment (4 out of 109 articles)

- Use of empirical data on creative design and infrastructure in correlation with evidence on resident wellbeing (3 out of 109 articles)

- Use of empirical data on human happiness levels (3 out of 109 articles)

- Data pertaining to actual crime levels, perceived risk of crime, and rates of mental ill-health (3 out of 109 articles)

- Data on reported risk of hazards and mental health outcomes in specific built environment contexts (1 out of 109 articles)

- Data examining the relationship between suicide rates and building design (1 out of 109 articles)

A breakdown of how health evidence has been discussed in the articles grouped within the Social-Ecological Determinants perspective is discussed below:

- ***Use of objective as well as subjective empirical data pertaining to human wellbeing (30 out of 109 articles)***

Thirty articles refer to ‘health evidence’ as evidence pertaining to human well-being, rather than physical or mental health and rates of disease. Four articles, discuss liveability and

quality of Life rather than disease prevention as an end in itself, drawing on subjective as well as objective data pertaining to human well-being (Easthope and Judd, 2010; Forster, 2006; Lofti and Koohsari, 2009; Raman, 2010). For example, 3 of these specifically discuss how reducing stress levels, risk of chronic diseases, security concerns and crime levels, in addition to promoting activity and social engagement, are seen as essential for positively influencing quality of life (Easthope and Judd, 2010; Forster, 2006; Raman, 2010). Two of these focus on human wellbeing and acknowledge how density affects quality of life for the community as a whole, as well as for individual residents (Easthope and Judd, 2010: 18; Raman, 2010). Another article (Lofti and Koohsari, 2009) examined the factors that have been shown to influence higher density residents' quality of life and resident satisfaction, by exploring neighbourhood relations are necessary for promoting healthy human environments. This approach to human health contrasts with traditional-medical models of health by providing a broader definition of what counts as health by including objective and subjective interpretations and measurements of quality of life (ibid).

- ***Empirical data examining the relationship between health outcomes, socio-economic factors and the built environment (29 out of 109 articles)***

Twenty-nine discussed the relationship between socio-economic inequalities amongst the population in high-density environments (Acioly and Davidson, 1996; Allen and Blandy, 2004; Badland et al., 2013; Badland et al., 2017; Beer and Faulkner, 2009; Christian et al., 2017; Costello, 2005; Easthope and Judd, 2010; Fincher, 2004; Gifford, 2007; Giles-Corti et al., 2012; Giles-Corti et al., 2014; Gunn et al., 2017; Hancock, 2017; Holman et al., 2015; Jabareen, 2006; Johnston-Lawrence et al., 2015; Kalcheva et al., 2015; Lloyd and Reid, 2013; Nicholls et al., 2017; Ormandy and Ezratty, 2016; Randolph, 2005; Randolph, 2006; Seo, 2002; Seo and Chiu, 2014; Taylor et al., 2016; Thompson and Paine, 2017;Vandentorren et al., 2006; Zhang and Lawson, 2009). For example, Hancock (2017: 9) highlights how people living in poverty are less healthy, less educated and are less economically and socially productive and are often excluded from participating in the social, civic and cultural life of their communities compared to wealthier members of society. Similarly, Easthope and Judd (2010) explain how that although high-rise housing in high socioeconomic areas with good neighbourhood amenities, built-in security, shared facilities, recreational spaces and opportunity for selective interactions may work well for people who can afford to live there,

those forced to live in smaller accommodation as a result of financial constraints, are more susceptible to health problems associated with overcrowding.

Four articles discuss how the risks of heat related mortality and poor health outcomes as a result of excessive heat or cool temperatures, as well as indoor and outdoor air pollution, are more prevalent amongst residents with low-socio economic status who live in higher density living environments (Nicholls et al., 2017; Ormandy and Ezratty, 2016; Taylor et al., 2016; Vandentorren et al., 2006).

A *Conversation* article by Thompson and Paine (2017) discuss how obstacles to health are greater for lower-income groups and that denser cities and high-rise apartment living are seen as the antidote to these problems. This is because when poorer communities are located in areas of lesser amenity due to lower housing costs it exacerbates existing health problems (ibid). Good design and building standards can mitigate health problems associated with overcrowding, specifically sleep deprivation, stress and anxiety, which are risk factors for more complex mental health problems, as well as being implicated in the emergence poor physical health (ibid). These risk factors are known to disproportionately affect low socio-economic groups (ibid). Thompson and Paine (ibid) also discuss how sleep deprivation is linked to obesity, which can lead to many chronic diseases. The article also stresses availability and financial limitations in accessing healthy food.

Fifteen articles illustrate the importance of promoting social equality through the enhancement of social capital and networks through high density development to overcome health inequalities associated with differences in the socio-economic backgrounds of residents (Badland et al., 2017; Beer and Faulkner, 2009; Bunker et al., 2002; Carmona, 2014; Cho et al., 2017; Christian et al., 2017; Costello, 2005; Easthope and Judd, 2010; Fincher, 2004; Kalcheva et al.,'s 2015; Komossa, 2010; Leccese and McCormick, 2000; Lloyd and Reid, 2013; Randolph, 2005; Seo, 2002). Three of these 15 articles discuss how the gentrification of densely populated urban centres through high-density developments has perpetuated existing socioeconomic health inequalities (Costello, 2005; Lloyd and Reid, 2013; Randolph, 2005; Seo, 2002). Seo (2002) explains that in England and Wales young professional people have become over-represented in inner-urban living, because gentrification had led to socially exclusive environments and demographic limitations. Consequently, this form of redevelopment risked enhancing existing unequal health outcomes

between rich and poor urban dwellers. Similarly, two other studies also discuss how the new neoliberal high-density development market is designed primarily with the needs of two social groups in mind: young professionals and empty nesters; thus, contributing to health inequity between the urban wealthy and poor (Costello, 2005; Lloyd and Reid 2013). In contrast, Randolph (2005) argues that higher density living can be associated with an increased facilitation of social capital in a socioeconomically diverse neighbourhood as it encourages community integration and social inclusion. However, this article also acknowledges that high density developments are often associated with high mobility rates, which can undermine the stability of communities through inhibiting the creation of long-term stable communities (ibid).

Seven of the 29 articles that discuss promoting social equality through the enhancement of social capital and networks through high density development highlight how specific features of the built environment can help to improve neighbourhood population diversity, which in turn, can help to decrease health inequalities amongst different socioeconomic groups (Badland et al., 2017; Beer and Faulkner, 2009; Bunker et al., 2002; Burton, 2000, in Easthope and Judd, 2010: 6; Christian et al., 2017; Easthope and Judd, 2010; Lecesse and McCormick, 2000, in Easthope and Judd, 2010: 16). For example, Leccesse and McCormick (ibid) draws on the New Urbanism approach to planning in the US, stressing how the benefits of mixed use developments and a diverse resident profile create healthy, socially vibrant communities (Leccese and McCormick, 2000; in Easthope and Judd, 2010: 16). Similarly, Bunker et al., (2002) discusses barriers to the creation of socially mixed, diverse communities in Sydney, highlighting the issue of segmentation between the different apartment submarkets. Badland et al., (2017) examined associations between area-level measures of housing density, tenure and affordability with individual-level measures of neighbourhood safety, community satisfaction and self-rated health. The study found that those living in areas with less affordable housing were more likely to feel unsafe and dissatisfied in the community. Renting also increased the likelihood of reporting poor self-rated health.

Four of the articles discuss how promoting equality access to communal spaces can help to existing social hierarchies to help to redistribute the benefits of access to communal spaces (Cho et al., 2017; Carmona, 2014; Komissa, 2011; Kalcheva et al., 2015). For example, Cho et al., 2017 discusses how promoting socialisation and equal access to the positive aspects of high-density living in Japan helped to reduce individualist mindsets and norms associated

with social hierarchies that can impede distribution of the benefits of high-density housing amongst those most marginalised. Similarly, Kalcheva et al.,'s (2015) explored how high-density living in Manchester, UK, helped to enhance the social and cultural capital of all residents, providing the greatest benefit to those from marginalised backgrounds. This resulted from embedding a focus on socioeconomic diversity into the redevelopment plan (ibid). However, six articles also question the assumption that close proximity to neighbours can always effectively contribute to a more inclusive social environment (Beer and Faulkner, 2009; Burton, 2000, in Easthope and Judd, 2010: 6; Christian et al., 2017; Cho et al., 2017; Easthope and Judd, 2010; Fincher 2004). For example, Easthope and Judd (2010: 6) question the assumption that close proximity to neighbours automatically results in a more inclusive social environment, stressing how living in close proximity to neighbours may lead to increased incidences of neighbourhood disputes and problems. Similarly, Christian et al., (2017) questions the ability of higher density living environments to enhance cognitive development in children from low socioeconomic backgrounds, but acknowledges that although effect of built environment is small, it could have lasting effects on population health over time. Fincher's (2004) article discusses how higher density housing in Australia is often perceived to be associated with increased social problems, due to historical experiences of city high-rise social housing blocks in the 1960s. As a result, there remains a stigma associated with higher density public housing (ibid). Beer and Faulkner (2009) call into question the life cycle approach to housing pathway, with increasing numbers of marital breakdowns, increasing numbers of young adults living with their parents, lower birth rates, and greater likelihood of people choosing to have children later rather than earlier in adulthood, influencing housing choice. Cho et al., (2017) highlights that public space is often particularly contested in high-density urban development, compared to other densities (ibid). Conflicts can occur because of functionality problems that result from a lack of shared space and facilities and resident rivalry over them. The outcomes of these conflicts is determined according to the social standing of resident groups and long-term normalisation of the appropriation of space by one user group, which results in those who are most socially marginalised being less likely to benefit from access to spaces that can promote healthy behaviours (ibid).

- ***Use of data to emphasise multi-directional relationships between different factors associated with human health and the built environment (24 out of 109 articles)***

Twenty-four articles explore the significance of the relationship between health and place through the discussion of empirical data from specific case studies. For example, Haarhoff et al., (2016) explores the relationship between health and place in contexts of different densities by examining the findings from case studies of residents in medium density housing in Auckland to examine the extent to which quality of life is being enhanced in intensified suburban contexts. The case study findings are then considered in relation to urban consolidation and higher density living (ibid). Larger cities in Australia and New Zealand have urban consolidation policies promoting higher density development, justified on the grounds of enhancing urban sustainability. One article examines how higher density cities are more transport fuel efficient than lower densities (Newman and Kenworthy, 1996). Three articles focusing on liveability discuss how higher density development makes public transport more economically viable and potentially reduces private car dependency and atmospheric pollution, leading to more sustainable and resilient urban lifestyles (Dodson, 2010; McCrea and Walters, 2012; Quastel et al., 2012).

Four of the 24 articles that understand health evidence to refer to multi-directional relationships between health and place focus specifically on the notion of liveability, which is understood as a two-directional relationship between society and environment. For example, Badland et al., (2017) presents an overview of the Victorian Liveability Research Program, which focuses on conceptualising and creating liveability indicators for higher density neighbourhood environments. The following neighbourhood attributes are defined as key liveability indicators: healthy and accessible food environment, affordable, attractive and well-designed housing with optimal light, humidity and temperature control, supportive social infrastructure, transport and walkability (Badland et al., 2017). Evidence of livable higher density communities is understood to refer to data pertaining to safety, aesthetics, social cohesion and inclusion, as well as environmental and economic sustainability (Badland et al., 2017).

- ***Quantifiable, measurable data pertaining to the use of active transport (18 out of 109 articles)***

Sixteen out of the 109 articles discuss the significance of access to public and active transport for improving human physical health. These studies focus specifically on reducing cardiovascular and cancer mortality, obesity rates, road traffic mortality and respiratory health

through improving access to physical activity. Eleven out of these 16 studies use empirical, quantifiable and measureable evidence to discuss how higher density provides better access to services and facilities and increases proximity, which results in higher walkability, active living and lower obesity rates (Ewing et al., 2007; Forsyth et al., 2008; Giles-Corti et al., 2012; Giskes and van Lenthe, 2011; Greenwald and Boarnet, 2001; Heath et al., 2006; Leal and Chaix, 2011; Moudon and Lee, 2003; Song and Knaap, 2004; Talen, 2006; Yan and Voorhees, 2010). Two of these studies specifically advocate for 'high-density', 'high-intensity', 'compact', 'mixed-use' and 'pedestrian-oriented' urban development as the desired strategies for positive health outcomes (Chan and Lee, 2008; Ewing et al., 2008). Two out of the 16 studies emphasise the negative physical health outcomes associated with high density living, specifically those associated with overcrowding (Evans et al., 2003; Gómez-Jacinto and Hombrados-Mendieta, 2002). Giles-Corti et al.,'s (2012) report suggests that higher residential density is associated with more positive health outcomes than lower density environments because of increased transport walking across all age groups. Similarly, Cowie et al., (2016) argues that higher density developments should promote walking to promote positive physical health outcomes, including reducing obesity rates, mortality and adverse birth outcomes.

Two of the 109 articles specifically focus on the significance of active transport for liveability and human well-being in high-density urban cities. Falconer and Richardson (2010) explore how active transport in high-density developments promotes positive health outcomes. Yang (2008) stresses the importance of active transport for improving the quality of life for residents and defines healthy, socially sustainable, urban cities as green, vibrant, more compact, walkable, accessible, which foster a unique sense of place, drawing on empirical research data pertaining to these features of the built environment and health behaviours located within specific forms of the built environment.

- ***Data pertaining to socio-cultural contextual factors, health behaviours and features of the built environment (14 out of 109 articles)***

Fourteen articles within the Socio-Ecological Determinants of Health category examine how deeply embedded socio-cultural beliefs and practices can create barriers to promoting positive health outcomes amongst higher density residents (Acioly and Davidson, 1996; Allen and Blandy, 2004; Gifford, 2007; Giles-Corti et al., 2012; Giles-Corti et al., 2014; Gunn et

al., 2017; Hancock, 2017; Holman et al., 2015; Jabareen, 2006; Johnston-Lawrence et al., 2015; Randolph, 2006; Seo and Chiu, 2014; Zhang and Lawson, 2009). For example, Kent (2015) acknowledges how the social and cultural makeup of the community will affect the capacity of the community to adapt to different ways of living, working and socialising. Vulnerable populations, such as those on low incomes or those with lower levels of educational achievement are acknowledged as being potentially more susceptible to the negative impacts of higher density living (ibid).

Seven out of these 14 articles examine how long-held perceptions about higher density living limit the attractiveness of these developments to members of the population. Three of these, Gifford (2007), Randolph (2005), Seo and Chiu (2014), discuss how living in high-density public housing remains associated with the socio-cultural stigma of poverty in western contexts, including in Australia. Another article by Zhang and Lawson (2009) argues that problems attributed to high-rise housing are triggered by the negative experience of density in the past. In addition, an article by Randolph (2006), explains that in Australia, high-density housing is still often viewed as a temporary and unappealing housing option for families and explains that concerns about pollution, traffic, lack of social cohesion and community integration place significant limitations on health promoting behaviours. While these articles all focus specifically on public high-density housing, one of these (Randolph 2006), and three other articles (Allen and Blandy, 2004; Holman et al., 2015; Jabareen, 2006) include a focus on new, private high-density developments. Holman et al. (2015) explains that there are negative perceptions of new, privately developed high-density developments regarding suspicions about their capacity to deliver a positive impact to society, which they argue stem from concerns about the ability of neoliberal economic planning to deliver benefits to enable all members of society to flourish. Allen and Blandy's (2004) case study in Manchester, UK, found that healthy agers and members of the LGBT community were more attracted to high-density city living than others. In contrast, resistance to high density was found to be strongest in families with young children and in those of retirement age (ibid).

Four articles mention how education can help to challenge embedded socio-cultural beliefs that inhibit the adoption of healthy behaviours amongst residents in high-density developments (Acioly and Davidson, 1996; Giles-Corti et al., 2014; Gunn et al., 2017; Jabareen, 2006; Johnston-Lawrence et al., 2015; Randolph, 2006). One of these, Giles-Corti et al., (2014) draws on empirical case studies and practice-based studies to emphasise that

there is a need for a combination of built environment features and education required to change behaviour to promote physical activity. Similarly, Gunn et al., (2017) argues that areas with high population density, mixed land uses and recreational and business destinations are the most successful for encouraging healthy behaviour, but acknowledges that modifying the built environment only produces modest effects on behaviour change in the absence of education and public health awareness raising.

- ***Data pertaining to social interaction levels, including at different stages of the life course (13 out of 109 articles)***

Thirteen of the 109 articles discuss how liveable environments should enhance social interaction to improve human wellbeing. Four of these articles argue that liveable higher density environments should enable residents to live closer to family, friends, to access goods and services as well as have access to reliable public transport (Howley et al., 2009; Lusher et al., 2008; Yang, 2008). For example, Lusher et al.,'s (2008) case study of designing liveable streets in New York City highlights how liveable streets in higher-density environments are underpinned by consideration for the wide needs of all users and good planning to dedicate increasing amounts of space to pedestrians, cyclists and public transport to promote quality of life. Haarhoff et al., (2016), draws on The Victorian Government's 'Activity Centre Toolkit' for promoting higher density, transit orientated development in Melbourne and Auckland's 'Auckland Plan' for creating the world's most liveable higher density city, to argue that neighbourhoods need to offer opportunities that are both health stimulating and aesthetically pleasing to enhance social cohesion and interaction and to enable people of all demographic groups to mix in cafes, restaurants, shops, services and public parks. Greater satisfaction in higher density housing in Vancouver is associated with enhancing quality of life through social interaction via amenity and services provision, and by greater involvement of citizens in urban planning at the local level (Haarhoff et al., 2016). This suggests that the place shaping process itself is important for enhancing liveability.

Seven of the articles focus on empirical data pertaining to the experiences and perceptions of the residents to draw attention to the importance of a residential environment that enables people to experience personal fulfilment and to attain their life goals (Diener & Suh, 1997; Marans & Couper, 2000; McCrea & Walters, 2012; Pacione, 2003, Raman 2010, van Kamp et al., 2003, Yang, 2008). Three articles specifically focus on the importance of enhancing

liveability in higher density environments across the different stages of the human life course (Giles-Corti et al., 2012, Kaźmierczak, 2013; Yung et al., 2017). Yung et al., (2017) highlights how the elderly often spend a considerable amount of time in public parks, drawing attention to how the social dimension of environments have a significant influence on the health and wellbeing of elderly people. Similarly, Giles-Corti et al., (2012: 14) also recognises the importance of public parks for enhancing liveability of higher density environments for older people. Interaction can be promoted through the design of space and by creating opportunities for participation in the general planning and design in local parks to contribute to healthy aging and to prevent and delay the onset of chronic disease, cognitive decline and mental ill health (Giles-Corti et al., 2012: 14). Parks should therefore enable elderly residents to socialise with friends, meet new friends and maintain a strong sense of connection. Open spaces should be within a short distance of nearby residents (ibid). Kaźmierczak (2013) focuses specifically on other stages of the life course, in addition to retirement and older age, to argue that spaces should be designed for a variety of simultaneous uses, for instance, to watch grandchildren playing while chatting to neighbours. Links to cultural heritage can provide opportunities for elderly people to share stories with young residents of where they have lived for many years, which can enhance the sense of community and close generational divides between community members (ibid). However, Giles-Corti et al., (2012: 14) also questions whether higher density environments can promote good health outcomes in older residents, arguing that high-rise living is associated with lower satisfaction levels and a poorer sense of community amongst elderly residents.

- ***Objective and subjective data on thermal comfort measured against objective, measureable empirical data human health outcomes associated with heat exposure (13 out of 109 articles)***

Thirteen of the 109 articles discuss the impacts of extreme heat and/or insufficient thermal control (to either heat or cold temperatures) on human health, examining how temperature extremes are linked to increased mortality and a range of negative health outcomes (Badland et al., 2017; Buys and Miller, 2012; Chan and Liu, 2018; Ewing and Rong, 2008; Guo et al., 2017; Haigh et al., 201l; Hu et al., 2016; Nicholls et al., 2017; Ormandy and Ezratty, 2016; Roulet et al., 2006; Taylor et al., 2016; Vandentorren et al., 2006; Wilson et al., 2008). One of the twelve articles highlights the importance of human behaviour for reducing heat-related mortality and morbidity, such as by increasing fluid intake during heat waves (Nicolls et al.,

2017). Twelve out of the thirteen articles examine the importance of the built environment on vulnerability to increased mortality and morbidity as a result of extreme heat. These articles reveal how vulnerability is greater in a higher density built environment because building form in these environments can result in higher indoor and outdoor temperatures than lower density environments (Badland et al., 2017; Buys and Miller, 2012; Chan and Liu, 2018; Ewing and Rong, 2008; Guo et al., 2017; Haigh et al., 2011; Nicholls et al., 2017; Ormandy and Ezratty, 2016; Roulet et al., 2006; Taylor et al., 2016; Vandentorren et al., 2006; Wilson et al., 2008). All thirteen articles that examine the relationship between thermal control and health emphasise that temperature has both a direct and indirect relationship on human health outcomes.

- ***Correlations between data pertaining to social interaction levels, data on mental health outcomes, and empirical data on the design of the built environment (12 out of 109 articles)***

Twelve out of the 109 articles within the sample focus on the relationship between social interaction and mental health, and the significance of the design of the built environment for influencing mental health outcomes (Evans et al., 2003; Feng et al., 2017; Giles-Corti et al., 2012; Gómez-Jacinto and Hombrados-Mendieta, 2002; Kane and Whitehead, 2018; Kent, 2015; Kent and Thompson, 2014; Thompson and Paine, 2017; Kitahara, 2018; Soderstrom et al., 2016; Turner and Wigfield, 2017; Vassos et al., 2012). Four of these 12 articles emphasise how accessible, well-connected street designs and buildings with quality open spaces can foster social interaction in the course of day-to-day life, which helps to improve resident mental health and reduce rates of depression amongst the population (Giles-Corti et al., 2012; Kane and Whitehead, 2018; Kent, 2015; Kent and Thompson, 2014). In contrast, two of the 12 articles argue that high-density environments are more likely to increase rather than decrease social isolation and overcrowding, leading to poor mental health outcomes (Evans et al., 2003; Gómez-Jacinto and Hombrados-Mendieta, 2002).

- ***Data pertaining to age, health outcomes and the built environment context (10 out of 109 articles)***

Ten of the 109 articles focus on age and inequalities in human health outcomes in high-density contexts (Chan and Liu, 2018; Giles-Corti et al., 2012: 13; He et al., 2014; Nicolls et

al., 2017; Powers, 2013; Shi, 2017; Sherry and Easthope, 2016; Taylor et al., 2016; Vandentorren et al., 2006; Villanueva et al., 2016). For example, Giles-Corti et al., (2012) discusses health equity in relation to how healthy higher density environments can reduce mortality in older adults by ensuring access to green space to halt the development of risk factors for chronic diseases (Giles-Corti et al., 2012: 7). Four of these articles examine discuss the relationship between age and vulnerability to the health risks associated with heatwaves and extreme cold in higher density environments, emphasising how elderly people and young children are more likely to be at risk of health problems compared to other members of the population (Chan and Liu, 2018; Nicholls et al., 2017; Vandentorren et al., 2006; Taylor et al., 2016). Two articles (Kent, 2015; and Giles-Corti et al., 2012: 9) mention the relationship between health and higher density for families. According to Giles-Corti et al., (2012: 9), density is associated with higher mortality rates throughout the life course, but suggests that this is due to crowding rather than density per se. Healthy higher density environments should therefore contain a minimum percentage of housing large enough to accommodate families and to provide social support and a sense of community for adult and child residents (ibid). Recreational facilities and cycling infrastructure can help to promote physical activity for the benefit of all family members (ibid: 9).

Six articles specifically focus on improving child health outcomes in high-density contexts (Giles-Corti et al., 2012: 13; He et al., 2014; Powers, 2013; Shi, 2017; Sherry and Easthope, 2016; Villanueva et al., 2016). These articles consider how children's health can be enhanced in higher density environments, as density, and living conditions more broadly, can affect child cognitive development, mental health, physical health and behaviour.

- ***Empirical data on resident access to fresh food measured data on actual and predicted human health outcomes (9 out of 109 articles)***

Four of the 43 articles emphasise the importance of resident access to healthy, fresh food in densely populated urban environments to achieve improvements in human physical health outcomes (Giles-Corti et al., 2016; Kent, 2015; Kent and Thompson, 2014; Lowe et al., 2015). For example, Lowe et al., (2015) emphasises that shops should be easy for residents to access safely. The number of fast food premises within a particular area should be carefully limited to help to encourage residents to choose healthy fresh food options (ibid).

- ***Empirical data pertaining on observable features of building design and quantifiable data on access to space to promote positive behaviour change (8 out of 109 articles)***

Eight out of the 109 articles discuss how observable data pertaining to specific urban design features can help to promote positive behaviour associated with improving health outcomes. For example, Paciência & Moreira (2017) explain how urban density and land use mix are associated with reduced levels of obesity because high-density areas can support increased levels of physical activity because of creating nearby walkable destinations. However, they acknowledge that the relationship between obesity levels and density is complex, because street intersections and mixed land use, together with low physical activity can increase reliance on highly processed and high fat foods (ibid). Similarly, a study by Kent and Thompson (2014) that discussed how urban design could promote positive health outcomes in higher density areas by promoting behaviours that mitigate physical inactivity. Kent (2015) and Thompson (2013) also discuss how density can influence opportunities for physical activity, which can reduce cardiovascular disease-related deaths. In contrast, Lu and Ye (2017) examined the association between density, diversity, design and walking behaviour in China from a survey of walking data and found that land use mix and street connectivity did not significantly relate to walking. They found that population density is only related positively to walking for transport and walking for leisure in the lower range of density, while related negatively to walking for leisure in the higher range of density. This suggests that the association between density and walking behaviour is complex and that density, diversity and design on their own may be insufficient to promote good health outcomes relating to the prevention and treatment of chronic illnesses through promoting walking behaviours. Kane and Whitehead (2018) discuss challenges to the positive health impacts associated with walking and public transport by looking at how increasing density of urban regions has led to increased mobility demands, wherein mobility disruptions can result in dysfunctional cities. They argue that policy makers and planners should consider potential future challenges to achieve a sustainable transport system in practice to promote the positive health impacts associated with walking. Similarly, Lowe et al., (2015) highlights future challenges for health promotion that result from knowledge and evidence of the association between the built environment and chronic disease not being currently translated into urban planning policy and practice in Australia. They argue that the location of shops, services, provision of active

and public transport, access to open spaces and recreational opportunities are associated with reductions in chronic disease factors such as physical activity levels.

- ***Correlations between objective and subjective empirical data on noise levels and mental health outcomes (6 out of 109 articles)***

Six of articles discuss the relationship between environmental stressors and mental health outcomes in high-density contexts. For example, Giles-Corti et al., (2012: 11) argues that healthy higher density environments should not be crowded or noisy and should include optimum indoor air quality and light to influence mental health. Noise causes annoyance, which in turn causes stress and poor-quality housing is associated with greater psychological distress (ibid). Healthy higher density environments should therefore be well governed and well maintained to create a functional living environment to ensure that social control is maximised (Giles-Corti et al., 2012: 11). Access to green environments, including vegetated areas such as parks, open spaces and playgrounds are associated with health benefits in a range of cross-sectional studies, including mental health outcomes and factors protective of mental health (ibid: 13). This is important because adults with access to green spaces walk more, and nature can have a restorative value for those living with existing mental health conditions. Similarly, Kent (2015) explains that density can be associated with negative mental health outcomes and can breed stress and social isolation, which can lead to the development of depression and anxiety disorders. To mitigate these risks, healthy high density environments should be well ventilated and insulated and should enable access to public and private open space to prevent isolation and community dislocation as this can erode or prevent the development of healthy aspects of higher-density living, including physical activity (ibid). Two articles examine how density in both neighbourhoods and households have been associated with stress, leading to the development of psychosis (Vassos et al., 2012; Soderstrom et al., 2016). Soderstrom et al.,'s (ibid) article focuses on the reasons why high density living is associated with poor mental health outcomes by taking an in-depth, qualitative, experience-based approach to understand the link between density and psychosis to conclude that density is associated with sensory overload, in addition to social isolation.

- ***Empirical data on resident access to fresh food measured data on actual and predicted human health outcomes (5 out of 109 articles)***

Five of the 43 articles specifically discuss the importance in urban planning of ensuring that streets are designed to limit human exposure to traffic fumes to help to reduce rates of chronic respiratory illness in residents, such as asthma and chronic bronchitis, and to encourage greater outdoor activity (Cowie et al., 2016; Giles-Corti et al., 2012; Kane and Whitehead, 2018; Kent and Thompson, 2014; Lowe et al., 2015).

- ***Data linking gender, health outcomes, and the built environment (4 out of 109 articles)***

Four articles discuss the relationship between gender and health outcomes in high-density development and suggest ways that existing equalities may be countered through appropriation of the built environment (Fincher, 2004; Foster et al., 2015; Giles-Corti et al., 2012; Reid et al., 2017). One of these four articles refers to how high density is associated with decreased cardiovascular mortality and lower cancer mortality for both males and females (Giles-Corti et al., 2012: 8). Another of these articles, Foster et al., (2015), looks at how features of the neighbourhood influence sedentary behaviour in Perth, Australia; concluding that the link between the built environment and sedentary behaviour is stronger for women than men. This case study also highlights that higher density walkable neighbourhoods are most beneficial for females as they provide greater access to community infrastructure, which positively influences physical and mental health (ibid). Another article, Reid et al., (2017), draws on feminist theory to argue that vertical high-density city community design is heavily male dominated and reflective of male values and interests. Using a material discursive lens, the article explores women's perceptions of liveability and consumption of space, highlighting how changing demographic and societal trends linked to marriage, family and household composition in South-East Queensland have led to increasing rates of female occupation of high-density developments. They found that the evidence of the poorer quality of life found amongst women was influenced by the materiality of the buildings that created unsafe and inappropriate spaces for children, as well as affecting ability to form social relationships and to socialise ibid). Similarly, Fincher (2004) found that in Melbourne, women's experiences and needs are still largely ignored, with little attention being paid to how women use, manage and experience space in and around high-rise settings. Apartment design was noted to be particularly detrimental to the quality of life of women with children, with opportunities to engage in social interaction being limited by building

design of and a lack of access to green space that created tensions around safety and risk to children. Healthy higher density living environments therefore need to be responsive to women's needs as well as men to promote positive health and quality of life impacts (ibid).

- ***Use of empirical data on creative design and infrastructure in correlation with evidence on resident wellbeing (3 out of 109 articles)***

Three articles stress the role of density as a situational composition and an affective atmosphere influencer (Anderson, 2009; Duff, 2012; Fitzgerald et al., 2016). Focusing on the relationship between density and first-hand experiences of mental ill-health, Duff (2012: 367) argues that, 'rather than a fixed substance, the city is approached as a flow of experiences in which patients encounter elements that are assembled in various ways depending on how they see and practice 'the urban''. In other words, evidence for health looks at the importance of place making for influencing quality of life, rather than the places themselves (ibid).

- ***Use of empirical data on human happiness (3 out of 109 articles)***

A further three articles within the sample emphasise how healthy higher density environments feature the promotion of positive health-related social behaviours through selective design (Buys and Miller, 2012; Giles-Corti et al., 2014; Kent, 2017). For example, Giles-Corti et al., (2014), defines liveable environments as 'creat[ing] conditions to optimise health and wellbeing outcomes in residents by influencing various social determinants of health – such as neighbourhood walkability, access to public transport, public open space, local amenities, and social and community facilities.' Giles-Corti et al., (2014) also describes how The National Liveability Study, funded through the Australian Prevention Partnership centre, aimed to develop and validate a set of spatially derived built environment liveability indicators that impact upon non-communicable disease risk behaviours and health outcomes in highly populated city environments. Similarly, Buys and Miller (2012) examine the predictors of residential satisfaction in inner urban higher density environment surveying 636 residents in Brisbane, Australia, about the importance of dwelling design and neighbourhood for living well. They identified that the following specific features of the neighbourhood and dwelling to be critical in predicting residential satisfaction: satisfaction with dwelling position, design and facilities, noise, walkability, safety and condition of local area, and

distance from social contacts in the neighbourhood. In addition, Kent (2017) examines how both the built and perceived environment feature together in influencing human happiness.

- ***Data pertaining to actual crime levels, perceived risk of crime, and rates of mental ill-health (3 out of 109 articles)***

Three of the 109 articles highlight the link between crime and fear of crime in densely populated urban areas and poor mental health outcomes (Giles-Corti et al., 2012; Kent, 2015; Soderstrom et al., 2016). Kent (2015) argues that crime can be reduced through features of environmental design and of the building itself, as well as by promoting cohesive local neighbourhoods, which can improve resident comfort and sense of security, which in turn, can help to lead to positive mental health outcomes

- ***Data on reported risk of hazards and mental health outcomes in specific built environment contexts (1 out of 109 articles)***

One article, Turner and Wigfield (2017), discusses how risks associated with living in high-rise environments can have a negative impact on mental health, with high-rise living evoking fear from fires, falls and suicide, and fears about the threat of communicable diseases. In earthquake-prone countries, residents of high-rise buildings report increased feelings of loneliness isolation and fear (ibid).

- ***Data examining the relationship between suicide rates and building design (1 out of 109 articles)***

Turner and Wigfield (2017) draw on historical suicide statistics from Singapore to suggest that the buildings may have been partly responsible for an increase in suicide rates between 1960 and 1976 by giving people a means of committing suicide and ready access to it (ibid).

### *3.1.3: Planetary Health*

According to the 20 articles embedded upon a Planetary Health perspective, the term ‘health evidence’ can be understood to refer to the following:

- Quantifiable, measurable data on the human and environmental health impacts of anthropogenic climate change and data on the mitigative impacts of features of the built environment (16 out of 20 articles)

- Empirical data pertaining to human health outcomes, environmental health outcomes, and the built environment and the complex relationships between each (15 out of 20 articles)

- Non-linear use of descriptive data to discuss relationships between human, environmental and built environmental health factors (15 out of 20 articles)

- Human and environmental health sustainability indicator data (13 out of 20 articles)

- Empirical data on green space access and its relationship to human and environmental health outcomes over different periods of time (4 out of 20 articles)

- Use of data pertaining to ecosystem management functions to critique objective forms of scientific inquiry (1 out of 20 articles)

A breakdown of understandings of evidence located within articles grouped within the Planetary Health theoretical domain is discussed below:

- ***Quantifiable, measurable data on the human and environmental health impacts of anthropogenic climate change and data on the mitigative impacts of features of the built environment (16 out of 20 articles)***

When discussing the impacts and threats of anthropogenic climate change, 16 out of the 20 articles embedded upon a Planetary Health theoretical foundation refer to evidence pertaining to environmental health, human health and the health of the built environment, thereby revealing an understanding of health evidence beyond human health. However, each of these articles consider how the various forms of health evidence can be measured in order to indicate evidence of their interrelationship, thereby suggesting a preference for quantifiable forms of health evidence that can be measured using objective measurement tools.

- ***Empirical data pertaining to human health outcomes, environmental health outcomes, and the built environment and the complex relationships between each (15 out of 20 articles)***

Fifteen articles draw upon evidence pertaining to human health, the health of the natural environment, as well as the health of the built environment, for enhancing the sustainability of the natural environment and for promoting positive human health. For these articles, health evidence does not equate solely with evidence of human health, such as indicators of disease, indicators of disease prevention activities (i.e. active transport, healthy diet), indicators of happiness, or a mere inclusion of indicators of the factors (cultural, social, economic, political) that impact upon human health. Instead, health evidence refers to evidence pertaining to human health, environmental health and the health of the built environment. For example, Giridharen et al., (2004) consider environmental health, human health and the health of the built environment for reducing air temperatures to combat Heat Island Effect. Similarly, Jowell et al., (2017) consider health evidence more broadly than in terms of human health, referring to evidence as data pertaining to social deprivation, displacement, evidence of temperature change and of building health. In total, all 15 of the articles that focus on discussing the co-benefits of human and environmental health, consider health evidence to refer to evidence pertaining to a) human health and wellbeing, b) environmental health, and c) building health (Barthel et al., 2010; Bellamy et al., 2017; Emmanuel and Steemers, 2018; Giridharen et al., 2004; Holmes et al., 2015; Kleerekoper et al., 2012; Lee and Braham, 2017; Lee et al., 2015; Mirzaei, 2015; Ng et al., 2012; Pattanayak and Haines, 2017; Perini and Magliocco, 2014; Speak et al., 2012; Tan et al., 2016; Watts et al., 2015).

- ***Non-linear use of descriptive data to discuss relationships between human, environmental and built environmental health factors (15 out of 20 articles)***

Fifteen articles highlight a holistic approach to environmental health and human health discuss the complex interplay between human, environmental and building health. In doing so, these 15 articles reveal a consideration of evidence in relation to theory beyond simple, linear, cause and effect relationships. Instead, they emphasise that the interplay between evidence of environmental change, human health and the built environment is complex and interdependent. Thirteen out of the 15 articles make reference to complexity between

evidence and arguments of causality, stating that evidence can only suggest a possible relationship between different factors, rather than indicate certainty.

- ***Human and environmental health sustainability indicator data (13 out of 20 articles)***

Thirteen articles frame discussions of environmental sustainability in terms of quantifiable forms of environmental, human and built environment health evidence that can be translated into indicators of sustainability. For example, Ren et al., (2012) and Shi et al., (2018) examine quantifiable measurements of temperature, air pollution, densification, and human thermal comfort in order to determine influencers of environmental sustainability. This suggests that evidence required to demonstrate sustainability needs to be associated with a significant degree of certainty in order to draw firm conclusions. However, as two out of these 13 articles note (Jowell et al., 2017; Lotfabadi, 2014), specific measureable data pertaining to long-term future outcomes on planetary health (i.e. planet cooling, biodiversity), are not readily available, meaning that certainty pertaining to long-term outcomes can never be guaranteed, but only indicated through measurements pertaining to short-term outcomes and their known impacts on the potential to generate favourable long-term outcomes.

- ***Empirical data on green space access and its relationship to human and environmental health outcomes over different periods of time (4 out of 20 articles)***

Four articles emphasise that healthy higher density developments should prioritise opportunities for accessing and attending to nature to provide co-benefits for both human physical and mental health and for environmental health (Barthel et al., 2010; Bellamy et al., 2017; Davern et al., 2017; Speak, 2012). For example, Davern et al., (2017) emphasise the importance of green spaces for the development of healthy high-density cities, highlighting the significance of non-human health in urban environments for responding to climate change and for mitigating further climate change processes as part of a wider, holistic, longer-term approach to enhancing human wellbeing.

- ***Use of data pertaining to ecosystem management functions to critique objective forms of scientific inquiry (1 out of 20 articles)***

One out of the 20 articles within Planetary Health takes a critical view of objective forms of scientific inquiry by reinforcing the idea that scientific theory itself is a complex social construction (Barthel et al., 2010). Evidence focused on ecosystem management functions as collectively shared mental maps for dealing with a complex world rather than a representation of fact. As a result, the ways that evidence, theory and indeed the process of scientific inquiry itself can be considered to be a social product rather than an objective process.

### *3.1.4: Discussion and Significance of Findings*

The similarities and differences between understandings of what counts as health-related evidence between articles located within each of the three theoretical domains of health have been conceptualized and summarized within **Table 8** below:

| **Comparison of Indicators of Understandings of What Can be Regarded as Health-Related Evidence for Each of the Different Theoretical Perspectives of Health** | | | | |
|---|---|---|---|---|
| | | **Theoretical Perspective of Health** | | |
| | | **Global Public Health** | **Social-Environmental Determinants** | **Planetary Health** |
| **Features Indicating Understanding and Approach to Health Evidence** | Focus of Health Evidence | Human Health and the Urban Environment, of which the built environment forms an aspect of | Human Health and the Built Environment | Human and Environmental Health and the Built Environment |
| | Direction of Relationship between Determinants of Health | Linear, One-Directional | Focused on interplay between multiple determinants; differentiates between direct and indirect determinants and variation in strength of inter-relationships | Non-Linear, Multi-directional, direct and indirect relationships and complex feedback loops |
| | Disciplinary Focus of Evidence Use | Mostly single disciplinary (but with criticism) | Multi-disciplinary | Trans-disciplinary |
| | Inclusion of Types of | • Chronic and | • Demographic Factors | • Human Health |

| | | | | |
|---|---|---|---|---|
| | Empirical Data as 'Health Evidence' | Acute Disease<br>• Health Behavior<br>• Transport<br>• Evidence for Health Governance | • Socio-cultural Factors<br>• Socio-Economic Factors<br>• Built Environment Factors<br>• Health Behaviour<br>• Chronic Disease<br>• Air Quality<br>• Thermal Comfort<br>• Transport<br>• Food & Nutrition<br>• Hazard Risk | Impacts associated with Anthropogenic Climate Change<br>• Environmental Health Impacts of Climate Change<br>• Built Environment Climate Change Mitigation<br>• Human and Environmental Sustainability Indicators |
| | Relationship between Empirical Evidence and Theory | Mostly Deductive | Inductive and Deductive | Inductive and Deductive |
| | Generalizability of Findings | Emphasis on Generalizability at the Regional and Global Level | Emphasis largely on Regional and Context Specific Findings | Emphasis on Local/Regional Context for Wider Global Impact |

**Table 8: Comparison of Indicators of Understandings of What Counts as 'Health-Related Evidence' for Each of the Three Theoretical Perspectives of Health**

Comparison of Similarities and Differences between the different Health Domains

- ***Focus of Health Evidence***

While articles embedded upon a Global Public and Population Health perspective focus largely on data pertaining to human health outcomes and behaviours within the context of the Urban Environment, articles ground upon a Social-Ecological Determinants of Health perspective use data focusing on human health outcomes and behaviours in relation to key features of the built environment. In contrast, articles framed upon a Planetary Health perspective, focus on both human and environmental health outcomes and their relationship to the built environment.

- ***Direction of Relationship between Determinants of Health and Features of the Built Environment***

In addition, the examination of the data reveals that the relationship between determinants of health is largely conceptualized in linear, one-directional form within the Global Public and Population Health articles. In contrast, the Social-Ecological Determinants-focused articles focus more on the interplay between multiple factors in relation to the production of specific human health outcomes and behaviours. These articles also draw greater attention to the direct and indirect determinants of health. The Planetary Health-embedded articles examine the interplay between different human health, environmental health and built environmental factors and emphasise the multi-directional, direct and indirect relationships and complex feedback loops.

- ***Disciplinary Focus of Evidence Use***

The empirical data drawn upon in the Global Public and Population Health consists largely of evidence drawn from research in the Medicine and Public Health Spheres. However, several articles emphasise the need for Public Health to adopt a greater inter-disciplinary focus and to include data pertaining to the wider domains of health from research in Psychology, Sociology and Behaviour Science in order to improve health outcomes through scientific research. In contrast, articles within the Social-Ecological Determinants group emphasise a multi-disciplinary approach to research and group draw on data from research within a wide

variety of academic disciplines, including Urban Studies, Planning, Public Health and Sociology. Articles grouped within the Planetary Health perspective highlight the importance of adopting a transdisciplinary, problem-focused approach to improving health outcomes, incorporating empirical data from a wide range of academic disciplines.

- ***Inclusion of Types of Empirical Data as 'Health Evidence'***

Articles grouped within each domain draw on different types of empirical evidence. Articles within the Global Public and Population Health category discuss evidence of chronic and acute disease rates, health behaviors, transport use and availability, and health governance. Articles in the Social-Ecological Determinants of Health category also use evidence focusing on chronic disease levels, transport use and access, and health behavior, but they also draw on evidence linked to a wide range of health-determining factors, including demographic factors, socio-cultural factors, built environment factors, air quality, thermal comfort, food and nutrition, hazard risk perception, and socio-economic factors. Articles embedded upon Planetary Health differ by placing greater emphasis on human and environmental health evidence indicating outcomes associated with anthropogenic climate change and the role of the built environment in helping to mitigate the risk of negative health outcomes associated with climate change.

- ***Relationship between Empirical Evidence and Theory***

Articles located within each of the three health perspectives also differ considerably in terms of their use of empirical data in relation to the development of theory. Articles grouped within Global Public and Population Health mostly utilise deductive approaches to scientific inquiry, while articles located within the Social-Ecological Determinants and Planetary Health categories adopt both deductive and inductive approaches.

- ***Generalizability of Findings***

Articles embedded within Global Public and Population Health place more emphasis on the generalisability of research findings for the regional and global levels. However, articles grouped within the Social-Ecological Determinants perspective are largely regional and

locally-specific in terms of the applicability of findings. Planetary Health-focused articles place emphasis on applicability at the local level for impact at the wider planetary scale.

### *3.1.5: Recommendations and Actions*

Recommendations

There are both significant and subtle differences between the different theoretical understandings of health as to what can be considered to constitute 'health-related evidence'. It is therefore recommended that the HHD project should:

- Examine how health evidence has been understood within the development of Victoria Park and Green Square case study sites by both health and planning professionals who were involved in the development;

- Explore, through discussions with senior academics from a wide range of academic disciplines with an interest in urban health and planning, how health evidence has been understood within each academic discipline and in relation to healthy planning in order to advance new, transdisciplinary understandings of health evidence for mobilisation in research and practice.

Actions

The following actions will be undertaken to develop these recommendations within the scope of the HHD project:

- To undertake a review of government, industry and policy literature focusing on health in higher density urban development within the New South Wales context to explore how health evidence has been understood within planning policy documents and to examine if this understanding varies across different institutions and whether it has changed over time;

- To examine government, industry and policy documents pertaining to the development of Victoria Park and Green Square Town Centre to find out how health

evidence has been understood within the development of two New South Wales local case study site areas;

- Through interviews and discussions with planning professionals involved in the development of Victoria Park and Green Square, identify and explore how planning professionals understand and apply the term ‘health evidence; and analyse how this aligns with the different theoretical conceptualizations of health found in the academic literature;

- Discuss with members of the project team how health evidence has been understood within the context of the different academic disciplines and work together to advance new transdisciplinary approaches to solving human health dilemmas by thinking about how different theoretical understandings of health evidence can be better aligned in both academic and applied-action research.

## 3.2: What Types of Health Evidence are Being Used in the Literature to Link Health to Higher Density Living?

This part focuses on how the literature uses different types of evidence to link health to higher density living. It builds upon the findings of the preliminary literature review for this project, presented in Connon et al., (2018), which highlighted that higher density is rarely defined in a tangible way, despite being a term that is frequently used.

### *3.2.1: Evidence Used to Define Healthy Higher Density Living Environments*

Given the paucity of a clear and specific definition for high density, it is not surprising that this Evidence Review yielded little in terms of concrete and specific definitions of healthy higher density living. Only one article out of the total of 141 provided an explicit definition of healthy higher density (Giles-Corti et al., 2012: 36). Giles-Corti et al., (2012) defined healthy higher density environments as consisting of ‘a net density threshold of 20 dwellings per hectare or a gross density of 18 dwellings per hectare’, on the basis that this is ‘the minimum density required to encourage transport walking’. No other study linked health to higher density by providing a specific definition of what constitutes a healthy higher density environment.

Giles-Corti et al., (2012) developed their definition of healthy higher density living environments on the basis of evidence exploring the impact of the density of the built environment on a range of health outcomes and across the lifespan, including physical activity, cardiovascular and cancer mortality, road traffic mortality, respiratory health, and mental health. The type of evidence used to develop this definition is cross-sectional data that was obtained from a range of studies examining the relationship between health and features of the built environment (2012: 7), and includes a specific focus on data examining residential density and walking behavior. Giles-Corti et al., (2012: 7) recognize the limitations associated with the use of cross sectional data as evidence of the relationship between health outcomes and the built environment, specifying that causality cannot be determined on the basis of cross-sectional studies alone.

### *3.2.2: Linking Health to Higher Density Through Health-Focused Evidence Used to Develop Qualitative and Quantitative Descriptors Characteristic of Higher Density Living Environments*

A number of articles within the sample – 12 out of 141- provide both qualitative and quantitative descriptors that are characteristic of high-density environments and which influence health outcomes. These descriptors relate to numbers of people within a spatially defined area, numbers of buildings within an area, the size of buildings within an area, and the health and socio-economic conditions associated with these environments. A range of related evidence is used within these articles to denote descriptors and characteristics associated with a higher density living environment. In particular, the evidence used to develop understandings of the features associated with good health outcomes varied, but involved applying existing measurements, definitions and guidelines, and developing new ways of measuring specifically defined spatial areas and population numbers. These types of evidence are detailed below:

- ***Using quantifiable indicators of health (4 out of 141 articles)***

Only four articles provided specific quantifiable indicators that were used to determine good health outcomes in relation to density (Badland et al., 2017; Easthope and Judd, 2010; Haigh et al., 2011; and Udell et al., 2014). For example, Haigh et al., (2011: 10) drew on government specifications to provide evidence for defining higher density by using the specifications for density definitions for the Mackay region in Queensland, Australia. According to the Mackay criteria, high density refers to 100 or more site dwellings (dwellings per ha), net density of 86 or more (dwellings per ha), an unspecified lot size (based on lots occupied by one dwelling), and consists of medium-rise and high-rise apartments as the typical building form (ibid: 10).

Similarly, Badland et al (2017: 19) uses the ABS ‘mesh block unit’ as an area within which to calculate density based on ‘dividing the number of residential units by the size of the SA1 and collapsed into quartiles’. Other density measures highlighted by Badland et al., (2017: 22) draw on the 2006 South Australia Planning Document, which categorises net dwelling density on a spectrum from very low to high with fewer than 17 dwellings per hectare being regarded as very low and more than 67 dwellings per hectare being regarded as high.

- ***Using evidence of population density and numbers of units within a specific spatially defined area (2 out of 141 articles)***

Easthope and Judd (2010: 2) draw on evidence of population density and numbers of units within a specifically defined data to define density as 'the number of units (people, dwellings, employees) per unit of land area. Easthope and Judd's (2010: 2) understanding of high density consists of over 60 dwellings per hectare and generally in units of five storeys or more. This, they argue, is associated with positive health outcomes. Similarly, Udell et al., (2014) defines high density as consisting of over 60 dwellings per hectare and argue that this is the minimum required to promote walking behavior to generate positive health outcomes.

### *3.2.3: Using health-related evidence to link health to higher density descriptively or qualitatively and in opposition to the health determinants of low density living*

Fourteen out of 141 articles examine health in relation to high density descriptively or qualitatively and in opposition to the health determinants of low density living (Christian et al., 2011; Feng et al., 2010; Fincher, 2004; Gifford, 2007; Giles-Corti et al., 2014; Giles-Corti et al., 2016; Kalcheva et al., 2016; Lee and Chan, 2008; Lofti et al., 2009; Redman and Jones, 2005; Seo, 2002; Seo and Chan, 2011; Soderstrom et al., 2016; Yang, 2008). The types evidence used to generate understandings of high density varied across the 14 articles:

- ***Using indicators of health outcomes to compare evidence for higher and lower densities (8 out of 141 articles)***

Eight out of these 14 articles drew upon health evidence to contrast high and low density environments and emphasized the need to 'build up' in order to avoid health problems associated with urban sprawl, particularly those that result from car dependency and sedentary lifestyles that are viewed as an indirect consequence of low-density living (see Christian et al., 2011; Feng et al., 2010; Fincher, 2004; Giles-Corti et al., 2014; Giles-Corti et al., 2016; Lofti et al,. 2009; Redman and Jones, 2005; Yang, 2008). The evidence used to compare the health benefits of higher density to lower densities included Giles-Corti et al.,'s (2014) examination of national liveability indicators that are (a) aligned with state and federal urban policy, (b) developed using national data (where available), (c) standard and consistent

over time, (d) suitable for monitoring progress towards creating more liveable, equitable and sustainable communities, (e) validated against selected non-communicable disease risk behaviours and/or health outcomes, and (f) practical for measuring local, national and federal built environment interventions. Redman and Jones (2005) drew on cross-sectional empirical data pertaining to economic growth, poverty rates, pollution levels, disease rates and social inequality, in addition to comparative data focusing on land expansion, energy demand and food demand, consumption and accessibility across different spatial areas.

- ***Using objective and subjective quality of life evidence to undertake a comparison between low and higher density living environments (1 out of 141)***

Lofti et al., (2009) draws on evidence from objective and subjective methods of measuring quality of life in urban spaces to contrast high and low density environments. The objective measures included drawing on Geurs and Ritsema van Eck's (2003, in Lofti et al., 2009) three basic perspectives on the measurement of accessibility. These are 1). Infrastructure-based measures to describe the level of service in transport infrastructure, 2). Activity-based measures to describe the level of access to spatially distributed activities and 3). Utility-based measures that focus on the (economic) benefits people derive from access to spatially distributed activities. The subjective methods used involved drawing on evidence from field studies such as questionnaires and interviews to understand urban resident tendencies and mental imagination and calculating the satisfaction of neighborhood residents to the local facilities on the basis of direct interviews. Statistical sampling was used to obtain a target group in two neighbourhoods, with the total samples and samples for each neighbourhood being calculated using the Proportional Allocation Method.

- ***Examining evidence pertaining to health behaviours and choices in relation to the design of the built environment (5 out of 141 articles)***

Five articles emphasise how differences in the density of environment can influence behavior (Christian et al., 2011; Feng et al., 2010; Fincher, 2004; Giles-Corti et al., 2016; Yang, 2008). For example, Christian et al.'s (2011) study of walking behaviour in mixed land use argues that walkable neighbourhoods are conducive to transport walking, and recreational walking, both of which promote physical activity, which are linked to human health benefits. Evidence used to draw conclusions involved examining different entropy based computations of land

use mix used in the development of walkability indices and their association with walking behavior, drawing on participant self-reported mins/week of recreational, transport and total walking using a neighbourhood physical activity questionnaire.

- ***Using evidence of neighbourhood satisfaction levels (1 out of 141 articles)***

Yang's (2008) study of neighbourhood satisfaction implies that healthy higher density is when people feel satisfied with their neighbourhood and feel safe. This study involved examining evidence of the effects of neighborhood housing density, land use mix, the mix of housing structure types, and street network connectivity on residents' ratings of neighborhood satisfaction by using evidence from a multilevel dataset that combined individual household information with neighborhood contextual variables across two different case study sites.

- ***Evidence of lifestyle and activity levels (3 out of 141 articles)***

Fincher (2004) conceptualises high density as the opposite of the low density and mundane urban family home. It is an urban form associated with a particular type of lifestyle ('exciting'), and characteristic of dwellers. Implied here is the experience of high density is more desirable and positively psychologically rewarding than non-high density living, and this could be assumed to have beneficial mental health outcomes for some. Fincher uses evidence obtained from an examination of developers' narratives about the construction of expensive, high rise housing in central Melbourne, for themes that characterise the taken-for-granted ways in which these developers view the gendered life courses of housing consumers and analyzing how these narrative reiterate the characteristics of an essentialised 'empty nester', or 'young professional' housing consumer, who is envisaged to occupy the new housing and is defined according to life course stage and gender. Feng et al., (2010) defines density as a measure of the amount of activity found within an area that can be defined in terms of population, housing unit, or employment density; however, they use the term 'high density' to mean anything higher than low density and note that there is no consensus on how the term should be used. Feng et al., (2010) draw on epidemiological literature focusing on the relationship between the built environment and obesity to identify differences in health outcomes between lower and higher density settings.

Giles-Corti et al., (2016) refers to density as an aspirational measure for particular health outcomes: ‘sufficient density’ for walking and ‘optimum density’ for social contact: High density = aspirational for health outcomes characterised by sufficient space for walking and social contact. This article draws on evidence from transport planning and design interventions that directly and indirectly affect health by influencing daily living options and transport mode choices and demand, which in turn determine eight risk exposures related to road trauma, and other adverse health outcomes, which ultimately determine quality of life and health, social, and environmental equity.

- ***Socio-economic and crime-level data with observation of environmental aesthetics and building design (6 out of 141 articles)***

Six articles refer to ‘higher density’ descriptively, in terms of built environment aesthetics and as sites of socioeconomic poverty and the production and reproduction of health inequalities and social problems, such as crime (Seo, 2002; Gifford, 2007; Lee and Chan, 2008; Seo and Chiu, 2014; Soderstrom et al., 2016; Yang, 2008). Articles based on studies conducted within the UK (2 out of 141) link higher density to health via evidence of high socio-economic poverty, poor health outcomes and distinctive high rise architectural styles, increased hazard risk from fire or accidents, and run-down neighbourhoods.

- ***Examining subjective evidence of resident experiences of ‘dwelling’ and ‘living’ in relation to features of the built environment (1 out of 141 articles)***

One articles examine the way density is experienced through the concept of dwelling. Gifford (2007), does not examine healthy high density per se, but rather considers what aspects of higher density living are good or bad in relation to: experiencing the dwelling; residential satisfaction and preferences; strain, crowding and mental health; suicide; behaviour problems; crime and fear of crime; prosocial behaviour; social relations; and children in high rises. Gifford (2007) draws on a range of evidence and methodological approaches in order to draw conclusions about higher density environments and ranks these in order of methodological validity:

1) In the simplest and least rigorous design, an outcome measure (e.g., satisfaction or helping behavior) is examined in a case study of a single high rise or solely in high-rise buildings;
2) Second, research designs involve comparing high rises with low rises,
3) Third, more sophisticated research designs compare numerous high rises with numerous low rises, and consider at least some potential moderators, perhaps in a more sophisticated correlational or quasi-experimental design
4) Research designs compare many high rises with many low rises and considers many potential moderators, but also involve (a) random or essentially random assignment of residents to buildings and (b) investigator control of key variables.
5) Studies that involve assessing the progress of a group of residents over time, in a longitudinal design.

- ***Using qualitative and quantitative survey data (3 out of 141 articles)***

Studies that explore the gentrification of higher density living environments and the impact on health draw on evidence from questionnaire surveys to examine the opinions of health professionals and citizens (Seo and Chiu, 2014; Yang, 2008). These surveys can include the gathering of both qualitative and quantitative survey data and the use of regression analysis and qualitative analysis (Seo and Chiu, 2014). Yang (2008) draws on empirical survey data in a comparative analysis of the subjective measurements of quality of life. This involved: 1) empirical assessment of environmental characteristics associated with compact development from a user's perspective, 2) use of hierarchical modelling to assess the relationship between the form of the built environment and survey evidence for measuring quality of life, and 3) examination of whether the findings can be explained by latent disparities in environmental qualities and people's attitudes.

One study defines density as a site associated with qualitative experiences of sensory overload and increased risk of mental ill health and poor recovery from mental ill health (Soderstrom et al., 2016). In this study, higher density is presented as places associated with an enhancement of the mental health risks identified and associated with urban living.

- ***Drawing on findings from observational research***

One article – Soderstrom et al., (2016) argues that while epidemiology has been very useful in ‘correlating discrete elements in urban neighbourhoods such as social deprivation and fragmentation with an increased risk of later developing psychosis’ its methodology cannot account for ‘how different aspects of urban living (from air quality and noise to social interaction and place-attachment) interact in the life experience of individuals’ (Soderstrom et al., 2016: 104). Instead, Soderstrom et al., (2016) draw on the findings from sensory observation in order to try to capture the subjective sensory experience of living in higher density urban environments.

### *3.2.4: Theoretical focus of literature using health-related evidence to link health to higher density*

Using the three theoretical domains outlined in Section 1 of this Evidence Review, this section outlines the theoretical focus of the literature that uses health-related evidence to link health to higher density living environments.

#### 3.2.4.1: Global Public and Population Health

The only article that provided a specific definition of ‘Healthy Higher Density’ living environments - Giles-Corti et al., (2012) - was grouped within the Global Public and Population Health domain. This article drew on evidence from data from cross-sectional data from a range of studies.

Only one out of the 12 articles that link health to higher density through socially defined, quantitative sets of criteria was grouped within Global Public and Population Health (Easthope and Judd, 2010). However, it is worth noting that Easthope and Judd (2010) was also grouped within the Social-Ecological Determinants of Health domain because it discusses elements pertaining to both perspectives in its review of existing literature on higher density living. This article drew on evidence of population density and numbers of units within a specifically defined data to define density as ‘the number of units (people, dwellings, employees) per unit of land area’ required to promote positive health outcomes.

Two of the 14 articles that linked health to higher density through descriptions and qualitative information or in opposition to the health determinants of low density living were grouped

within the Global Public and Population Health domain (Giles-Corti et al., 2012; Redman and Jones, 2005). These articles drew on evidence of national liveability indicators (Giles-Corti et al., 2012) and cross-sectional empirical data (Redman and Jones, 2005).

3.2.4.2: Social-Ecological Determinants of Health

All 12 out of 12 articles that used health-related evidence to link health to the higher density living environment through socially defined, quantitative sets of criteria were grouped within the Social-Ecological Determinants of Health domain (Allen and Blandy, 2004; Badland et al., 2017; Cho et al., 2017; Easthope and Judd, 2010; Forsyth et al., 2007; Guo et al., 2017; Haigh et al., 2011; Kalcheva et al., 2016; Randolph and Tice, 2011; Talen, 2006; Udell et al., 2014; Zhang and Lawson, 2009). The range of evidence drawn upon in these articles included government specifications for density definitions (Haigh et al., 2011), official planning regulatory documents (Badland et al., 2017), and evidence of the number of housing units per area required to promote healthy behaviours (see Udell et al., 2014).

12 out of the 14 articles that linked health to high density descriptively or qualitatively and in opposition to the health determinants of low density living were grouped within the Social-Ecological Determinants of Health domain (Christian et al., 2011; Feng et al., 2010; Fincher, 2004; Gifford, 2007; Giles-Corti et al., 2016; Kalcheva et al., 2016; Lee and Chan, 2008; Lofti et al., 2009; Seo, 2002; Seo and Chan, 2011; Soderstrom et al., 2016; Yang, 2008). A wide range of evidence was drawn upon in these articles, ranging from: participant self-reported data (Christian et al., 2011), multi-level data sets (Yang, 2008), analysis of developer narratives (Fincher, 2004), objective and subjective indicators of quality of life (Lofti et al., 2009), survey questionnaire data (Lofti et al., 2009), interview data (Lofti et al., 2009; Soderstrom et al., 2016), epidemiological data (Feng et al., 2010), and evidence from transport planning documents (Giles-Corti et al., 2016).

3.2.4.3: Planetary Health

None of the articles that drew on health-related evidence to link health to higher density were grouped within the Planetary Health domain. Likewise, none of the articles that linked health to density via qualitative descriptors were included in this category.

### *3.2.5: Use of Health-Related Evidence to to Link Health to Specific Features of the Higher Density Built Environment*

A significant number of articles within the sample discuss specific features of the higher density built environment that are key to improving health outcomes. These articles draw upon various types of health-related evidence in order to indirectly link particular health attributes to specific features of the built environment. The types of evidence used in order to develop this link vary according to the theoretical perspective of health that each article is embedded upon.

#### 3.2.5.1: Global public and population health

Several articles (14 out of 141) focused on healthy higher density from within Global Health, Public Health and Population Health perspective. These articles explored healthy higher density living in terms of improving health outcomes for the wider population and by designing cities and approaches to urban development that maximise human health outcomes and are responsive to 21st century global population health challenges (Easthope and Randolph, 2009; Easthope and Judd, 2010; Giles-Corti et al., 2012; Grant et al, 2017; Hanlon et al., 2012; Randolph and Holloway, 2005).

The specific types of evidence used within the articles grouped within this category ranges from:

- Epidemiological cross sectional health research data (12 out of 14 articles);
- Reviews of existing academic literature pertaining to health and the built environment (5 out of 14 articles);
- Reviews of the local impacts of urban consolidation and the Australian paradigm of metropolitan planning (3 out of 14 articles);

- A discussion of the role of strata as governance in relation to the upkeep of high density living, drawing on evidence in the form of literature review, legal framework, and strata schemes (3 out of 14 articles);

- The use of the ABS Index of Disadvantage to construct social profiles of different environmental contexts (1 out of 14 articles);

- Review and application of existing academic literature focusing on lifestyle choice and health outcomes (1 out of 14 articles);

- Empirical data of evidence of health indicators from 109 countries (1 out of 14 articles);

- Cross-sectional data focusing on economic growth, poverty rates, pollution levels, disease rates and social inequality (1 out of 14 articles).

A breakdown of the types of evidence that can be identified in the articles grouped within Global Public and Population health that are used to link health to specific features of the built environment is detailed below:

- ***Epidemiological cross-sectional study data (12 out of 14 articles)***

Twelve articles draw on evidence from epidemiological cross-sectional research data. Two of these focus specifically on the need to improve population health outcomes in the megacity context, with a particular focus on Asia, recognising the need for increasingly dense cities to meet the needs of growing urban population in developed countries (Grant et al., 2017; Hanlon et al., 2012: 313). Grant et al., (2017) draws on evidence of morbidity and mortality from a range of health conditions in order to draw conclusions about the existing public health challenges across the globe and over a period of time. For example, they examine facts and figures concerning the rise of communicable diseases and injuries, growth of mental ill health and substance abuse, chronic infectious diseases such as HIV, and acute conditions resulting from poor sanitation. Hanlon et al., (2012) discuss how epidemiological data is most commonly used in public health to measure and assess health outcomes within different global locations, however they argue that global health needs to be more integrative and more

ecological in its use of evidence in order to fully appreciate how social and cultural factors influence health outcomes in different contexts.

Eight articles focus on how physical health outcomes can be linked to specific features of the built environment. These articles draw on secondary data from existing epidemiological studies to support conclusions about the relationship between health and the environment, and to compare outcomes over time and across different geographic contexts. For example, Grant et al., (2017) recommend the use of higher density development to reduce deaths from chronic diseases in the developed world. They use comparative morbidity and mortality statistics for chronic diseases in developed and developing countries to support this recommendation. Healthy higher density environments can contribute to reducing chronic diseases (e.g. ischaemic heart disease, stroke, lower respiratory infections and chronic obstructive lung disease), which are more commonly associated with urban lifestyles and increasingly sedentary behaviours (Grant et al., ibid). Similarly, Giles-Corti et al., (2012) draw on secondary epidemiological data to explain that creating and sustaining healthy higher density living conditions represents a growing public health challenge. Evidence of chronic disease, transport use data, and data on physical activity are also used to argue that high density developments can improve human health outcomes through prioritising walking, cycling and public transport over motor vehicle travel, and by enhancing interaction to reduce incidents of physical ill-health. According to Giles-Corti et al., (2012) health in higher density cities can be measured in terms of rates of chronic disease, specifically heart disease, respiratory disease, diabetes, and levels of obesity. Similarly, Wells et al., (2010) draws on secondary empirical data from medical and social sciences to highlight connections between chronic disease outcomes and residential-environment characteristics, including density. Redman and Jones (2005) also draw on epidemiological data from the existing literature to compare and contrast the physical health outcomes associated with urban expansion between developing and developed countries.

Two articles draw on secondary epidemiological cross sectional data of incidences of mental ill-health (i.e. rates of depression and anxiety) to illustrate how reducing physical inactivity, sedentary behaviours and unhealthy diets through high-density development will also help to improve mental health outcomes (Giles-Corti et al., 2012) and to demonstrate how air pollution rates, noise and heat island effects that characterise dense city environments can also be linked to poor mental health outcomes (Grant et al., 2017: 1).

- ***Reviews of existing academic literature pertaining to health and the built environment (3 out of 14 articles)***

One article - Easthope and Judd (2010: 4) - discuss the development of high-density living environments in Australia within the context of the challenges posed to public health because of the growth of the urban population. This study uses evidence from existing academic literature in order to draw conclusions about the factors necessary to generate the conditions associated with healthy higher density. Easthope and Judd's (2010) work is highly pertinent to high density, with its focus on 'living well' in greater density. Multiple factors are identified which are of salience for healthy higher density. The need to cater for diverse populations, including those on low to moderate incomes, and families with children, is highlighted, as higher density needs to meet the needs of all types of residents (Easthope and Judd 2010: 16). Evidence of neighbourliness and a sense of social cohesion was identified as an important factor for healthy higher density (Easthope and Judd, 2010: 21).

Three articles draw upon the findings from existing academic literature to link mental health to attributes of the higher density built environment. One of these examines how increasing higher density development will improve mental health outcomes by promoting safety, comfort and interaction, which can help to reduce rates of depression, loneliness and anxiety (Easthope and Judd, 2010). Another, King (2018), reviews existing academic evidence-based literature to examine the link between air pollution and mental health outcomes, arguing that high-rise buildings can help reduce exposure to pollution and proximity to major roads, which can help to improve mental health outcomes. In addition, Barton (2009) draws upon the findings from existing studies to argue that healthy dense urban environments can reduce rates of mental ill health by ensuring access outdoor green and recreational spaces and well-designed indoor spaces.

- ***Reviews of the local impacts of urban consolidation and the Australian paradigm of metropolitan planning (3 out of 14 articles)***

Three studies within this category drew on evidence pertaining to infrastructure and transport provision, emphasizing the positive health outcomes associated with lower exposure to traffic pollution, increased walking for transport and less sedentary lifestyles (Bunker and Holloway,

2007; Easthope and Judd, 2010; Searle, 2007). In particular, Bunker and Holloway (2007) and Searle (2007) discuss how urban planners have responded to this challenge by focusing on higher density forms of housing to create more compact cities, which present solutions to the public health problems generated by residential urban growth. These studies draw on the findings of a review of the local impacts of densification in three local government areas in Sydney (Bunker and Holloway, 2007), and the Australian paradigm of metropolitan planning (Searle, 2007).

- ***A discussion of the role of strata as governance in relation to the upkeep of high density living, drawing on evidence in the form of literature review, legal framework, and strata schemes (3 out of 14 articles)***

Three other articles within this category discuss how higher density development presents the best option for meeting the health needs of an emerging urban demographic population profile. Easthope and Judd (2010) use the findings from a review of existing academic literature to argue that a discrepancy exists between emerging household types (for example, increasing numbers of smaller households) and available dwellings. Easthope and Randolph (2009) discuss the role of strata as governance in relation to the upkeep of high density living, drawing on evidence in the form of literature review, legal framework, and strata schemes. Hence, strata schemes could be taken as a form of health evidence. Easthope and Randolph (2009) use this evidence to argue that smaller households will not automatically be more likely to choose to live in small dwellings. A third study discusses how higher density housing attracts diverse household types, including families with children on low to moderate incomes (Randolph and Holloway, 2005).

- ***The use of the ABS Index of Disadvantage to construct social profiles of different environmental contexts (1 out of 14 articles)***

Randolph and Holloway's (2005) study uses the ABS Index of Disadvantage to distinguish locations where comparable levels of social disadvantage are associated with very different housing markets, one where public housing is prominent and others which are primarily areas of private sector housing, in order to construct social profiles of both types of area.

- ***Review of existing academic literature pertaining to lifestyle choice and health outcomes (1 out of 14 articles)***

One article within the articles grouped within the Global Public and Population Health domain - Barton (2009) – draws on the findings from a review the existing literature pertaining to lifestyle choices in relation to physical activity and diet in order to examine physical health inequalities in relation to transport planning and the form of the built environment.

- ***Empirical data of evidence of health indicators from 109 countries (1 out of 14 articles)***

One article, Flood (1997) draws on quantitative empirical data to examine poverty rates, shelter conditions, transport availability, and land management, across 236 cities from 109 countries. This data was gathered in the 1990s for the UNCHS (Habitat) Indicators Programme to provide baseline data to compare the conditions of human settlements over the course of time, and to measure the effectiveness of action plans and policies. From this data, 46 key indicators of healthy urban living conditions were derived.

- ***Cross-sectional data focusing on economic growth, poverty rates, pollution levels, disease rates and social inequality (1 out of 14 articles)***

Using a different evidence base from which to conceptualise a healthy living environment, Redman and Jones (2005), draw on cross-sectional empirical data on economic growth, poverty rates, pollution levels, disease rates and social inequality. In addition, they also draw on comparative data from previous studies focusing on land expansion, energy demand and food demand, consumption and accessibility across different spatial areas in order to argue that higher density environments in developed countries need to be future-orientated in their design and be designed to address the dramatic increase in life expectancy and chronic disease rates.

3.2.5.2: Socio-Ecological Determinants of Health Perspectives

The specific types of evidence drawn upon to link attributes of health to key features of the higher density living environment for the 109 articles embedded upon a Socio-Ecological Determinants of Health perspective were:

- Reviews and analysis of existing academic literature and secondary research data (55 out of 109 articles)
- Primary and secondary data focusing on walking behaviour and health outcomes (18 out of 109 articles)
- Evidence of how environmental factors influence light, air and heat-related health outcomes (18 out of 109 articles)
- Primary and secondary data focusing on socio-cultural contextual factors, human health and the built environment (14 out of 109 articles)
- Primary and secondary data examining age, health outcomes, and the built environment (12 out of 109 articles)
- Evidence of proximity to services and health outcomes (10 out of 109 articles)
- Quantitative data from resident survey questionnaires (7 out of 109 articles)
- Review of existing policy documents and literature (6 out of 109 articles)
- Qualitative interview data (6 out of 109 articles)
- Data from Mapping, Modelling and Simulation Techniques (6 out of 109 articles)
- Comparative case study evidence (4 out of 109 articles)
- Data focused on the gendered dimensions of health outcomes (4 out of 109 articles)
- Evidence of building design and rates of mental ill-health (4 out of 109 articles)
- Evidence of crime rates, information about types of crime, and evidence of resident worries about crime (3 out of 109 articles)
- Site observations and visual data (3 out of 109 articles)
- Objective and subjective quality of life indicators (3 out of 109 articles)
- Use of census or other quantitative data, e.g. economic/transport data and/or combined with spatial/geographic measures (3 out of 109 articles)
- Recorded video diaries (2 out of 109 articles)
- Reviews of Health Impact Assessments (2 out of 109 articles)
- Evidence of quality of indoor space and data focused on mental health outcomes (2 out of 109 articles)
- Evidence from a public lecture (1 out of 109 articles)
- Evidence from evaluation of existing planning developments (1 out of 109 articles)

- Evidence of resident perception of hazard risk (1 out of 109 articles)
- Statistics focusing on suicide rates in higher density environments (1 out of 109 articles)
- Open-ended, qualitative resident survey questionnaires (1 out of 109 articles)
- Review of existing health baseline data (1 out of 109 articles)
- Systematic analysis of site plans (1 out of 109 articles)

A breakdown of how these types of evidence are used to draw conclusions linking health to features of the higher density build environment is presented below:

- ***Reviews and analysis of existing academic literature and secondary research data (55 out of 109 articles)***

Fifty-five out of the 109 articles embedded upon a Social-Ecological Determinants of Health perspective draw on the findings from review of existing academic literature and the analysis and discussion of secondary research data in order to link health to key features of the higher density urban built environment.

Thirteen of these 55 articles drew upon reviews of the existing academic literature to investigate the link between quality of life and the higher density built environment (Allen and Blandy, 2004; Badland et al 2017; Buys and Miller, 2012; Easthope and Judd, 2010; Gifford, 2007; Giles Corti et al., 2016; Haarhoff et al., 2016; Holman et al., 2015; Kalcheva et al., 2016; Lofti and Koohsari, 2009; Lusher et al., 2009; Yang, 2008; Zhang and Lawson, 2009). Kalcheva et al., (2016) draw on existing research and their own site observations of high rise developments in Salford Quays in the UK to understand the development quality, the sufficiency of infrastructure, and the use of public space, in relation to resident quality of life. Similarly, Yang (2008: 312) examined the relationship between built form and quality of life drawing on a literature review and analysis of secondary data from the American Housing Survey and the Transportation Planning Package in order to aggregate individual levels of neighbourhood satisfaction. Gifford (2007) reviewed literature on living in high rise buildings to examine whether high rises are good or bad for the people living in them. Further, Holman et al., (2015) drew on the literature and case studies of high rise developments in London to understand how to balance the positive and negative impacts of high density.

Twenty out of the 55 articles draw on evidence presented in the existing body of academic literature to link attributes of the higher density built environment to physical health outcomes. For example, Christian et al., (2011), Cowie et al., (2016); Forsyth et al., (2007); and Haigh et al., (2011) all drew on evidence from the existing academic literature to examine the impacts of physical activity on overall health, and investigated the relationship between dwelling and population density and walking behaviour.

Three articles out of 55 drew on evidence from previous study, previously collected data sets, and the existing body of scholarly literature in order to link the higher density built environment specifically to mental health outcomes (Soderstrom et al., 2016; Soderstrom et al., 2017; Volker and Kistemann, 2015). For example, Soderstrom et al., (2017) and Soderstrom et al., (2016) identified a relationship between psychosis and density by drawing on other prior quantitative studies.

Twenty-nine out the 55 articles examine the relationship between socio-economic inequalities and health inequalities amongst the population in high-density environments. For example, Hancock (2017: 9) draws on insights from decades of research to highlight how people living in poverty are less healthy, less educated, less economically and socially productive, and more likely to be excluded from participating in the social, civic and cultural life of their communities compared to wealthier members of society. Similarly, Easthope and Judd (2010), review existing academic literature to discuss how those forced to live in smaller accommodation as a result of financial constraints, are more susceptible to health problems associated with overcrowding. Ormandy and Ezratty (2016) review existing literature to discuss how heat related mortality are more prevalent amongst residents with low-socio economic status who live in higher density living environments (Ormandy and Ezratty, 2016). Lloyd and Reid (2013) draw on existing research to examine social cohesion in higher density communities amongst residents with varying socio-economic capital.

- ***Primary and secondary data focusing on walking behaviour and health outcomes (18 out of 109 articles)***

Eighteen articles use evidence comprising primary and secondary data focusing on walking behaviour and health outcomes (For examples see Chan and Lee, 2008; Evans et al., 2003; Ewing et al., 2007; Ewing et al., 2008; Forsyth et al., 2008; Giles-Corti et al., 2012; Giles-

Corti et al., 2014; Giskes and van Lenthe, 2011; Gómez-Jacinto and Hombrados-Mendieta, 2002; Greenwald and Boarnet, 2001; Heath et al., 2006; Leal and Chaix, 2011; Lu et al., 2017; Moudon and Lee, 2003). These studies focus on reducing cardiovascular and cancer mortality, obesity rates, road traffic mortality and respiratory health through improving access to physical activity through the design of the higher density built environment.

- ***Evidence of how environmental factors influence light, air and heat-related health outcomes (18 out of 109 articles)***

Eighteen articles that are embedded upon a Socio-Ecological Determinants of Health perspective discuss evidence of the relationships between environmental factors such as light, heat ventilation and air quality in determining human health outcomes (Badland et al., 2017; Buys and Miller, 2012; Chan and Liu, 2018; Cowie et al., 2016; Ewing and Rong, 2008; Giles-Corti et al., 2012; Guo et al., 2017; Haigh et al., 2011; Hu et al., 2016; Kane and Whitehead, 2018; Kent and Thompson, 2014; Lowe et al., 2015; Nicholls et al., 2017; Ormandy and Ezratty, 2016; Roulet et al., 2006; Taylor et al., 2016; Vandentorren et al., 2006; Wilson et al., 2008). Five articles specifically discuss the importance in urban planning of ensuring that streets are designed to limit human exposure to traffic fumes to help to reduce rates of chronic respiratory illness in residents, such as asthma and chronic bronchitis, and to encourage greater outdoor activity (Cowie et al., 2016; Giles-Corti et al., 2012; Kane and Whitehead, 2018; Kent and Thompson, 2014; Lowe et al., 2015). Thirteen articles discuss the impacts of extreme heat and/or insufficient thermal control (to either heat or cold temperatures) on human health, examining how temperature extremes are linked to increased mortality and a range of negative health outcomes (Badland et al., 2017; Buys and Miller, 2012; Chan and Liu, 2018; Ewing and Rong, 2008; Guo et al., 2017; Haigh et al., 2011; Hu et al., 2016; Nicholls et al., 2017; Ormandy and Ezratty, 2016; Roulet et al., 2006; Taylor et al., 2016; Vandentorren et al., 2006; Wilson et al., 2008). While 18 articles refer to this type of evidence however, 12 articles make reference to existing data and studies rather in order to draw conclusions than to develop this form of evidence in new ways in order to generate new findings altogether.

- ***Primary and secondary data focusing on socio-cultural contextual factors, human health and the built environment (14 out of 109 articles)***

Fourteen examine how deeply embedded socio-cultural beliefs and practices can create barriers to promoting positive health outcomes amongst higher density residents (Acioly and Davidson, 1996; Allen and Blandy, 2004; Gifford, 2007; Giles-Corti et al., 2012; Giles-Corti et al., 2014; Gunn et al., 2017; Hancock, 2017; Holman et al., 2015; Jabareen, 2006; Johnston-Lawrence et al., 2015; Randolph. 2006; Seo and Chiu, 2014; Zhang and Lawson, 2009). For example, Kent (2015) draws on evidence from a review commissioned by the Heart Foundation to discuss how the social and cultural makeup of the community will affect the capacity of the community to adapt to different ways of living, working and socialising, with those with lower levels of educational achievement being more likely to succumb to the negative health impacts associated with higher density living (ibid). Eleven articles discuss evidence of long-standing beliefs about the character of higher density living environments stigmas embedded in western contexts associated with higher density living, which limit the effectiveness of health promoting behaviours (Acioly and Davidson, 1996; Allen and Blandy, 2004; Gifford, 2007; Giles-Corti et al., 2014; Gunn et al., 2017; Holman et al., 2015; Jabareen, 2006; Johnston-Lawrence et al., 2015; Randolph, 2005; Seo and Chiu, 2014; Zhang and Lawson, 2009). These articles draw on evidence of socio-cultural beliefs and resident perceptions of higher density living environments from review of the existing academic literature and from primary evidence from comparative case study research. For example, Allen and Blandy's (2004) case study in Manchester, UK, found that healthy agers and members of the Lesbian, Gay, Bisexual and Transgender (LGBT) community were more attracted to high-density city living than others. In contrast, resistance to high density was found to be strongest in families with young children and in those of retirement age (ibid). Four articles draw on empirical case studies and evidence from practice-based studies to mention how education can help to challenge embedded socio-cultural beliefs that inhibit the adoption of healthy behaviours amongst residents in high-density developments (Acioly and Davidson, 1996; Giles-Corti et al., 2014; Gunn et al., 2017; Jabareen, 2007). For example, Giles-Corti et al., (2014) emphasise that there is a need for a combination of built environment features and education required to change behaviour to promote physical activity.

- ***Primary and secondary data examining age, health outcomes, and the built environment (12 out of 109 articles)***

Twelve articles focus on age and inequalities in human health outcomes in higher density contexts (Beer and Faulkner, 2009; Chan and Liu, 2018; Christian et al., 2017; Giles-Corti et al., 2012: 13; He et al., 2014; Nicolls et al., 2017; Powers, 2013; Shi, 2017; Sherry and Easthope, 2016; Taylor et al., 2016; Vandentorren et al., 2006; Villanueva et al., 2016). For example, Giles-Corti et al., (2012) discusses health equity in relation to how healthy higher density environments can reduce mortality in older adults by ensuring access to green space to halt the development of risk factors for chronic diseases (Giles-Corti et al., 2012: 7). Four articles draw on demographic data to discuss the relationship between age and vulnerability to the health risks associated with heatwaves and extreme cold in higher density environments, emphasising how elderly people and young children are more likely to be at risk of health problems compared to other members of the population (Chan and Liu, 2018; Nicholls et al., 2017; Vandentorren et al., 2006; Taylor et al., 2016). Six articles draw on evidence of child cognitive development, mental health, physical health and behaviour to examine how children's health can be enhanced in higher density environments (Giles-Corti et al., 2012: 13; He et al., 2014; Powers, 2013; Shi, 2017; Sherry and Easthope, 2016; Villanueva et al., 2016). Similarly, Christian et al., (2017) draws on data pertaining to developmental vulnerability from the 2012 AEDC population-wide census of all Australian children in their first year of schooling to examine the effect of high density living on childhood development.

- ***Evidence of proximity to services and health outcomes (10 out of 109 articles)***

Ten articles within the sample draw on evidence examining residential proximity to services and outcomes for physical health (Giles-Corti et al., 2014; Haigh et al., 2011; Kane and Whitehead, 2018; Kent, 2015; Kent and Thompson, 2014; Lowe et al., 2015; Lu and Ye, 2017; Paciência & Moreira, 2017; Thompson, 2013; Udell et al., 2014). For example, Paciência & Moreira (2017) explain how urban density and land use mix are associated with reduced levels of obesity because high-density areas can support increased levels of physical activity because of creating nearby walkable destinations. However, they acknowledge that the relationship between obesity levels and density is complex, because street intersections and mixed land use, together with low physical activity can increase reliance on highly processed and high fat foods (ibid). Similarly, a study by Kent and Thompson (2014) discussed how urban design could promote positive health outcomes in higher density areas by promoting behaviours that mitigate physical inactivity through a review of exiting

literature. Kent (2015) and Thompson (2013) also discuss how density can influence opportunities for physical activity, which can reduce cardiovascular disease-related deaths, from reviewing the findings in the existing literature. Good cardiovascular health is enabled through access to walkable neighbourhoods, connected streets, quality open spaces and public and active transport. According to Kent (2015), good planning can make these options safe, comfortable and accessible, as grid-like street networks with short blocks can make travel routes more direct. However, this study also acknowledges that good design will not make people more active on its own (Kent 2015). Five studies examine evidence of ability to access fresh food and physical health outcomes (Giles-Corti et al., 2016; Haigh et al., 2011; Kent, 2015; Kent and Thompson, 2014; Lowe et al., 2015).

- ***Quantitative data from resident survey questionnaires (7 out of 109 articles)***

Three articles use survey data specifically designed for residents of higher density development (Buys and Miller, 2012; Cho et al., 2017; Yang, 2008). These surveys are often designed to measure resident satisfaction however other data on practices and indicators related to health are also included.

In addition, three other articles draw on data from survey questionnaires (Christian et al., 2011; Forsyth et al., 2007; Lu et al., 2017) to examine the relationship between walking behavior and the higher density built environment. For example, Forsyth et al., (2007) use the International Physical Activity Questionnaire to measure walking along with physical activity measured by an accelerometer. They also draw on the literature to inform their analysis of findings.

One other article drew on evidence from a standardised and measureable survey questionnaire to examine the relationship between thermal comfort and socio-economic factors in higher density living environments (Vandentorren et al., 2006).

- ***Review of existing policy documents and literature (6 out of 109 articles)***

Four articles presented evidence from a review of existing policy documents and literature to examine the link between quality of life and the higher density built environment (Allen and Blandy, 2004; Badland et al., 2017; Easthope and Judd, 2010; Lusher et al., 2008).

Two other articles drew on evidence from a review of existing policy documents (Bunker et al., 2002; Carmona, 2014) to explore how socio-economic factors affected the impact of higher density living in influencing of positive and negative health-related outcomes.

- ***Qualitative interview data (6 out of 109 articles)***

Five articles draw upon data from interviews to link human wellbeing and quality of life to the higher density built environment (Allen and Blandy, 2004; Easthope and Judd, 2010; Haarhoff et al., 2016; McCrea and Walters, 2012; Reid et al., 2017). For example, McCrea and Walters (2012) interviewed residents at two Brisbane suburbs to understand their experiences of densification. In relation to the needs of residents, Reid et al., (2017) investigated female experiences of vertical apartment living in Queensland, drawing on semi-structured interviews as a data source. Haarhoff et al., (2016) took a nuanced approach to understanding the multiple dimensions and experiences of high density, drawing on evidence from interviews with residents in medium and high-density housing in Auckland, New Zealand, to understand liveability. This included exploration of housing choices, trade-offs for living in higher density, and how their experiences of higher density influenced their perceptions, and future housing aspirations.

Another article drew on evidence from interviews to examine the health risks associated with heat stress and socio-economic factors amongst residents living in high rise buildings in France (Nicholls et al., 2012).

- ***Data from Mapping, Modelling and Simulation Techniques (6 out of 109 articles)***

Two articles draw on evidence from mapping, modelling and simulation techniques to link health to attributes of the built environment in higher density contexts (Badland et al., 2013; Lu et al., 2017). For example, Badland et al., (2013: 3) drew on data in AURIN to generate scenarios for modelling walking behaviour to determine health outcomes, focusing on proximity to destinations in Melbourne. Lu et al., (2017) study of walking behaviour drew on Geographic Information System data for 36 housing estates in Hong Kong to explore the importance of proximal destinations on walking behaviour.

A further three articles drew on evidence from GIS mapping, modelling and simulation techniques to examine links between socio-economic inequalities and health inequalities amongst residents living in higher density built environments (Badland et al., 2017; Cho et al., 2017; Taylor et al., 2016). One article uses evidence obtained from GIS mapping and simulation techniques to explore heat related stress in relation to socio-economic and income levels in the urban built environment (Taylor et al., 2016). In addition, Badland et al., (2017) examined associations between area-level measures of housing density, tenure and affordability with individual-level measures of neighbourhood safety, community satisfaction and self-rated health. The study found that those living in areas with less affordable housing were more likely to feel unsafe and dissatisfied in the community. Renting also increased the likelihood of reporting poor self-rated health (ibid). Cho et al., (2017) undertook a comparative analysis of critical parameters and urban space design in determining health outcomes.

One article discussed evidence obtained from the modelling of future scenarios using simulation technologies and techniques to explore the link between quality of life and the built environment in higher urban density contexts (Allen and Blandy, 2004).

- ***Comparative case study evidence (4 out of 109 articles)***

Three articles draw on evidence pertaining to higher density site case studies and comparisons of sites in order to link health to higher density urban development (Allen and Blandy, 2004; Cho et al., 2017; Holman et al., 2015). For example, Allen and Blandy (2004: 6) undertook case studies in Manchester and Sheffield including interviews with stakeholders (estate agents, sales offices, developers, letting agents, managing agents, lenders, planners, city center managers and a few residents) to explore informed insights into the city center housing market, and emergent problems such as health inequities between population groups. A fourth article, Udell et al., (2014), reviewed evidence from a case study in Australia and overseas in order to understand how neighbourhood environments influence walkability.

- ***Data focused on the gendered dimensions of health outcomes (4 out of 109 articles)***

Four articles discuss the relationship between gender and health outcomes in high-density development and suggest ways that existing inequalities may be countered through

appropriation of the built environment (Fincher, 2004; Foster et al., 2015; Giles-Corti et al., 2012; Reid et al., 2017). One of these four draws on statistics of cardiovascular and cancer mortality for males and females and between those living in high density environments and the general population (Giles-Corti et al., 2012: 8). Another of these four articles, Foster et al., (2015), draws on evidence of gender, evidence of sedentary behaviour, data measuring walking behaviour and evidence of access to community infrastructure. Another article, Reid et al., (2017), draws on feminist theory and evidence of the design of the built environment to argue that vertical high-density city community design is heavily male dominated and reflective of male values and interests. In addition, Reid et al., (2017) also draws on evidence of social inclusion (social relationships, quality of life indicators) to examine gendered differences in quality of life in higher density environments. Similarly, Fincher (2004) also draws on evidence of quality of life, access to green space, and perceptions of safety in relation to gender, as well as in relation to family composition. They found that quality of life outcomes were poorer amongst women with children than those without in higher density environments.

- ***Evidence of building design and rates of mental ill-health (4 out of 109 articles)***

Four articles link the higher density built environment specifically to mental health outcomes, by drawing on evidence examining the link between access to public spaces and the connectivity of street designs for social interaction (Giles-Corti et al., 2012; Kane and Whitehead, 2018; Kent, 2015; Kent and Thompson, 2014).

- ***Evidence of crime rates, information about types of crime, and evidence of resident worries about crime (3 out of 109 articles)***

Three articles highlight the link between crime and fear of crime in densely populated urban areas and the risk of poor mental health outcomes (Giles-Corti et al., 2012; Kent, 2015; Soderstrom et al., 2016). Kent (2015) argues that crime can be reduced through features of environmental design and of the building itself, as well as by promoting cohesive local neighbourhoods, which can improve resident comfort and sense of security, which in turn, can help to lead to positive mental health outcomes.

- ***Site observations and visual data (3 out of 109 articles)***

Three articles focus on data obtained through site observations and from visual photographic evidence (Cho et al., 2017; Kalcheva et al., 2016; Zhang and Lawson, 2009). For example, Cho et al., (2017) compared three high rise developments in Japan, China and Singapore to investigate the qualities and conditions of urban spaces and their overall performance. They conducted site visits and observed the spaces, and also conducted a user perception survey (Cho et al., 2017: 618). Zhang and Lawson (2009) investigated the ways residents in high density in Brisbane (Australia) experience public space using systematic site reviews, and site observations, including notes and photos (Zhang and Lawson, 2009: 209).

- ***Objective and subjective quality of life indicators (3 out of 109 articles)***

Three articles link health to features of higher density living environments through the use of quality of life indicators which could be measured as objective or subjective (Badland et al., 2017; Lofti and Koohsari, 2009). For example, Lofti and Koohsari (2009) drew on objective and subjective measures to understand urban quality of life in a case study site of Tehran, a location with very high density. Objective measures included measures of transport congestion and average travelling speed on the road network, activity measures such as time-space measures at micro-level, and utility-based measures which focused on the economic benefits that people derived from access to spatially distributed activities such as access to schools and stores (Lotfi and Koohsara, 2009: 422-3). Subjective measures were taken from two case study sites which investigated individual's satisfaction with their neighbourhood, objective and subjective measures were compared (Lotfi and Koohsara, 2009: 425). Badland et al., (2017: 18) use data from metropolitan Melbourne to build a case for developing, applying and monitoring liveability indicators and to spatially test pathways associated with health and wellbeing. In a similar vein, in their study of eight new developments in the inner suburbs of 'transitional' Brisbane, Buys and Miller (2012: 324) drew on resident satisfaction opinions in regards to design, neighbourhood, and neighbours using a 22-page questionnaire and Likert measures.

- ***Use of census or other quantitative data, e.g. economic/transport data and/or combined with spatial/geographic measures (3 out of 109 articles)***

Three articles draw on quantitative data such as census data, economic data and data on transport access and use. These are often combined with spatial/geographic measures (Badland et al., 2017; Buys and Miller, 2012; Lofti and Koohsari, 2009). For example, ABS Census data is used to compare respondent demographic characteristics with the overall population in Buys and Miller (2012). In their plan recommending liveable streets for New York, Lusher et al., (2008) draw on a review of the literature, and international plans and policies to suggest quality of life benefits from suitable street design.

- ***Recorded video diaries (2 out of 109 articles)***

Two articles used evidence from the video recorded diaries of the researcher to explore how human and built density impacts on the mental health of people in urban environments (Soderstrom et al., 2016; Soderstrom et al., 2017).

- ***Reviews of Health Impact Assessments (2 out of 109 articles)***

Two articles discussed evidence from a review of Health Impact Assessments (Cowie et al., 2016; Haigh et al., 2011). Cowie et al., (2016) also used an abridged version of the walkability index to ascertain how walkable Sydney neighbourhoods were in relation to traffic density.

- ***Evidence of quality of indoor space and data focused on mental health outcomes (2 out of 109 articles)***

Two articles draw on evidence of mental ill-health and data pertaining to the spatial dynamics and quality of indoor space to argue that high-density environments are more likely to increase rather than decrease social isolation and overcrowding, leading to poor mental health outcomes (Evans et al., 2003; Gómez-Jacinto and Hombrados-Mendieta, 2002).

- ***Evidence from a public lecture (1 out of 109 articles)***

One article drew on evidence from a public lecture (Thompson and Paine, 2017). Thompson and Paine (2017) discuss how obstacles to health are greater for lower-income groups and that denser cities and high-rise apartment living are seen as the antidote to these problems.

This is because when poorer communities are located in areas of lesser amenity due to lower housing costs it exacerbates existing health problems (ibid).

- ***Evidence from evaluation of existing planning developments (1 out of 109 articles)***

One article draws on the New Urbanism approach to planning in the US, stressing how mixed- use developments and a diverse resident profile helps to create healthy, socially vibrant communities (Leccese and McCormick, 2000).

- ***Evidence of resident perception of hazard risk (1 out of 109 articles)***

One article, Turner and Wigfield (2017) draws on evidence of resident perception of risks of fires, falls, earthquakes suicide and the spread of communicable diseases and their impact on the mental health of residents.

- ***Statistics focusing on suicide rates in higher density environments (1 out of 109 articles)***

Turner and Wigfield (2017) draw on historical suicide statistics from Singapore to argue that healthy density environments should designed to help to safeguard people against the risk of suicide.

- ***Open-ended, qualitative resident survey questionnaires (1 out of 109 articles)***

One article drew on evidence from an open-ended qualitative questionnaire (Volker and Kistemann, 2015). In their study of the impacts of urban blue in cities on individual's mental well-being, Volker and Kistemann (2015: 198-99) used short, open ended, 5-point qualitative questionnaires that were delivered face to face to ascertain perceptions. Statements made by participants in the study were coded using a frequency analysis (Volker and Kistemann 2015).

- ***Review of existing health baseline data (1 out of 109 articles)***

One article drew on evidence from a review of an existing health evidence base (Allen and Blandy, 2004).

- ***Systematic analysis of site plans (1 out of 109 articles)***

One article drew on evidence from a systematic analysis of site plans (Zhang and Lawson, 2009).

3.2.5.3: Planetary Health

The following specific types of evidence were used to link attributes of health to key features of the higher density built environment out of the total of 20 articles that were embedded upon a Planetary Health perspectives:

- Data from modelling/simulation techniques (16 out of 20 articles);
- Literature Review (9 out of 20 articles);
- Mapping/spatial data (5 out of 20 articles);
- Social survey data (4 out of 20 articles);
- Evidence of air pollution (3 out of 20 articles);
- Evidence from case studies (3 out of 20 articles);
- Measurements of indoor/outdoor heat (2 out of 20 articles);
- Evidence from social collective memory (1 out of 20 articles);
- Soil sampling data (1 out of 20 articles);
- International Panel on Climate Change (IPCC) report (1 out of 20 articles);
- Policy intervention review (1 out of 20 articles);
- Evidence of local engagement in learning activities (1 out of 20 articles);
- Energy use statistics (1 out of 20 articles).

Details of these are provided below:

- ***Data from modelling/simulation techniques (16 out of 20 articles)***

Seven out of 15 articles use evidence from modelling and simulation techniques to link a co-benefits approach to enhancing human and environmental health to specific attributes of the high density living environment (Bellamy et al., 2017; Emmanuel and Steemers, 2018; Kleerkoper et al., 2012; Lee and Braham, 2017; Lee et al., 2015; Ng et al., 2012; Perini and

Magliocco, 2014). For example, Bellamy et al., 2017 examines evidence obtained from the modelling of pollination levels in order to identify target areas for improving environmental and human health. They argue that by identifying areas associated with poor human health and overlaying these against pollination target areas, areas where improvements and efforts should be targeted can be more readily identified (Bellamy et al., ibid). Ng et al., (2012) draws on evidence from mesoscale and microclimate numerical modelling to examine urban heat including air temperature rise and humidity decrease, in combination with an on-site survey and remote sensing parametric studies using ENVI-MET, which is a three dimensional model. Similarly, Kleerekoper et al., (2012) draws on data from modelling and monitoring of health outcomes associated with heat stress, such as mortality rates and cardiovascular disease and lung inflammation morbidity in combination with data from the. Perini and Magliocco (2014) draw on evidence from simulation tools to examine the impact of location, building design, building height and vegetation type and quantity on air temperature. Lee and Braham (2017) examine the findings from an 'emergy study', which consists of an analysis of energy and material flow in relation to urban development patterns at multiple scales.

Two additional articles draw on data from modelling and simulation techniques to highlight the interdependency between building form, human health benefits/impacts and ecological planetary health (Red et al., 2013; and Tan et al., 2016). For example, Tan et al., (2016) uses simulation techniques to emphasise the importance of building height variation for Sky View Factor (SVF) and for enhancing urban greening and cooling.

Eight articles explore specific possibilities for reducing the Urban Heat Island (UHI) effect through design of the built environment in cities across the globe, in order to promote planet cooling, as well as to reduce risks posed to human health by extreme heat (Emmanuel and Steemers, 2018; Holmes et al., 2015; Kleerekoper et al., 2012; Lee and Braham, 2017; Mirzaei, 2015; Ng et al., 2012; Perini and Magliocco, 2014, Tan et al., 2016). These eight articles draw primarily on evidence from modelling and simulation techniques (seven out of the eight articles) in order to draw conclusions about the short and long term consequences of interventions to mitigate the impacts of anthropogenic climate change. For example, Emmanuel and Steemers (2018) draw on data from mapping and measuring interactions between urban form, shading and energy consumption to draw conclusions about how best to respond to the human and environmental impacts associated with anthropogenic climate change. Similarly, Kleerkoper et al., (2012) also draws on data derived from climate change

modelling and measures of air quality and temperature, in addition to data from the International Panel on Climate Change, support conclusions regarding the use of vegetation to mitigate the long-term impacts of climate change, as well as to enable human adaptation to reduce ill health associated with heat stress. Ng et al., (2016) also draws on data from numeric modelling to study patterns of urban heat to make specific recommendations about optimal building form for mitigating both the immediate and long term impacts associated with anthropogenic climate change.

One article - Jowell et al., (2017) - refers to data from building scale models in order to draw conclusions about the sustainability of the built environment form with the aim of highlighting how the design of the built environment in higher density contexts can help to promote environmental sustainability. Tall, high-rise buildings present an opportunity for sustainable energy development as their height means that they have more potential than other building typologies to use sustainable sources, such as solar power.

- ***Literature review (9 out of 20 articles)***

Two articles draw on evidence from existing literature to link both environmental and human health to the higher density built environment as part of a co-benefits approach to improving health outcomes (Giridharen et al., 2004; Watts et al., 2015). For example, Giridharen et al., (2004) examines academic literature focused on urban heat island intensity and the built environment and combines this with case studies for measuring air temperature and humidity and observation of atmospheric conditions in specific high-density housing developments.

Six articles draw on evidence from systematic literature reviews to discuss the holistic and complex relationship between human health, quality of life, and environmental stability, and discuss how this can be promoted through features of the design of the built higher density urban environment (Giridharan et al., 2004; Holmes et al., 2015; Lotfadabi, 2014; Jowell et al., 2017; Ren et al., 2013; and Shi et al., 2018).

One article, Holmes et al., (2015), uses evidence from a review of existing literature focused on the urban health island effect (UHI). This article emphasises how adaptation to climate change through the built environment can help to reduce the risks posed to human health, and

how improvements in the built environment can help to mitigate the causes as well as effects of anthropogenic climate change.

- ***Mapping/spatial data (5 out of 20 articles)***

One article - Bellamy et al., (2017) – draws on evidence from the mapping of urban landscape features in combination with other forms of evidence to link a co-benefits approach to improving both human and planetary health through the design of the higher density urban environment.

Four studies draw on spatial data to link features of the higher density built environment to human and planetary wellbeing (Emmanuel and Steemers, 2018; Lee et al., 2015; Lee and Braham, 2017; and Ren et al., 2013). For example, Ren et al., (2013) uses an urban climate map and date from Geographical Information Systems (GIS) mapping in order to draw conclusions about building data, thermal comfort and environmental change.

- ***Quantitative social survey data (4 out of 20 articles)***

One article, Barthel et al., (2010), draws on data from a survey for identifying capacity for local management of ecosystem services, as part of a co-benefits approach to improving human and environmental health through the design of the urban higher density environment.

Three other articles draw on evidence from survey data to link health to higher density by emphasising the complex and holistic relationship between human well-being, the natural environment and the built environment (Bellamy et al., 2017; Jowell et al., 2017; and Lotfadabi, 2014). For example, Lotfabadi (2014) drew on a questionnaire with inhabitants of the Tehran International Tower to understand their perceptions of energy demands. The questionnaire asked about aspects such as how satisfied they were with natural light, and whether or not they used mechanical ventilation systems for heating or cooling (Lotfabadi, 2014: 290).

- ***Evidence from air pollution measurement data (3 out of 20 articles)***

Three studies draw on air pollution data (Giridharan et al., 2004; Jowell et al., 2017; and Shi et al., 2018). Shi et al., (2018) examined the prevalence of particulate matter in order to ascertain air pollution between human health, environmental health and building morphology design factors.

- ***Evidence from case studies (3 out of 20 articles)***

Three out of the 20 articles within the Planetary Health domain drew on evidence from case studies to link health to attributes of the higher density built environment (Barthel et al., 2010; Bellamy et al., 2017; and Speak et al., 2012). For example, drawing on evidence from a case study in a high-rise development area in the city of Edinburgh in Scotland, Bellamy et al., (2017) discusses how the inclusion of bees and hoverflies in local environments delivers health benefits to society by providing opportunities for accessing nature near residents' home and promotes citizen engagement and interest in wildlife gardening, which, in turn, improves environmental biodiversity, enhances environmental stewardship, and creates an attractive city. The study also discusses how residents report greater immediate psychological benefits in areas with high levels of biodiversity and that focusing on enhancing biodiversity and ecosystem services through neighbourhood design helps to ensure sustainable environments for promoting human health. (ibid). This can help to ensure better air and water quality and food security in the future (ibid). Similarly, Barthel et al., (2010) and Speak et al., (2012) use evidence from case studies to discuss how productive urban ecosystems improve the biodiversity of the environment and provide a range of cultural, provisioning and regulating services to society, including supporting urban climate adaptation, community cohesion and food production.

- ***Measurements of indoor/outdoor heat (2 out of 20 articles)***

Two studies draw on evidence of measurements of indoor/outdoor heat (Holmes et al., 2015, Kleerekoper et al., 2012). Holmes et al., (2015), combines evidence from a literature search and evidence from indoor heat surface measurements to investigate urban cooling and heat island effects. Kleerekoper et al., (2012) uses evidence from the monitoring of surface air temperature and evidence of its impact on the different types of vegetation and water features at precinct level in order to measure the urban heat island effect and the impacts of greening and bluing measures for human thermal comfort.

- ***Evidence from narratives of social collective memory (1 out of 20 articles)***

One article uses evidence from narratives of collective social memory (Barthel et al., 2010), in combination with evidence of participation in community activities and from a social survey to examine the capacity for local management of ecosystem services for improving both human and environmental health outcomes.

- ***Soil sampling data (1 out of 20 articles)***

Only one article uses evidence from soil sampling to link health to features of the built higher density environment. Speak et al., (2012) looks at evidence from vegetation sampling, elemental measurements and statistical analysis in order to draw conclusions about the health impacts of vegetation and urban greening.

- ***International Panel on Climate Change (IPCC) report (1 out of 20 articles)***

One study drew on evidence from the International Panel on Climate Change report (Kleerkoper et al., 2012) to emphasise a co-benefits approach to improving health outcomes.

- ***Policy intervention review (1 out of 20 articles)***

One article, Pattanayak and Haines (2017), adopt a capacity driven approach to improving human and environmental health by drawing on and evaluating evidence from existing policy intervention.

- ***Evidence of local engagement in learning activities (1 out of 20 articles)***

One article (Bellamy et al., 2017) draws on evidence of local engagement in learning activities in combination with a case study of community engagement in greenspace learning activities, and evidence from stakeholder workshops to highlight the link between human health, environmental health, and design of the built environment.

- ***Energy use statistics (1 out of 20 articles)***

One article, Kleerkoper et al., (2012), uses evidence on energy use and availability, use of heating and cooling appliances and the impacts of building form, urban greening and blue-ing to highlight the benefits of the use of renewable energies in high-rise environments as a way of off-setting the impacts of climate change, arguing that improving the health of the planet requires investment in renewable energy sources as well as ways of reducing energy demands (Jowell et al., 2017; Loftabadi, 2014; Kleerkoper et al., 2012).

### *3.2.6: Discussion: Comparison of the use of evidence used to link health to higher density living across each of the three theoretical perspectives of health*

While only one article provides a definition of healthy higher density, 26 others refer to attributes associated with positive health outcomes that are used to conceptualise higher density environments. Fourteen of these do this descriptively and comparatively in opposition to low density living environments, while 12 do so according to specific spatially defined and quantified sets of criteria. Articles embedded upon a Global Public and Population Health use health evidence to define and conceptualise higher density environments pre-dominantly through the use of socially-defined, quantitative sets of criteria, as well as through evidence of national liveability indicators. Similarly, articles framed upon a Social-Ecological Determinants of Health group also used quantitative sets of criteria to link health to conceptualisations of higher density environments. However, articles within this category also use health-related evidence to link health to high density urban environments descriptively or qualitatively and in opposition to the health determinants associated with low density living environments.

These findings suggest that more emphasis is given to qualitative evidence and indicators of health amongst articles framed upon a Social-Ecological Determinants of Health perspective. The limited number of articles defining density or linking health to conceptualisations of higher density using quantitative indicators in the Global Public and Population Health articles suggests that little attention has been given to defining what exactly a healthy higher density environment consists of, and how health evidence can be linked to understandings and conceptualisations of healthy higher density living environments. Again, the relatively limited number of articles using health evidence to link health to higher density in the Socio-Ecological Determinants category suggests a need to define exactly what is meant by the term

healthy higher density living. The lack of direct linkage between health evidence and understandings of healthy higher density living in Planetary Health-focused articles presents an opportunity for developing a definition and conceptualization of a healthy higher density living environment that includes evidence and attributes associated with both human and environmental health and the interplay between these.

However, while the majority of articles within the sample do not use health-related evidence to directly link health to understandings and conceptualisations of the higher density living environment, all 141 articles within the sample use health-related evidence to indirectly link attributes of health to specific features of the higher density built environment. These articles draw upon various types of evidence. The types of evidence used in order to develop this link vary according to the theoretical perspective of health that each article is embedded upon.

**Table 9** shows a summary of the similarities and differences in the types of evidence used to link health to specific features of the higher density living environment:

**Table 9: Comparison of Types of Evidence Used to Link Health to Features of the Higher Density Built Environment for each Theoretical Perspective of Health**

| Comparison of the Different Types of Evidence Used to Link Health to Specific Features of the Higher Density Built Environment | | | | |
|---|---|---|---|---|
| | | Theoretical Perspective of Health | | |
| | | Global Public and Population Health | Social-Ecological Determinants of Health | Planetary Health |
| **Type of Evidence Used to Link Health to Specific Features of the Higher Density Built Environment** | Review/analysis of academic literature | ✓ | ✓ | ✓ |
| | Review of urban consolidation plans | ✓ | | |
| | Legal evidence and strata schemes | ✓ | | |
| | ABS Index of Disadvantage | ✓ | | |
| | Health Indicators | ✓ | | |
| | Cross sectional socio-economic contextual data | ✓ | | |
| | Data on lifestyle choice and health | ✓ | | |
| | Epidemiological cross sectional health research data | ✓ | ✓ | |
| | Quality of life indicators | | ✓ | |
| | Census data | | ✓ | |
| | Interview data | | ✓ | |
| | Site observations | | ✓ | |
| | Policy documents and literature | | ✓ | |
| | Review of health impact assessments | | ✓ | |
| | Primary data on walking behavior | | ✓ | |
| | Data on proximity to services | | ✓ | |
| | Evidence of environmental factors, i.e. air quality | | ✓ | |
| | Building design data | | ✓ | |
| | Evidence of indoor space quality | | ✓ | |
| | Recorded video diaries | | ✓ | |
| | Open ended qualitative questionnaires | | ✓ | |
| | Crime statistics | | ✓ | |
| | | Theoretical Perspective of Health | | |

| **Type of Evidence Used to Link Health to Specific Features of the Higher Density Built Environment** | | Global Public and Population Health | Social-Ecological Determinants of Health | Planetary Health |
|---|---|---|---|---|
| | Evidence of resident fear/worry about hazards | | ✓ | |
| | Suicide statistics | | ✓ | |
| | Demographic health statistics for gender and health | | ✓ | |
| | Demographic health statistics for age and health | | ✓ | |
| | Evidence of socio-cultural contextual factors | | ✓ | |
| | Evidence from a public lecture | | ✓ | |
| | Evaluation of existing planning strategy developments | | ✓ | |
| | Socio-economic data and statistics | | ✓ | |
| | Spatial data/GIS data | | ✓ | ✓ |
| | Survey questionnaires | | ✓ | ✓ |
| | Review of existing health baseline data | | ✓ | |
| | Analysis of site plans | | ✓ | |
| | Simulation technique data | | | ✓ |
| | Case studies | | | ✓ |
| | Evidence of engagement n learning activities | | | ✓ |
| | Narrative of social collective memory | | | ✓ |
| | Measurements of indoor/outdoor temperatures | | | ✓ |
| | Soil sampling | | | ✓ |
| | Data on air pollution levels | | | ✓ |
| | IPCC report | | | ✓ |
| | Policy intervention review report | | | ✓ |
| | Energy use statistics | | | ✓ |

- ***Commonalities across theoretical perspectives***

For the purposes of using health-focused evidence to link health to features of the higher density built environment, articles grouped within all three theoretical perspectives are similar in that a significant number of articles within each group draw on evidence from reviews and analysis of the existing academic literature or secondary research data to discuss attributes of health to specific features of the higher density built environment.

- ***Similarities and differences in the types of evidence used most frequently***

The most commonly used type of evidence used to link health to the higher density built environment in articles grouped within Global Public and Population Health was epidemiological cross-sectional health research data, with 12 out of the 14 articles drawing on evidence from this type of data. This type of evidence was also used in the articles within the Socio-Ecological Determinants of Health perspective, however evidence from reviews and secondary analysis of the data presented within existing academic literature was the most common type of evidence found in articles grouped within this category, with 55 out of 109 articles using this type of evidence. In contrast, the most common type of evidence used to link health to features of the built environment in articles embedded upon a Planetary Health perspective was data from modelling and simulation techniques, with 16 out of 20 articles including evidence obtained from the use of these methods.

- ***Extent of variation in types of evidence used***

The greatest spread and variation in types of evidence used was found amongst articles framed upon a Social-Ecological Determinants of Health perspective, with a total of 27 different types of evidence being drawn upon, compared to 8 types within articles grouped within Global Public and Population Health and 13 grouped within Planetary Health.

- ***Key differences between the types of evidence used***

Reviews of the local impacts of urban consolidation policy, evidence of the role of strata, and evidence from the ABS Index of Disadvantage are emphasised in articles grouped within the Global Public and Population Health category. However, articles within this category

predominately focus on quantifiable, measureable forms of evidence. Greater emphasis is placed on qualitative forms of evidence in articles grouped within the Social-Ecological Determinants of Health category compared articles grouped within the other two categories. However, the majority of articles within this category drew upon quantifiable and measurable forms of evidence, including demographic health statistics, suicide rate statistics, crime rate statistics, and evidence of walking behavior, and spatial GIS data, rather than qualitative forms of evidence. Articles group within the Planetary Health category focus on both quantitative and qualitative forms of evidence, including narratives of social collective memories, soil sampling data, energy use statistics, policy intervention reviews, and measurements of indoor and outdoor temperature.

### *3.2.7: Recommendations and Actions*

The following recommendations and actions can be made within the scope of the HHD project on the basis of these findings:

<u>Recommendations</u>

- To develop a comprehensive understanding of a healthy higher density living environments that aligns existing quantitative and qualitative indicators and descriptors of the built environment to human and environmental health as holistically conceptualised by utilising and aligning the different foci of health emphasised by each of the different theoretical understandings of health highlighted in the literature;

- To identify which specific features of the built environment are linked to evidence of positive health outcomes in higher density living environments and consider how these may be applied within the specific New South Wales context in future planning strategy developments.

- To examine planning documents for the Victoria Park and Green Square Town Centre case study sites to identify what types of health evidence planning professionals have drawn on and whether this changed over time in order to link health to higher density in practice;

- To compare and contrast the types of evidence used in the case study site literature with the types of evidence discussed in the literature and consider what other types of evidence from the articles could potentially be applied at the case study sites to link health to the higher density built environment;

- To identify current gaps and evidence in the academic evidence base and consider how future studies may involve collection of new types of health evidence. For example, at present, little qualitative evidence is available. In addition, with the majority of existing articles drawing on secondary quantitative research data, opportunities for conducting primary data collection on different aspects of human and environmental health should be identified for future research projects and research funding applications.

Actions

- To undertake a transdisciplinary, collaborative problem-solving workshop with academics from a wide range of disciplines and professionals from a range of government and private sector organisations to develop an integrated definition of a healthy higher density living environment and to identify specific indicators of health evidence appropriate to the higher density urban environment for mobilisation in a project toolkit used to inform future planning strategy developments

- To undertake a context study of evidence obtained from Landcom and City of Sydney planning documents for the Victoria Park and Green Square case study sites to see how health has been linked higher density within specific local case study sites;

- To develop a conceptual framework for linking health evidence and attributes to higher density built environment drawing on evidence from all three theoretical domains of health;

- To critically analyse existing uses of health evidence at the project site by comparing these to the types of health evidence discussed in the literature and used to form the conceptual framework as part of an evidence mapping exercise;

- To conduct interviews and workshop activities with health professionals and planning professionals to find out what types of health evidence have been prioritised in planning and the reasons for this, as well as to discuss what other types of evidence could be considered for linking health to the higher density built environment in future development strategies;

- To discuss with health experts from the Project Reference Group what types of data sources, existing epidemiological datasets and other types of datasets are available for the NSW and for the city of Sydney contexts, which the project could draw upon and find out if it would be possible to access and examine these datasets;

- To work collaboratively with members of the academic project team to identify opportunities for future research and develop research proposals and funding applications accordingly.

## 3.3: What Types of Evidence are Currently Translated into Planning Strategies for Healthy Higher Density Living?

### *3.3.1: Introduction*

This part presents the types of health-related evidence that has been *actively* translated into planning strategies. It considers examples from the sample literature where steps have been taken to research or consider evidence which then had an impact on how higher density urban development was conceived, planned, and embedded - or, 'translated' from research into practice. It is organised according to the theoretical perspectives outlined in the methodology.

### *3.3.2: A note on 'planning strategies'?*

According to Barton (2015), planning strategies can be broken down into two key types:

- Bureaucratic and/or
- Action-based strategies or interventions.

Under the umbrella of bureaucratic strategies are:

- Legislation,
- Policies,
- Plans,
- Guidelines,
- Tools.

In summary, bureaucratic strategies are the formal documented texts, which are used as a basis to guide planning, but which are not necessarily enacted. Legislation is a key aspect of bureaucratic strategies, which gives a regularity context as this mandates planning approaches and provides some power to force compliance, with repercussions for non-compliance.

Action-based strategies or interventions follow on from bureaucratic strategies, in that they are enacted or implemented in a real and/or physical sense. This may be after a plan has been documented, or, as part of the planning process. These interventions can include changes to:

- Land use policies (Barton, 2015),
- Building controls (Barton, 2015: 6),
- Standards for green space (Davern et al., 2017),
- Preserving open spaces (Kent and Thompson, 2014: 240),
- Infrastructure in relation to transport, energy, water, health and education (Barton 2015: 6) and street connectivity (ibid).

Design interventions are also enacted as part of action-based planning strategies, including:

- Site selection and appraisal developers (Barton, 2015: 6),
- Design of buildings, streets and landscapes, master planning or estates and neighbourhoods (Barton, 2015: 6), and
- Built environment features, such as location, height, land use mix and design (Davern et al., 2017), street design features.

Action-based strategies can also include participatory processes by:

- Collaboratively involving stakeholders.

In the first Literature Review Report for the HHD project, Connon et al., (2018) discuss the various types of planning strategies examined in the articles within the sample and which grouped within each the three theoretical domains of health, and compares the similarities and differences in suggestions for improving health in the higher density urban planning context. The review presented in this Evidence Report illustrates the types of health-related evidence that have been used to actively translate health evidence into the bureaucratic and action-implementation planning strategies, as well as the evidence used to directly critique the outcomes of existing planning strategies.

### *3.3.3: Health-related evidence currently translated into planning practice from a Global Public and Population Health perspective*

- ***Evidence from review and analysis of existing academic literature (2 out of 14 articles)***

Only two out of the 14 articles grouped within the Global Public and Population Health category provide examples of how health-related evidence has been actually transferred or incorporated into existing planning strategies at the bureaucratic level (Easthope and Judd, 2010; Grant et al., 2017). These two articles that discuss how health evidence has been integrated into existing planning policy use evidence from the analysis and synthesis of existing academic research literature to support arguments and draw conclusions about the feasibility of existing policy for improving human health outcomes. Grant et al., (2017), mentions that there have been positive health outcomes associated with participatory budgeting in Brazil, drawing upon the conclusions of a 2013 study conducted by Vlahov and Caiaffa. Similarly, Easthope and Judd (2010) draw upon previous research conducted by Churchman (1999), Hopkins (2007), Leccese and McCormick (2000) and Talen (2008) (as referenced in Easthope and Judd, 2010) to explore how the New Urbanism planning movement stressed the benefits of mixed land use for improving social integration for improving mental health outcomes. They also draw upon an earlier study conducted by Newman (1983, in Easthope and Judd, 2010) to explain that health concerns identified in higher density environments during the 1960s and 1970s were less likely to feature in contemporary developments as a result of lessons learnt by government authorities planning officials about the provision of amenities, adequate waste collection, transport and sanitation, which had been incorporated into urban consolidation movements in Australia. In addition, Easthope and Judd (2010) also draw upon evidence from three previous studies (Beer and Faulkner 2009, Kendig 1984 and Vulker 1986, in Easthope and Judd, 2010) to argue that planners have increasingly recognized factors such as increased divorce rates, increasing numbers of young adults living at home, and partnering and having children in later life, in the creation of diverse housing pathways.

None of the 14 articles embedded upon a Global Public and Population Health perspective highlight how health evidence has currently been incorporated into action and implementation strategies. This is likely to reflect that articles framed upon a Global Public and Population Health perspective tend to focus more on higher level governance and

decision-making for influencing health outcomes (see Grant et al., 2017; Hanlon et al., 2012; for evidence of the focus of public health governance), rather than specific practices of implementation at the local level.

### *3.3.4: Health-related evidence currently translated into planning practice from a Social-Ecological Determinants of Health perspective*

Five out of 109 articles grouped within the Socio-Ecological Determinants of Health category discuss how health-focused evidence has been translated into existing planning strategies at the bureaucratic level (Bunker et al., 2002; Carmona, 2014; Cowie et al., 2016; Haigh et al., 2011; Leccese and McCormick, 2000). The types evidence that these articles draw on and discuss in relation to their implementation are detailed below:

- ***Evidence from survey questionnaire data combined with data on land use, density, socio-economic factors, air pollution and transport infrastructure (2 out of 109 articles)***

Two articles discuss how evidence from land use design, density, air pollution statistics and transport infrastructure and human health outcomes influenced urban consolidation policies in Australia (Bunker et al., 2002; Carmona, 2014). Bunker et al., (2002), discusses how consolidation policies in Australia have attempted to manage urban ‘sprawl’ over the past 20 years (low density growth), underlined by the notion that more compact cities could improve health outcomes. Carmona (2014) discusses how supporters of the policy in New South Wales claim that it has been successful in achieving its basic aims.

- ***Surveys of walking behaviour combined with measures of density and land use mix (1 out of 109 articles)***

One article out of 109 (Cowie et al., 2016) discussed how health evidence had been incorporated into walkability indexes, designed to influence planning developments. Cowie et al., (2016) uses an abridged version of a walkability index previously developed in Sydney in 2006 to ascertain how walkable Sydney neighbourhoods were in relation to traffic density. Mentioned within this article is how the Sydney Walkability Index was drawn up using evidence of built environment characteristics required to promote walking behavior. This

walkability index is a tool intended to guide urban planning development. The evidence used to draw up the Sydney index referred to: a) residential density (number of dwellings per square kilometer of residential land use, b) intersection density (the number of intersections with three or more road junctions per square mile), and c) land use mix. Cowie et al., (2016) also mentions the development of the South Australian PLACE study index and the North American Walkability Index, which were based on health evidence of walking behavior, accessibility, density and land use mix.

- ***Quantifiable empirical data focusing on density, activity levels, mental health, social interaction and children's health and development, accident risk, and social-economic characteristics from existing/secondary datasets (1 out of 109 articles)***

One article within the Social-Ecological Determinants of Health category discussed how secondary empirical data focusing on density, activity levels, social interaction, and child health and development was used to develop Health Impact Assessments for implementation and in order to analyse and evaluate the relationship between health and the built environment for incorporation into planning strategies at an early stage (Haigh et al., 2011). Haigh et al., (ibid) explains that a Health Impact Assessment (HIA) is a widely acknowledged decision making tool that facilitates decision makers to consider more explicitly the social determinants of human health, wellbeing and equity prior to the implementation of a project, policy or plan (London Health Commission and Environment Committee of the Assembly 2002). In Australia, the Greater Western Sydney Urban Development Strategy Health Impact Assessment (2007) drew on secondary data pertaining to walkability, car dependency, child health, human interaction levels and density and reported that high density housing potentially lowered the number of cars per household which increased the rates of incidental physical activity amongst resident. Haigh et al., (2011) also discusses how the Keri-keri Waipapa Structure Plan WIA (2007) drew on data pertaining to walking behavior, cycling, transport access, distance from main roads, children's play activity levels, and roadside accident levels. In addition, the article discusses how evidence of risk of injury amongst children was incorporated into the Parramatta City Council's Draft Local Environment Plan Health Impact Assessment (2010). Furthermore, in New Zealand, the Heretaunga Plains Urban Development Strategy Health Impact Assessment (2010) reported drew on data focusing on the socio-economic characteristics of residents from the area to examine interaction levels between residents with different levels of socio-economic capital to develop

the ‘inequity gradient’ and to measure the impact of socio-economic segregation on mental health outcomes in higher density environments. The Flaxmere Town Centre Urban Design Framework Proposal Health Impact Assessment (2010) drew on evidence of crime levels.

- ***Evidence from previous academic research on health outcomes and their relationship to land use, street design and public space (1 out of 109 articles)***

One article looks at how evidence of health outcomes, land use, street design, and public space was used to develop the New Urbanism approach to planning in the US to stress how the benefits of mixed-use developments and diverse resident profile create socially vibrant communities (Leccese and McCormick, 2000). New Urbanism seeks to mitigate these and other problems through the manipulation of the built environment. Among other solutions, typical New Urbanist communities incorporate mixed use centers, diverse design of streets, public space, as well as provision of parks and open space, and transit-oriented development.

None of the 109 articles embedded upon a Social-Ecological Determinants of Health perspective discuss examples of how health-related evidence has actually been translated into existing planning strategies at the action-implementation stage.

### *3.3.5: Health-related evidence currently translated into planning practice from a Planetary Health perspective*

Four out of the 20 articles embedded upon a Planetary Health perspective discuss examples of how evidence focused on both human and environmental health has been incorporated into existing planning policy and practice at the bureaucratic level.

- ***Evidence from green infrastructure development (4 out of 20 articles)***

One out of the 20 articles embedded upon a Planetary Health discusses how research evidence of the benefits to environmental health from green structure development has been applied within existing planning policy. Bellamy et al., (2017) discusses how evidence from a study of green infrastructure development in the Scottish city of Edinburgh was used to identify pollinator habitat hotspots and areas with existing poor human health indicators and used to influence approaches to municipal planning.

- ***Evidence from existing research measuring food security and environmental biodiversity (1 out of 20 articles)***

One out of the 20 articles, Jowell et al., (2017), highlights how data from existing studies examining human food security and environmental biodiversity has been used to address food insecurity and in planning policy in evolving megacities including Singapore and New York City to enable them to be agriculturally independent.

- ***Thermal and wind measurement data (1 out of 20 articles)***

One article, Ren et al., (2013), discussed the development of an urban climatic map for use in a Geographic Information System that was incorporated into planning policy to ascertain sensitive areas for planning in Kaosiung, Taiwan, using parameters for thermal environment and wind environment.

- ***Evidence from inter-institutional expertise and evidence of green space use and impact (1 out of 20 articles)***

Another out of the 20 articles, Davern et al., (2017), discusses how the South Australian Government brought together multiple actors to facilitate the design of public green space. This includes the Heart Foundation, Departments of Health and Ageing, Environment Water and Natural Resources, Office for Recreation and Sport, the South Australian Local Government Association and the Office of the Chief Architect, as well as researchers from RMIT University and the University of Melbourne. This new shift in urban greening practice has been led by practitioners, with support from research evidence provided by academics. This has led to policy developments that draw attention to the importance of private green space (Davern et al., 2017).

Two out of the 20 articles grouped within the Planetary Health domain discuss how health-related evidence has already been incorporated into current planning strategies at the action and implementation stage (Davern et al., 2017; Jowell et al., 2017):

- ***Evidence from research on water security and human wellbeing (1 out of 20 articles)***

One article, Jowell et al., (2017), discusses how research evidence of food security and human well-being has been used in greening technology and urban design to improve water storage and safety in global megacities.

- ***Evidence of thermal conditions, the viability of tree species and statistics of anti-depressant prescriptions (1 out of 20 articles)***

Another article, Davern et al., (2017), explains that evidence of urban heat monitoring and measurements and evidence of the viability of tree species, together with evidence of anti-depressant prescriptions within a specific geographic area, has been used to improve urban greening practices for improving both human and environmental health.

**Table 10** presents a comparative summary of the findings of the types of health-related evidence translated into existing planning practice at the bureaucratic and action-implementation levels for each of the three theoretical perspectives of health:

**Table 10: Health-Related Evidence Translated into Existing Planning Strategy at the Bureaucratic and Action-Implementation Levels and for Each Perspective of Health (N=141)**

| Articles that Discuss Types of Health-Related Evidence as Translated into Planning Practice (n=11) | | | | | |
|---|---|---|---|---|---|
| Health-Related Evidence Translated at the Bureaucratic Level (n=11) | | | Health-Related Evidence Translated at the Action-Implementation Level (n=2) | | |
| **Global Public and Population Health (n=2)** | **Socio-Ecological Determinants of Health (n=5)** | **Planetary Health (n=4)** | **Global Public and Population Health (n=0)** | **Socio-Ecological Determinants of Health (n=0)** | **Planetary Health (n=2)** |
| • Evidence from synthesis, analysis and application of existing academic research literature (n=2) | • Evidence of land use design, density, air pollution statistics and transport infrastructure on health outcomes (n=4);<br>• Surveys of walking behaviour (n=1);<br>• Evidence from synthesis, analysis and application of existing academic research literature (n=1)<br>• Quantifiable empirical data focused on density, activity levels, mental health, social interaction, and children's health from existing/secondary datasets (n=1) | • Evidence from green infrastructure research (n=1);<br>• Evidence of food security and environmental biodiversity (n=1);<br>• Temperature and wind measurements (n=1)<br>• Evidence from inter-institutional experts and evidence of green space use and impact on health (n=1) | | | • Evidence of food security and human well-being (n=1);<br>• Temperature measurement, assessment of viability of tree species, with evidence of anti-depressant prescriptions (n=1) |

### *3.3.6: Health-related evidence that has been used to critique planning practice at the bureaucratic and action-implementation level for each of the three theoretical domains of health*

Although only a limited number of articles discuss how health-related evidence has been translated and used in planning strategy development, a significant number of these same articles instead use health-focused evidence in order to critique existing planning strategies at both the bureaucratic and action-implementation stages of development. The ways in which health-related evidence has been used to critique existing planning strategies however, varies according to the theoretical perspective that the articles are framed upon.

3.3.6.1: Health-related evidence used to critique existing planning strategies from a Global Public and Population Health perspective

Four articles embedded upon a Global Public and Population Health perspective discuss the limitations of existing bureaucratic planning strategies using various types of health-focused evidence. These articles discuss how current planning strategies lack the preparedness to cope with the health impacts of increasing urbanization and 21st century demographic change (Bunker and Holloway, 2007; Easthope and Judd, 2010; Grant et al., 2017; Hanlon et al., 2012) and how these limitations result of a lack of integration between planning and health professionals within the policy development stage (see Grant et al., 2017; Hanlon et al., 2012).

- ***Evidence from synthesis and analysis of existing academic literature (4 out of 14 articles)***

All four articles draw upon the findings of previous research and the synthesis and analysis of existing academic literature in order to suggest greater incorporation of health evidence in planning strategies at the policy or bureaucratic level. For example, Bunker et al., (2002) draws on evidence from a range of studies (McLoughlin, 1991; Troy, 1996, 1997, Urban Frontiers Programme 2011, in Bunker et al., 2002) that examine development data and outcomes over a 20 year period to argue that urban consolidation policies in Australia have resulted in social, economic and environmental costs, which are generally poorly acknowledged by policy makers. In particular, they argue that despite rigorous promotion of urban consolidation, it has not been able to fully mitigate urban sprawl in the city of Sydney. Similarly, Searle (2007) draws upon evidence from the Urban Research Program to understanding Australia's urban challenges and explores limitations in urban consolidation plans for mitigating urban sprawl. Easthope and Judd (2010) also draw on a wealth of existing studies to argue that higher density environments fail to increase social capital amongst residents. Finally, Grant et al., (2017) draws upon arguments from previous studies (Lim et al. 2016, Oni, Smit et al., 2016, in Grant et al., 2017) to argue that urban planners and designers need to work more closely with health professionals in order to better promote and protect health because current strategies do not demonstrate that communities of practice have fully understood how the best conditions for human health can be created. One article,

Hanlon et al., (2012), reviews academic literature throughout the history of public health to argue that paradigm shifts need to be linked to major shifts in thinking about the nature of society and health. The article draws on evidence from current studies of health from the developed world context to argue that current challenges to public health that result from cultural characteristics such as materialism, individualism, consumerism, and economic growth, are not being challenged by current policy developments and initiatives and applications, including application in urban development strategies.

None of the articles embedded upon a Global Public and Population Health perspective used health-related evidence to critique existing planning strategies at the action and implementation stage.

3.3.6.2: Health-related evidence used to critique existing planning strategies from a Social-Ecological Determinants of Health perspective

Sixteen out of the 109 articles framed upon a Social-Ecological Determinants of Health perspective draw on health-related evidence to critique existing planning strategies at the bureaucratic level (Allen and Blandy, 2004; Anderson, 2009; Buys and Miller, 2012; Costello, 2005; Duff, 2012; Easthope and Judd, 2010; Foster, 2006; Gifford, 2007; Giles-Corti et al., 2014; Gunn et al., 2017; Johnson-Lawrence et al., 2015; Lofti and Koohsari, 2009; Lloyd and Reid, 2013; Raman, 2010; Randolph, 2005; Seo and Chiu, 2014).

- ***Evidence of socio-demographic, socio-economic and socio-cultural characteristics of sample populations (9 out of 109 articles)***

Nine articles criticise existing approaches to planning at the bureaucratic level on the basis that planning strategies tend to view health factors supporting positive health outcomes in isolation rather than in terms of how the different factors inter-relate to produce particular health outcomes (Allen and Blandy, 2004; Anderson, 2009; Easthope and Judd, 2010; Duff, 2012; Gifford, 2007; Gunn et al., 2017; Johnson-Lawrence et al., 2015; Randolph, 2006; Seo and Chiu, 2014). These articles use evidence of the different social factors influencing health in particular local contexts, including the historical, socio-demographic, socio-economic and socio-cultural characteristics particular to the context and sample population.

Six articles out of 109 articles embedded upon a Social-Ecological Determinants of Health perspective use health-related evidence to critique existing planning strategies at the action-implementation level (Costello, 2005; Easthope and Judd, 2010; Giles-Corti et al., 2014; Lloyd and Reid, 2013; Randolph, 2005; Seo, 2002).

- ***Evidence of subjective perceptions of health from questionnaires (6 out of 109 articles)***

Six articles suggest that current strategies fail to fully acknowledge the significance of subjective as well as objective perspectives of health, randomised-controlled evidence and epidemiological measurements of health (Buys and Miller, 2012; Easthope and Judd, ibid; Foster, 2006; Giles-Corti et al., 2014; Raman, 2010; Lofti and Koohsari, 2009).

- ***Evidence from review of the findings presented in the existing academic research literature (6 out of 109 articles)***

These six articles discuss the lack of integration between planning and health in strategy development and draw on health-focused evidence from existing literature to highlight how existing power trajectories of information sharing, decision-making and embedding evidence limits innovation and creative change within planning (Giles-Corti et al., 2014; Easthope and Judd, 2010; Costello, 2005; Lloyd and Reid, 2013; Randolph, 2005; Seo, 2002).

- ***Evidence from survey questionnaires and indicators of quality of life (3 out of 109 articles)***

Three articles draw on evidence from survey questionnaires and indicators of quality of life to argue that current planning strategies remain overly focused on individual rather than community satisfaction and quality of life, leading to failures to fully encourage social interaction for improving health outcomes (Easthope and Judd, 2010; Gifford, 2007; Gunn et al., 2017).

3.3.6.3: Health-Related evidence used to critique existing planning strategies from a Planetary Health perspective

Eighteen out of the 20 articles framed upon a Planetary Health or Relational Ecological perspective use human and ecological health-related evidence to critique existing bureaucratic level planning strategies.

- ***Review and analysis of the findings presented in existing academic research literature (18 out of 20 articles)***

All these 18 articles highlight how little attention has been given to addressing the problems caused by anthropogenic climate change on human health, the long-term consequences of environmental degradation, and the role that the natural environment plays in supporting human health in existing planning strategies, through review and critical analysis of the existing multi-disciplinary academic research literature (see Barthel et al., 2010; Bellamy et al., 2017; Davern et al., 2017; Emmanuel and Steemers, 2018; Giridharan et al., 2004; Holmes et al., 2016; Jowell et al., 2017; Kleerkoper et al., 2012; Lotfadabi, 2014; Mirzaei, 2015; Ng et al., 2016; Perini and Magliocco, 2014; Pattanayak and Haines, 2017; Ren et al., 2013; Shi et al., 2018; Speak et al., 2012; Tan et al. 2016; Watts et al., 2015).

Three out of the 20 articles embedded upon a Planetary Health perspective also use health-related evidence to critique existing planning strategy developments at the action-implementation stages. These articles emphasise a lack of integration at the early stage of planning policy development, which perpetuates existing approaches to strategy development rather than the development of new approaches based upon alternative conceptualisations of the relationship between health and the environment that, they argue, could lead to improved long-term human and environmental health outcomes (See Davern et al., 2017; Pattanayak and Haines, 2017; Watts et al., 2015).

- ***Reviews of existing research findings examining environmental sustainability for supporting human health (3 out of 20 articles)***

These three articles all draw on evidence from existing research examining the viability of the natural environment for supporting human health in the future to critique existing action-implementation level planning strategies.

**Table 11** presents a comparative summary of the types of health-related evidence that have been used to critique existing planning strategies and developments at the bureaucratic and action-implementation levels for each of the theoretical perspectives of health:

**Table 11: Types of Health-Related Evidence Used to Critique Existing Planning Strategies at the Bureaucratic and Action-Implementation Levels for Each Perspective of Health (N=141)**

| How Health-Related Evidence is Used to Critique Existing Planning Practice (N=141) | | | | | |
|---|---|---|---|---|---|
| **Health-Related Evidence to Critique Bureaucratic Level Interventions (n=38)** | | | **Health-Related Evidence Used to Critique Action-Implementation Level Interventions (n=9)** | | |
| **Global Public and Population Health (n=4)** | **Socio-Ecological Determinants of Health (n=16)** | **Planetary Health (n=18)** | **Global Public and Population Health (n=0)** | **Socio-Ecological Determinants of Health (n=6)** | **Planetary Health (n=3)** |
| • Evidence from research on how current planning strategies lack the preparedness to cope with the health impacts of increasing urbanisation and demographic change (n=4) | • Resident survey questionnaires (n=3);<br>• Randomised controlled evidence and epidemiological measurements of health (n=6);<br>• Evidence of local contextual socio-demographic, socio-economic and socio-cultural characteristics of sample populations (n=9); | • Evidence from existing research and systematic literature reviews (n=18) | | • Evidence from reviews of existing literature (n=6); | • Evidence from existing research examining the viability of the natural environment for supporting human health (n=3) |

### *3.3.7: Discussion of findings*

The findings indicate that very little information is currently available of how health-related evidence has been incorporated into planning practice to date. Most of the 141 documents that were reviewed did not directly discuss how health-related evidence had been translated into planning strategies for higher density living. Although a number of articles drew on health evidence to criticise existing approaches to planning, in these articles the actual implementation of health evidence - transferred from idea to enactment ('translation') - was not reported. It is possible that in many cases the research was used to inform changes to planning that occurred later, however, this remains unknown from this review of the literature. However, in general, the findings suggests there is a paucity of evidence being used or translated prior to the development of higher density urban developments. This strongly

indicates that there is a need to improve the integration of research and practice at the planning stages of development. Whilst there is a greater amount of research in the scholarly literature about the impacts of planning strategy developments for human and environmental health, in most cases this research is conducted after the strategy has already been implemented rather than before.

The absence of articles within the Global Public and Population Health and Social-Ecological Determinants of Health domains that discuss how health-related evidence has been implanted at the action and implementation level may possibly reflect the situation reported in the articles analysing existing approaches to planning of the lack of interaction between health professionals, policy makers and planners in both research and practice. In addition, the absence of evidence within articles within the Global Public and Population Health domain may also be reflected of the fact that the discipline of Global Public Health is more focused on health governance at the global, regional and strategic level, rather than at the implementation or local level. The limited number evidence within Planetary Health likely reflects the fact that planetary health represents an emerging area and because little consideration has been given to planetary health and the impacts of climate change in planning until recently.

### *3.3.8: Recommendations and Actions*

Recommendations

The following recommendations can be made for action within the scope of the HHD project on the basis of the findings:

- Given the limited research examining how health evidence has been integrated into planning development, this suggests a need for further case study research into how health evidence has been implemented in order to advance understandings of how health evidence can mobilised in planning policy and practice to improve health-related outcomes. On the basis of this, one recommendation would be to examine what types of health evidence have been incorporated into or used to influence planning developments at the case study sites and how this has/may have differed over time;

- To consider how the types of evidence that may have been implemented at the case study sites reflects the foci of the different theoretical domains of health to showcase how different understandings of health in planning may have influenced current health outcomes and the current challenges to health that are evident in higher density urban living environments today;

- To draw upon criticisms outlined in the literature about the lack of integration between planning and health experts at the early stages of planning developments by establishing a trans-disciplinary and inter-institutional focus group to collaborate on devising new strategies for the implementation of health evidence in planning policy and practice at the development stage;

- The lack of evidence in the articles relating to the actual implementation of health evidence in practice presents opportunities for further research, both in terms of evaluating existing strategies, as well as for devising new developments. Another recommendation would therefore be to work with members of the academic project team to identify and discuss opportunities for future research projects and grant applications.

- Given the lack of evidence focusing on evidence translation for the higher density urban context, consider how health evidence has been translated into urban planning strategies more broadly and for other densities and work with health and planning academics and professionals to discuss whether these strategies: a) can be appropriated for a higher density context, and b) what considerations would need to be made to apply them within a high density context.

<u>Actions</u>

- Identify and analyse what health evidence has been implemented into existing policy and practice at the case study sites and in the New South Wales context more broadly by reviewing Landcom and relevant government documents pertaining to Green Square Town Centre and Victoria Park;

- Through interviews and discussions with planning professionals find out more about what health evidence was used to develop and/or influence planning decision-making and to gather their opinions about: a) the effectiveness of interaction levels between health and planning professionals in the planning development field to date, b) what evidence was not included, but which they think should have been included, c) what was deliberately excluded and why, and d) at what stages do they think different types of evidence can potentially be included;

- To conduct interviews and discussions with health professionals to gather their opinions about a) the effectiveness of interaction levels between health and planning professionals in the planning development field to date, b) what evidence was not included, but which they think should have been included, and c) at what stages do they think different types of evidence can be included;

- To compare the findings from the discussions and interviews with the two groups of professionals to identify similarities and differences in ideas for improving the integration of health evidence in planning strategies; and work with professionals from both groups to devise a framework for implementation of health evidence in future planning policy and practice specific to the higher density context;

- To publish 4-6 collaborative academic journal articles over the next year in order to advance knowledge in this field of academic research;

- To set up a workshop meeting with all members of the academic project team to devise future research projects and develop research grant and funding applications;

- To consult health and planning experts and work with all members of the academic project team to find out more about how health evidence has been mobilised in other planning development contexts and for other densities and consider how these strategies, approaches and techniques may be appropriated for application in planning strategies for higher density contexts.

### 3.4: What Types of Health Evidence are Proposed for Translation into Planning Strategies for Healthy Higher Density Living?

### *3.4.1: Introduction*

This part examines the types of health-related evidence used to develop suggestions and proposals for implementation into planning strategies for higher density urban development at both the bureaucratic and action-implementation levels in order to improve health outcomes. The findings are organised in terms of the theoretical domains of health outlined in the methodology section.

Many of the articles within the overall sample present a range of suggestions for improving planning strategies by drawing on a wide range of evidence pertaining to human health and the higher density urban environment (Global Public and Public Health), human health and the built higher density environment within specific local contexts (Social-Ecological Determinants of Health), and human and environmental health (Planetary Health).

### *3.4.2: Health-related evidence proposed for translation into planning strategies from a Global Public and Population Health perspective*

Seven articles (of 14) that utilised a Global Public and Population Health perspective explained how bureaucratic level planning strategies might be used to support healthy higher density living through the incorporation of health-related evidence (Barton et al., 2010; Giles-Corti et al., 2012; Grant et al., 2017; Hanlon et al., 2012; King et al., 2018; Randolph and Holloway, 2009; Wells et al., 2010).

- ***Quantifiable empirical data of disease morbidity and mortality across different scales and over time (5 out of 14 articles)***

Five out of the 14 articles grouped within the Global Public and Population Health domain discuss how health evidence in the form of empirical data concerning human disease rates across scale and time should be used to drive policy development so that health service planning can features heavily in the design of new living environment (Barton et al., 2010; Giles-Corti et al., 2012; Grant et al., 2017; Hanlon et al., 2012; Wells et al., 2010).

- ***Evidence from reflection of the benefits of adopting a transdisciplinary approach to urban planning (5 out of 14 articles)***

Five out of 14 articles emphasise that a transdisciplinary approach needs to be taken to successfully plan for 21st century higher density living and to meet the health challenges associated with increased urbanisation and a changing demographic profile amongst urban residents. These studies suggest that empirical data pertaining to health outcomes need to be shared across different sectors to overcome silo thinking that currently characterises relations between urban planning, transport planning, environment and public health professionals (see Grant et al., 2017; Easthope and Judd, 2010; Easthope and Randolph, 2009; Hanlon et al., 2012; Wells et al., 2010).

- ***Evidence of good practice in health governance (4 out of 14 articles)***

Four out of the 14 articles highlight the importance of moving from randomised control evidence to evidence focusing on greater governance for health for the development of improved approaches to planning (Barton et al., 2010; Grant et al., 2017; Hanlon et al., 2012; Wells et al., 2010). One out of these four articles emphasises the need for examining evidence pertaining to best practice for improving the integration of national, regional and local planning policy (Grant et al., 2017). Another of the 4 articles argues for a transformative approach to public health and planning, wherein ‘greater attention within planning is paid to how health is actually created rather than focusing on its traditional remit of promoting and protecting health, preventing ill-health and prolonging life (Hanlon et al., 2012: 313).

- ***Evidence of social and economic factors at the local level (4 out of 14 articles)***

Four out of the 14 articles (Easthope and Judd, 2010; Easthope and Randolph, 2009; King et al., 2018; Randolph and Holloway, 2005) emphasise that greater consideration needs to be made to the local social and economic contexts when developing planning strategies. According to King et al., (2018) planners and policy makers need to consider evidence pertaining to: 1) The demographic profile of the residents; 2) lifestyle factors such as diet, physical exercise and work-life balance; 3) community networks; 3) The local economy, 4) Access to public space, 5) The design of the build environment, and 6) The natural environment. Where these factors can be seen to be actively promoting positive health

outcomes, they ought to be sustained. However, where one or more are lacking or promoting negative behaviours, planning and health professionals should aim to improve on that area through selective design of aspects of the built environment (ibid). Randolph and Holloway (2005: 197) make recommendations that policy makers need to develop integrated programs that address social, economic, and housing market problems in order to ensure that trends of social disadvantage do not intensify. They suggest that the ABS index of Disadvantage is a valuable tool to highlight where disadvantage is entrenched however that this tool needs to be considered with caution in order to take full consideration of the local context. In a similar vein, Easthope and Randolph (2009: 256) suggest that as high density and hence the strata sector grows, there will be an increasing number of stakeholders, and that there will be inequities here, partly as a consequence of 'purchasing power'. They suggest that governance and greater consideration of how social and economic factors impact upon resident choice is needed to avoid challenges with these inequities.

Three out of the 14 articles within the Global Public and Population Health domain provide suggestions for how health-related evidence can be incorporated into action and design interventions that can be embedded into planning strategies to improve health outcomes in higher density contexts (Easthope and Judd, 2010; Giles-Corti et al., 2012; King, 2018).

- ***Evidence of existing health inequality to develop multi-scaled, inclusive approaches to health improvement (3 out of 14 articles)***

Three articles suggested that planning strategies should utilise a multi-levelled, multi-scaled approach (Giles-Corti et al., 2012; Grant et al., 2017; Hanlon et al., 2012). Two of these articles (Grant et al., 2017; and Hanlon et al., 2012) draw upon evidence from existing literature to argue that empirical data pertaining to health inequality should be used to advance the development of multi-scaled, inclusive approaches to improving human health outcomes. Giles-Corti et al., (2012) draws on the findings from cross sectional epidemiological evidence to argue that overcoming disparities in health outcomes in designing healthy higher density cities requires a multi-levelled, multi-sectoral response to determine positive human health outcomes.

- ***Evidence linking urban design to measureable health outcomes (3 out of 14 articles)***

Three out of the 14 (Barton et al., 2010; Hanlon et al., 2012; Wells et al., 2010) articles suggest that planning and public health policies need to move towards placing greater emphasis on harnessing urban design to quantifiable empirical evidence measuring health outcomes on a much longer-term basis than at present.

- ***Evidence of how international political and economic forces affect local health outcomes (3 out of 14 articles)***

Three out of the 14 articles suggest greater consideration needs to be made with regards to how international political and economic forces affect health (Grant et al., 2017; Giles-Corti et al. 2012; King et al., 2018). This would involve examining empirical health data in relation to political-economic data in order to provide a more holistic perspective on the determinants of human health outcomes. For example, King et al., (2018) discusses how external political and international economic forces affect neighbourhoods, which can affect the mental health of residents, and which should be prioritised in healthy planning strategies.

- ***Evidence of density and dwelling size from reviews of existing literature (2 out of 14 articles)***

Two articles, Easthope and Judd (2010) and Giles Corti et al., (2012) draw upon the findings from existing literature to provide suggestions for improving planning activities. For example, Easthope and Judd (2010) draw upon a wealth of existing studies pertaining to human health and the built environment, particularly in the Australian context, in order to argue that planning designs should focus on building up rather than out to mitigate the negative health outcomes associated with urban sprawl and lower density suburban development. These existing studies are also used to suggest that dwelling sizes need to meet the needs of a changing demographic profile and socio-economic context.

- ***Evidence from the World Health Organisation Healthy Cities Project (1 out of 14 articles)***

One article, King et al., (2018), suggests that healthy planning should be guided by considerations for improving health equity in the terms recognised by the World Health Organisation Healthy Cities Project to ensure that new strategies fully recognise current international global health challenges.

- ***Evidence from cross-sectional studies of epidemiological data pertaining to human health, human activity levels and transport provision (1 out of 14 articles)***

One article, Giles-Corti et al., (2012), draws upon cross-sectional epidemiological evidence to argue that infrastructure and transport provision needs to be included in site specific plans in order to enable positive human health outcomes.

- ***Evidence of air quality and statistics of rates of mental ill-health (1 out of 14 articles)***

One article out of the 14 grouped within this health domain draws upon evidence focusing on the relationship between mental health and air pollution levels to suggest that planners need to consider the design and availability of public spaces, transport networks, street networks, and both the perceived and actual safety of an area to promote positive mental health outcomes (King et al., 2018). Research evidence focused on mental health can also be used to promote mixed land use, including housing, industry, commercial, retail and educational facilities within close proximity. King (ibid) also draws on data to provide suggestions as to what actions planners should avoid, which includes locating shops far from housing areas, and building uniform, predominantly detached housing areas and locating housing developments far away from employment opportunities.

### *3.4.3: Health-related evidence proposed for translation into planning strategies from a Social-Ecological Determinants of Health perspective*

Thirty-four out of 109 articles grouped within the Social-Ecological Determinants of Health domain make suggestions as to how evidence relating to human health and its relationship to the built environment can be used to drive health-improvements for higher density living through embedding within planning strategies at the bureaucratic level.

- ***Evidence of social and environmental determinants of health and consideration of the scale at which these factors impact upon health (29 out of 109 articles)***

Twenty-nine out of the 109 articles grouped within the Social-Ecological Determinants of Health domain suggest that suggest that planning strategies can be improved by undertaking greater consideration of the local and regional social and environmental determinants when developing guidelines and specific plans, in addition to global factors which also have an impact on shaping health outcomes at a local level. For example, Gifford (2007), Gunn et al., (2017) and Johnson-Lawrence et al., (2015) discuss the importance of acknowledging the historic, socio-demographic, socio-economic and cultural characteristics of a particular development site throughout all stages of the planning strategy development to ensure that the strategy is fully embedded in the specific local context. Barton (2013) argues for normative planning strategies to be informed by global evidence to give clear normative principles. He elucidates that future population research will inform decisions for housing mechanisms and urban forms to generate social mix and alleviate health inequalities (Barton 2013: S121).

- ***Evidence of how the built environment overlaps with social factors in optimising health behavior (10 out of 109 articles)***

Ten articles out of 109 consider the role of the built environment and how it overlaps with social factors in optimising specific behaviours associated with improving health outcomes (Anderson, 2009; Black and Macinko, 2008; Barton et al., 2009; Buys and Miller, 2012; Duff, 2012; Easthope and Judd, 2010; Giles-Corti et al., 2014; Haigh et al., 2011; Kent and Thompson, 2014; Thompson, 2013). As a result, planners must focus on how the design of higher density built environments can optimise active transport, public transport and social interaction. For example, Giles-Corti et al., (2014) describes how the National Liveability Study, funded through the Australian Prevention Partnership Centre, developed a set of spatially derived built environment liveability indicators that impact upon non-communicable disease risk behaviours and health outcomes in densely populated city environments. Use of these indicators at an early stage of the planning process could therefore help to ensure that liveability for positive health outcomes and quality of life are embedded into the design of new higher density developments. Similarly, Kent and Thompson (2014) argue that

understanding the linkages between health and the built environment can help to foster understanding amongst professions about the relational processes that underpins built environment health outcomes and highlight how built interventions support human health as they address the major risk factors for chronic disease.

- ***Evidence of the effectiveness of resident engagement (10 out of 109 articles)***

Ten out of the 109 articles embedded upon a Socio-Ecological Determinants of Health perspective of Health suggest that approaches to strategy development not only need to be context specific, but actively involve residents and other members of the public from different socio-demographic groups in informing the development of the strategies (Acioly and Davidson, 1996; Bunker et al., 2002; Easthope and Judd 2010: 17-18; Fincher, 2004; Haigh et al., 2011; Hancock, 2017; Kent, 2015; Randolph, 2005; Reid et al., 2017; Thompson and Paine, 2017). Two out of these 10 articles argue that greater attention to women's experiences and needs for higher density living and design of the built environment needs to be given to improve unequal gendered health behaviours and quality of life (Fincher 2004, Reid et al., 2017). Four of the 10 articles emphasise that professionals should consider residential developments with the needs of specific vulnerable population groups in mind, including single parents and persons with disabilities (Acioly and Davidson, 1996; Haigh et al., 2011; Kent, 2015; Thompson and Paine, 2017). One of these articles states that extra effort may need to be made to involve people from marginalised groups in planning processes as they are more likely to experience social exclusion and are less likely to come forward to participate of their own initiative (Hancock, 2017).

- ***Evidence of the factors that influence health equity and inequity, including the role of planning professionals (7 out of 109 articles)***

Seven out of 109 articles that offer suggestions for improving planning strategies from a Social-Ecological Determinants of Health perspective suggest that planning should be guided by considerations for improving health equity in a way that ensures that planning professionals understand their own specific roles in promoting health equity (Allen and Blandy, 2004; Gifford, 2007; Haigh et al., 2011; Johnson-Lawrence et al., 2015; Gunn et al., 2017; Randolph, 2006; Seo and Chiu 2014). One of these articles, Haigh et al., (2011), takes this suggestion further by detailing how the strategy development process should also seek to

ensure that planning professionals understand the consequences of planning design in terms of health equity.

- ***Evidence of the effectiveness of cross-sectoral partnerships (5 out of 109 articles)***

Five articles discuss that as healthy urban development occurs at the intersection between planning and health, cross-sectoral partnerships are necessary for ensuring that ideas remain relevant over time so that maximum benefit can be achieved (Bunker et al., 2002; Easthope and Judd 2010: 17-18; Haigh et al., 2011: 16; Randolph, 2005; Thompson and Paine, 2017). Understanding the wider determinants of health also 'opens up a range of opportunities for collaboration and partnerships', including partnerships with social workers departments and other government and private industry personnel, who have knowledge to contribute to each other's work (Thompson and Paine, 2017). Collaborative relationships are also important for enabling early engagement and more proactive approaches to development (Easthope and Judd, 2010; Randolph, 2005).

- ***Evidence of subjective perspectives of health (4 out of 109 articles)***

Four out of the 109 articles argue that planning professionals should draw on subjective as well as objective evidence and perspectives of health (Easthope and Judd, 2010; Foster, 2006; Lofti and Koohsari, 2009; Raman, 2010).

- ***Evidence specific to the national context (4 out of 109 articles)***

Four articles framed upon a Socio-Ecological Determinants of Health perspective stress that the use of evidence-based approaches in planning strategy development needs to be undertaken with care, especially when they involve applying evidence from different countries as the context and experience of higher density living in the UK, South Asia and US is different from the Australian context (Bunker et al., 2002; Easthope and Judd 2010: 17-18; Randolph, 2005; Thompson and Paine, 2017). Instead, planning professionals should engage with health professionals, social researchers, education departments and third sector professionals to obtain evidence and a level of understanding of the needs of a specific community group to develop a context-specific supportive infrastructure to promote health equity (Thompson and Paine, 2017). Without this knowledge, planning agenda risk

reinforcing and exacerbating health inequalities, especially if a uniform agenda is followed (ibid). Two of the articles also discuss how planning professionals need to together with both private and public sector developers to achieve this context specificity and to reduce the issue of segmentation between different submarkets in order to promote diverse, socially mixed communities (Easthope and Judd, 2010; Randolph, 2005).

- ***Evidence of the impacts of human behaviour for influencing health outcomes (3 out of 109 articles)***

Three articles acknowledge the importance of human behaviour for influencing health outcomes (Buys and Miller, 2012; Giles-Corti et al., 2014). Two of the articles specifically suggest that greater acknowledgement should be made by planning professionals of the importance of human behaviour in influencing health outcomes, particularly in devising criteria for measuring the success of specific health interventions in a planning context (Buys and Miller, 2012; Giles-Corti et al., 2014).

- ***Evidence of community health and quality of life (3 out of 109 articles)***

Three articles suggest that health professionals should give greater consideration to evidence focusing on community health and quality of life rather than individual health outcomes for improving planning strategies and for reducing health inequalities across the whole population (Anderson, 2009; Gifford, 2007; Gunn et al., 2017).

- ***Evidence from health mapping techniques (2 out of 109 articles)***

Two articles discuss how utilising evidence from health mapping techniques can help to highlight the interdependent interactions between the different factors that influence health outcomes in higher density urban environments (Barton et al., 2006; Haigh et al., 2011).

- ***Evidence of the importance of resident satisfaction (2 out of 109 articles)***

Two articles emphasise that planning professionals need to work more closely with health professionals to identify the factors that influence residential satisfaction in order to assist in the planning and design of neighbourhoods (Giles-Corti et al., 2014; Randolph, 2006). This

can help to ensure a lower resident turnover rate and facilitates greater acceptance of higher density living as a long-term housing choice (Randolph, ibid). This can also help to enhance community cohesion and inclusion in higher density environments (ibid).

- ***Evidence of the importance of challenging deeply-embedded cultural views (2 out of 109 articles)***

Two articles argue that in Australia there is a need to challenge long-standing cultural values that prefer lower density as part of the process of promoting higher density living (Randolph, 2006; Giles-Corti et al., 2014).

- ***Evidence of the diversity of lived experience amongst residents (2 out of 109 articles)***

Two articles, Allen and Blandy (2004: 33-4) and Buys and Miller (2012: 335), propose that further research and knowledge is needed to ascertain the different types of city dwellers to move away from the notion that this group is an undifferentiated mass, and to explore how a wider social mix can be attracted to city centres. Links to 'capacity studies' can help to determine the limits that can be placed on cities (Allen and Blandy, 2004). In regards to better understanding the needs of residents, Buys and Miller (2012: 335) suggest that more work is needed to understand the 'living experience' of people in different density neighbourhoods in order to 'understand and enhance the high-density residential experience'.

- ***Evidence of the impact of upstream participation and early engagement of health professionals in planning policy strategy development (1 out of 109 articles)***

One article, Haigh et al., (2011), explains that early engagement of health professionals in planning is more likely lead to improved health outcomes through longer-term feedback processes on draft versions of publicly exhibited policies, plans and proposals. Maximum influence on health outcomes can be achieved when there are opportunities for all players to contribute at the earliest stages of a project's inception (ibid). This is known as 'upstream participation' and involvement of health professionals from the start is more effective for enhancing health through built environment design than asking a proponent to amend an already formulated and drafted policy or plan (ibid: 27). This can be achieved using a

checklist, such as the New South Wales Healthy Urban Development Checklist, and by ensuring that health professionals have prior knowledge of the planning system and development process to participate on a proactive basis early on in the development process (ibid).

- ***Evidence of investment in active and public transport (1 out of 109 articles)***

One out of the 109 article suggests that planners need to financially invest heavily in transport, biking and pedestrian infrastructure to deliver the urban fabric needed to achieve the deep social transformation required to end automobile dependence (Newman et al., 2015).

- ***Evidence from existing checklists (1 out of 109 articles)***

One article, Haigh et al., (2011: 31), also suggests that checklists can help to encourage ongoing processes of engagement and mutual development planners and health professionals that can help to ensure that 'planning and development become more health promoting over time.'

- ***Evidence of the effectiveness of organisational capacity (1 out of 109 articles)***

One out of the 109 Socio-Ecological Determinants of Health-embedded articles highlights the importance for planning and health organisations to strengthen their own capacity, including resources and commitment to health improvement, in order to maximise the effectiveness of collaborative working and co-development of healthy urban living plans (Haigh et al., 2011: 31).

- ***Evidence of the effectiveness of co-learning opportunities (1 out of 109 articles)***

One out of the 109 articles highlights that to promote behaviour change to enhance the equity of physical and mental health outcomes and reduce inequalities across different socio-demographic groups, co-learning opportunities that involve both health and planning professionals should be considered as a fundamental part of professional education for planning professionals (Haigh et al., 2011).

Thirty-six out of 109 articles grouped within the Socio-Ecological Determinants of Health perspective present suggestions for how to improve existing planning strategies for higher density urban development at the design and action implementation level through the incorporation of various types of health-related evidence in order to improve health outcomes.

- ***Evidence of the importance of design space for meeting the health needs of residents at different stages of their lives (11 out of 109 articles)***

Eleven out of the 109 articles highlight that high-density environments need to be specifically designed to meet the health needs of people at different stages of the life course (Badland et al., 2017; Christian et al., 2017; Giles-Corti et al., 2012: 14; Holliday, 2006; Kalcheva et al., 2016; Quigley and Ball, 2007; Reid et al., 2017; Shi, 2017; Strath and Greenwald, 2007; Talen, 2006; Yung et al., 2017). Two of these articles suggest that particular attention should be paid to ensuring that local parks are designed for a variety of multiple uses to achieve this target (Giles-Corti et al., 2012: 14; Strath and Greenwald, 2007). These articles also suggest that open spaces should be located within a short distance of nearby residents (ibid). One of these articles suggests that links to cultural heritage can provide opportunities for elderly people to share stories about the history of the area, which can help to foster a sense of community (Giles-Corti et al., 2012: 14). Holliday (2006: 24) emphasises that parks and public spaces should be accessible at most hours and include places to sit down and eat or have coffee, as these features are likely to be more important than the formal design aspects. Yung et al., (2017) propose that understanding evaluations of elderly people can help with considerations for the design of public parks to make them more amenable to healthy ageing. High-rise developments also need to have ‘quiet natural settings for the elderly’ to ‘sustain social integration’ (Kalcheva et al., 2016: 971). Regarding children, Shi’s (2017) work highlights the importance of children’s needs for their healthy development. Christian et al., (2017: 95) suggest that further research is needed to identify the ‘optimum amount and quality (attributes) of home outdoor spaces required to facilitate outdoor play and optimise early child development’. Reid et al (2017: 22) suggest that there is a need to consider the views of female’s experiences, perceptions and intentions to live in high density dwelling at different points across the lifespan, in addition to more research about the needs and wants of women with children to inform the development industry. Badland et al., (2017: 21) propose using a ‘suite of potential (and readily available) spatial measures [for housing] that could be

operationalised and applied to assess selected housing attribute with selected outcomes'. Census data can also be drawn upon to inform impacts of housing characteristics and urban form on health (Badland et al., 2017: 21). Crime data and trends can also be used to inform density-safety trends (Badland et al., 2017: 22). In terms of considering the needs of diverse populations, Talen (2006: 30), whose work focuses on diversity (meaning of age, race/ethnicity, family type and socioeconomic status) of populations living in different neighbourhoods, suggests that the design of the built environment needs to take social diversity in all its forms into account.

- ***Evidence of factors important for improving quality of life (10 out of 109 articles)***

Ten out of the 109 articles identify specific features of quality of life that need to be implemented into higher density planning designs to enable the built environment to create favourable health conditions (Badland et al., 2015; Buys and Miller, 2012; Hu et al., 2016; Kent, 2015; Kent and Thompson, 2014; Nicolls et al., 2017; Ormandy and Ezratty, 2016; Roulet et al., 2006; Vandentorren et al., 2006; Wilson et al., 2008). These include ensuring that neighbourhood and dwelling position enable social interaction, ensuring safety from traffic, crime and noise pollution (Buys and Miller, 2012; Kent, 2015). Other articles focus on implementing strategies to ensure optimal thermal comfort to improve quality of life, particularly for those deemed to be more vulnerable to the impacts of temperature extremes, including elderly people, young children and those from a low socio-economic background (Hu et al., 2016; Nicolls et al., 2017; Ormandy and Ezratty, 2016; Roulet et al., 2006; Vandentorren et al., 2006; Wilson et al., 2008).

- ***Evidence of how to improve ventilation and mitigate the impacts of heat (8 out of 109 articles)***

Eight out of the 109 article discuss how higher density indoor and outdoor built environments need to be designed to ensure adequate ventilation and protection from heat to improve health outcomes (Chan and Liu, 2018; Guo et al., 2017; Hu et al., 2016; Roulet et al., 2006; Ormandy and Ezratty, 2016; Vandentorren et al., 2006; Wilson et al., 2008; Zhang et al., 2016). Guo et al., (2017); Hu et al., (2016); Roulet et al., (2006); Vandentorren et al., (2006); and Wilson et al., (2008) show how natural ventilation performance in high-density cities can be optimised to prevent the harmful effects of heat on human health by incorporating

scattered morphology and green spaces. Hu et al., (2016) suggests that the urban heat island effect can be mitigated by using digital techniques to find the optimum urban form for maximising and minimising the sky view factor (SVF) values in high-density environments. Zhang et al., (2012) argues that sky exposure in densely populated urban areas needs to be maximised as a lack of exposure to natural light can lead to an increase in perceptions of spatial confinement that can have a harmful effect on mental wellbeing. In tropical climates, high-level sky exposure without proper shading can also compromise thermal comfort levels (ibid). However, Vandentorren et al., (2006) discusses how adapting building insulation and using reflective materials can help to provide protection from heat waves.

- ***Evidence of the effectiveness of specific design features for improving health outcomes (7 out of 109 articles)***

Seven out of the 109 articles discuss how planning professionals can design and implement specific built environment features to enhance social interaction (Easthope and Judd, 2010; Giles-Corti et al., 2012; Kalcheva et al., 2015; Pomeroy, 2011; Setti, 2013; Udell et al., 2014; Wener and Carmalt, 2006). In relation to design dimensions, Easthope and Judd (2010: 26-27) propose that there is a need to stimulate community interaction using serendipitous design features, encouragement of diverse community interaction (e.g. community gardens, shared common rooms) and digital augmentation, meaning buildings need to have good internet access. Design should reduce noise penetration and residents need to have education and awareness raising on how to avoid noise problems (Easthope and Judd, 2010: 33). Udell et al., (2014) propose the use of the six Ds (density, distance to public transport, destination accessibility, and diversity, design and demand management) as essential to walkable higher density. Setti (2013) highlights how hybrid-type shared spaces, relational spaces, common places and ‘interspaces’ present alternative and innovative settings for social interaction from traditional meeting spaces, which helps to generate social interaction in a way that challenges traditional socialisation patterns. Two articles discuss how specific features such as sunken and rooftop gardens, elevated plazas, multilevel vertical open spaces and sky bridges can help to create a stimulating environment (Pomeroy, 2011; Wener and Carmalt ,2006). In addition, one other article explores how investment in public art, cinemas, galleries and museums helps to enhance both human capital and the social value of the development (Kalcheva et al., 2015).

- ***Evidence of land use mix and design (6 out of 109 articles)***

Six articles (Badland et al., 2015; Chan and Liu, 2018; Giles-Corti et al., 2012; Haarhoff et al., 2016; Hu et al., 2016; Wilson et al., 2008) discuss how land use mix and diversity of housing type can enhance liveability and health outcomes because 'it impacts housing choice, which in turn, underpins a walkable community' (Badland et al., 2015: 31), and because it can influence the urban heat island effect that affects the indoor and outdoor temperatures in higher density environments (Chan and Liu, 2018; Hu et al., 2016; Wilson et al., 2008).

- ***Evidence of amenity provision on positive health outcomes (6 out of 109 articles)***

Six articles discuss the importance of amenity provision for influencing health outcomes (Bramley et al., 2006; Haarhoff et al., 2016; Kalcheva et al., 2016; Kent and Thompson, 2014; Sharp, 2003; Thompson and Paine, 2017). Kalcheva et al., (2016: 971) argues that plazas should have sustainable characteristics to provoke social interactions and 'sustain recreational everyday activities'. Kent and Thompson (2014) suggest that healthy built environments need to encompass: opportunities for physical activity; opportunities for connecting and strengthening communities; and, opportunities for enabling access to healthy food. Kent and Thompson (2014: 241) also highlight that the built environment can be 'modified to facilitate or constrain' 'increase opportunities' or 'reduce barriers' to physical activity, and which vary depending on population group, purpose, and context. The authors note that there is a need for consistent and objective measurements of the built environment to better understand the relationship of the built environment and health (Kent and Thompson 2014: 248). Bramley et al., (2006), Haarhoff et al., (2016), and Kent and Thompson (2014) discuss how car use can be limited through planning design to promote walkability and reduce air pollution. Two articles, Sharp (2003) and Thompson and Paine (2017), argue that higher density developments should ensure that residents have access to healthy dietary choices to avoid the problems associated with the 1970's tower block estates in the UK wherein the provision of nearby shops and amenities were neglected. Good design and building standards can mitigate health problems associated with overcrowding, sleep deprivation, stress and anxiety (Thompson and Paine, 2017). Garden spaces can enable residents to grow and harvest their own food and access to sunlight/daylight in both private and public spaces should be implemented in planning designs to enable this action (ibid).

Thompson and Paine (2017) also identified Community Food Box programs and limitations on the number of fast food outlets as key initiatives for promoting positive health, especially amongst lower income groups.

- ***Evidence of existing health inequities and evidence of reducing these inequities through design of the built environment (6 out of 109 articles)***

Six out of the 109 articles focus on improving gendered health outcomes through the design of the built environment (Jabareen, 2006; Powers, 2013; Randolph, 2005; Sherry and Easthope, 2016; Shi, 2017; Yang, 2009). Four of these draw attention to learning lessons from previous experiences of poor built environment design to improve health for women, children, families and older people (Powers, 2013; Sherry and Easthope, 2016; Shi, 2017; Yang, 2009). For example, Sherry and Easthope (2016) argue that to enhance child development, higher density environments need to provide easy access to schools. Planners therefore need to consider current and anticipated demands for school places within the wider educational context regarding access to schools (ibid). One article, Jabareen (2006), suggests that negative perceptions about higher density environments can be challenged with the following sustainable urban form design concepts: compactness, sustainable transport, mixed density, mixed land uses, population diversity and greening. Another article, Randolph (2005), argues that features of the dwelling, including position, design, size of rooms, communal facilities, external illumination at night and safety are also significant for promoting greater equality of health outcomes.

- ***Evidence from mapping exercises and techniques (5 out of 109 articles)***

Five out of the 109 articles suggest that planners should draw on evidence from mapping activities to improve health outcomes (Badland et al., 2017; Cowie et al., 2016; Giles-Corti et al., 2014; Matan et al., 2015; Zhang et al., 2012). Cowie et al., (2016: 6) suggests that maps are a useful source of evidence to understand and identify neighbourhoods that are ‘sweet spots’ of high walkability and low traffic density. Maps can also identify ‘sour spots’, with poor walkability and this can also be compared to geographic data for other issues such as air pollution and rates of disease (Cowie et al., 2016: 9). Matan et al., (2015) suggest that design mapping and models can predict health outcomes, which can then be used to incorporate activity-related health impacts of transit use into precinct assessments. Badland et al., (2017)

discusses how the use of conceptual area-level mapping of area-level measures of housing together with selected health and wellbeing indicators can help identify factors that create barriers to healthy living and help identify areas requiring improvement.

- ***Evidence specific to the local context (3 out of 109 articles)***

Three out of 109 articles highlight the importance of drawing on evidence particular to the individual local context of the proposed development (Haigh et al., 2011; Kent and Thompson, 2014; and Yang, 2008). Kent and Thompson (2014: 249) argue that evidence needs to be understood in relation to the local context. Yang (2008) makes extensive recommendations for planning strategies based on her research into satisfaction in neighbourhoods in North Carolina and Oregon.

- ***Evidence of good practice in governance for policy integration and implementation (3 out of 109 articles)***

Three articles draw on evidence of good practice for governance of planning policy implementation (Crommelin et al., 2017; Giles-Corti et al., 2016; Lusher et al., 2008). Lusher et al., (2008: 4, 36-7) propose eight strategies for liveable streets in New York which includes the suggestion to mandate liveable streets at governance level (i.e. the Mayor mandates this via construction, zoning etc.). In a similar vein, Giles Corti et al., (2016) draw on the literature to propose that there is a need for integrated, well-implemented urban systems policies, and for ministers to develop appropriate legal, administrative and technical frameworks. Crommelin et al., (2017: 9) argue that 'inclusionary zoning' may be a way to incentivise or require developers to provide a certain percentage of affordable housing in new density development as an effective tool to increase affordable housing supply.

- ***Evidence of strategies for improving the management of buildings (3 out of 109 articles)***

Three out of 109 articles discuss evidence related to improving the management of buildings for improving health outcomes (Allen and Blandy, 2004; Sharp, 2003; Thompson and Paine, 2017). Allen and Blandy (2004: 30-34) draw on research for city living in Manchester and Sheffield and suggest that there is a need to consider implications in relation to the

management of new apartment blocks, management of the city centre environment, and social inclusion and sustainable city centres. Residents tended to be more satisfied when there was a resident caretaker as this ensured a higher quality of service (Allen and Blandy, 2004: 30). They recommend a legal framework and resident common hold responsibility of apartment blocks (Allen and Blandy, 2004: 30). Allen and Blandy (2004: 31) also note an implicit tension between night-life which entices some groups and also provides a way to expand the night-time economy, and the consequent 'vibration, noxious smells and light pollution' which they suggest requires licensing interventions to address. Two other articles, Sharp (2003) and Thompson and Paine (2017), also suggest that the provision of ongoing building maintenance and management are crucial to improving quality of life for residents in higher density environments.

- ***Evidence of the housing market (3 out of 109 articles)***

Three of the articles highlight the need to draw on evidence of the current housing market (Haarhoff et al., 2016; Holman et al., 2015; and Randolph and Tice, 2011). For example, Randolph and Tice (2011: 2678) suggest that there needs to be a 'fine tuning' of what drives the demand of markets, and to better understand the investor and ownership markets.

- ***Evidence of the importance of resident participation in place design (2 out of 109 articles)***

Two articles out of 109 articles highlight the importance of providing opportunities to involve residents in place-shaping activities (Haarhoff et al., 2016; Holliday, 2006). These articles argue that provision should be made during the development stages of planning to involve residents in local urban planning activities and later on in the development process to involve residents in place-shaping activities (Haarhoff et al., 2016). This can help to foster resident satisfaction and self-esteem (Haarhoff et al., ibid). Holliday (2006) argues that this is best undertaken as part of a 'co-production' rather than a top-down development process.

- ***Evidence from existing toolkits (2 out of 109 articles)***

Two articles focus on how toolkits, such as the Victorian Government 'Activity Centre Toolkit' for promoting higher density, transit-orientated development in Melbourne and the

‘Auckland Plan’ in New Zealand, can provide specific guidance on attributes that need to be implemented into planning designs to enhance social cohesion and quality of life (Diez Roux and Mair, 2010; Haarhoff et al., 2016). To influence physical activity, social interaction, and positive mental and physical health, developments should ensure a high availability of places for residents to be physically active, be safe and aesthetically pleasing, have gyms located nearby which are affordable, and be supported by regional transport infrastructure that increases the availability of public transport and limits automobile use in higher density neighbourhoods (Diez Roux and Mair, 2010).

- ***Evidence of minimum standards for indoor space (1 out of 109 articles)***

One out of the 109 articles suggests that overcrowding can be reduced by providing a minimum percentage of housing large enough to accommodate families (Giles-Corti et al., 2012: 9).

- ***Evidence from existing guidelines and indicators of human development (1 out of 109 articles)***

One article, Hancock et al., (2017), emphasises that equality of health outcomes can be enhanced through the amendment and implementation of specific guidelines, such as the Medellin City Council guidelines, that were based on the concept of ‘social urbanism’. Implementation of these guidelines can help to ensure that specific indicators of human development and quality of life guide public investment and built environment design and in a way that prioritises the needs of the most vulnerable population groups (ibid: 96-98). This can help to ensure that education and culture can be cultivated in higher density environments that promote social co-existence to improve health and quality of life for all (ibid).

- ***Evidence from observation of sites (1 out of 109 articles)***

One article highlights the significance of evidence from observation of particular case study sites. Zhang and Lawson’s (2009) research highlights that the ways public spaces in high-density buildings are designed may have an impact on how people use them for social and other activities, and this may not be as expected. It is important therefore to draw on

observations of the site to better understand the ways that people use public spaces, and to consider how design can be welcoming to social uses by residents.

- ***Evidence of the importance of access to green space for improving mental health (1 out of 109 articles)***

Kalcheva et al., (2016: 973-4) draw on their analysis of liveability in high rises in Salford Quays to suggest seven steps to 'inform the future designer's work'. These are that the design should provide high quality green spaces and vertical landscaping to avoid psychological strain from separation from the natural environment. High-rise buildings should be properly integrated with their surroundings, with a mix of uses and amenities in walking distance. High-rise buildings can be 'landmark buildings' to visually contribute to a rich skyline.

### *3.4.4: Health-related evidence proposed for translation into planning strategies from a Planetary Health perspective*

Seven out of the 20 articles embedded within a Planetary Health Perspective draw on health-related evidence to offer suggestions for improving planning strategies at the bureaucratic level to improve health outcomes in higher density urban developments (Barthol et al., 2010; Bellamy et al., 2017; Davern et al., 2017; Jowell et al., 2017; Pattanayak and Haines, 2017; Speak et al., 2012; Watts et al., 2015). These articles draw on the following types of evidence:

- ***Evidence of impacts of anthropogenic climate change, e.g. severe weather, extreme heat (7 out of 20 articles)***

All seven of the articles that offer suggestions for improving planning strategies at the bureaucratic level from a Planetary Health perspective emphasise that planning and health professionals need to consider climate change when planning for higher density neighbourhood development (Barthol et al., 2010; Bellamy et al., 2017; Davern et al., 2017; Jowell et al., 2017; Pattanayak and Haines, 2017; Speak et al., 2012; Watts et al., 2015). These articles discuss how planning strategy needs to involve consideration of adaptation to climate change threats, such as flooding and heat, through built environment change, and more significantly, mitigation of the greenhouse gas emissions that worsen the impacts of climate change in the long term through innovation of the built environment. For example,

Watts et al., (2015) uses evidence from the Lancet Commission on Health and Climate Change to argue that urban planning practices need to urgently consider the effects of climate change activity on both short and long-term human and environmental health outcomes.

- ***Evidence from previous collaborative, transdisciplinary actions aimed at improving existing urban planning development processes (6 out of 20 articles)***

Six articles (Barthol et al., 2010; Davern et al., 2017; Jowell et al., 2017; Pattanayak and Haines, 2017; Speak et al., 2012; Watts et al., 2015) draw upon evidence from existing literature and studies (Bathol et al., 2010; Jowell et al., 2017; Watts et al., 2015), evaluations of existing government strategies and policy interventions (Davern et al., 2017; Pattanayak and Haines, 2017), survey data (Barthol et al., 2010), and site sampling data (Speak et al., 2012) to suggest that planetary health-focused approaches to planning need to bring together multiple actors from diverse institutions to co-plan for positive change in a way that is problem-solving orientated, transdisciplinary. New developments in planning strategies should be underpinned by a recognition of the significance of all contributions made by the different institutions in an overarching conceptualisation of what constitutes progress in health that transcends individual institutional aims and values (Jowell et al. 2017, Watts et al., 2015). For example, Davern et al., (2017) uses evidence from the South Australian Government's design of public green spaces in denser cities to suggest that planetary health-focused approaches to planning need to involve inter-institutional co-planning for positive change.

- ***Evidence of interconnections between human and environmental health from review of evidence of existing literature (5 out of 20 articles)***

Five articles (Barthol et al., 2010; Bellamy et al., 2017; Davern et al., 2017; Jowell et al., 2017; Watts et al., 2015) draw upon evidence presented in existing studies of human and environmental health outcomes to argue that planning professionals need to consider to a greater extent the role that the natural environment plays in supporting human health to fully appreciate the threat that is being posed by anthropogenic climate change to human health. For example, Watts et al., (2015) suggest that planning professionals need to embrace a deeper understanding of the interconnectedness between humans and the wider ecological environment on which it depends. Rethinking the relationship between health, humans and

the environment through evidence of their inter-connectedness can promote transformation in planning practices by challenging core ideas that traditional approaches to practice are embedded upon (ibid). Watts et al., (2015) also argues that panning professional should move beyond focusing on identifying single issues and problems to consider the complex health sequelae of the natural and built environmental landscapes when approaching health problems through planning strategy development.

- ***Evidence of challenges and limitations in existing planning strategies (1 out of 20 articles)***

One article, Davern et al., (2017), evaluates existing South Australian government approaches to planning in relation to data from existing epidemiological studies to highlight existing barriers to improving planning strategies to more readily address the challenges posed by anthropogenic climate change and to suggest ways that these may be overcome.

Fifteen out of the 20 articles grouped within the Planetary Health domain offer suggestions for improving planning strategy development at the design and action implementation stage. (Barthol et al., 2010; Bellamy et al., 2017; Emmanuel and Steemers, 2018; Giridharan et al., 2004; Holmes et al., 2015; Kleerekoper et al., 2012; Lee and Braham, 2017; Lee et al., 2015; Mirzaei, 2015; Ng et al., 2012; Perini and Magliocco, 2014; Ren et al., 2013; Speak et al., 2012; Shi et al., 2018;Tan et al., 2016). The following types of health-related evidence are drawn on in these articles in order to propose suggestions for translating and embedding into action-implementation stage planning strategies:

- ***Evidence of the impact of green space and wildlife gardens for human and environmental health outcomes (7 out of 20 articles)***

Seven articles discuss how planners can promote both human and environmental health through introducing diverse ecosystems, providing access to nature, and through the design of green space and wildlife gardens (Barthel et al., 2010; Bellamy et al., 2017; Emmanuel and Steemers, 2018; Kleerekoper et al., 2012; Ng et al., 2012; Ren et al., 2013; Tan et al., 2016). For example, Bellamy et al. (2017) highlights that tree species for park environments need to be selected, not just to enhance the appeal of the space for residents in high density neighbourhoods, but to enhance the biodiversity of the wider ecosystem and to provide planet

cooling benefits. Emmanuel and Steemers (2018), Kleerekoper et al., (2012), Ng et al., (2012), and Tan et al., (2016) examine how different implementations of greenery may help to mitigate the urban heat island effect in high density urban environments.

- ***Evidence of building morphology, measurements of air temperature, and air quality indicators (7 out of 20 articles)***

Seven articles within the sample focus on how evidence pertaining to building morphology in higher density settings illustrates how environmental health can be improved through the enhancement of pollution dispersion to improve air quality (Giridharan et al., 2004; Holmes et al., 2015; Kleerekoper et al., 2012; Lee and Braham, 2017; Lee et al., 2015; Perini and Magliocco, 2014; Shi et al., 2018). Six of these seven articles also examine evidence of how building morphology, including height and variation, can be used to decrease ambient air temperatures (Giridharan et al., 2004; Holmes et al., 2015; Kleerekoper et al., 2012; Lee and Braham, 2017; Lee et al., 2015; Perini and Magliocco, 2014).

- ***Human and environmental health indicator evidence (5 out of 20 articles)***

Five articles argue that human and environmental health evidence and indicators can be used to introduce diverse ecosystems through the design of green space and wildlife gardens (Barthel et al., 2010; Bellamy et al., 2017; Emmanuel and Steemers, 2018; Kleerekoper et al., 2012; Ng et al., 2012; Ren et al., 2013; Tan et al., 2016).

- ***Evidence of building height and impact of sustainable energy sources (4 out of 20 articles)***

Four articles (Emmanuel and Steemers, 2018; Mirzaei, 2015; Ren et al., 2013; and Shi et al., 2018) discuss how tall, high-rise buildings present a great opportunity for implementing sustainable energy sources, such as solar power, to enhance environmental health, upon which human health depends.

- ***Urban climate evidence (1 out of 20 articles)***

One article suggests that urban climate knowledge can be promoted in higher density planning to improve the extent to which development can enhance human and environmental health for future generations by highlighting visually and spatially the critical importance of urban greenery and coverage, urban air paths, open spaces, water bodies and rivers, and building morphology for enhancing both human and environmental health (Ren et al., 2013).

A summary of the findings of the types of health-related evidence proposed for translation into planning strategies is presented in **Table 12:**

**Table 12: Types of Health-Related Evidence Proposed for Translation into Planning Strategies at the Bureaucratic and Action-Implementation Levels for Each Perspective of Health (N=141)**

| Articles Proposing How Health-Related Evidence can be Implemented into Planning Policy and Practice | | | | | |
|---|---|---|---|---|---|
| Health-Related Evidence Translated at the Bureaucratic Level (n=48) | | | Health-Related Evidence Translated at the Action-Implementation Level (n=54) | | |
| **Global Public and Population Health (n=7)** | **Socio-Ecological Determinants of Health (n=34)** | **Planetary Health (n=7)** | **Global Public and Population Health (n=3)** | **Socio-Ecological Determinants of Health (n=36)** | **Planetary Health (n=15)** |
| • Evidence from existing literature pertaining to health inequality (n=2);<br>• Cross-sectional epidemiological data (n=1);<br>• Evidence from transdisciplinary approaches to improving urban health (n=5);<br>• Evidence of good practice in health governance (n=4);<br>• Quantifiable empirical data pertaining to disease morbidity and mortality across different (n=5);<br>• Evidence of how international political and economic forces affect health (n=3);<br>• Evidence from the World Health | • Evidence of local and regional social and environmental health determinants (n=29);<br>• Evidence of how the built environment overlaps with social factors in order to optimise health behaviours (n=10);<br>• Evidence of resident satisfaction (n=10);<br>• Evidence of the role of planning professionals in improving health equity (n=7);<br>• Evidence of the effectiveness of cross-sectoral partnerships (n=5);<br>• Evidence from health mapping techniques | • Evidence of the human and environmental health impacts of anthropogenic climate change (n=7);<br>• Evidence from existing research focused on collaborative, transdisciplinary approaches aimed at improving urban planning development processes at multiple densities (n=6);<br>• Evidence from reviews of existing studies of human and environmental health outcomes (n=5) | • Evidence of density and dwelling size and its impacts on health (n=2);<br>• Evidence from cross-sectional studies of epidemiological data pertaining to human health, human activity levels and transport provision (n=1);<br>• Evidence of the mental health impacts associated with the design and availability of public spaces, transport networks, street networks (n=1) | • Evidence of the importance of design space for meeting the health needs of residents at different stages of their lives (n=11);<br>• Evidence of neighbourhood factors important for improving quality of life (n=10);<br>• Evidence of how to improve ventilation and mitigate the impacts and risks associated with the urban heat island effect (n=8);<br>• Evidence of the effectiveness of specific design features of the built environment (n=7);<br>• Evidence of benefits associated | • Human and environmental health evidence and indicators (n=5);<br>• Evidence of the impact of green space and wildlife gardens for both human and environmental health outcomes (n=7);<br>• Evidence pertaining to building morphology, pollution dispersal and air quality (n=7);<br>• Evidence of the implementation of sustainable energy sources (n=4);<br>• Urban climate knowledge(n=1); |

| | | | | | |
|---|---|---|---|---|---|
| Organisation Healthy Cities project (n=1);<br>• Evidence of local socio-economic factors (n=2); | (n=2);<br>• Evidence of human health behaviour (n=3);<br>• Evidence of community health (n=3);<br>• Evidence of the impact of upstream participation (n=1);<br>• Evidence of investment in active and public transport (n=1);<br>• Evidence from the application of existing checklists (n=1);<br>• Evidence of co-learning opportunities (n=1);<br>• Evidence of organisational capacity (n=1);<br>• Evidence of challenging deeply-embedded cultural views (n=2) | | | with land use mix and design (n=6);<br>• Evidence of amenity provision on health behaviour (n-6);<br>• Evidence of interaction drawn from observation of public spaces (n=1);<br>• Evidence of the importance of access to green space (n-1);<br>• Evidence of minimum standards for indoor space (n=1);<br>• Evidence of the importance of resident participation in place design (n=2);<br>• Evidence of the effectiveness of strategies aimed at improving the management of buildings (n=3) | |

### *3.4.5: Discussion of findings*

Key commonalities and divergences between the types of health-related evidence proposed for translation into planning strategies for healthy higher density living across the three theoretical perspectives of health

Articles grouped within all three domains of health suggest that evidence of the potential health benefits that may be gained from adopting a transdisciplinary approach to the

development of planning strategies at the bureaucratic level needs to be incorporated into approaches to planning for higher density urban developed.

Articles grouped within the Global Public and Population Health domain and the Socio-Ecological Determinants of Health domain both stress the need to base planning developments upon evidence of chronic disease morbidity and mortality and existing health inequities in order to design solutions appropriate for reducing identified inequities. However, articles framed upon a Socio-Ecological Determinants of Health perspective place greater emphasis on the need to include evidence over time and at multiple scales. Both domains include articles that propose the need to include evidence linking health to the design of the built environment.

Articles grouped within the Global Public and Population Health category emphasise the need to incorporate: evidence of good planning in governance for planning; evidence of the impacts of international politics and economics on health at the local level, and evidence from the World Health Organisation Healthy Cities report.

However, none of these suggestions are shared with articles embedded upon the two other theoretical perspectives of health. Articles grouped within the Socio-Ecological Determinants of Health domain include a greater number of suggestions than the other two domains. However, articles framed upon a Planetary Health perspective are the only ones to highlight the need to incorporate: a) evidence of the human and environmental health impacts associated with anthropogenic climate change, and b) evidence of the known challenges and barriers to addressing both the causes and impacts of anthropogenic climate change through the design of the built environment.

### *3.4.6: Recommendations and Actions*

The following recommendations and points of action have been made on the basis of the findings for carrying out within the next stage of the HHD project:

<u>Recommendations</u>

- Given the difference between the numbers of articles discussing what types of evidence should be included in planning strategy development versus what has actually already been implemented in existing planning strategy, one recommendation would be to examine to what extent suggestions made by articles framed upon each of the three domains of health have actually been implemented at the case study site;

- From this, identify gaps in terms of the application of proposed types of health evidence in planning strategies at the case study site;

- To identify appropriate suggestions which have not already been implemented at the case study sites for possible embedding within the proposed toolkit of recommendations to be produced as a final outcome of the HHD project;

- To test and evaluate the implementation of these suggestions within the specific case study site context;

- To devise student projects and course assignments to test and evaluate the implementation of these suggestions;

- To gather feedback from the testing phase and revise suggestions and implementations accordingly;

- To record the challenges, barriers and limitations to implementation;

- To contribute to the scholarship of health and the built environment by writing collaborative journal articles that look at: a) how suggestions for implementing evidence within planning have been included at the case study site, and b) how new strategies were tested and implemented at the case study site, and c) what the challenges faced translating and implemented health evidence into planning strategies at the case study site were;

- To work collaboratively with health and planning professionals and other academic experts from a wide range of scholarly disciplines to produce the toolkit for guidance

on decision-making for embedding health evidence in planning strategies for higher density development.

Actions:

- To plan and conduct interviews with planning professionals to examine what suggestions have already been included in planning development at the case study sites;

- To review existing planning documentation for the case study site context to identify what suggestions have been included and to identify areas where suggestions could be applied to improve future planning developments;

- To undertake collaborative workshops with planning and health professionals and academic experts from a wider variety of disciplines to explore how suggestions can be implemented;

- To embed strategy testing within existing undergraduate and postgraduate student coursework and assessment and to development new postgraduate and undergraduate modules that the strategy testing phase could link to;

- To contact the course coordinators of the relevant existing modules to discuss how student projects can align with the proposed project activities;

- To create a collaborative working document that all project team members can contribute to in order to record evidence of barriers, challenges and limitations to translating evidence at the project case study sites;

- To hold academic writing workshops as part of the project team meetings to identify the focus of academic articles for publication in high ranking academic journals and to work collaboratively with project team members to co-author the journal articles;

- To identify dates for workshop meetings focused on production of the guidance toolkit.

# 4.0: Conclusion

## 4.1: Concluding Discussion

This Evidence Review follows on from the first Literature Review report undertaken as part of the *Healthy Higher Density Living: Translating Evidence to Support Planning Strategies for Healthier Higher Density Living* research project which aims to: a) provide an understanding of how health evidence can be used to plan higher density precinct developments to enhance population health, and b) develop planning strategies to apply health evidence within planning for higher density development. This Evidence Review presents a detailed overview of the findings from a combined systematic and narrative inductive review of the academic literature focused on health and higher density living in order to answer the question: *What Evidence are Available to Translate into Planning Strategies for Healthy Higher Density Living?*

To answer the question, it is important to consider what is meant by the term ‘evidence’, or more specifically, ‘health evidence’ or ‘health-related evidence’. The findings reveal that what is understood by the terms ‘health evidence’ or ‘health-related evidence’ is not universally upheld by academic researchers spanning the vast disciplinary journals in which the articles within the sample were drawn from. Importantly, the lack of clear definitions or descriptions about the meaning of the term ‘health evidence’ from articles within the sample itself, suggests that researchers take for granted their understandings or interpretations of what is meant by ‘health evidence’ and assume that other researchers share this understanding. The findings from this Evidence Review however, reveal what is considered to encompass ‘health evidence’ or ‘health-related evidence’ varies according to the theoretical perspective of health that each article is embedded upon. Given that differences in theoretical perspectives of health which shape understandings of what counts as ‘health and ‘health evidence’ do not correspond to differences in the academic disciplinary focus of the articles (also see Connon et al., 2018), the findings therefore suggest understandings of ‘health evidence’ vary within as well as across academic disciplines. Further, the lack of agreed consensus suggests a need for critical questioning of assumptions held by both researchers and planning and health professionals about what the terms ‘health’ and ‘health-related evidence’ refer to, and as well as a need to foster shared understandings and appreciation of

the breadth of information that the term ‘health evidence’ can apply to when considered from multiple perspectives. This is necessary to enhance awareness and appreciation of the vast breadth of health-evidence available that can potentially be translated into planning strategies for higher density living in order to improve health outcomes.

To consider how health-related evidence can be translated into planning practice, it is also important to understand how linkages and understandings of the relationship between health and higher density living have been achieved in existing research and what types of health-related evidence can be used to support this link. The review of evidence has also shown that the types of evidence used to link health to higher density living also vary depending upon the theoretical perspective and understanding of ‘health’ underpinning each article. While only one article uses health evidence to construct a definition of a healthy higher density living environment, a limited number of other articles use evidence of positive and negative health outcomes to directly evaluate features and attributes of the higher density urban built environment and the vast majority of articles do not directly link health to higher density, but instead indirectly link various specific attributes of health to features of the higher density built environment in order to draw conclusions. However, the types of evidence used to establish linkages between health and the higher density urban environment – both directly and indirectly – vary according to the theoretical perspective of health. The findings suggest that greater emphasis is given towards both qualitative and quantitative research evidence and indicators of health for directly establishing links between health and higher density within articles framed upon a Socio-Ecological Determinants of Health perspective. While indirect linking of attributes of health to the higher density built environment was often achieved by reviewing existing academic research literature and secondary analysis of research findings rather than through primary research within articles framed upon each of the different theoretical perspectives of health, others forms of evidence drawn upon differed according to theoretical perspective. The most common type of evidence found in the Global Public and Population Health articles used to generate conclusions was epidemiological cross-sectional health research data. This type of evidence was also used in the articles embedded upon a Socio-Ecological Determinants of Health perspective, however evidence from analysis of existing research data and reviews of the data presented within existing academic literature was the most common type of evidence utilised within these articles. Again, greater emphasis was also placed on qualitative forms of research evidence relating to human health and wellbeing in articles framed upon this perspective compared to articles focused within the

other two perspectives. The most common type of evidence used to link health to features of the built environment in articles framed upon a Planetary Health perspective was data obtained from modelling and simulation techniques. Articles located within global public health primarily focus on quantifiable, measureable forms of evidence.

These findings present important considerations for future research both within the HHD project and beyond. First, as the types of evidence used to link health to higher density are determined by theoretical understandings of health, it suggests that consideration of the wealth of evidence actually available is at present being constrained in the existing research. Challenging taken for granted assumptions in research about the nature of 'evidence' would therefore allow broader exploration of the links between health and higher density and which would consider the relationship between health and higher density through multiple perspectives and lenses. Second, given that the majority of existing research draws upon secondary research data and existing academic literature in order to draw conclusions, this suggests that, at least up to the present time, examination of the relationship between health and higher density has not received much attention in terms of primary research in specific case study site contexts in order to advance understandings of what constitutes healthy higher density living environments. This presents exciting opportunities for possible future research.

Thinking about how health-related evidence can be translated into planning practice involves identifying what types of health-related evidence have already been translated into planning practice for higher density living and what current limitations and opportunities exist in the translational component of the research focused on health and the higher density urban development. The findings of this Evidence Review also indicate that very little information and research is currently available of how health-related evidence has been actively 'translated' and incorporated into planning practice and development. Most of the 141 documents that were reviewed did not focus directly on types of evidence that had been translated into planning strategies for higher density living currently, although they drew on evidence focused on a range of human health outcomes in order to criticise existing approaches to planning. It is possible that in many cases the research was used to inform changes to planning that occurred later, however this remains unknown from this review of the literature. However, in general, the study suggests that there is a paucity of evidence being translated for embedding and use in the actual development of strategies for higher

density urban living. This presents a need for health and planning professionals to collaborate on planning strategy developments for healthy higher density living at an early stage.

In contrast, the findings also indicate that a considerable wealth of research exists that proposes a variety of different types of health-related evidence for embedding in higher density planning policy and practice in order to improve human and also the environmental health outcomes. However, while this research has led to the emergence of various proposals for integrating health evidence in planning policy and practice, it remains unknown whether and how these suggestions may be mobilised in actual processes of planning strategy development, and what challenges or barriers may influence the extent to which this evidence may be successfully integrated in specific local contexts. This indicates that a need to conduct research focusing on the actual process of the implementation and mobilisation of evidence in order to fully understand the challenges and opportunities that influence processes of health-evidence translation into planning practice. This presents an exciting research opportunity for the HHD project to explore.

The review of evidence also highlights that the majority of the small number of articles that explore how health evidence has been translated and integrated into planning policy and practice focus on the integration of evidence at the bureaucratic level of planning development. Similarly, most of the health-focused evidence that it used to critique existing planning strategies is focused at the bureaucratic level. However, over half of the articles that draw on health-related evidence in order to make arguments for integrating health-evidence in planning practice discuss how this may be achieved at the action and implementation level of planning development. This gulf between research focusing on how health evidence has actually been translated into planning practice at the action-implementation level and the amount of research that proposes ways for health-evidence to be integrated at this stage of planning suggests that significant opportunities exist for further research to be undertaken both within and beyond the HHD project that applies these proposals in practice in order to evaluate the suitability and limitations of embedding these suggestions within a real-world context.

The findings also show how the theoretical perspective of health upon which research articles are embedded upon influences what types of health-focused evidence are applied in planning strategy development and what types of health-related evidence are proposed for translation

and integration in planning policy and practice. The absence of articles embedded upon both a Global Public and Population Health and a Socio-Ecological Determinants of Health perspective discussing the implementation of evidence at the action and implementation level may possibly reflect a situation whereby there has been little interaction between health professionals, policy makers, and planners in research and practice to date focusing on improving health outcomes in the higher density urban context. Therefore, although existing research suggests that there exists a limited number of opportunities for health researchers to influence planning at the policy and bureaucratic level, there remains little interaction at the local action-level. This therefore may be suggestive of a need for greater collaborative transdisciplinary approaches to higher density urban development, which the HHD project aims to fulfil through its integration of health and planning, and research and practice in order to improve health-related outcomes in the development of future planning strategies for higher density urban developments.

### 4.2: Actioning the Recommendations

The recommendations made within this Evidence Review for actioning within the HHD project are focused towards achieving the main goal of the project: To advance knowledge of ways to plan for creating healthier higher density urban precinct developments by enabling industry to identify how health and wellbeing can be integrated into planning policy and practice. The specific recommendations made in light of the findings from each of the sub-questions centre upon the undertaking of five key activities:

1) The undertaking of a specific case study site review of how health has been embedded in practice within two higher density urban developments;
2) The undertaking of a series of semi-structured interviews and a focus group workshop with planning and health professionals and a wide range of academic research specialists from multiple disciplinary backgrounds;
3) Working collaboratively with members of the project team, the project reference group, and with a variety of planning and health professionals in order to advance and embed the project research findings in planning practice through the development of a guidance document or toolkit for implementing health-related evidence into planning strategies for higher density urban development;

4) Advancing the existing healthy planning and translational research scholarships through publication of the project findings; and
5) The identification of opportunities for further research in order to improve the integration of both human and planetary health in higher density urban planning.

The undertaking of a specific case study site review involving the examination and analysis of government, industry and policy literature within the regional New South Wales context and in the development of Victoria Park and Green Square Town Centre will enable a study to be actioned in how health evidence has been understood by health and planning professionals over time and professional practice in a specific regional and local context. This will also allow an identified shortcoming in the existing literature to be addressed – the need for further case study research into how health evidence has been implemented in planning development – in order to advance understandings of how health evidence can be mobilised in planning policy and practice to improve health-related outcomes. In addition, the consideration of the types of health-related evidence that may have been implemented at the case study as to how they may reflect the foci of the different theoretical domains of health could shed important insights into how different understandings of health in planning practice have influenced current health outcomes and challenges that are evident in higher density urban planning to date. This will also allow identification of gaps and opportunities in terms of the application of proposed types of health-related evidence for actioning within planning strategies at the case study site in order to improve future higher density planning developments.

Undertaking of a series of semi-structured interviews and a focus group workshop with planning and health professionals and a wide range of academic research specialists from multiple disciplinary backgrounds will be useful for enabling further insights to be gained in terms of how health evidence has been understood within each academic discipline and in healthy planning practice in order for new, broader, and more encompassing, transdisciplinary understandings of health evidence to be mobilised in research and practice for improving human and planetary health outcomes. Interviews with health and planning professionals will be particularly important for gaining deeper insights into how health evidence has been understood in planning practice and how these understandings align with the different theoretical conceptualisations of health evidence found in the academic literature. In addition, the interviews will enable the HHD project team to find out what types of health evidence

have been prioritised in local planning practice and the reasons underpinning decisions made as to which particular attributes of health were given priority in planning developments. Comparison of the findings between the two groups of professionals – health and planning – will be useful for identifying similarities and differences in ideas for integrating health evidence within planning.

The information obtained from the interviews should, in turn, prove useful for enabling a toolkit of recommendations for improving the integration of health within planning to be devised from the project research findings, as well as for enhancing the collaboration between researchers and professionals to improve future planning developments to ensure healthy outcomes. A focus group workshop will also likely prove useful for achieving this outcome. In particular, it will enable the testing and evaluation of proposed strategies for improving health through the design of the higher density built environment and the integration of specific types of health evidence that are proposed for translation into planning development through interactive activities designed to test and evaluate their suitability for integration within the specific local case study site contexts. The feedback obtained from this should be helpful for devising the final set of recommendations. Student projects and course assignments should also prove useful for testing and evaluating the suitability of these strategies for implementation at the case study sites. In addition, the challenges, barriers and limitations to implementation can be recorded and subsequently used to contribute to the existing scholarship where at present limited research is available examining the actual process of the implementation of health-evidence in practice. Furthermore, a collaborative workshop will allow a comprehensive and shared understanding of a healthy higher density living environment and shared conceptual framework of healthy planning attributes to be devised and mobilised in future healthy planning developments specific to the higher density context. Additionally, given the lack of available research focusing on evidence translation for the higher density urban context, the workshop could also provide an opportunity for considering how health evidence has been translated into urban planning strategies more broadly and for other densities and for discussing whether these strategies: a) can be appropriated for a higher density context, and b) what considerations would need to be made to apply them within a high density context.

These proposed collaborative and transdisciplinary recommendations and activities will help to advance the existing healthy planning and translational research scholarships through

publication of the project findings in academic journals as well as through the dissemination of the final project toolkit. The publication of 4-6 collaborative academic journal articles over the next year in order to advance knowledge in these fields of academic research will therefore be undertaken as a key project outcome.

While the HHD project aims to identify how health-evidence can be better integrated into planning strategies to improve health-related outcomes in the higher density urban context and apply the project findings into practice, given the existing scholarly limitations in terms of the process of the application of evidence into practice the project also seeks to identify areas where future research can be conducted to further improve both the higher density healthy planning scholarship and the application of research in practice. The project activities will therefore also include working collaboratively with members of the project team to identify these opportunities for future research and to develop research proposals and funding applications accordingly.

### 4.3: Limitations of this Review:

While this Evidence Review aimed to be as detailed and comprehensive as possible in order to examine and evaluate the full range of information available for considering how health-related evidence can be translated into planning practice for higher density development, some of the literature reviewed may relate to strategies that have been translated into planning post publication of the research. Whether or not it has been translated into practice post-publication is not possible to ascertain from the review of the literature alone. Therefore, while this review suggests that health-related evidence has largely not been translated into planning strategies, this conclusion could potentially be erroneous, even despite the lack of available research exploring the process of actual implementation into practice. However, regardless of whether or not it has been translated in practice at a later date, it nevertheless remains that there is, at present, an absence of research available in the scholarly literature examining the challenges, limitations, and successes of the actual process of translating health-related evidence into practice. Furthermore, the review has not included books, or book chapters. This literature may provide relevant and useful insights that have been missed in this review. The review has focused on the academic literature, rather than the policy literature. Inclusion of the policy literature may have provided additional relevant insights,

however this limitation will be addressed by the proposed case study site and context review recommended as one of the key next steps to be undertaken within the scope of the HHD project. In addition, the particular evidence discussed within many of the academic articles focuses on specific regional and local settings, the majority of which lie outwith Australia. This means that it cannot be assumed that the findings from these studies will be appropriate for application within an Australian context. However, this limitation will be addressed by the proposed interviews and focus group workshop to be undertaken during the remainder of the HHD project timeframe where the suitability of these strategies and types of evidence will be assessed, tested and evaluated for implementation into planning practice within the specific New South Wales and local case study site context.

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# 6.0: Appendices

## 6.1: Appendix 1

List of domain and sub-domain keywords for the database keyword searches

***Domain keywords:***

High Density Development; High Density Development, planning and health; Environmental Sustainability, planning and health; High Density Development, Environmental Sustainability, planning and health; Methods, planning and health; High Density Development, Methods, Planning and Health

*Total: 6*

***Sub-domain keywords***

Australia; New South Wales; Sydney; Victoria; Melbourne; Community/ies; Community garden; Local area; Neighbourhood(s); Suburb; Precinct; Zone; Environment; Built Environment; Sustainable Environment; Europe; United Kingdom; Fitness Professionals; Medical Professionals; Allied Health professional; Physiotherapist; Nutritionist; Dietician Doctor; General Practitioner (GP); Naturopath; Nurse; Metropolitan; Metro; Urban; North America; Canada; United States; Organisations; Commonwealth Government; Federal Government; State Government; Local Government; General Practice; Health Centre; Government Bodies; Government Institutions; Gym; Functional Fitness; Fitness Club; Hospital; Non-government Organisations; NGOs; Planetary Health; Alternative Health; Complementary Health; Integrative Health; Ecological Health; Emotional Health; Environment and Health; Geographies of Health; Public Health; Physical Health; Relational Ecology; Social Dimensions of Health; Spiritual Health; Wellbeing; Planning; Climate Change; Green Planning; Multi-Sector Planning; Spatial Planning; Spatial Planning and Health; Planning Professionals; Architects; Designers; Urban Designers; Planners; Policy advisors; Policy makers; Policy officers; applied; Applied-action; Barriers; Obstacles; Case studies; Collaborative; Decision-Making; Decision-Making Gaps; Decision-Making; Translation; Evidence-based; Practice-relevant; Policy-relevant; Inter-institutional;

Transdisciplinary; Public-Private Partnership; Translation; Sustainable communities; Sustainable Development; Sustainable Futures; Sustainable Growth; Sustainable Urban; Growth; Sustainable Planning; Tools; Approaches; Checklist; Toolkit; Rating; Strategies; Transport; Access; Cycling; Driving; Sustainable transport; Walking; Urban density; Urban development; Urban Growth; Urban Planning; Western; Developed countries; Developed World; Neoliberal; Neoliberal institutions

*Total: 119*

## 6.2: Appendix 2

Database Keyword Search Results

*Wiley Online Library Database (Planning and Architecture Journal Search)*

| | High Density Development | High Density Development, planning and health | Environmental Sustainability, planning and health | High Density Development, Environmental Sustainability, planning and health | Methods, planning and health | High Density Development, Methods, Planning and Health |
|---|---|---|---|---|---|---|
| Australia | 10 | 0 | 0 | 0 | 0 | 0 |
| New South Wales | 0 | 0 | 0 | 0 | 0 | 0 |
| Sydney | 0 | 0 | 0 | 0 | 0 | 0 |
| Victoria | 2 | 2 | 5 | 1 | 7 | 2 |
| Melbourne | 8 | 0 | 0 | 0 | 31 | 6 |
| Community/ies | 18 | 4 | 3 | 2 | 67 | 8 |
| Community garden | 0 | 0 | 0 | 0 | 0 | 0 |
| Local area | 0 | 0 | 14 | 0 | 25 | 0 |
| Neighbourhood(s) | 5 | 5 | 34 | 1 | 37 | 17 |
| Suburb | 16 | 12 | 59 | 7 | 79 | 4 |
| Precinct | 12 | 10 | 64 | 1 | 78 | 3 |
| Zone | 0 | 0 | 0 | 0 | 0 | 0 |
| Environment | 0 | 0 | 32 | 0 | 27 | 0 |
| Built Environment | 0 | 0 | 4 | 0 | 19 | 0 |
| Sustainable Environment | 0 | 0 | 8 | 0 | 23 | 0 |
| Europe | 24 | 53 | 117 | 31 | 238 | 27 |
| United Kingdom | 20 | 24 | 52 | 6 | 89 | 3 |
| Fitness Professionals | 0 | 0 | 0 | 0 | 0 | 0 |
| Medical Professionals | 0 | 0 | 3 | 0 | 17 | 0 |
| Allied Health professional | 0 | 0 | 0 | 0 | 0 | 0 |
| Physiotherapist | 0 | 0 | 0 | 0 | 5 | 0 |
| Nutritionist | 0 | 0 | 0 | 0 | 0 | 0 |
| Dietician | 0 | 0 | 0 | 0 | 0 | 0 |
| Doctor | 0 | 0 | 0 | 0 | 0 | 0 |
| General Practitioner (GP) | 0 | 0 | 0 | 0 | 0 | 0 |
| Naturopath | 0 | 0 | 0 | 0 | 0 | 0 |
| Nurse | 0 | 0 | 0 | 0 | 3 | 0 |
| Metropolitan | 4 | 7 | 18 | 3 | 65 | 2 |
| Metro | 18 | 12 | 23 | 10 | 87 | 10 |
| Urban | 6 | 2 | 17 | 0 | 46 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| North America | 1 | 1 | 5 | 0 | 13 | 0 |
| Canada | 0 | 0 | 4 | 0 | 7 | 0 |
| United States | 1 | 0 | 17 | 0 | 61 | 1 |
| Organisations | 23 | 11 | 49 | 3 | 109 | 4 |
| Commonwealth Government | 0 | 0 | 0 | 0 | 2 | 0 |
| Federal Government | 0 | 0 | 3 | 0 | 2 | 0 |
| State Government | 0 | 0 | 1 | 0 | 6 | 0 |
| Local Government | 1 | 1 | 36 | 0 | 47 | 0 |
| General Practice | 0 | 0 | 0 | 0 | 0 | 0 |
| Health Centre | 0 | 0 | 0 | 0 | 0 | 0 |
| Government Bodies | 0 | 0 | 7 | 0 | 0 | 0 |
| Government Institutions | 0 | 0 | 0 | 0 | 0 | 0 |
| Gym | 0 | 0 | 0 | 0 | 0 | 0 |
| Functional Fitness | 0 | 0 | 0 | 0 | 0 | 0 |
| Fitness Club | 0 | 0 | 0 | 0 | 0 | 0 |
| Hospital | 2 | 0 | 0 | 0 | 19 | 0 |
| Non-government Organisations | 0 | 0 | 0 | 0 | 0 | 0 |
| NGOs | 0 | 0 | 0 | 0 | 0 | 0 |
| Planetary Health | 4 | 4 | 8 | 0 | 5 | 0 |
| Alternative Health | 3 | 1 | 5 | 0 | 18 | 1 |
| Complementary Health | 0 | 0 | 2 | 0 | 7 | 0 |
| Integrative Health | 0 | 0 | 0 | 0 | 0 | 0 |
| Ecological Health | 9 | 5 | 62 | 2 | 71 | 3 |
| Emotional Health | 0 | 0 | 38 | 0 | 49 | 0 |
| Environment and Health | 8 | 3 | 93 | 0 | 113 | 2 |
| Geographies of Health | 3 | 0 | 38 | 0 | 81 | 0 |
| Public Health | 9 | 5 | 17 | 0 | 42 | 3 |
| Physical Health | 4 | 0 | 41 | 0 | 43 | 0 |
| Relational Ecology | 0 | 0 | 4 | 0 | 0 | 0 |
| Social Dimensions of Health | 2 | 1 | 31 | 0 | 63 | 0 |
| Spiritual Health | 0 | 0 | 2 | 0 | 4 | 0 |
| Wellbeing | 0 | 0 | 1 | 0 | 3 | 0 |
| Planning | 31 | 23 | 95 | 6 | 158 | 3 |
| Climate Change | 0 | 0 | 3 | 0 | 7 | 0 |
| Green Planning | 0 | 0 | 6 | 0 | 15 | 0 |
| Multi-Sector Planning | 1 | 0 | 1 | 0 | 7 | 0 |
| Spatial Planning | 0 | 0 | 0 | 0 | 2 | 0 |
| Spatial Planning and Health | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Planning Professionals | 0 | 0 | 0 | 0 | 0 | 0 |
| Architects | 1 | 1 | 5 | 0 | 7 | 1 |
| Designers | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Designers | 0 | 0 | 0 | 0 | 0 | 0 |
| Planners | 3 | 2 | 26 | 0 | 53 | 0 |
| Policy advisors | 0 | 0 | 35 | 0 | 74 | 0 |
| Policy makers | 0 | 0 | 21 | 0 | 43 | 0 |
| Policy officers | 0 | 0 | 4 | 0 | 35 | 0 |
| applied | 1 | 1 | 0 | 0 | 6 | 0 |
| Applied-action | 0 | 0 | 0 | 0 | 1 | 0 |
| Barriers | 0 | 0 | 2 | 0 | 74 | 0 |
| Obstacles | 0 | 0 | 0 | 0 | 34 | 0 |
| Case studies | 0 | 0 | 43 | 0 | 79 | 0 |
| Collaborative | 0 | 0 | 12 | 0 | 32 | 0 |
| Decision-Making | 0 | 0 | 3 | 0 | 4 | 0 |
| Decision-Making Gaps | 0 | 0 | 0 | 0 | 0 | 0 |
| Decision-Making Translation | 0 | 0 | 0 | 0 | 0 | 0 |
| Evidence-based | 0 | 0 | 0 | 0 | 0 | 0 |
| Practice-relevant | 0 | 0 | 0 | 0 | 0 | 0 |
| Policy-relevant | 0 | 0 | 0 | 0 | 4 | 0 |
| Inter-institutional | 0 | 0 | 0 | 0 | 1 | 0 |
| Transdisciplinary | 0 | 0 | 2 | 0 | 3 | 0 |
| Public-Private Partnership | 0 | 0 | 0 | 0 | 0 | 0 |
| Translation | 1 | 0 | 0 | 0 | 36 | 0 |
| Sustainable communities | 7 | 5 | 42 | 2 | 49 | 3 |
| Sustainable Development | 9 | 7 | 75 | 4 | 158 | 4 |
| Sustainable Futures | 0 | 0 | 2 | 0 | 35 | 0 |
| Sustainable Growth | 1 | 1 | 4 | 1 | 52 | 0 |
| Sustainable Urban Growth | 0 | 0 | 2 | 0 | 45 | 0 |
| Sustainable Planning | 1 | 1 | 16 | 1 | 63 | 0 |
| Tools | 3 | 0 | 6 | 0 | 53 | 0 |
| Approaches | 0 | 0 | 4 | 0 | 32 | 0 |
| Checklist | 0 | 0 | 0 | 0 | 2 | 0 |
| Toolkit | 0 | 0 | 0 | 0 | 15 | 0 |
| Rating | 0 | 0 | 0 | 0 | 0 | 0 |
| Strategies | 5 | 0 | 23 | 0 | 43 | 0 |
| Transport | 26 | 16 | 89 | 2 | 153 | 1 |
| Access | 0 | 0 | 23 | 0 | 32 | 0 |
| Cycling | 0 | 0 | 0 | 0 | 0 | 0 |
| Driving | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable transport | 0 | 0 | 0 | 0 | 2 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Walking | 0 | 0 | 0 | 0 | 3 | 0 |
| Urban density | 3 | 2 | 4 | 0 | 5 | 0 |
| Urban development | 7 | 4 | 24 | 2 | 63 | 3 |
| Urban Growth | 5 | 2 | 32 | 0 | 53 | 2 |
| Urban Planning | 16 | 7 | 36 | 2 | 54 | 4 |
| Western | 0 | 0 | 0 | 0 | 3 | 0 |
| Developed countries | 0 | 0 | 0 | 0 | 2 | 0 |
| Developed World | 0 | 0 | 3 | 0 | 2 | 0 |
| Neoliberal | 3 | 1 | 2 | 1 | 6 | 2 |
| Neoliberal institutions | 2 | 2 | 1 | 0 | 5 | 1 |

*Health Collections Database*

| | High Density Development | High Density Development, planning and health | Environmental Sustainability, planning and health | High Density Development, Environmental Sustainability, planning and health | Methods, planning and health | High Density Development, Methods, Planning and Health |
|---|---|---|---|---|---|---|
| Australia | 6 | 1 (not relevant) | 0 | 0 | 248 | 1 (not relevant) |
| New South Wales | 1 (not relevant) | 0 | 7 (relevant) | 0 | 39 (1 relevant) | 0 |
| Sydney | 0 | 0 | 1 (relevant) | 0 | 51 (2 relevant) | 0 |
| Victoria | 0 | 0 | 1 (relevant) | 0 | 38 (some highly relevant) | 0 |
| Melbourne | 2 (relevant) | 0 | 0 | 0 | 38 | 0 |
| Community/ies | 1 (not relevant) | 0 | 1 (relevant) | 0 | 73 (some relevant) | 0 |
| Community garden | 0 | 0 | 0 | 0 | 0 | 0 |
| Local area | 0 | 0 | 0 | 0 | 3 (all relevant) | 0 |
| Neighbourhood(s) | 0 | 4 (3 relevant) | 0 | 0 | 2 (relevant) | 0 |
| Suburb | 0 | 0 | 0 | 0 | 0 | 0 |
| Precinct | 0 | 0 | 0 | 0 | 0 | 0 |
| Zone | 0 | 0 | 0 | 0 | 0 | 0 |
| Environment | 0 | 0 | 1 (possibly relevant) | 0 | | |
| Build Environment | 0 | 0 | 0 | 0 | 4 (3 relevant) | 0 |
| Sustainable Environment | 0 | 0 | 0 | 0 | 0 | 0 |
| Europe | 0 | 0 | 0 | 0 | 0 | 0 |
| United Kingdom | 0 | 0 | 0 | 0 | 4 (not relevant) | 0 |
| Fitness Professionals | 0 | 0 | 0 | 0 | 3 (1 relevant) | 0 |
| Medical Professionals | 0 | 0 | 0 | 0 | 28 (few relevant) | 0 |
| Allied Health professional | 0 | 0 | 0 | 0 | 3 (not relevant) | 0 |
| Physiotherapist | 0 | 0 | 0 | 0 | 0 | 0 |
| Nutritionist | 0 | 0 | 0 | 0 | 1 (relevant) | 0 |
| Dietician | 0 | 0 | 0 | 0 | 0 | 0 |
| Doctor | 0 | 0 | 0 | 0 | 3 (not relevant) | 0 |
| General Practitioner | 0 | 0 | 0 | 0 | 9 (not | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| (GP) | | | | | relevant) | |
| Naturopath | 0 | 0 | 0 | 0 | 0 | 0 |
| Nurse | 0 | 0 | 0 | 0 | 21 (not relevant) | 0 |
| Metropolitan | 0 | 0 | 0 | 0 | 10 (1 relevant) | 0 |
| Metro | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban | 0 | 0 | 1 (relevant) | 0 | 10 (several relevant) | 0 |
| North America | 0 | 0 | 0 | 0 | 0 | 0 |
| Canada | 0 | 0 | 0 | 0 | 3 (not relevant) | 0 |
| United States | 0 | 0 | 0 | 0 | 4 (not relevant) | 0 |
| Organisations | 0 | 0 | 0 | 0 | 16 (2 relevant) | 0 |
| Commonwealth Government | 0 | 0 | 0 | 0 | 0 | 0 |
| Federal Government | 0 | 0 | 0 | 0 | 0 | 0 |
| State Government | 0 | 0 | 0 | 0 | 6 (1 relevant) | 0 |
| Local Government | 1 (relevant) | 1 (relevant) | 1 (relevant) | 0 | 10 (some relevant) | 0 |
| General Practice | 0 | 0 | 0 | 0 | 33 (not relevant) | 0 |
| Health Centre | 1 (possibly relevant) | 0 | 1 (relevant) | 0 | 78 (some relevant) | 0 |
| Government Bodies | 0 | 0 | 0 | 0 | 2 (not relevant) | 0 |
| Government Institutions | 0 | 0 | 0 | 0 | 0 | 0 |
| Gym | 0 | 0 | 0 | 0 | 0 | 0 |
| Functional Fitness | 0 | 0 | 0 | 0 | 0 | 0 |
| Fitness Club | 0 | 0 | 0 | 0 | 0 | 0 |
| Hospital | 5 (not relevant) | 0 | 0 | 0 | 69 (not relevant) | 0 |
| Non-government Organisations | 0 | 0 | 0 | 0 | 0 | 0 |
| NGOs | 0 | 0 | 0 | 0 | 0 | 0 |
| Planetary Health | 0 | 0 | 0 | 0 | 0 | 0 |
| Alternative Health | 1 (not relevant) | 0 | 0 | 0 | 11 (1 relevant) | 0 |
| Complementary Health | 0 | 0 | 0 | 0 | 3 (not relevant) | 0 |
| Integrative Health | 0 | 0 | 1 (relevant) | 0 | 1 (not relevant) | 0 |
| Ecological Health | 0 | 0 | 0 | 0 | 2 (relevant) | 0 |
| Emotional Health | 0 | 0 | 0 | 0 | 7 (not relevant) | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Environment and Health | 0 | 0 | 2 (1 relevant) | 0 | 21 (some relevant) | 0 |
| Geographies of Health | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Health | 1 (relevant) | 1 (relevant) | 1 (relevant) | 0 | 75 (some relevant) | 0 |
| Physical Health | 1 (not relevant) | 0 | 0 | 0 | 29 (some relevant) | 0 |
| Relational Ecology | 0 | 0 | 0 | 0 | 0 | 0 |
| Social Dimensions of Health | 0 | 0 | 0 | 0 | 0 | 0 |
| Spiritual Health | 0 | 0 | 0 | 0 | 0 | 0 |
| Wellbeing | 0 | 0 | 0 | 0 | 9 (some relevant) | 0 |
| Planning | 2 (1 relevant) | 2 (1 relevant) | 2 (1 relevant) | 0 | 248 (some relevant) | 1 (not relevant) |
| Climate Change | 0 | 0 | 0 | 0 | 3 (all relevant) | 0 |
| Green Planning | 0 | 0 | 0 | 0 | 6 (not relevant) | 0 |
| Multi-Sector Planning | 0 | 0 | 0 | 0 | 0 | 0 |
| Spatial Planning | 0 | 0 | 0 | 0 | 3 (1 relevant) | 0 |
| Spatial Planning and Health | 0 | 0 | 0 | 0 | 3 (1 relevant) | 0 |
| Planning Professionals | 0 | 0 | 0 | 0 | 82 (some relevant) | 0 |
| Architects | 0 | 0 | 0 | 0 | 0 | 0 |
| Designers | 0 | 0 | 0 | 0 | 1 (not relevant) | 0 |
| Urban Designers | 0 | 0 | 0 | 0 | 0 | 0 |
| Planners | 0 | 0 | 0 | 0 | 18 (some relevant) | 0 |
| Policy advisors | 0 | 0 | 0 | 0 | 0 | 0 |
| Policy makers | 0 | 0 | 0 | 0 | 6 (some relevant) | 0 |
| Policy officers | 0 | 0 | 0 | 0 | 1 (relevant) | 0 |
| applied | 1 (not relevant) | 0 | 0 | 0 | 0 | 0 |
| Applied-action | 0 | 0 | 0 | 0 | 0 | 0 |
| barriers | 0 | 0 | 0 | 0 | 24 (some relevant) | 0 |
| Obstacles | 0 | 0 | 0 | 0 | 1 (not relevant) | 0 |
| Case studies | 0 | 0 | 0 | 0 | 8 (1 relevant) | 0 |
| Collaborative | 0 | 0 | 0 | 0 | 13 (some relevant) | 0 |
| Decision-Making | 0 | 0 | 0 | 0 | 16 (some relevant) | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Decision-Making Gaps | 0 | 0 | 0 | 0 | 0 | 0 |
| Decision-Making Translation | 0 | 0 | 0 | 0 | 1 (relevant) | 0 |
| Evidence-based | 0 | 0 | 0 | 0 | 13 (some relevant) | 0 |
| Practice-relevant | 0 | 0 | 0 | 0 | 0 | 0 |
| Policy-relevant | 0 | 0 | 0 | 0 | 0 | 0 |
| Inter-institutional | 0 | 0 | 0 | 0 | 0 | 0 |
| Transdisciplinary | 0 | 0 | 0 | 0 | 0 | 0 |
| Public-Private Partnership | 0 | 0 | 0 | 0 | 0 | 0 |
| Translation | 0 | 0 | 0 | 0 | 4 (1 relevant) | 0 |
| Sustainable communities | 0 | 0 | 1 (relevant) | 0 | 2 (not relevant) | 0 |
| Sustainable Development | 0 | 0 | 1 (not relevant) | 0 | 5 (not relevant) | 0 |
| Sustainable Futures | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Growth | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Urban Growth | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Planning | 0 | 0 | 1 (not relevant) | 0 | 9 (not relevant) | 0 |
| Tools | 0 | 0 | 0 | 0 | 13 (some relevant) | 0 |
| Approaches | 0 | 0 | 0 | 0 | 18 (some relevant) | 0 |
| Checklist | 0 | 0 | 0 | 0 | 1 (not relevant) | 0 |
| Toolkit | 0 | 0 | 0 | 0 | 0 | 0 |
| Rating | 0 | 0 | 0 | 0 | 3 (not relevant) | 0 |
| Strategies | 1 (not relevant) | 1 (not relevant) | 0 | 0 | 50 (some relevant) | (not relevant) |
| Transport | 0 | 0 | 0 | 0 | 6 (some relevant) | 0 |
| Access | 1 (relevant) | 1 (relevant) | 0 | 0 | 23 (some relevant) | 0 |
| Cycling | 0 | 0 | 0 | 0 | 3 (2 relevant) | 0 |
| Driving | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable transport | 0 | 0 | 0 | 0 | 0 | 0 |
| Walking | 0 | 0 | 0 | 0 | 7 (3 relevant) | 0 |
| Urban density | 1 (not relevant) | 1 (not relevant | 0 | 0 | 1 (relevant) | 0 |
| Urban development | 1 (not relevant) | 0 | 0 | 0 | 0 | 0 |
| Urban Growth | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Urban Planning | 0 | 0 | 1 (relevant) | 0 | 10 (some relevant) | 0 |
| Western | 0 | 0 | 0 | 0 | 31 (some relevant) | 0 |
| Developed countries | 0 | 0 | 0 | 0 | 5 (not relevant) | 0 |
| Developed World | 0 | 0 | 0 | 0 | 4 (not relevant) | 0 |
| Neoliberal | 0 | 0 | 0 | 0 | 0 | 0 |
| Neoliberal institutions | 0 | 0 | 0 | 0 | 0 | 0 |

*Web of Science*

| | High Density Development | High Density Development, planning and health | Environmental Sustainability, planning and health | High Density Development, Environmental Sustainability, planning and health | Methods, planning and health | High Density Development, Methods, Planning and Health |
|---|---|---|---|---|---|---|
| Australia | 54 | 9 | 23 | 1 | 1236 (too broad) | 4 |
| New South Wales | 62 (3 relevant) | 1 | 3 | 0 | 153 | 1 |
| Sydney | 49 | 2 | 0 | 0 | 110 | 1 |
| Victoria | 55 | 0 | 0 | 0 | 147 | 0 |
| Melbourne | 26 | 2 | 1 | 0 | 76 | 1 |
| Community/ies | 2813 | 28 | 115 | 1 | 7126 | 12 |
| Community garden | 21 | 0 | 5 | 0 | 23 | 0 |
| Local area | 964 | 16 | 34 | 3 | 872 | 3 |
| Neighbourhood(s) | 376 | 22 | 26 | 2 | 451 | 9 |
| Suburb | 93 | 0 | 1 | 0 | 37 | 0 |
| Precinct | 7 | 0 | 0 | 0 | 4 | 0 |
| Zone | 2181 | 11 | 14 | 0 | 326 | 6 |
| Environment | 4282 | 51 | 4 | 4 | 2632 | 6 |
| Build Environment | 470 | 24 | 100 | 2 | 470 | 8 |
| Sustainable Environment | 305 | 10 | X | X | 165 | 0 |
| Europe | 482 | 3 | 9 | 0 | 627 | 2 |
| United Kingdom | 60 | 1 | 5 | 0 | 365 | 0 |
| Fitness Professionals | 1 | 1 | 2 | 0 | 0 | 0 |
| Medical Professionals | 18 | 2 | 5 | 0 | 1119 | 0 |
| Allied Health professional | 1 | 0 | 0 | 0 | 115 | 0 |
| Physiotherapist | 0 | 0 | 0 | 0 | 94 | 0 |
| Nutritionist | 4 | 0 | 0 | 0 | 39 | 0 |
| Dietician | 8 | 0 | 0 | 0 | 109 | 0 |
| Doctor | 47 | 1 | 0 | 0 | 1202 | 0 |
| General Practitioner (GP) | 30 | 4 | 1 | 0 | 911 | 2 |
| Naturopath | 0 | 0 | 0 | 0 | 3 | 0 |
| Nurse | 113 | 8 | 12 | 0 | 3695 | 4 |
| Metropolitan | 298 | 15 | 9 | 0 | 406 | 4 |
| Metro | 42 | 1 | 0 | 0 | 32 | 1 |
| Urban | 1910 | 71 | 120 | 4 | 2284 | 22 |
| North America | 297 | 1 | 3 | 0 | 114 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Canada | 481 | 4 | 13 | 1 | 1142 | 0 |
| United States | 967 | 13 | 24 | 0 | 3471 | 6 |
| Organisations | 974 | 14 | 64 | 0 | 4489 | 5 |
| Commonwealth Government | 2 | 0 | 0 | 0 | 0 | 0 |
| Federal Government | 18 | 1 | 4 | 0 | 123 | 0 |
| State Government | 101 | 3 | 13 | 0 | 420 | 1 |
| Local Government | 423 | 2 | 19 | 0 | 423 | 0 |
| General Practice | 140 | 3 | 3 | 0 | 1593 | 3 |
| Health Centre | 164 | 18 | 29 | 1 | 4989 | 10 |
| Government Bodies | 16 | 0 | 2 | 0 | 24 | 0 |
| Government Institutions | 24 | 0 | 6 | 0 | 118 | 0 |
| Gym | 5 | 0 | 0 | 0 | 10 | 0 |
| Functional Fitness | 23 | 0 | 0 | 0 | 29 | 0 |
| Fitness Club | 0 | 0 | 0 | 0 | 11 | 0 |
| Hospital | 393 | 12 | 24 | 0 | 6300 | 6 |
| Non-government Organisations | 6 | 0 | 3 | 0 | 106 | 0 |
| NGOs | 6 | 0 | 3 | 0 | 62 | 0 |
| Planetary Health | 3 | 0 | 1 | 0 | 2 | 0 |
| Alternative Health | 94 | 5 | 24 | 1 | 1177 | 3 |
| Complementary Health | 27 | 2 | 3 | 0 | 361 | 0 |
| Integrative Health | 10 | 1 | 4 | 0 | 203 | 1 |
| Ecological Health | 62 | 10 | 59 | 1 | 390 | 2 |
| Emotional Health | 16 | 2 | 4 | 0 | 816 | 0 |
| Environment and Health | 281 | 51 | 381 | 4 | 2632 | 14 |
| Geographies of Health | 18 | 7 | 5 | 0 | 163 | 4 |
| Public Health | 389 | 49 | 115 | 0 | 7001 | 21 |
| Physical Health | 422 | 30 | 67 | 0 | 4225 | 10 |
| Relational Ecology | 0 | 0 | 0 | 0 | 1 | 0 |
| Social Dimensions of Health | 2 | 0 | 13 | 0 | 186 | 0 |
| Spiritual Health | 1 | 0 | 1 | 0 | 126 | 0 |
| Wellbeing | 18 | 0 | 17 | 0 | 244 | 0 |
| Planning | 1666 | 138 | 381 | 4 | 36030 | 50 |
| Climate Change | 941 | 13 | 53 | 0 | 305 | 2 |
| Green Planning | 100 | 15 | 41 | 2 | 212 | 1 |
| Multi-Sector Planning | 10 | 2 | 5 | 0 | 94 | 0 |
| Spatial Planning | 354 | 23 | 20 | 1 | 572 | 10 |
| Spatial Planning and Health | 23 | 23 | 20 | 1 | 572 | 10 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Planning Professionals | 26 | 9 | 37 | 0 | 4260 | 3 |
| Architects | 22 | 0 | 2 | 0 | 21 | 0 |
| Designers | 159 | 1 | 5 | 0 | 59 | 1 |
| Urban Designers | 18 | 1 | 3 | 3 | 11 | 1 |
| Planners | 140 | 8 | 381 | 4 | 387 | 6 |
| Policy advisors | 1 | 0 | 0 | 0 | 14 | 0 |
| Policy makers | 73 | 5 | 34 | 0 | 941 | 2 |
| Policy officers | 3 | 1 | 2 | 0 | 68 | 0 |
| applied | 5271 | 15 | 39 | 0 | 3081 | 8 |
| Applied-action | 1 | 0 | 0 | 0 | 1 | 1 |
| Barriers | 1300 | 3 | 21 | 0 | 3039 | 1 |
| Obstacles | 273 | 2 | 5 | 0 | 322 | 0 |
| Case studies | 3013 | 16 | 67 | 0 | 4260 | 7 |
| Collaborative | 119 | 3 | 19 | 0 | 926 | 2 |
| Decision-Making | 222 | 7 | 37 | 1 | 2362 | 1 |
| Decision-Making Gaps | 7 | 0 | 1 | 0 | 124 | 0 |
| Decision-Making Translation | 2 | 2 | 2 | 0 | 74 | 0 |
| Evidence-based | 83 | 3 | 19 | 0 | 1891 | 1 |
| Practice-relevant | 0 | 0 | 0 | 0 | 6 | 0 |
| Policy-relevant | 2 | 0 | 3 | 0 | 27 | 0 |
| Inter-institutional | 0 | 0 | 1 | 0 | 6 | 0 |
| Transdisciplinary | 3 | 0 | 1 | 0 | 26 | 0 |
| Public-Private Partnership | 4 | 0 | 1 | 0 | 52 | 0 |
| Translation | 177 | 0 | 10 | 0 | 479 | 0 |
| Sustainable communities | 175 | 5 | 46 | 1 | 256 | 1 |
| Sustainable Development | 1349 | 19 | 103 | 4 | 371 | 4 |
| Sustainable Futures | 236 | 6 | 44 | 1 | 130 | 3 |
| Sustainable Growth | 302 | 7 | 20 | 3 | 51 | 1 |
| Sustainable Urban Growth | 95 | 6 | 13 | 3 | 14 | 0 |
| Sustainable Planning | 239 | 19 | 169 | 3 | 728 | 4 |
| Tools | 3055 | 23 | 65 | 1 | 3428 | 11 |
| Approaches | 6879 | 25 | 156 | 2 | 6859 | 8 |
| Checklist | 14 | 1 | 6 | 1 | 388 | 0 |
| Toolkit | 19 | 0 | 2 | 0 | 81 | 0 |
| Rating | 177 | 5 | 33 | 2 | 8835 | 12 |
| Strategies | 4216 | 36 | 103 | 1 | 5951 | 10 |
| Transport | 3998 | 16 | 30 | 0 | 508 | 7 |
| Access | 1096 | 18 | 32 | 0 | 4187 | 8 |
| Cycling | 3910 | 2 | 40 | 0 | 751 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Driving | 2962 | 4 | 24 | 0 | 930 | 1 |
| Sustainable transport | 115 | 0 | 19 | 0 | 40 | 0 |
| Walking | 264 | 15 | 18 | 0 | 554 | 6 |
| Urban density | 1915 | 71 | 11 | 4 | 123 | 22 |
| Urban development | 1915 | 71 | 62 | 4 | 483 | 22 |
| Urban Growth | 448 | 18 | 20 | 3 | 15121 | 50 |
| Urban Planning | 582 | 71 | 120 | 4 | 2291 | 22 |
| Western | 1643 | 6 | 8 | 0 | 755 | 2 |
| Developed countries | 504 | 11 | 43 | 0 | 2152 | 3 |
| Developed World | 485 | 8 | 31 | 0 | 922 | 3 |
| Neoliberal | 5 | 0 | 1 | 0 | 3 | 0 |
| Neoliberal institutions | 0 | 0 | 0 | 0 | 1 | 0 |

*d) APAFT – Australian Public Affairs Full Text*
*APAIS-ATSIS – Australian Public Affairs Information Service – Aboriginal and Torres Strait Islander Subject*
*APAIS-Health – Australian Public Affairs Information Service - Health*

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| Australia | 10 (2 relevant - saved) | 0 | 7 (saved) | 0 | 153 (saved) | 0 |
| NSW | 1 NA | 0 | 1 NA | 0 | 74 (not saved, same as above) | 0 |
| New South Wales | 1 NA | 0 | 3 saved | 0 | 282 | 0 |
| Sydney | 0 | 0 | 0 | 0 | 287 | 0 |
| Victoria | 1 NA | 0 | 2 saved | 0 | 231 | 0 |
| Melbourne | 2 NA | 0 | 1 saved | 0 | 202 | 0 |
| Communit* | 2 (2 – saved) | 0 | 2 NA | 0 | 608 | 0 |
| Community garden | 0 | 0 | 0 | 0 | 0 | 0 |
| Local area | 1 | 2 NA | 17 (saved) | 0 | 48 (saved) | 0 |
| Neighbour(s)/hood | 0 | 0 | 1 | 0 | 12 (saved) | 0 |
| Suburb | 0 | 0 | 0 | 0 | 3 NA | 0 |
| Precinct | 0 | 0 | 1 NA | 0 | 0 | 0 |
| Zone | 0 | 1 saved | 4 NA | 0 | 0 | 0 |
| Environment | 0 | 5 saved | 4 NA | 0 | 28 saved | 0 |
| Built environment | 0 | 0 | 11 saved | 0 | 8 saved | 0 |
| Sustainable environment | 0 | 3 saved | 40 saved | 0 | 0 | 0 |
| Europe | 0 | 0 | 5 saved | 0 | 0 | 0 |
| England | 1NA | 0 | 6 saved | 0 | 0 | 0 |
| United Kingdom | 0 | 1 | 1 NA | 0 | 9 | 0 |
| Fitness professionals | 0 | 0 | 0 | 0 | 5 saved | 0 |
| Medical professionals | 0 | 0 | 0 | 0 | 55 saved | 0 |
| Allied Health professional | 0 | 0 | 0 | 0 | 4 | 0 |
| Physiotherapist | 0 | 0 | 0 | 0 | 0 | 0 |
| Nutritionist | 0 | 0 | 0 | 0 | 2 | 0 |
| Dietician | 0 | 0 | 0 | 0 | 0 | 0 |
| Doctor | 0 | 0 | 0 | 0 | 2 | 0 |
| General Practitioner/GP | 0 | 0 | 0 | 0 | 8 | 0 |
| Naturopath | 0 | 0 | 0 | 0 | 0 | 0 |

| | High Density Development | High Density Development (and planning and health) | Environmental Sustainability Planning and Health | High density development Environmental Sustainability Planning and Health | Methods Planning and Health | High density development Methods planning and health |
|---|---|---|---|---|---|---|
| Australia | 10 (2 relevant - saved) | 0 | 7 (saved) | 0 | 153 (saved) | 0 |
| NSW | 1 NA | 0 | 1 NA | 0 | 74 (not saved, same as above) | 0 |
| Nurse(s) | 0 | 0 | 0 | 0 | 20 | 0 |
| Metropolitan | 3 NA | 2 saved | 2 saved | 0 | 0 | 0 |
| Metro | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban | 10 | 3 saved | 45 | 0 | 16 | 0 |
| North America | 0 | 0 | 0 | 0 | 0 | 0 |
| Canada | 0 | 0 | 0 | 0 | 2 NA | 0 |
| United States | 0 | 0 | 0 | 0 | 4 | 0 |
| Organisations | 0 | 0 | 4 NA | 0 | 33 saved | 0 |
| Commonwealth government | 0 | 1 NA | 0 | 0 | 0 | 0 |
| Federal government | 0 | 1NA | 0 | 0 | 0 | 0 |
| State government | 3NA | 2 NA | 0 | 0 | 17 SAVED | 0 |
| Local government | 3 NA | 3 NA | 0 | 0 | 20 saved | 0 |
| General Practice | 0 | 2 NA | 0 | 0 | 31 NA | 0 |
| Health Centre | 2 NA | 2 NA | 0 | 0 | 94 saved | 0 |
| Government bodies | 0 | 1 | 0 | 0 | 4 saved | 0 |
| Government institutions | 0 | 0 | 0 | 0 | 0 | 0 |
| Gym | 0 | 0 | 0 | 0 | 0 | 0 |
| FUNCTIONAL FITNESS | 0 | 0 | 0 | 0 | 0 | 0 |
| Fitness centre | 0 | 0 | 0 | 0 | 3 NA | 0 |
| Fitness club | 0 | 0 | 0 | 0 | 0 | 0 |
| Hospital | 4 NA | 3 NA | 1 | 0 | 73 | 0 |
| Non government organisations | 0 | 0 | 0 | 0 | 0 | 0 |
| Non-government organisations | 0 | 0 | 0 | 0 | 0 | 0 |
| Non-government- | 0 | 0 | 0 | 0 | 0 | 0 |

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| Australia | 10 (2 relevant - saved) | 0 | 7 (saved) | 0 | 153 (saved) | 0 |
| NSW | 1 NA | 0 | 1 NA | 0 | 74 (not saved, same as above) | 0 |
| organisations | | | | | | |
| NGOs | 0 | 0 | 0 | 0 | 0 | 0 |
| Planetary health | 0 | 0 | 0 | 0 | 0 | 0 |
| Alternative health | 0 | 2 saved | 2 NA | 0 | 12 | 0 |
| Complementary health | 0 | 0 | 0 | 0 | 4 NA | 0 |
| Integrative health | 0 | 0 | 0 | 0 | 0 | 0 |
| Ecological health | 0 | 0 | 0 | 0 | 4 | 0 |
| Emotional health | 0 | 0 | 0 | 0 | 3 | 0 |
| Environment and health | 0 | 5 saved | 7 | 0 | 28 saved | 0 |
| Geographies of health | 0 | 0 | 0 | 0 | 0 | 0 |
| Public health | 0 | 6 saved | 10 Saved | 0 | 105 saved | 0 |
| Physical health | 0 | 2 saved | 2 NA | 0 | 46 | 0 |
| Relational ecology | 0 | 0 | 0 | 0 | 0 | 0 |
| Social dimensions of health | 0 | 0 | 0 | 0 | 0 | 0 |
| Spiritual health | 0 | 0 | 0 | 0 | 0 | 0 |
| Wellbeing | 1 NA | 0 | 2 NA | 0 | 15 saved | 0 |
| Planning | 11 NA | 15 saved | 21 | 0 | 304 | 2 NA |
| Climate change | 0 | 1 saved | 6 | 0 | 6 saved | 0 |
| Green planning | 0 | 2 NA | 0 | 0 | 7 | 0 |
| Multi-sector planning | 0 | 0 | 0 | 0 | 0 | 0 |
| Spatial planning | 0 | I NA | 0 | 0 | 2 saved | 0 |
| Spatial planning and health | 0 | 1 NA | 0 | 0 | 2 saved | 0 |
| Planning professionals | 0 | 0 | 6 NA | 0 | 155 | 0 |
| Architects | 0 | 0 | 0 | 0 | 0 | 0 |
| Designers | 0 | 0 | 0 | 0 | 2 | 0 |

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| Australia | 10 (2 relevant - saved) | 0 | 7 (saved) | 0 | 153 (saved) | 0 |
| NSW | 1 NA | 0 | 1 NA | 0 | 74 (not saved, same as above) | 0 |
| | | | | | | |
| Urban Designers | 0 | 0 | 0 | 0 | 0 | 0 |
| Planners | 0 | 0 | 0 | 0 | 10 | 0 |
| Policy | | 7 | 10 saved | 0 | 62 saved | 0 |
| Policy Advisors OR/Makers/OR Officers | | 975 | 859 | 0 | 6506 | 0 |
| Applied policy /Applied action | | 0 | 0 | 0 | 5944 | 0 |
| Barriers/Obstacles to policy | | 975 | 0 | 28 saved | 0 | 0 |
| Policy case studies | | 0 | 0 | 0 | 0 | 0 |
| Collaborative policy | | 0 | 0 | 0 | 6 saved | 0 |
| Policy and decision making | | 0 | 4 saved | 0 | 8 saved | 0 |
| Policy gap | | 0 | 0 | 0 | 5 saved | 0 |
| Policy translation | | 0 | 0 | 0 | 2 | 0 |
| Evidence based policy | | 0 | 0 | 0 | 9 saved | 0 |
| Policy to practice / OR practice relevant policy | | 0 | 0 | 28 saved | 0 | 30 NA |
| Inter-institutional policy | 0 | 0 | 0 | 0 | 0 | 0 |
| Transdisciplinary policy | 0 | 0 | 0 | 0 | 0 | 0 |
| Public Private Partnership | 1 (saved) | 0 | 0 | 0 | 0 | 0 |
| Decision making | 9 | 1 NA | 4 | 0 | 0 | 0 |
| Research* | 617 | 9 saved | 5 | 0 | 173 | 2 NA |

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| Australia | 10 (2 relevant - saved) | 0 | 7 (saved) | 0 | 153 (saved) | 0 |
| NSW | 1 NA | 0 | 1 NA | 0 | 74 (not saved, same as above) | 0 |
| Researcher | 9 | 0 | 0 | 0 | 2 | 0 |
| Evaluation | 98 NA | 1NA | 7 | 0 | 96 | 0 |
| Research gaps | 3 NA | 0 | 0 | 0 | 11 NA | 0 |
| Research methods | 97 (saved) | 4 | 4 saved | 0 | 173 | 2 NA |
| Research review | 53 NA | 3 NA | 0 | 0 | 60 saved | 0 |
| Research translation | 0 | 0 | 0 | 0 | 2 | 0 |
| Sustainable | 96 (saved) | 4 saved | 11 NA | 0 | 5 saved | 0 |
| Sustainable communities | 10 (saved) | 0 | 11 NA | 0 | 4 saved | 0 |
| Resilient communities | 1 NA | 0 | 0 | 0 | 0 | 0 |
| Sustainable development | 96 (saved) | 4 save | 9 NA | 0 | 3 NA | 0 |
| Sustainable futures | 0 | 0 | 1 NA | 0 | 0 | 0 |
| Sustainable growth / OR Sustainable urban growth | 1476 | 995 | 862 | 0 | 0 | 28 NA |
| Sustainable growth | 31 (saved) | 3 saved | 0 | 0 | 0 | |
| Sustainable urban growth | 5 (saved) | 1 saved | 0 | 0 | 0 | |
| Sustainable planning | 30 | 4 saved | 11 saved | 0 | 5 | 0 |
| Tools | 25 NA | 0 | 0 | 0 | 19 saved | 0 |
| Approach(es) | 22 (saved) | 0 | 1 | 0 | 25 saved | 0 |
| Checklist(s) | 0 | 0 | 0 | 0 | 0 | 0 |
| Rating | 12 NA | 0 | 0 | 0 | 0 | 0 |

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| Australia | 10 (2 relevant - saved) | 0 | 7 (saved) | 0 | 153 (saved) | 0 |
| NSW | 1 NA | 0 | 1 NA | 0 | 74 (not saved, same as above) | 0 |
| Strategies | 99 | 6 NA | 6 NA | 0 | 70 saved | 2 |
| Transport | 138 Not saved | 4 NA | 2 NA | 0 | 11 saved | 0 |
| Access | 49 Saved | 2 | 2 NA | 0 | 28 saved | 0 |
| Cyclist/OR Cycling | 12201 | 0 | 859 | 28 NA | 0 | 0 |
| Driver/Driving | 11763 | 0 | 859 | 28 NA | 0 | 0 |
| Sustainable transport | 22 saved | 1 | 0 | 0 | 0 | 0 |
| walking | 8 saved | 1 SAVED | 0 | 0 | 13 saved | 0 |
| urban | 152 | 3 saved | 5 NA | 0 | 2 saved | 0 |
| Urban density | 152 | 3 saved | 0 | 0 | 2 saved | 0 |
| Urban development | 152 | 3 saved | 5 NA | 0 | 7 saved | 0 |
| Urban growth | 27 NA | 2 saved | 0 | 0 | 2 | 0 |
| Urban planning | 85 saved | 3 | 5 | 0 | 16 NA | 0 |
| Western countries | 7 NA | 0 | 0 | 0 | 2 | 0 |
| Developed countries | 18 NA | 0 | 0 | 0 | 2 NA | 0 |
| Neoliberal countries / institutions | 991 | 975 | 0 | 0 | 5944 | 0 |

*ATRI, Health and Society (using Informit)*

| | **High Density Development** | **High Density Development ( and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| Australia | 63 saved | 1 saved | 10 saved | 0 | 43 saved | 0 |
| NSW | 1 NA | 0 | 0 | 0 | 21 saved | 0 |
| New South Wales | 10 saved | 0 | 0 | 0 | 19 saved | 0 |
| Sydney | 15 NA | 0 | 2 saved | 0 | 17 saved | 0 |
| Victoria | 28 saved | 1 saved | 2 saved | 0 | 16 saved | 0 |
| Melbourne | 22 saved | 1 saved | 2 saved | 0 | 15 saved | 0 |
| Communit* | 18 saved | 0 | 5 saved | 0 | 40 saved | 0 |
| Community garden | 0 | 0 | 0 | 0 | 0 | 0 |
| Local area | 5 NA | 0 | 5 saved | 0 | 2 NA | 0 |
| Neighbour(s)/hood | | 0 | 1 NA | 0 | 3 NA | 0 |
| Suburb | 2 NA | 0 | 0 | 0 | 0 | 0 |
| Precinct | 0 | 0 | 0 | 0 | 0 | 0 |
| Zone | 1 saved | 0 | 0 | 0 | 0 | 0 |
| Environment | 21 saved | 0 | 11 saved | 0 | 14 saved | 0 |
| Built environment | 8 saved | 0 | 1 saved | 0 | 0 | 0 |
| Sustainable environment | 5 saved | 0 | 5 saved | 0 | 0 | 0 |
| Europe | 1 NA | 0 | 2 | 0 | 0 | 0 |
| England | 0 | 0 | 0 | 0 | 0 | 0 |
| United Kingdom | 0 | 0 | 0 | 0 | 0 | 0 |
| Fitness professionals | 0 | 0 | 0 | 0 | 0 | 0 |
| Medical professionals | 0 | 0 | 0 | 0 | 0 | 0 |
| Allied Health | 0 | 0 | 0 | 0 | 0 | 0 |

| | **High Density Development** | **High Density Development ( and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| professional | | | | | | |
| Physiotherapist | 0 | 0 | 0 | 0 | 0 | 0 |
| Nutritionist | 0 | 0 | 0 | 0 | 0 | 0 |
| Dietician | 0 | 0 | 0 | 0 | 0 | 0 |
| Doctor | 0 | 0 | 0 | 0 | 0 | 0 |
| General Practitioner/GP | 0 | 0 | 0 | 0 | 0 | 0 |
| Naturopath | 0 | 0 | 0 | 0 | 0 | 0 |
| Nurse(s) | 0 | 0 | 0 | 0 | 0 | 0 |
| Metropolitan | 12 saved | 0 | 1 | 0 | 0 | 0 |
| Metro | 4 saved | 0 | 0 | 0 | 0 | 0 |
| Urban | 53 saved | 0 | 11 saved | 0 | 0 | 0 |
| North America | 1 NA | 0 | 0 | 0 | 0 | 0 |
| Canada | 1 saved | 0 | 1 NA | 0 | 0 | 0 |
| United States | 5 NA | 0 | 0 | 0 | 0 | 0 |
| Organisations | 1 saved | 0 | 0 | 0 | 0 | 0 |
| Commonwealth government | 0 | 0 | 0 | 0 | 0 | 0 |
| Federal government | 2 saved | 0 | 0 | 0 | 0 | 0 |
| State government | 4 saved | 0 | 1 saved | 0 | 0 | 0 |
| Local government | 4 saved | 0 | 1 saved | 0 | 0 | 0 |
| General Practice | 0 | 0 | 0 | 0 | 0 | 0 |
| Health Centre | 0 | 0 | 4 saved | 0 | 0 | 0 |
| Government bodies | 0 | 0 | 0 | 0 | 0 | 0 |
| Government institutions | 0 | 0 | 0 | 0 | 0 | 0 |
| Gym | 0 | 0 | 0 | 0 | 0 | 0 |
| FUNCTIONAL FITNESS | 0 | 0 | 0 | 0 | 0 | 0 |
| Fitness centre | 0 | 0 | 0 | 0 | 0 | 0 |
| Fitness club | 0 | 0 | 0 | 0 | 0 | 0 |
| Hospital | 0 | 0 | 0 | 0 | 0 | 0 |
| Non government organisations | 0 | 0 | 0 | 0 | 0 | 0 |
| Non-government | 0 | 0 | 463 | 165 | 119 | |

| | **High Density Development** | **High Density Development ( and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| organisations OR Non-government-organisations OR NGOs | | | | | | 46 NA |
| Planetary health | 0 | 0 | 0 | 0 | 0 | 0 |
| Alternative health | 0 | 0 | 1 saved | 0 | 4 | 0 |
| Complementary health | 0 | 0 | 0 | 0 | 0 | 0 |
| Integrative health | 0 | 0 | 0 | 0 | 0 | 0 |
| Ecological health | 0 | 0 | 0 | 0 | 0 | 0 |
| Emotional health | 0 | 0 | 0 | 0 | 0 | 0 |
| Environment and health | 2 saved | 0 | 11 | 0 | 9 saved | 0 |
| Geographies of health | 0 | 0 | | 0 | 0 | 0 |
| Public health | 2 saved | 1 saved | | 0 | 14 saved | 0 |
| Physical health | 2 | 1 | 5 saved | 0 | 7 saved | 0 |
| Relational ecology | 0 | 0 | 0 | 0 | 0 | 0 |
| Social dimensions of health | 0 | 0 | 0 | 0 | 0 | 0 |
| Spiritual health | 0 | 0 | 0 | 0 | 0 | 0 |
| Wellbeing | 0 | 0 | 1 saved | 0 | 2 saved | 0 |
| Planning | 43 saved | 2 saved | 19 | 0 | 34 | 0 |
| Climate change | 0 | 0 | 1 saved | 0 | 0 | 0 |
| Green planning | 1 | 0 | 0 | 0 | 1 | 0 |
| Multi-sector planning | 0 | 0 | 0 | 0 | 0 | 0 |
| Spatial planning | 0 | 0 | 2 saved | 0 | 3 NA | 0 |
| Spatial planning and health | 0 | 0 | 2 saved | 0 | 3 NA | 0 |
| Planning professionals | 1 NA | 0 | 0 | 0 | 1 | 0 |
| Architects | 0 | 0 | 0 | 0 | 0 | 0 |
| Designers | 1 NA | 0 | 0 | 0 | 0 | 0 |
| Urban Designers | 0 | 0 | 0 | 0 | 0 | 0 |
| Planners | 4 saved | 0 | 0 | 0 | 2 | 0 |

| | **High Density Development** | **High Density Development ( and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| Policy | 23 saved | 2 saved | 9 | 0 | 15 saved | 0 |
| Policy Advisors OR/Makers/OrOfficers | 119 | 119 | 462 | 0 | 9260 | 0 |
| Applied policy/Or Applied action | 0 | 0 | 0 | 0 | 8645 | 0 |
| Barriers/Obstacles to policy | 0 | 0 | 0 | 119 | 0 | 0 |
| Policy case studies | 1 saved | 0 | 0 | 0 | 4 | 0 |
| Collaborative policy | 0 | 0 | 0 | 0 | 1 | 0 |
| Decision making | 1 | 0 | 0 | 0 | 2 | 0 |
| Policy gaps | 0 | 0 | 0 | 0 | 1NA | 0 |
| Policy translation | 0 | 0 | 0 | 0 | 0 | 0 |
| Evidence based policy | 0 | 0 | 1 saved | 0 | 1 | 0 |
| Policy to practice | 5 NA | 0 | 1 | 0 | 1 NA | 0 |
| Policy relevant / practice relevant | 0 | 0 | 466 | 119 | 8648 | 120 |
| Inter-institutional policy | 0 | 0 | 0 | 0 | 0 | 0 |
| Transdisciplinary | 0 | 0 | 0 | 0 | 1 NA | 0 |
| Public private partnership | 0 | 0 | 0 | 0 | 1 NA | 0 |
| Decision making | 1 NA | 0 | 0 | 0 | 2 NA | 0 |
| Research /Researchers | 0 | 0 | 489 | 0 | 8646 | 0 |
| Case studies | 0 | 0 | 0 | 0 | 5 saved | 0 |
| Evaluation | 2 | 0 | 2 | 0 | 9 saved | 0 |
| Research gaps | 0 | 0 | 0 | 0 | 2 NA | 0 |
| methods | 5 NA | 0 | 0 | 0 | 34 saved | 0 |
| review | 5 NA | 0 | 0 | 0 | 3 | 0 |
| Translation | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable | 0 | 0 | 462 | 0 | 8645 | 119 |

| | **High Density Development** | **High Density Development ( and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| communities OR (resilient) | | | | | | |
| Sustainable development | 11 saved | 0 | 2 saved | 0 | 4 saved | 0 |
| Sustainable futures | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable growth / urban growth | 214 | 0 | 467 | 0 | 0 | 0 |
| Sustainable planning | 7 saved | 0 | 9 saved | 0 | 5 saved | 0 |
| Tools | 2 NA | 0 | 1 saved | 0 | 3 saved | 0 |
| Approaches | 4 NA | 0 | 1 saved | 0 | 3 saved | 0 |
| Checklist | 0 | 0 | 0 | 0 | 0 | 0 |
| Rating | 1 NA | 0 | 0 | 0 | 1 | 0 |
| Strategies | 13 saved | 1 NA | 2 saved | 0 | 5 NA | 0 |
| Sustainable transport | 10 saved | 0 | 8 saved | 0 | 5 NA | 0 |
| Access | 10 saved | 0 | 2 saved | 0 | 8 saved | 0 |
| Cyclist/Cycling | 1897 | 0 | 483 | 0 | 0 | 0 |
| Driver/Driving | 9121 | 13011 | 473 | 0 | 1NA | 0 |
| Walking | 8 saved | 1 saved | 6 | 0 | 5 saved | 0 |
| Urban density/ OR development/OR growth/OR planning | 5 saved | 63 saved | 5292 | 119 | 9094 | 915 |
| Western countries | 0 | 0 | 0 | 0 | 0 | 0 |
| Developed countries/ Or developed world | 277 | 747 | 0 | 119 | 0 | 0 |
| Neoliberal countries OR Neoliberal institutions | 119 | 0 | 0 | 0 | 8645 | 0 |

| | High Density Development | High Density Development, planning and health | Environmental Sustainability, planning and health | High Density Development, Environmental Sustainability, planning and health | Methods, planning and health | High Density Development, Methods, Planning and Health |
|---|---|---|---|---|---|---|
| Australia | 8 | 0 | 3 | 0 | 10 | 0 |
| New South Wales | 2 | 0 | 0 | 0 | 2 | 0 |
| Sydney | 1 | 0 | 1 | 0 | 3 | 0 |
| Victoria | 3 | 0 | 1 | 0 | 2 | 0 |
| Melbourne | 2 | 0 | 1 | 0 | 2 | 0 |
| Community/ies | 3 | 0 | 0 | 0 | 5 | 0 |
| Community garden | 0 | 0 | 0 | 0 | 0 | 0 |
| Local area | 0 | 0 | 0 | 0 | 1 | 0 |
| Neighbourhood(s) | 0 | 0 | 0 | 0 | 0 | 0 |
| Suburb | 0 | 0 | 0 | 0 | 0 | 0 |
| Precinct | 0 | 0 | 0 | 0 | 0 | 0 |
| Zone | 1 | 0 | 0 | 0 | 0 | 0 |
| Environment | 3 | 0 | 2 | 0 | 2 | 0 |
| Build Environment | 1 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Environment | 1 | 2 | 0 | 0 | 0 | 0 |
| Europe | 0 | 0 | 0 | 0 | 0 | 0 |
| United Kingdom | 0 | 0 | 0 | 0 | 0 | 0 |
| Fitness Professionals | 0 | 0 | 0 | 0 | 0 | 0 |
| Medical Professionals | 0 | 0 | 0 | 0 | 0 | 0 |
| Allied Health professional | 0 | 0 | 0 | 0 | 0 | 0 |
| Physiotherapist | 0 | 0 | 0 | 0 | 0 | 0 |
| Nutritionist | 0 | 0 | 0 | 0 | 0 | 0 |
| Dietician | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Doctor | 0 | 0 | 0 | 0 | 0 | 0 |
| General Practitioner (GP) | 0 | 0 | 0 | 0 | 0 | 0 |
| Naturopath | 0 | 0 | 0 | 0 | 0 | 0 |
| Nurse | 0 | 0 | 0 | 0 | 0 | 0 |
| Metropolitan | 1 | 0 | 0 | 0 | 0 | 0 |
| Metro | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban | 4 | 0 | 0 | 0 | 0 | 0 |
| North America | 0 | 0 | 0 | 0 | 0 | 0 |
| Canada | 1 | 0 | 0 | 0 | 1 | 0 |
| United States | 1 | 0 | 0 | 0 | 0 | 0 |
| Organisations | 0 | 0 | 0 | 0 | 1 | 0 |
| Commonwealth Government | 0 | 0 | 0 | 0 | | 0 |
| Federal Government | 0 | 0 | 0 | 0 | | 0 |
| State Government | 2 | 0 | 0 | | | |
| Local Government | 1 | 0 | 0 | | | |
| General Practice | 0 | 0 | 0 | 0 | | 0 |
| Health Centre | 0 | 0 | 1 | 0 | | 0 |
| Government Bodies | 0 | 0 | 0 | 0 | | 0 |
| Government Institutions | 1 | 0 | 0 | | | |
| Gym | 0 | 0 | 0 | 0 | | 0 |
| Functional Fitness | 0 | 0 | 0 | 0 | | 0 |
| Fitness Club | 0 | 0 | 0 | 0 | | 0 |
| Hospital | 0 | 0 | 1 | 0 | | 0 |
| Non-government Organisations | 0 | 0 | 0 | 0 | | 0 |
| NGOs | 0 | 0 | 0 | 0 | | 0 |
| Planetary Health | 0 | 0 | 0 | 0 | | 0 |
| Alternative Health | 0 | 0 | 0 | 0 | | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Complementary Health | 0 | 0 | 0 | 0 | | 0 |
| Integrative Health | 0 | 0 | 0 | 0 | | 0 |
| Ecological Health | 0 | 0 | 0 | 0 | | 0 |
| Emotional Health | 0 | 0 | 0 | 0 | | 0 |
| Environment and Health | 0 | 0 | 2 | 0 | | 0 |
| Geographies of Health | 0 | 0 | 0 | 0 | | 0 |
| Public Health | 1 | 0 | 0 | | | |
| Physical Health | 0 | 0 | 0 | 0 | | 0 |
| Relational Ecology | 0 | 0 | 0 | 0 | | 0 |
| Social Dimensions of Health | 0 | 0 | 0 | 0 | | 0 |
| Spiritual Health | 0 | 0 | 0 | 0 | | 0 |
| Wellbeing | 1 | 0 | 0 | 0 | | 0 |
| Planning | 5 | 0 | 2 | 0 | | 0 |
| Climate Change | 1 | 0 | 0 | 0 | | 0 |
| Green Planning | 1 | 0 | 0 | 0 | | 0 |
| Multi-Sector Planning | 0 | 0 | 0 | 0 | 0 | 0 |
| Spatial Planning | 0 | 0 | 1 | 0 | 0 | 0 |
| Spatial Planning and Health | 0 | 0 | 1 | 0 | 0 | 0 |
| Planning Professionals | 0 | 0 | 5 | 0 | 0 | 0 |
| Architects | 0 | 0 | 0 | 0 | 0 | 0 |
| Designers | 1 | 0 | 0 | 0 | 0 | 0 |
| Urban Designers | 1 | 1 | 0 | 0 | 0 | 0 |
| Planners | 1 | 1 | 0 | 0 | 0 | 0 |
| Policy advisors | 0 | 0 | 0 | 0 | 0 | 0 |
| Policy makers | 1 | 1 | 1 | 0 | 1 | 0 |
| Policy officers | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Applied | 4 | 0 | 0 | 0 | 1 | 0 |
| Applied-action | 0 | 0 | 0 | 0 | 0 | 0 |
| Barriers | 0 | 0 | 0 | 0 | 0 | 0 |
| Obstacles | 0 | 0 | 0 | 0 | 0 | 0 |
| Case studies | 0 | 0 | 1 | 0 | 2 | 0 |
| Collaborative | 0 | 0 | 0 | 0 | 1 | 0 |
| Decision-Making | 0 | 0 | 0 | 0 | 0 | 0 |
| Decision-Making Gaps | 0 | 0 | 0 | 0 | 0 | 0 |
| Decision-Making Translation | 0 | 0 | 0 | 0 | 0 | 0 |
| Evidence-based | 0 | 0 | 0 | 0 | 0 | 0 |
| Practice-relevant | 0 | 0 | 0 | 0 | 0 | 0 |
| Policy-relevant | 0 | 0 | 0 | 0 | 0 | 0 |
| Inter-institutional | 0 | 0 | 0 | 0 | 0 | 0 |
| Transdisciplinary | 0 | 0 | 0 | 0 | 0 | 0 |
| Public-Private Partnership | 0 | 0 | 0 | 0 | 0 | 0 |
| Translation | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable communities | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Development | 3 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Futures | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Growth | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Urban Growth | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable Planning | 1 | 0 | 9 | 0 | 0 | 0 |
| Tools | 0 | 0 | 1 | 0 | 2 | 0 |
| Approaches | 1 | 0 | 2 | 0 | 2 | 0 |
| Checklist | 0 | 0 | 0 | 0 | 0 | 0 |
| Toolkit | 0 | 0 | 0 | 0 | 0 | 0 |
| Rating | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Strategies | 0 | 0 | 1 | 0 | 4 | 0 |
| Transport | 1 | 1 | 0 | 0 | 0 | 0 |
| Access | 0 | 0 | 1 | 0 | 2 | 0 |
| Cycling | 0 | 0 | 0 | 0 | 0 | 0 |
| Driving | 0 | 0 | 0 | 0 | 0 | 0 |
| Sustainable transport | 0 | 0 | 0 | 0 | 0 | 0 |
| Walking | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban density | 4 | 0 | 0 | 0 | 0 | 0 |
| Urban development | 4 | 0 | 0 | 0 | 0 | 0 |
| Urban Growth | 2 | 0 | 0 | 0 | 0 | 0 |
| Urban Planning | 4 | 0 | 0 | 0 | 0 | 0 |
| Western | 0 | 0 | 0 | 0 | 1 | 0 |
| Developed countries | 0 | 0 | 0 | 0 | 0 | 0 |
| Developed World | 1 | 0 | 0 | 0 | 0 | 0 |
| Neoliberal | 0 | 0 | 0 | 0 | 0 | 0 |
| Neoliberal institutions | 0 | 0 | 0 | 0 | 0 | 0 |

*Science Direct*

| | High Density Development | High Density Development, planning and health | Environmental Sustainability, planning and health | High Density Development, Environmental Sustainability, planning and health | Methods, planning and health | High Density Development, Methods, Planning and Health |
|---|---|---|---|---|---|---|
| Australia | 53157 | 9226 | 16358 | 4898 | 72305 | 14254 |
| New South Wales | 16882 | 3524 | 4868 | 1879 | 13226 | 3208 |
| Sydney | 17953 | 2893 | 3967 | 1500 | 12212 | 2630 |
| Victoria | 20633 | 3422 | 4652 | 1732 | 14888 | 3113 |
| Melbourne | 14205 | 2428 | 4 | 2 | 9770 | 2222 |
| Community/ies | 202655 | 38968 | 73234 | 18033 | 217737 | 33537 |
| Community garden | 11721 | 4558 | 7073 | 2910 | 11763 | 3886 |
| Local area | 450109 | 46802 | 68898 | 20844 | 185948 | 40911 |
| Neighbourhood(s) | 53353 | 11947 | 11124 | 4359 | 27414 | 7458 |
| Suburb | 3177 | 1198 | 1269 | 625 | 2911 | 969 |
| Precinct | 591 | 221 | 317 | 147 | 512 | 174 |
| Zone | 356838 | 25770 | 28069 | 12470 | 65511 | 22947 |
| Environment | 554709 | 51591 | 110433 | 6815 | 233253 | 45172 |
| Build Environment | 113913 | 19851 | 38099 | 11874 | 61490 | 17319 |
| Sustainable Environment | 146496 | 26819 | 110432 | 26816 | 88545 | 23219 |
| Europe | 255613 | 34541 | 50691 | 15013 | 156259 | 29974 |
| United Kingdom | 45949 | 9818 | 14534 | 4475 | 49514 | 8624 |
| Fitness Professionals | 3866 | 2091 | 3561 | 1106 | 9143 | 1837 |
| Medical Professionals | 24156 | 11462 | 25594 | 4190 | 114347 | 9913 |
| Allied Health professional | 1706 | 1301 | 3292 | 668 | 10319 | 1157 |
| Physiotherapist | 1075 | 527 | 1144 | 177 | 6762 | 476 |
| Nutritionist | 3163 | 1409 | 1475 | 516 | 6112 | 1185 |
| Dietician | 3211 | 1590 | 1576 | 489 | 7949 | 1337 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Doctor | 22823 | 7083 | 14041 | 2439 | 75231 | 6152 |
| General Practitioner (GP) | 26121 | 9492 | 20925 | 4075 | 80414 | 8384 |
| Naturopath | 173 | 91 | 155 | 36 | 627 | 79 |
| Nurse | 19722 | 7379 | 17366 | 2363 | 94285 | 6296 |
| Metropolitan | 23213 | 8165 | 9747 | 4101 | 29153 | 6824 |
| Metro | 6280 | 2056 | 2242 | 1094 | 5773 | 1682 |
| Urban | 98842 | 27044 | 40062 | 13927 | 95089 | 23058 |
| North America | 119649 | 21643 | 28464 | 9620 | 85703 | 18671 |
| Canada | 14593 | 19472 | 27020 | 8372 | 94359 | 17304 |
| United States | 153555 | 31415 | 47102 | 12751 | 167369 | 27026 |
| Organisations | 201719 | 32689 | 63098 | 14320 | 191505 | 28238 |
| Commonwealth Government | 2837 | 1295 | 2842 | 794 | 5541 | 1112 |
| Federal Government | 21222 | 9177 | 4777 | 18288 | 41993 | 7880 |
| State Government | 78196 | 25203 | 52299 | 13531 | 115416 | 21382 |
| Local Government | 69525 | 24545 | 49439 | 13716 | 97475 | 20755 |
| General Practice | 251882 | 39980 | 16865 | 68113 | 237780 | 35255 |
| Health Centre | 145690 | 47798 | 66759 | 17630 | 280496 | 41986 |
| Government Bodies | 45817 | 16382 | 32489 | 8817 | 71993 | 14154 |
| Government Institutions | 36292 | 15358 | 38627 | 9048 | 75939 | 12707 |
| Gym | 5067 | 1359 | 1445 | 394 | 8291 | 1359 |
| Functional Fitness | 14455 | 2869 | 3485 | 1492 | 8624 | 2595 |
| Fitness Club | 1231 | 591 | 1029 | 343 | 2197 | 513 |
| Hospital | 126244 | 22731 | 32574 | 6595 | 222195 | 19931 |
| Non-government Organisations | 31615 | 13908 | 32829 | 8065 | 62250 | 11969 |
| NGOs | 8329 | 3360 | 10639 | 2496 | 12930 | 2734 |
| Planetary Health | 2780 | 1502 | 2166 | 827 | 3237 | 1317 |
| Alternative Health | 134787 | 44851 | 64804 | 18601 | 211499 | 39578 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Complementary Health | 33686 | 11437 | 16581 | 5092 | 43574 | 10234 |
| Integrative Health | 69188 | 29400 | 14425 | 54254 | 131675 | 26035 |
| Ecological Health | 34644 | 17311 | 29784 | 10589 | 46788 | 15370 |
| Emotional Health | 17434 | 7990 | 19776 | 3216 | 78094 | 6829 |
| Environment and Health | 148492 | 51591 | 110433 | 26816 | 233253 | 45172 |
| Geographies of Health | 50197 | 26483 | 39457 | 12777 | 101773 | 23185 |
| Public Health | 99995 | 43343 | 76696 | 18945 | 251070 | 37322 |
| Physical Health | 137142 | 47039 | 64826 | 18709 | 233565 | 41246 |
| Relational Ecology | 936 | 353 | 856 | 248 | 1143 | 331 |
| Social Dimensions of Health | 15441 | 10528 | 24880 | 6139 | 56051 | 9253 |
| Spiritual Health | 2068 | 1532 | 5717 | 960 | 13025 | 1318 |
| Wellbeing | 4458 | 2766 | 7213 | 1781 | 14887 | 2379 |
| Planning | 235416 | 78228 | 110433 | 28816 | 518391 | 67855 |
| Climate Change | 127718 | 20142 | 37282 | 12315 | 60347 | 17670 |
| Green Planning | 64858 | 25471 | 34204 | 12490 | 81364 | 22916 |
| Multi-Sector Planning | 25160 | 11603 | 26894 | 7450 | 41480 | 10009 |
| Spatial Planning | 84900 | 25776 | 26267 | 11785 | 61286 | 23069 |
| Spatial Planning and Health | 25776 | 25776 | 26267 | 11785 | 61286 | 23069 |
| Planning Professionals | 30097 | 19070 | 46164 | 8086 | 168424 | 16279 |
| Architects | 8667 | 2711 | 5120 | 1633 | 10080 | 2288 |
| Designers | 37980 | 4913 | 8082 | 2527 | 18519 | 4469 |
| Urban Designers | 5375 | 2161 | 3461 | 1460 | 5108 | 1920 |
| Planners | 18158 | 7442 | 10693 | 4116 | 23746 | 6220 |
| Policy advisors | 2684 | 1394 | 4472 | 854 | 8377 | 1217 |
| Policy makers | 30698 | 12056 | 28481 | 7364 | 53500 | 10454 |
| Policy officers | 6933 | 3829 | 10829 | 2087 | 26119 | 3255 |

| | | | | | | |
|---|---|---|---|---|---|---|
| applied | 836115 | 48151 | 64874 | 18805 | 235242 | 44040 |
| Applied-action | 444714 | 33347 | 49987 | 14658 | 143256 | 30645 |
| Barriers | 227431 | 22661 | 39151 | 10774 | 106334 | 19880 |
| Obstacles | 66195 | 8525 | 16666 | 4445 | 40765 | 7504 |
| Case studies | 978576 | 65263 | 90081 | 23693 | 373217 | 57100 |
| Collaborative | 55177 | 11511 | 26915 | 5270 | 71928 | 10087 |
| Decision-Making | 109300 | 29641 | 61746 | 14336 | 168712 | 25974 |
| Decision-Making Gaps | 32349 | 11114 | 25273 | 6479 | 50384 | 9984 |
| Decision-Making Translation | 29289 | 9439 | 20437 | 5156 | 45233 | 8477 |
| Evidence-based | 560448 | 46716 | 66315 | 16455 | 267444 | 40469 |
| Practice-relevant | 138688 | 25970 | 50439 | 12179 | 147231 | 23307 |
| Policy-relevant | 55872 | 19630 | 44330 | 10883 | 97515 | 17201 |
| Inter-institutional | 72299 | 17289 | 35132 | 8641 | 90447 | 15188 |
| Transdisciplinary | 873 | 396 | 1362 | 315 | 1799 | 356 |
| Public-Private Partnership | 7944 | 4394 | 13912 | 3132 | 19419 | 3552 |
| Translation | 191540 | 18413 | 30341 | 7948 | 92713 | 16260 |
| Sustainable communities | 71036 | 21407 | 73233 | 18033 | 78815 | 18316 |
| Sustainable Development | 254983 | 34248 | 99330 | 26817 | 111600 | 29418 |
| Sustainable Futures | 2693 | 1128 | 4969 | 1044 | 4328 | 940 |
| Sustainable Growth | 153804 | 24186 | 62891 | 19899 | 65412 | 20721 |
| Sustainable Urban Growth | 28938 | 12088 | 27000 | 10897 | 24685 | 10102 |
| Sustainable Planning | 76087 | 34248 | 110435 | 26817 | 134756 | 29418 |
| Tools | 406320 | 38281 | 60859 | 16145 | 193452 | 34644 |

*Sociological Abstracts*

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| | | | | | | |
| Australia | 1383 | 496 | 710 | 124 | 3157 | 403 |
| NSW | 126 | 53 | 100 | 17 saved | 337 | 43 NA |
| New South Wales | 543 | 278 | 224 | 17 saved | 1084 | 243 |
| Sydney | 492 | 209 | 244 | 53 saved | 1043 | 171 |
| Victoria | 555 | 232 | 241 | 38 saved | 1211 | 191 |
| Melbourne | 450 | 200 | 231 | 50 | 973 | 165 |
| Communit* | 6162 | 2057 | 2234 | 467 | 14084 | 1621 |
| Community garden | 1062 | 463 | 440 | 135 | 1483 | 377 |
| Local area | 5106 | 1852 | 1969 | 446 | 9344 | 1463 |
| Neighbour(s)/hood | 2746 | 1108 | 704 | 214 | 4516 | 894 |
| Suburb | 1042 | 494 | 206 | 84 | 1172 | 367 |
| Precinct | 102 | 39 saved | 42 saved | 10 saved | 140 | 29 NA |
| Zone | 1919 | 746 | 649 | 216 | 2353 | 572 |
| Environment | 5535 | 1935 | 2222 | 478 | 11315 | 1544 |
| Built environment | 2257 | 985 | 1067 | 264 | 3902 | 766 |
| Sustainable environment | 1547 | 717 | 1731 | 387 | 2754 | 552 |
| Europe | 3115 | 1019 | 992 | 215 | 5481 | 802 |
| England | 1998 | 726 | 574 | 121 | 4315 | 587 |
| United Kingdom | 1333 | 535 | 485 | 98 (mostly not relevant, few saved) | 2826 | 450 |
| Fitness professionals | 120 | 37 saved | 39 saved | 9 saved | 316 | 27 saved |
| Medical professionals | 1050 | 522 | 386 | 77 saved | 4709 | 449 |
| Allied Health professional | 158 | 104 saved | 100 | 16 NA | 560 | 82 saved |
| Physiotherapist | 12 NA | 7 saved | 10 NA | 0 | 82 saved | 5 NA |
| Nutritionist | 26 NA | 6 NA | 10 saved | 3 NA | 68 saved | 6 NA |
| Dietician | 10 NA | 6 NA | 4 | 1 NA | 54 | 6 NA |
| Doctor | 830 | 376 | 249 | 58 saved | 3178 | 319 |
| General Practitioner/GP | 2014 | 384 | 459 | 89 | 3270 | 330 |
| Naturopath | 0 | 0 | 0 | 0 | 5 | 0 |
| Nurse(s) | 438 | 200 | 158 | 21 saved | 2557 | 176 |
| Metropolitan | 1968 | 809 | 469 | 154 | 2845 | 655 |
| Metro | 331 | 159 | 79 saved | 34 | 439 | 128 |
| North America | 2643 | 926 | 851 | 204 | 4392 | 735 |
| Canada | 1883 | 631 | 764 | 165 | 4151 | 493 |
| United States | 5254 | 1742 | 1734 | 366 | 11699 | 1394 |
| Organisations | 5494 | 1786 | 2063 | 411 | 12087 | 1396 |

| | High Density Development | High Density Development (and planning and health) | Environmental Sustainability Planning and Health | High density development Environmental Sustainability Planning and Health | Methods Planning and Health | High density development Methods planning and health |
|---|---|---|---|---|---|---|
| | | | | | | |
| Commonwealth government | 298 | 129 | 163 | 29 saved | 744 | 104 |
| Federal government | 1789 | 706 | 671 | 135 | 3815 | 543 |
| State government | 4846 | 1786 | 1964 | 135 | 10105 | 1369 |
| Local government | 4137 | 1630 | 1856 | 414 | 8018 | 1260 |
| General Practice | 4727 | 1569 | 1745 | 370 | 11317 | 1266 |
| Health Centre | 3926 | 2010 | 1908 | 437 | 13283 | 1589 |
| Government bodies | 2395 | 961 | 1132 | 223 | 5583 | 768 |
| Government institutions | 3372 | 1261 | 1471 | 300 | 6837 | 954 |
| Gym | 77 NA | 21 saved | 17 saved | 1 saved | 194 | 17 saved |
| FUNCTIONAL FITNESS | 102 saved | 26 saved | 19 saved | 2 saved | 155 | 19 saved |
| Fitness centre | 219 | 66 saved | 62 saved | 14 saved | 423 | 50 saved |
| Fitness club | 53 saved | 18 saved | 20 saved | 3 saved | 119 | 14 NA |
| Hospital | 1225 | 635 | 409 | 94 saved | 4738 | 519 |
| Non government organisations | 3115 | 29 saved | 1450 | 11 saved | 6678 | 941 |
| Non-government organisations OR Non-government-organisations OR NGOs | 14888 | 15336 | 14759 | 14863 | 15353 | 14793 |
| Planetary health | 80 saved | 54 | 133 | 30 | 170 | 38 saved |
| Alternative health | 2988 | 1513 | 1692 | 346 | 9681 | 1205 |
| Complementary health | 640 | 344 | 397 | 87 saved | 1860 | 279 |
| Integrative health | 328 | 136 | 219 | 44 saved | 1142 | 118 |
| Ecological health | 1551 | 839 | 1383 | 335 | 3199 | 677 |
| Emotional health | 1154 | 473 | 395 | 66 saved | 5722 | 401 |
| Environment and health | 3600 | 1935 | 2222 | 478 | 11315 | 1174 |
| Geographies of health | 1567 | 1039 | 947 | 279 | 3434 | 846 |
| Public health | 4121 | 2062 | 2178 | 447 | 14556 | 1629 |
| Physical health | 2826 | 1456 | 1336 | 348 | 9535 | 1190 |
| Relational ecology | 237 | 75 saved | 154 | 29 | 426 | 60 saved |
| Social dimensions of health | 2636 | 1308 | 1420 | 327 | 8144 | 58 saved |
| Spiritual health | 478 | 283 | 336 | 66 saved | 1740 | 240 |
| Wellbeing | 631 | 293 | 370 | 70 saved | 2239 | 264 |
| Planning | 3372 | 2296 | 2399 | 492 | 17958 | 1807 |
| Climate change | 1965 | 757 | 1121 | 242 | 3380 | 593 |
| Green planning | 1125 | 819 | 1135 | 276 | 3374 | 643 |
| Multi-sector planning | 8 | 6 NA | 16 | 4 saved | 31 saved | 4 |
| Spatial planning | 1637 | 1097 | 855 | 289 | 3206 | 902 |
| Spatial planning and | 1097 | 1097 | 855 | 289 | 3206 | 902 |

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| | | | | | | |
| health | | | | | | |
| Planning professionals | 1447 | 1075 | 1066 | 204 | 8774 | 874 |
| Architects | 515 | 307 | 155 | 43 saved | 816 | 242 |
| Designers | 242 | 96 saved | 99 | 22 saved | 574 | 72 saved |
| Urban Designers | 183 | 89 saved | 81 saved | 21 saved | 345 | 67 saved |
| Planners | 812 | 477 | 420 | 116 | 1690 | 361 |
| Policy | 6062 | 2113 | 2293 | 478 | 14299 | 1666 |
| Policy Advisors OR/Makers/OrOfficers | 39540 | 38680 | 39496 | 39459 | 39828 | 39477 |
| Applied policy/Or Applied action | 38207 | 37359 | 37229 | 37096 | 39623 | 37364 |
| Barriers/Obstacles to policy | 17308 | 16337 | 16457 | 15993 | 19241 | 16257 |
| Policy case studies | 5544 | 2002 | 2085 | 458 | 12654 | 1604 |
| Collaborative policy | 592 | 294 | 489 | 85 saved | 2088 | 237 |
| Decision making | 3902 | 1437 | 1705 | 358 | 10196 | 1146 |
| Policy gaps | 2405 | 914 | 992 | 217 | 5761 | 760 |
| Policy translation | 677 | 277 | 284 | 54 saved | 1837 | 234 |
| Evidence based policy | 4416 | 1630 | 1507 | 340 | 10184 | 1341 |
| Policy to practice | 4395 | 1669 | 2022 | 423 | 11333 | 1331 |
| Policy relevant / practice relevant | 3311 | 47014 | 49631 | 46884 | 48092 | 47038 |
| Inter-institutional policy | 11 NA | 6 NA | 20 NA | 3 | 50 | 5 NA |
| Transdisciplinary | 51 | 71 saved | 68 | 14 | 131 | 21 saved |
| Public private partnership | 738 | 346 | 652 | 121 | 2191 | 250 |
| Decision making | 3902 | 1437 | 1705 | 358 | 10196 | 1146 |
| Research /Researchers | 7252 | 104247 | 104371 | 130554 | 110053 | 104073 |
| Case studies | 6880 | 2160 | 2152 | 469 | 14943 | 1727 |
| Evaluation | 2658 | 947 | 1060 | 217 | 8297 | 799 |
| Research gaps | 2708 | 951 | 982 | 218 | 6357 | 793 |
| methods | 5689 | 1807 | 1706 | 387 | 17958 | 1807 |
| review | 6577 | 2056 | 2039 | 435 | 14809 | 1678 |
| Translation | 868 | 293 | 304 | 57 | 2153 | 247 |
| Sustainable communities OR (resilient) | 4900 | 4172 | 5044 | 3865 | 2899 | 4020 |
| Sustainable development | 1712 | 763 | 1808 | 394 | 3130 | 584 |
| Sustainable futures | 1431 | 674 | 1650 | 357 | 2753 | 525 |
| Sustainable growth / urban growth | 5269 | 4992 | 5308 | 30511 | 31165 | 4969 |
| Sustainable planning | 1079 | 763 | 1833 | 394 | 3194 | 584 |
| Tools | 2953 | 1022 | 1291 | 267 | 6865 | 852 |

| | **High Density Development** | **High Density Development (and planning and health)** | **Environmental Sustainability Planning and Health** | **High density development Environmental Sustainability Planning and Health** | **Methods Planning and Health** | **High density development Methods planning and health** |
|---|---|---|---|---|---|---|
| | | | | | | |
| Approaches | 6218 | 2005 | 2162 | 459 | 14201 | 1618 |
| Checklist | 118 saved | 41 saved | 67 saved | 13 saved | 697 | 35 NA |
| Rating | 639 | 210 | 195 | 48 saved | 2226 | 180 |
| Strategies | 5317 | 1747 | 1965 | 424 | 12198 | 1390 |
| Sustainable transport | 584 | 284 | 560 | 170 | 747 | 207 |
| Access | 4767 | 1735 | 1762 | 404 | 10584 | 1399 |
| Cyclist/Cycling | 1403 | 1396 | 468 | 1397 | 1420 | 1396 |
| Driver/Driving | 22430 | 22038 | 22140 | 21891 | 23090 | 22015 |
| Walking | 757 | 322 | 261 | 84 saved | 1588 | 249 |
| Urban density/ OR development/OR growth/OR planning | 76818 | 72700 | 76829 | 46464 | 76872 | 76873 |
| Western countries | 3155 | 1129 | 1083 | 52330 | 6122 | 899 |
| Developed countries/ Or developed world | 67640 | 1525 | 67238 | 83134 | 8555 | 51825 |
| Neoliberal countries OR Neoliberal institutions | 8252 | 8197 | 8239 | 9586 | 8354 | 8205 |

## 6.3: Appendix 3

**Table 1: Inclusion and Exclusion Criteria Developed to Assess each Article**

The following criteria were applied to limit the inclusion pool to the articles most relevant for the purposes of the study.

| **Inclusion Criteria - Main** | **Inclusion Criteria - detailed** | **Exclusion Criteria** |
|---|---|---|
| | | |
| **Geographic level – macro (countries and continents)** | 1. Australia<br>2. Asia<br>3. Europe<br>4. New Zealand<br>5. North America<br>6. Western developed countries | 1. Africa<br>2. South America<br>3. Any developing countries where there is no link or comparison to any of the developed countries listed |
| **Geographic level – micro (states and cities)** | 1. Brisbane<br>2. Melbourne<br>3. New South Wales<br>4. Perth<br>5. Sydney<br>6. Victoria<br>7. And/cities with high density | 1. Any of same, relating only to low density |
| **Geographic level - context** | 1. High density development<br>2. Urban development<br>3. Expanding urban development/sites | 1. Rural only<br>2. Remote<br>3. Master planned estates<br>4. Low/Medium density, unless compared to high density<br>5. Suburban, unless compared/discusses in relation to high density<br>6. Small community case studies unless directly related to/compared to densely populated urban areas |
| **Topic level - Transport** | 1. Types of transport – bus, train, tram, cycle, walking<br>2. Road | 1. Freeway/Highway |
| **Topic level - health** | Relates to:<br>1. Physical/emotional/spiritual health<br>2. Medical model and CAM<br>3. Socio-environmental | 1. Disease prevention/healthcare with no reference to the built/living environment |

| | | |
|---|---|---|
| | determinant models of health<br>4. Socio-ecological and relational approaches to health<br>5. Public and Population Health<br>6. Global Health<br>7. Planetary Health<br>8. Health, wellbeing, human flourishing, human happiness<br>9. Planning in public health, health and sustainable livelihoods,<br>10. Healthy human environment<br>11. Co-benefits approach to human and environmental health<br>12. Place and human health,<br>13. Age and public health planning<br>14. Collaborative/partnership working<br>15. Cross-/inter-/multi-disciplinary/multi-sector approaches and health<br>Health and<br>16. Environment/Planning/Translation<br>17. Fitness/Physical activity/Diet and nutrition | 2. Sexual health<br>3. Smoking<br>4. Palliative care<br>5. Breastfeeding<br>6. Malnutrition<br>7. End of life |
| **Topic level - environment** | 1. Focus on the built environment,<br>2. Focus on the natural environment in relation to human livelihoods<br>3. Relates to urban areas and humans | 1. Does not relate to humans<br>2. Non-urban environments<br>3. Focus specifically on Marine environments with no reference to how this affects humans or no discussion of relationship between marine health and human health<br>4. Coastal environment case studies with no reference or link to urban environment and/or population migration and/or food security<br>5. Analysis of the geological |

| | | |
|---|---|---|
| | | environment only |
| **Topic level – subsistence** | 1. Food<br>2. Drink<br>3. Food security/Food insecurity/nutritional insecurity/under nutrition/malnutrition<br>4. Community gardens | 1. Does not relate to humans and/or the relationship between humans and environments (i.e. species nutrition case studies with no reference/links of how this relates to human diet/nutrition |
| **Topic level – education** | 1. Students – any level<br>2. Professionals<br>3. Knowledge<br>4. Understanding<br>5. Widening perspective<br>6. Practice-Orientated<br>7. Inter-institutional research, practice and learning<br>8. Inter-disciplinary approaches to problem solving | |
| **Topic level – actions, behaviours, values and emotions** | 1. Barriers/obstacles/denial/challenges<br>2. Feelings/Perceptions/Views<br>3. Anxiety/Happiness/Stress/Wellbeing<br>4. Quality of life<br>5. Resilience<br>6. Emotionality/human flourishing<br>7. Life satisfaction/quality of life<br>8. Human security<br>9. Affect<br>10. Human interaction<br>11. Inclusion/Integration/Socialisation | |
| **Topic level - tools** | 1. Approaches<br>2. Indicator<br>3. Index<br>4. Measure<br>5. Model<br>6. Predictor<br>7. Rating<br>8. Trials<br>9. Toolkit | |
| **Topic level – population** | 1. General population<br>2. Socioeconomic groups/inequality<br>3. Children and young people | 1. Individuals with highly specific needs e.g. autistic people, unless part of the |

| | | |
|---|---|---|
| | 4. Older people<br>5. Adults (all ages)<br>6. Refugees<br>7. Rural-to-urban migrants<br>8. Climate change refugees<br>9. Employed/unemployed adults<br>10. Elderly persons residing in care homes/retirement complexes/sheltered pensioner accommodation<br>11. Persons with disabilities and/or chronic medical conditions (physical and/or mental disabilities or ill-health) | general inclusion criteria<br>2. Indigenous people (unless part of the inclusion criteria)<br>3. Animal populations unless pets living in human household or specifically focusing on relationships between humans and animals for quality of life, i.e. pet-keeping and designing urban environments for enhancing human wellbeing. |
| **Topic level – governance** | 1. Policy<br>2. Law<br>3. Plan<br>4. Report<br>5. Government (any level)<br>6. NGO<br>7. Strategy<br>8. Development<br>9. Decision<br>10. Decision-making<br>11. Implementation<br>12. Practice | |
| **Quality of the study - timeliness** | Publications in the last 10 years were favoured, unless:<br>1. A classic study<br>2. Unique/rare content<br>3. Specifically focused on high-density environments in theoretical/empirical studies<br>4. Content directly focusing on relationship between urban planning, human health, population change and policy and practice with reference to high density environments | 1. Publications that were older than 1990 |
| **Quality of the study – methodology** | 1. Where empirical, has a high quality methodological approach with key finding(s).<br>2. Includes some kinds of discussion – for example:<br>- Strengths/weaknesses, points for practice/implementation etc.<br>- Comparative study | |

| | | |
|---|---|---|
| | - Critical Study<br>- Case Study<br>- Theoretical discussion<br>- Approach evaluation/analysis<br>- Practice piece<br>- Interdisciplinary research methods<br>- Inter-institutional research and/or<br>research involving multiple stakeholders | |
| **Quality of the study – theoretical** | 1. Related to a clearly defined philosophical position e.g. Neoliberalism<br>2. Or evidence-based/empirical study used to support/evaluate existing theories and/or to suggest new contributions to knowledge and/or understandings<br>3. Questioning of particular theoretical/philosophical positions through research frameworks and/or empirical evidence | |

## 6.4: Appendix 4

**Table 2: Number of Articles Grouped within Each of the Theoretical Perspectives of Health**

| Approach | Theoretical Approach to Health | | |
|---|---|---|---|
| | **1** | **2** | **3** |
| | Global Public and Population Health | Social-Ecological Determinants of Health | Planetary Health (relational ecological approaches health) |
| **Number of Articles (N=141)** | n=14 | n=109 | n=20 |

* Two of the articles within the sample discuss approaches relevant to more than one of the theoretical perspectives of health (Easthope and Judd 2010, Giles-Corti et al., 2012). In these instances, they have been included in more than one group.

## 6.5: Appendix 5

**List of articles grouped under each theoretical perspective of health**

Total number of articles within the sample: 141

***Global Public and Population Health (Total: 14 out of 141)***

Barton, H., 2009. ‘Land use planning and health and wellbeing’. *Land use policy*, vol. 26 (Suppl), S115–S123.

Bunker, R. and Holloway, D. 2007, “How far and in what way is Sydney’s new Metropolitan strategy likely to be implemented?” *Australian Planner*, Vol. 44, no 1, , pp. 26-33

Easthope, H., and Judd, S., 2010. *Living well in greater density*, Shelter NSW and City Futures, Sydney.

Easthope, H. & Randolph, B. 2009, 'Governing the Compact City: The Challenges of Apartment Living in Sydney, Australia', *Housing Studies*, vol. 24, no. 2, pp. 243-59.

Flood, J. 1997, 'Urban and Housing Indicators', *Urban Studies*, vol. 34, no. 10, pp. 1635-65.

Giles-Corti, B.K.R., Dr Sarah Foster, 2012, *Increasing density in Australia: maximising the health benefits and minimising harm*, National Heart Foundation of Australia.

Giles-Corti, B., Badland, H., Mavoa, S., Turrell, G., Bull, F., Boruff, B., Pettit, C., Bauman, A., Hooper, P., Villaneuva, K., Astell-Burt, T., Feng, X., Learnihan, V., Davey, R., Grenfell, R. & Thackway, S. 2014, 'Reconnecting Urban Planning with Health: A Protocol for the Development and Validation of National Liveability Indicators Associated with Noncommunicable Disease Risk-Behaviours and Health Outcomes', *Public Health Research in Practice*, vol. 25, no. 1.

Grant, M., Brown, C., Caiaffa, W.T., Capon, A., Corburn, J., Coutts, C., Crespo, C.J., Ellis, G., Ferguson, G., Fudge, C., Hancock, T., Lawrence, R.J., Nieuwenhuijsen, M.J., Oni, T., Thompson, S., Wagenaar, C. & Ward Thompson, C. 2017, 'Cities and health: an evolving global conversation', *Cities & Hea*lth, vol. 1, no. 1, pp. 1-9.

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Randolph, B. & Holloway, D. 2005, 'Social Disadvantage, Tenure and Location: An Analysis of Sydney and Melbourne', *Urban Policy and Research*, vol. 23, no. 2, pp. 173-201.

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Wells, N. M., Evans, G. W., 2010, 'Environments and health: planning decisions as public-health decisions', *Journal of Architecture and Planning Research*, vol. 27, no. 2, pp.124-143.

***Socio-Ecological Determinants of Health (Total: 109 out of 141)***

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Allen, C. & Blandy, S. 2004. *The Future of City Centre Living: Implications for Urban Policy,* London: Department for Communities and Local Government

Anderson, B. 2009, 'Affective Atmospheres.', *Emotion, Space and Society*., vol. 2, no. 2. pp. 77-81.

Astell-Burt, T., Feng, X.Q., Mavoa, S., Badland, H.M. & Giles-Corti, B. 2014, 'Do low-income neighbourhoods have the least green space? A cross-sectional study of Australia's most populous cities', *Bmc Public Health*, vol. 14.

Badland, H., Foster, S., Bentley, R., Higgs, C., Roberts, R., Pettit, C. & Giles-Corti, B. 2017, 'Examining associations between area-level spatial measures of housing with selected health and wellbeing behaviours and outcomes in an urban context', *Health & Place*, vol. 43, pp. 17-24.

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Chan, I. Y. S., & Lui, A. M. M., 2018, ‘Effects of neighbourhood on building design, height, greenspace, and cleanliness on indoor environment and health of building occupants’, *Building and Environment*, vol. 145, pp. 213-222.

Cho, I.S., Trivic, Z. & Nasution, I. 2017, 'New high-density intensified housing developments in Asia: qualities, potential and challenges', *Journal of Urban Design*, vol. 22, no. 5, pp. 613-36

Christian, H., Ball, S.J., Zubrick, S.R., Brinkman, S., Turrell, G., Boruff, B. & Foster, S. 2017, 'Relationship between the neighbourhood built environment and early child development', *Health and Place*, vol. 48, pp. 90-101.

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## 6.6: Appendix 6

## Key characteristics of Healthy Higher Density Living and associated influencing attributes for each of the theoretical perspectives of health

**Table 3: Key Characteristics of Healthy Higher Density Living and the Influencing Attributes from a Global Public and Population Health Perspective**

| Global Public and Population Health | | | | |
|---|---|---|---|---|
| | Key Characteristics | | | |
| | 1 | 2 | 3 | 4 |
| | **Global Challenge Responsive** | **Promotes Positive Physical Health** | **Promotes Positive Mental Health** | **Focused on Long-Term Health Outcomes** |
| **Number of Articles that discuss each characteristic (Out of a total of 14)** | 14 | 13 | 5 | 2 |
| **Attributes required to influence/support each of the key characteristics of healthy higher density living** | • Focused on solving public health challenges resulting from increased urbanisation<br>• Improvements to infrastructure and transport provision<br>• Solve problems resulting from changing urban demographic population profile | • Good Air Quality<br>• Adequate Outdoor Space<br>• Pedestrian Friendly Outdoor Spaces<br>• Safety<br>• Adequate indoor space<br>• Low neighbourhood traffic levels<br>• Access to Quality Food | • Good Air Quality<br>• Adequate outdoor space<br>• Pedestrian friendly outdoor spaces<br>• Safety and human interaction<br>• Adequate indoor space<br>• Low neighbourhood traffic levels<br>• Low crime levels | • Action-orientated<br>• Future-orientated |

**Table 4: Key Characteristics of Healthy Higher Density Living and the Influencing Attributes from a Socio-Ecological Determinants of Health Perspective**

| Socio-Ecological Determinants of Health | | | | |
|---|---|---|---|---|
| | Key Characteristics | | | |
| | 1 | 2 | 3 | 4 |
| | **Liveability** | **Positive Physical Health** | **Positive Mental Health** | **Health Equity** |
| **Number of Articles that discuss each characteristic (Out of a total of 109)** | 30 | 43 | 12 | 48 |
| **Attributes required to influence/support each of the key characteristics of healthy higher density living** | a) Promotion of Liveability and Quality of Life rather than Disease Prevention<br>b) Uses Stimulating Design and Infrastructure to enhance Resident Wellbeing<br>c) Promotes Human Happiness<br>d) Emphasises a Two-Directional Relationship between the Built Environment and Human Wellbeing<br>e) Promotion of active transport<br>f) Enhances Social Interaction, including at different stages of the life course | a) Provides access to public and active transport<br>b) Building Design and Access to space promotes positive behaviour change<br>c) Enables access to fresh food<br>d) Limits exposure to air pollution<br>e) Promotes thermal comfort and reduces heat-related illness | a) Decreases Social Isolation<br>b) Limits noise pollution and other environmental stressors<br>c) Reduces Crime and Fear of Crime<br>d) Reduces Fear of the health risks associated with Environmental Hazards through appropriate Building Design<br>e) Decreases Suicide Rates through Effective Building Design | a) Age and Health<br>b) Gender and Health<br>c) Socio-Cultural Factors and Health Behaviours<br>d) Socio-Economic Inequalities and Health |

**Table 5: Key Characteristics of Healthy Higher Density Living and the Influencing Attributes from a Planetary Health Perspective**

| Planetary Health | | | | |
|---|---|---|---|---|
| | Key Characteristics | | | |
| | 1 | 2 | 3 | 4 |
| | **Co-benefits approach to human and environmental health** | **Holistic approach to human wellbeing** | **Addresses global health challenges, especially climate change** | **Promotes planetary sustainability in built environment design** |
| **Number of Articles that discuss each characteristic (Out of a total of 20)** | 15 | 19 | 18 | 13 |
| **Attributes required to influence/support each of the key characteristics of healthy higher density living** | • Enhancing biodiversity of the natural environment<br>• Promoting long-term food security<br>• Enhancing air quality and reducing atmospheric pollution<br>• Improving water quality<br>• Promoting human and environmental flourishing for long-term quality of life<br>• Reducing the human and environmental impacts of increased planetary heat | • Provides opportunities for accessing and attending to nature<br>• Promotes urban greening<br>• Promotes local food production | • Promotes adaptation to climate change<br>• Promotes mitigation of climate change through reduction in greenhouse gases | • Uses renewable energy<br>• Innovative environmentally-friendly building design<br>• Building design helps to promote long-term planet cooling effects and sustainable energy efficiency |

## 6.7: Appendix 7

**Table 6: Similarities and Differences in Suggestions for Planning Strategies at the Bureaucratic Level for each of the Theoretical Perspectives of Health**

| Suggestions for improving planning strategies at the Bureaucratic Level of Planning Strategy Development | | | | |
|---|---|---|---|---|
| | | **Global Public Health** | **Socio-Ecological Determinants of Health** | **Planetary Health (Relational Ecological Approaches)** |
| **Suggestions at the Bureaucratic Level for Inclusion in the Following Aspects of Planning Strategy Development:**<br>• **Legislation,**<br>• **Policies,**<br>• **Plans,**<br>• **Guidelines,**<br>• **Tools.** | **Scale of Approach** | | | |
| | Multi-levelled, multi-scaled approach | ✓ | ✓ | ✓ |
| | Greater consider of how international political and economic factors affect local health | ✓ | | |
| | Greater focus on how local social and economic factors that affect health in through a combined Global to Local level Approach | ✓ | | |
| | Focus on community health and quality of life rather than individual health | | ✓ | |
| | **Institutional Involvement** | | | |
| | Adopt a transdisciplinary approach to the development of new planning strategies | ✓ | ✓ | ✓ |
| | More cross-sectoral partnerships in planning strategy developments | ✓ | ✓ | ✓ |
| | Incorporate multiple actors from diverse institutions in collaborations | | ✓ | ✓ |
| | Utilise existing checklists to encourage successful collaboration processes | | ✓ | |
| | Strengthen individual capacities of institutions to enable better resourced collaborations | | ✓ | |
| | | **Global Public** | **Socio-** | **Planetary Health** |

| | | | | |
|---|---|---|---|---|
| | | **Health** | **Ecological Determinants of Health** | **(Relational Ecological Approaches)** |
| | Encourage greater awareness and sense of a shared responsibility between institutions for shaping health outcomes | | ✓ | |
| | Co-learning approaches for planners and health professionals | | ✓ | ✓ |
| | **Use of Evidence** | | | |
| | Move from randomised control evidence to greater governance for health | ✓ | ✓ | ✓ |
| | Draw on subjective as well as objective health evidence and perceptions of health | | ✓ | |
| | Show greater awareness of how human behaviour affects outcomes | | ✓ | |
| | **Temporality of Approach** | | | |
| | Adopt a long term outlook | ✓ | | ✓ |
| | Adopt a distant long-term future outlook | | | ✓ |
| | **Conceptualisation of the relationship between society and the built environment** | | | |
| | Greater focus on the relationship between the built environment and social factors for influencing health-related behaviour | | ✓ | |
| | Show greater awareness of the inter-relationships between the different determinants | | ✓ | |
| | **Conceptualisation of the relationship between the social and natural environment** | | | |
| | Consideration of the role that the health of the natural environment plays in supporting human wellbeing in decision-making | | | ✓ |
| | Rethink relationship between health and environment in terms of multi-dimensional feedback loops | | | ✓ |
| | | **Global Public** | **Socio-** | **Planetary Health** |

| | | Health | Ecological Determinants of Health | (Relational Ecological Approaches) |
|---|---|---|---|---|
| | Consider the significance of anthropogenic climate change in approaches to planning development | | | ✓ |
| | **Focus of making change through planning strategies** | | | |
| | Greater focus on improving health equity | | ✓ | |
| | Challenge culturally embedded barriers to positive health outcomes | | ✓ | |
| | Encourage greater use of active and public transport | | ✓ | |
| | Enhance environmental sustainability | | | ✓ |

## 6.8: Appendix 8

**Table 7: Similarities and Differences in Suggestions for Planning Strategies at the Action-Implementation Level for each of the Theoretical Perspectives of Health**

| Suggestions for improving planning strategies at the Design and Action-Intervention Level of Planning Strategy Development | | | | |
|---|---|---|---|---|
| | | **Global Public Health** | **Socio-Ecological Determinants of Health** | **Planetary Health (Relational Ecological Approaches)** |
| **Specific Suggestions at the Design and Action-Implementation Level for Inclusion in Planning Strategy Developments** | Consider the role of how the built environment overlaps with social factors in planning design | ✓ | ✓ | ✓ |
| | Implement factors and evidence relating quality of life into planning design | ✓ | ✓ | ✓ |
| | Build 'up' rather than 'out' | ✓ | ✓ | ✓ |
| | Building design should reflect changing demographic profile of local area | ✓ | ✓ | |
| | Design and implementation of public spaces, transport networks, street networks and mixed land use | ✓ | ✓ | |
| | Limit car use through street design | | ✓ | |
| | Involve residents in place-making and planning decision making | | ✓ | |
| | Use existing toolkits to embed attributes evidenced to improve health outcomes | | ✓ | |
| | Implement minimum standards for indoor space | | ✓ | |

| | | Global Public Health | Socio-Ecological Determinants of Health | Planetary Health (Relational Ecological Approaches) |
|---|---|---|---|---|
| | Reduce existing health inequalities (gender and socio-economic) through building design | | ✓ | |
| | Obtain and use evidence specific to national and local context | | ✓ | |
| | Enhance social interaction through design of the built environment | | ✓ | |
| | Provide ongoing building maintenance | | ✓ | |
| | Provide facilities for access to healthy food | | ✓ | |
| | Use conceptual mapping to identify barriers to healthy living | | ✓ | |
| | Improve air quality to disperse pollution and combat problems associated with extreme heat | | ✓ | ✓ |
| | Introduce diverse ecosystems | | | ✓ |
| | Use sustainable energy sources | | | ✓ |
| | Apply urban climate knowledge to develop green space | | | ✓ |