

**THE EFFECTS OF PHYSICAL AND
SOCIAL ENVIRONMENTS ON THE
HEALTH AND WELLBEING OF
CHILDREN AND YOUNG PEOPLE**

*Prepared for the W.A Commissioner for Children and Young People
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1. INTRODUCTION

The environment in which children live is one of the key influences on their health and wellbeing. It is not just a matter of the direct physical impact - for example, of polluted air or water – but also of the indirect social and behavioural effects which flow from where they live – the exercise they take, the people they meet, the aesthetic and natural qualities of their neighbourhoods and the quality of the housing, education, health, transport and other services and facilities available to them.

This review is designed to elucidate how the environments in which children and young people live affect their health and wellbeing. Research from psychology, sociology, human geography, urban planning and the health sciences has been systematically surveyed to provide a summary of the principal findings and conclusions which appear to be generally supported.

Research into what influences whether children are healthy and have rich and fulfilling lives has often focused on individual child and parental characteristics and behaviour. While these are clearly important, the need to take account of the effects of the broader physical and social environments in which children live has become an increasing focus of inquiry, not least because individual and family variables do not account for all, or even much, of the variance in health and wellbeing. At a population level, as Hood and colleagues have argued for health outcomes, the “determinants exerting the most powerful and sustained influence on health and the distribution of disease, illness, injury, disability, and premature death in the population are social and economic factors”¹ (p 2).

Bronfenbrenner was the first psychologist to systematically explore² the importance of considering the environments and systems in which children live in order to fully understand the trajectories of their development. His model has been widely adopted as a framework for understanding the broader environmental effects on children’s development. According to his ecological model, children develop through interactions, not only *within* their immediate environments but also as result of those *between* their immediate environments and wider social environments. This model, and the many variants which have been developed since, describes the influences on children’s development as occurring within concentric circles; the innermost circles representing the closest influences, and outer circles representing broader

¹ Hood C, Gennuso K, Swain G, and Catlin B. (2016). County Health Rankings: Relationships between determinant factors and health outcomes. *American Journal of Preventative Medicine*, 50(2):129-33.

² Bronfenbrenner, U., & Morris, P. (1998). The ecology of developmental processes. In W. Damon, & R. Lerner (Eds.) *Handbook of child psychology: Theoretical models of human development* (vol. 1, (5th ed.)). New York: Wiley.

social influences. Bronfenbrenner³ originally identified four main elements in his ecological model:

- the settings where children have face-to-face interactions with family, peers, and neighbours and in child care and educational settings;
- the relationships between children's immediate settings; for example, between home and school, and the compatibility between these settings in styles, expectations or values;
- the settings in which children are not active participants but which, nonetheless, influence them indirectly, for example, the parental workplace; and
- the broader social contexts of their communities - cultural, political systems and social values in operation.

Over his life, Bronfenbrenner revised his theory several times and added a time dimension to capture changes with age and in the child's personal and social circumstances, for example, changes following the death of a parent.

While Bronfenbrenner's model did not explicitly identify the influence of the physical environments (natural and built) in which children live, they are implied in his model. Building on his approach, others have sought to explicitly insert direct environmental and ecological influences such as food, green space and biodiversity, the nature of the built environment and exposure to toxins and atmospheric systems^{4 5 6}. It is these influences and the relationships between them and "social determinants" which are the prime focus of this review.

2. SOCIAL DETERMINANTS

For people generally, evidence supports the close relationship between people's health and wellbeing and their social and physical environments – collectively known as the social determinants of health. The World Health Organization (WHO) commissioned a major review of the social determinants of health (Commission on the Social Determinants of Health – CSDH),⁷ chaired by Professor Michael Marmot, which described social determinants as: "the circumstances in which people grow, live, work, and age, and the systems put in place to deal with illness. The conditions in which people live and die are, in turn, shaped by political, social, and economic forces."

The Commission, like Bronfenbrenner, took a holistic view of the social determinants of health. After reviewing a substantial body of evidence, they concluded that the poor health of the poor, the social gradients of various health indices within countries, and the marked health inequities between countries resulted from the unequal distribution of power, income,

³ Bronfenbrenner, U. and Morris, P. (2006). The bioecological model of human development, in R. M. Lerner (ed.), *Handbook of Child Psychology* (6th ed., Vol. 1, pp. 793–828), John Wiley and Sons, New Jersey.

⁴ Stanger, N. R. G. (2011). Moving "eco" back into socio-ecological models: A proposal to reorient ecological literacy into human developmental models and school systems. *Human Ecology Review*, 18(2), 167-173.

⁵ Maller, C. J. (2009). Promoting children's mental, emotional and social health through contact with nature: A model. *Health Education*, 109(6), 522-543.

⁶ Schusler, T. M., & Krasny, M. E. (2010). Environmental action as context for youth development. *Journal of Environmental Education*, 41(4), 208-223.

⁷ World Health Organization (WHO). 2008. Closing the gap in a generation: Health equity through action on the social determinants of health. Geneva: WHO. Final Report of the Commission on Social Determinants of Health. https://www.who.int/social_determinants/thecommission/finalreport/en/.

goods, and services. They argued that these inequities and the resultant inequity in the circumstances of people's lives – their access to health care, schools, and education, their conditions of work and leisure, their homes, communities, towns, or cities – were important causes of disparities in their health and wellbeing. They insisted that “this unequal distribution of health-damaging experiences is not in any sense a ‘natural’ phenomenon but is the result of a toxic combination of poor social policies and programmes, unfair economic arrangements, and bad politics.”

These inequalities are particularly evident in the conditions of early childhood and schooling, the nature of employment and working conditions, the physical form of the built environment, and the quality of the natural environments in which people live. The Commission concluded that, depending on the nature of these environments, different groups will have different experiences of material conditions, psychosocial support, and behavioural options, which influence their health and wellbeing.

According to the WHO, the important social determinants are:

- socioeconomic status (SES);
- early life (e.g. low birth weight);
- social exclusion;
- employment and work;
- housing and homelessness;
- the built environment;
- the natural environment;
- rural versus urban residence;
- neighbourhoods.

Separating out and evaluating the influences of natural, physical and social environments on child health and wellbeing obviously requires a careful assessment of the various components of children's health and wellbeing as well as a rigorous analysis of the postulated determinants of health and their relationships with one another. The first step is to gain a clear understanding of the current state of children's health and wellbeing, any trends indicative of improvement or deterioration, and any variation across the groups and places where children live and go to school.

3. THE SPATIAL DIMENSIONS OF CHILDREN'S LIVES IN WA

3.1 Population profile

Western Australia is home to approximately 593,000 children and young people, making up 23% of the population at the last Census. Of these, around 40,000 are Aboriginal children aged under 18, some 39.6 per cent of the total WA Aboriginal population. Although the rate of migration has slowed in WA since the last Census, the number of WA children and young people is predicted to increase by 91% by 2058.

Most of the children in WA live in the Perth metropolitan area (74%), with 17 per cent residing in regional areas and 10 percent in the remote parts of the State. However, around 58% of Aboriginal children and young people live outside the Perth metropolitan area. For the entire

population of children, small increases in the population share living in the metropolitan area were recorded in the last Census, along with declines in some remote areas, such as the Gascoyne and Esperance.

According to the 2011 Census, (the 2016 figures appear not to be available) it appears that the vast majority of Western Australian households with children live in separate houses (87%), a further 7.4% in semi-detached, row or terrace houses and 5.4% in flats, including high-rise.

3.2 Social profile

Despite the comparative wealth of the WA community, there is still significant inequality, with some 44,000 children and young people living below the 50% poverty line and, of these, some 18,574 are in 'deep' poverty – below 30% of the median income. Aboriginal children are more likely to experience poverty and to live in out-of-home care and to be in the youth justice system. Area differences in childhood vulnerability and access to services are evident and there are clear concentrations of disadvantage both within urban areas and between city and country. This is evident in the 2016 ABS Socioeconomic Indices for Areas (SEIFA)⁸ data for Western Australia, which show continuing high levels of disadvantage in remote areas of WA. The most advantaged local government area is Peppermint Grove, the least advantaged, Ngaanyatjaraku. Within the greater Perth metropolitan area, Kwinana and Mandurah are the most disadvantaged, followed by Belmont and Gosnells. Jobless households are most common in Mandurah and Kwinana, comprising one in five families in these areas, while Rockingham, Armadale and Gosnells are also high – 15%.⁹

3.3 Children's health and wellbeing

There have been several attempts in Australia to provide long term, population wide assessments of the state of children's health and general wellbeing, as well as many smaller, one-off attempts to track individual indices. Some of them also provide data on geographical variations. Some have been prepared specifically for Western Australia. These data sets are described (Section 3.3.2) and their main findings on children's health and wellbeing reviewed.

3.3.1 Definitions and measurement of health and wellbeing

In assessing both community and individual health, most policy makers and researchers now adopt the broad and multidimensional WHO definition of health as "a state of complete mental, physical and social wellbeing and not merely the absence of disease or infirmity" (WHO 1946). The WHO¹⁰ separately defines mental health as "a state of wellbeing in which an individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community." Both definitions stress wellbeing, rather than illness or disability, viewing health as the foundation

⁸The SEIFA index is a composite of income, educational attainment, employment and occupation, <https://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa>.

⁹ Cassells, R., A. Dockery, and A. Duncan.(2014). Falling through the Cracks: Poverty and disadvantage in Australia. Perth, Western Australia: Bankwest Curtin Economics Centre.

¹⁰ World Health Organization (WHO). (2005). Promoting mental health: Concepts, emerging evidence, practice. Geneva: WHO. http://www.who.int/mental_health/publications/promoting_mh_2005/en/.

for both individual wellbeing and the effective functioning of our communities. Key to these definitions is the understanding that health is anchored in the social, economic, political, environmental and spatial contexts of everyday life.

A similar approach has been adopted by the Australian Institute of Health and Welfare (AIHW) which provides regular updates of the state of the nation's health and welfare. In their publications,¹¹ health is described as *"a state of wellbeing" which "reflects the complex interactions of a person's genetics, lifestyle and environment."* Generally, they argue, a person's health depends on both *determinants* (factors that influence health) and *interventions* (actions taken to improve health, and the resources required for these interventions).

In describing the state of child indicators research, Asher Ben-Arieh¹² notes the shift from indicators of survival to those which capture wellbeing; from negative to positive. At least since the 90s, health and wellbeing indicators have shifted focus to some degree from dying, distress, disability and discomfort to enjoyment, satisfaction, and general wellbeing. In reality, much of the research continues to focus on the negative - illness, disability and dysfunction (such as disease rates, obesity, drug abuse and mental illness), in part because data on these attributes are more likely to be routinely collected.

Nonetheless, in addition to such illness indicators, there are many individual indices as well as more comprehensive data sets where the focus, at least in part, is on the positive aspects of health and wellbeing. Some have been specifically designed for the Australian population of children and young people. The Australian indicators are described below. Since each of the indices focuses on slightly different aspects of children's health and wellbeing, findings from each approach are presented separately.

3.3.2 Children's health and wellbeing data sets

Australian Institute for Health and Welfare (AIHW)

Summary

In attempting to capture the state of health and wellbeing of children in Australia, the AIHW surveyed expert opinion to judge what were likely to be the best indicators. The resulting 19, the Children's Headline Indicators (CHI), were designed to enable better policy development and evaluation, and to identify the immediate environments critical to children's health, development and wellbeing within three broad areas—health, early learning and care, and family and community. As the description implies, these indicators do not necessarily measure health and wellbeing outcomes directly, but may relate to a range of factors which influence outcomes. For example, "breastfeeding" is an indirect, predictive factor for good child health while injury deaths is a direct measure.

After widespread consultation, the AIHW also developed a detailed measurement of *social and emotional* wellbeing. They emphasise *"the individual social and emotional strengths of children, rather than simply the absence of mental ill health"*, and attempt to capture the

¹¹ <https://www.aihw.gov.au/getmedia/e546e087-d50d-42da-a53d-35e528643d97/aihw-aus-221-chapter-1-1.pdf.aspx>.

¹² Ben-Arieh, A. (2008). The child indicators movement: Past, present, and future, *Child Indicators Research*, 1(1), 3–16.

influence that families, schools and communities have on children’s social and emotional wellbeing.

Like many researchers in the field, they approach social and emotional wellbeing through the *ecological frame* described above – identifying those influences which are individual in nature and those which describe the relationships children have with the people and places where they live. The latter include the influences of environments closest to the child (such as the home, early childhood education and care settings and school), as well as more distant ones (such as the wider community and society at large). Social and emotional wellbeing is conceived as being influenced by interactions between these multiple environments (home, school and community), as well as the individual characteristics of the child.

Building on the work of Hamilton & Redmond¹³ and following consultation with a range of experts in the field, the AIHW adopted the well-researched and extensively validated Strengths and Difficulties Questionnaire (SDQ)¹⁴ as the basis for assessing the social and emotional wellbeing of Australian children. This instrument has been widely adopted as a population measure of children’s social and emotional wellbeing, both internationally and in Australia. The SDQ is comprised of five subscales each with five items. Items in four of these subscales – emotional problems, conduct problems, hyperactivity and peer problems - are combined to arrive at a total difficulties score. These scores are then used to categorise children’s behaviour as 'normal', 'borderline' or 'abnormal', with scores in the abnormal range (the highest 10%) indicating a substantial risk for clinically significant problems¹⁵. It is perhaps indicative of the general approach in this field that the emphasis in reporting is almost always on the difficulties rather than strengths.

Findings

In addition to their generic reports on the health of the Australian population, the AIHW regularly provides reports on their headline indicators, highlighting shifts in direction – both favourable and unfavourable - in the health and wellbeing of Australia’s children and young people. The data show that, over the decade between 2007 and 2017, child abuse and neglect rates increased, dental health and immunisation rates declined, while infant mortality and injury death rates improved.

In some groups, child health is clearly worse than the Australian average. For example, in the period 2014-2016, the injury death rate among Indigenous children were around 5.7 times higher than the rate for non-Indigenous children and children from low-SES areas also experienced higher injury death rates. In Western Australia there was a reduction between 2011 and 2015 to below the Australian average in the proportion of children who were overweight or obese, although 22% of children still fell into this category.

The proportion of children who were classified as “abnormal”, based on parent responses to the Strengths and Difficulties Questionnaire, was found to be higher among low SES children – 16% among the most disadvantaged fifth of the sample compared to 7.2% among the least

¹³ https://www.aracy.org.au/publications-resources/command/download_file/id/91/filename/Conceptualisation_of_social_and_emotional_wellbeing_for_children_and_young_people_and_policy_implications.pdf.

¹⁴ https://depts.washington.edu/dbpeds/Screening%20Tools/Strengths_and_Difficulties_Questionnaire.pdf.

¹⁵ Goodman R. (1997). The Strengths and Difficulties Questionnaire: a research note. *Journal of Child Psychology and Psychiatry*, 38(5):581–586.

disadvantaged. Higher rates were also observed for step-families, blended families and families with one parent or carer. The highest rates of “abnormality” on the SDQ for children between 4 and 12 years old were seen in children from outer regional Australia, while the lowest rates were recorded for remote communities¹⁶.

Australian Research Alliance for Children and Youth (ARACY)

Summary

The Australian Research Alliance for Children and Youth (ARACY) have adopted a somewhat different approach – the Nest framework. ARACY notes that while there is no universally agreed definition of children’s wellbeing, two common approaches are evident around the world: researchers determine what things are important in a child’s life and select indicators; and/or children are asked to assess their own wellbeing.

ARACY used both of these approaches in seeking to determine the key dimensions of wellbeing and arrived at six dimensions:¹⁷

- being loved and safe
- having material basics
- being healthy
- learning
- participating
- having a positive sense of identity and culture.

They then developed indicators for each dimension and now report on trends and international comparisons of these indicators at regular intervals.

Findings

In their most recent report card (2018), ARACY has compared Australian children with those from the other relatively wealthy countries which make up the Organisation for Economic Co-operation and Development (OECD). It shows that some indicators are heading in the wrong direction and/or that we rank in the bottom third of the OECD. For example, over time more children have become overweight and mental health is a significant issue for more young Australians: in 2014-15, 15.4 per cent of Australians aged 18-24 years suffered high or very high psychological distress, up from 11.8 per cent in 2011. The rate of mental illness is even higher among Aboriginal and Torres Strait Islander youth, with a third having a probable mental illness. Young Aboriginal and Torres Strait Islanders are also over three times more likely to commit suicide than non-Indigenous youth.

¹⁶ Assessment of the degree of remoteness was based on the 2011 Australian Statistical Geography Standard (ASGS) which divides Australia into 5 classes on the basis of a measure of relative access to services - major cities, inner regional, outer regional, remote and very remote. The SDQ survey did not extend to very remote areas, <https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/1270.0.55.005Main%20Features1July%202016?opendocument&tabname=Summary&prodno=1270.0.55.005&issue=July%202016&num=&view=>

¹⁷ Achenbach, T.M Becker A, Döpfner M, Measuring Child Deprivation and Opportunity in Australia: Applying the Nest framework to develop a measure of deprivation and opportunity for children using the Longitudinal Study of Australian Children Australian Research Alliance for Children and Youth, https://www.aracy.org.au/publications-resources/command/download_file/id/384/filename/ARACY_Measuring_child_deprivation_and_opportunity_in_Australia.pdf.

While there had been no change in the percentage of children 0-14 who live in relative poverty (less than 50% national median income) nearly double the average, 17.4% of indigenous children live in poverty. The report card also showed that Australia continues to perform in the lowest third of OECD nations for access to early childhood education and affordable childcare and a significantly lower proportion of our children than the OECD average report that school is a place where they feel happy.

Based on the NEST dimensions and using data from the Longitudinal Study of Australian Children (LSAC), ARACY assessed the extent to which children living in difficult circumstances suffer from greater deprivation than others. They found that around 20% of children experienced multi-dimensional deprivation, defined as being deprived in three or more of the five Nest dimensions, and up to a quarter experienced deep deprivation, denoting that a child is deprived in two or more indicators within a single Nest dimension. Their findings illustrate that while most children are doing well, significant pockets of deprivation still exist in Australia.

Rates of deprivation on some indicators were found to be particularly high. For example, around one-fifth of children were subjected to frequent yelling in their family; a quarter reported regular bullying or social exclusion; approximately 20% lived in families experiencing financial insecurity; and reported rates of poor mental health were rising as children got older. While most children took part regularly in extracurricular activities some 17% of 6-7 year olds were missing out.

Of significance for the study of the effects of children's environments on their general health and wellbeing is the ARACY finding, a common one, that children living in monetary poverty are significantly more likely to experience deprivation on many fronts. In the ARACY study, they had significantly poorer scores indicating deprivation in material basics, relationships with friends, experience of yelling in the home, enjoyment in exercise, adequate fruit and vegetables, mental health, school attendance, learning at home, and involvement in extracurricular activities. Clearly the impact of monetary poverty extends beyond the material circumstances of the child, affecting all areas of wellbeing.

Australian Child Wellbeing Project (ACWP)

Summary

Another project with similar objectives – the Australian Child Wellbeing Project - focused on children in the middle years (8-14) and surveyed their views about family, health, friends and school. As well as conducting in depth discussions with over 100 children, they surveyed a further 4600 children in years 4, 6 and 8. They then constructed an aggregate index which combined the five domains of wellbeing identified by the children – life satisfaction, subjective health, family cohesion, school engagement and relationship with peers, in addition to questions about neighbourhood and community and money. Their final report¹⁸ described wellbeing among young people in five marginalised groups – young people with disability, young carers, young people who are materially disadvantaged, culturally and linguistically diverse young people, and Indigenous young people. In addition, they provided

¹⁸http://www.australianchildwellbeing.com.au/sites/default/files/uploads/ACWP_Final_Report_2016_Full.pdf.

some analysis of wellbeing among young people in rural and remote Australia, although the sample was small.

Findings

The key findings from the assessment young Australians in their middle years were that marginalised groups - young people with disability, young carers, young people who are materially disadvantaged, culturally and linguistically diverse young people, and Indigenous young people - scored lower than the non-marginalised children, and the gap was higher among the year 8s. Marginalised children were more likely to go hungry, to be bullied, to miss school and to experience multiple health complaints. Despite the small sample, this was also true of young people from rural and remote areas who were more likely than other young people to go to school or bed hungry, to experience multiple health symptoms, and to have smoked or to have been drunk in the month before the survey.

Using a deprivation approach – whether they missed out on any of seven items, such as a bedroom of their own, a regular family holiday, a computer at home – the ACWP found that between 11% and 14% of young people missed out on at least two of the seven identified items. The rates were higher among the marginalised groups.

Australian Early Development Index (AEDI), renamed the Australian Early Development Census (AEDC) in July 2014

Summary

With a focus on early childhood, the Australian Early Development Index (AEDI) is a comprehensive nationwide census of early childhood development which has taken place every three years since 2009¹⁹. It is a modified form of the Canadian Early Development Instrument and is based on teachers' ratings of children's skills and capabilities in their first year at school. The AEDI encompasses five domains: physical health and wellbeing, social competence, emotional maturity, language and cognitive skills, and communication skills and general knowledge. Higher scores indicate a higher level of development in that domain and children who score below the 10th percentile are categorised as developmentally "vulnerable". Validation studies^{20 21} have established that it is a valid and reliable instrument.

Findings

In the latest AEDI/AEDC survey (2018)²², 21.7 % of children were categorised as developmentally vulnerable, a figure which has changed little since the data series began in 2009. Although it is not clear whether any of the shifts reported are statistically significant, slight increases were evident between 2009 and 2018 in the proportion of children judged to be developmentally vulnerable in the physical health and wellbeing domain (9.4% to 9.6%) and in social competence (9.5% to 9.8%), while there was a small improvement in emotional

¹⁹ <https://www.aedc.gov.au/>.

²⁰ Brinkman S, Silburn S, Lawrence D, et al.(2007). Investigating the validity of the Australian Early Development Index. *Early Education and Development*, 18: 427–51.

²¹ Janus M, Brinkman SA, Duku E. (2011) Validity and psychometric properties of the Early Development Instrument in Canada, Australia, United States and Jamaica. *Social Indicators Research*, 103:283–97.

²² <https://www.aedc.gov.au/resources/2018-aedc-results>.

maturity (8.9% to 8.4%) and somewhat greater improvements in communication skills and general knowledge (9.2% to 8.2%) and language and cognitive skills (8.9% to 6.6%).

Of note is the fact that the data show that where children live has a significant impact on their development; suburbs in Australia differ significantly in the proportion of children who are developmentally vulnerable²³; and children living in remote areas were found to be twice as likely as those living in major cities to be developmentally vulnerable. While the vulnerability status of Aboriginal and Torres Strait Islander children has improved since 2009, they were still twice as likely as non-Indigenous children to be developmentally vulnerable. Systematic state by state comparisons²⁴ of the 2009 data showed that, after taking account of differences between the states in Indigenous, second language and socioeconomic status, Western Australia showed the third highest ranking for the developmental vulnerability of its children. Uncorrected data for WA from 2018 show apparent improvements in the percentage of children categorised as developmentally vulnerable on two or more domains, from 11.2% in 2012 to 9.4% in 2018.

WA Health and Wellbeing Surveillance System (HWSS)

Summary

The Health and Wellbeing Surveillance System is a continuous data series that was initiated by the Department of Health in 2002 to monitor the health status of the WA population. At regular intervals, a random sample of parents/carers is interviewed about various aspects of the health and wellbeing of children in Western Australia – included are chronic health conditions, lifestyle risk factors, school and friendships, protective factors and socio-demographics. The sample is then weighted to reflect the profile of the Western Australian child population. The system allows differences between socio-economic (SEIFA) quintiles and metropolitan, rural and remote areas to be calculated and trends over time to be assessed.

Findings

In 2017²⁵, data from 780 parents/carers sampled for the HWSS survey showed that three in five children between 5 and 15 years were not undertaking sufficient physical activity for good health, a figure that was significantly higher than in 2007 and 2008; approximately one in four children were either overweight or obese, and the rate was higher among children living in the most disadvantaged areas of WA; approximately 22% (0-15 years) had sustained an injury in the previous 12 months that required treatment from a health professional. Of note is the finding that the prevalence of children ever treated for an emotional or mental health problem in 2017 (8.3%) was more than double the rate in 2002 (3.0%). In addition, approximately one third of the children were estimated to be in need of special help because of difficulties relating to emotions, concentration, behaviour or getting on with other people,

²³ Brinkman, S.A., Gregory, T.A., Goldfeld, S., Lynch, J.W., Hardy, M. (2014). Data Resource Profile: The Australian Early Development Index (AEDI). *International Journal of Epidemiology* 43, 1089–1096.

²⁴ Brinkman SA, Gialamas A, Rahman A, et al. (2012). Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2:e001075.

²⁵ Merema M, Radomiljac A. (2018). Health and Wellbeing of Children in Western Australia in 2017, Overview and Trends. Department of Health, Western Australia.

and the proportion of parents who reported that children were doing well at school declined significantly between 2002 (52.7%) and 2017 (42.3%).

Australian Child and Adolescent Survey of Mental Health and Wellbeing

Summary

This assessment of children's mental health and wellbeing, undertaken for the Commonwealth Department of Health, has been conducted twice, in 1998 and 2014²⁶. In the later survey, parents/ carers were interviewed about one of their randomly selected children or adolescents, resulting in interviews from 6310 parents of 4-17 year olds. The parent/carer questionnaire was based on a set of principles underpinning the main aims of the survey: to determine the prevalence of mental disorders and their impact, including on service use. In addition to the Strengths and Difficulties Questionnaire and questions relating to family characteristics and service use, parents/carers were asked questions about selected modules from the DISC-IV (the Diagnostic Interview Schedule for Children)²⁷, an instrument designed to enable administration by lay people with no clinical training. The most prevalent disorders determined from previous population estimates were included: in both survey rounds, major depressive disorder, ADHD and conduct disorder were included; in the 2014 survey, anxiety disorders were added. Adolescents aged 11-17 also completed a self-report questionnaire in privacy. The questionnaire included the DISC-IV questions; others about their experiences at school, family relationships, self-esteem, protective factors and a range of risk behaviours; the SDQ and the Kessler 10 Psychological Distress Scale.

Findings

The 2014 survey, *Young Minds Matter*, found that nearly 14% of 4-17 year-olds were assessed as having mental disorders in the previous 12 months, with males being more likely than females to have experienced mental disorders (16.3% compared with 11.5%). ADHD was the most commonly reported disorder (7.4%), followed by anxiety disorders (6.9%), major depressive disorder (2.8%) and conduct disorder (2.1%). The estimate of the prevalence of major depressive disorder was far higher when young people provided the information themselves than when their parents and carers did (7.7% compared with 4.7% of 11-17 year olds). In addition, 20% of adolescents reported very high or high levels of psychological distress – with female rates being almost twice that of males (25.9% for females and 14.8% for males). Of the three common disorders measured in the two surveys, only major depressive disorder rates increased.

There were demographic and regional variations. Children and adolescents from low-income families, with parents/carers who were less well educated and experiencing higher rates of unemployment were more likely to be assessed as having mental disorders. Children, particularly males, who lived in non-metropolitan areas showed higher rates of mental disorders than those in metropolitan areas.

²⁶ <http://www.health.gov.au/internet/main/publishing.nsf/Content/mental-pubs-m-child2>.

²⁷ https://www.cdc.gov/nchs/data/nhanes/limited_access/interviewer_manual.pdf.

Longitudinal Study of Australian Children (LSAC)

Summary

The Longitudinal Study of Australian Children (LSAC) is longitudinal study following the development of 10,000 young people and their families from all parts of Australia. It is a partnership between the Department of Social Services, the Australian Institute of Family Studies and the Australian Bureau of Statistics²⁸. The first wave was conducted in 2003 with a representative sample of children (who are now teens and young adults) from urban and rural areas of all states and territories in Australia. It examines a broad range questions about development and wellbeing over the life course on topics such as parenting, family, peers, education, child care and health. It will continue to follow participants into adulthood. Data are collected from two cohorts every two years. The first cohort of 5,000 children was aged 0–1 years in 2003–04, and the second cohort of 5,000 children was aged 4–5 years in 2003–04. Study informants include the young person, their parents (both resident and non-resident), carers and teachers.

One of the research questions specified at the outset was “How important are broad neighbourhood characteristics for child outcomes? Does their importance vary across childhood? How do family circumstances interact with neighbourhood characteristics to affect child outcomes?” Socio-economic status health effects were also targeted, along with questions about how much time children spend in various activities. Rather than being reported in an annual snapshot, the data are analysed by researchers to answer various questions e.g. on housing in the 2017 report.

Commissioner for Children and Young People (CCYP)

Western Australia’s Commissioner for Children and Young people has developed a Wellbeing Monitoring Framework to report on the wellbeing of children and young people in the State and is in the process of collating the indices which will allow trends to be evaluated. It is comprised of three components: learning and participating, healthy and connected and safe and supported, domains that are similar to those captured by the ARACY framework.

3.4 Summary

Despite the differences between these surveys in focus, coverage and timing, all point to continuing “pockets of deprivation”, gaps in health and wellbeing between Indigenous and non-Indigenous children and between those who are economically deprived and those who are better off. In addition, there are signs that mental ill health, obesity, psychological distress and behaviour problems may be increasing overall.

Unfortunately, most of the population based surveys described above are not generally reported in a way that allows for particularly fine grained, place-based analyses, although there are clearly average differences between the states and territories, between remote, regional and urban Australia (including within Western Australia), and between areas differing in socio-economic status. A systematic search for the place-based use of these data

²⁸ <https://growingupinaustralia.gov.au/sites/default/files/discussionpaper1.pdf>.

in the research literature was undertaken and is reported, when identified, in subsequent sections.

4. WHY PLACE MATTERS – THE NEIGHBOURHOOD

For adults, the neighbourhood may be little more than a ‘backdrop’ to their busy working lives; for children it is profoundly important^{29 30}. In this context, the descriptor, “neighbourhood”, is not restricted to urban environments, but refers to any geographically localised community within which children live and interact with others. The places where children grow up can exert lifelong influences on them: their physical and mental health; their cognitive development and fulfilment of their capacity; their identity and sense of self; their willingness to participate in society. Neighbourhoods also determine the larger context for children’s interactions with families and peers³¹. While children’s development, as broadly indicated in the measures outlined above, depends on many individual and family level influences, such as their genetic makeup and the quality of their relationships with their parents, the environments in which they live and go to school are also clearly critical³². These environments differ in their social, economic, cultural, built and natural features, and such differences are potent influences on children’s health and life chances; the place-based distribution of resources and risks may either constrain or enhance their chances of leading rewarding and flourishing lives³³.

There is now abundant evidence that communities and neighbourhoods where there is good access to basic goods and services, including childcare and schools, which are socially cohesive, and which have good quality natural environments typically result in better outcomes for everyone, especially children. Conversely, if their neighbourhoods are characterised by physical degradation and pollution, poverty and social disadvantage, children are more likely to experience low levels of safety, greater social disorder, and less social cohesion. The result is that children’s development is compromised, with poorer language, emotional and behavioural outcomes for children^{34 35 36}. Such effects are potent in the early years of children’s lives when their developing brains make them particularly

²⁹ Macintyre, S., S. Maciver, and A. Sooman. (1993). Area, Class and Health: Should we be Focusing on Places or People? *Journal of Social Policy*, 22 (2): 213–234.

³⁰ Moore, R. (1986). *Childhood' domain: Play and Place in Child Development*. London: Croom Helm.

³¹ Li, M., Johnson, S.B., Musci, R.J. & Riley, A.W. (2017). Perceived neighborhood quality, family processes, and trajectories of child and adolescent externalizing behaviors in the United States, *Social Science & Medicine*, 192, 152-161.

³² Leventhal, T. & Brooks-Gunn, J. 2000. The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. *Psychological Bulletin*, 126, 309-337.

³³ Minh, A., Muhajarine, N., Janus, M., Brownell, M. & Guhn, M. (2017). A review of neighborhood effects and early child development: How, where, and for whom, do neighborhoods matter?, *Health & Place*, 46, 155-174,

³⁴ Singh, G.K., Ghandour, R.M., (2012). Impact of neighborhood social conditions and household socioeconomic status on behavioral problems among US children. *Maternal and Child Health Journal*, 16 (1), S158 – S169.

³⁵ Galster, G.C. & Santiago, A.M. (2015). Evaluating the potential of a natural experiment to provide unbiased evidence of neighborhood effects on health. *Health Services Outcomes Research Methodology*, 15, 99-135.

³⁶ Froiland, J.M., Powell, D.R. & Diamond, K.E. (2014) Relations among neighborhood social networks, home literacy environments, and children's expressive vocabulary in suburban at-risk families. *School Psychology International*, 35, 429-444.

susceptible to environmental stimuli³⁷. It is clear that these early effects, in turn, predict the quality of their future lives³⁸.

Untangling the relative importance of these aspects of the places where children live, and separating neighbourhood effects from individual level effects is obviously extremely difficult. Furthermore, the field is characterised by a plethora of approaches which makes any conclusions somewhat problematic. One of the key shortcomings identified by Sampson³⁹ and others^{40 41} is that the data sources typically used by neighbourhood researchers— census and other government statistics such as those outlined in Section 3 —may provide information about the sociodemographic make up of defined statistical areas (e.g., Socio-economic status or racial group) but not the dynamic processes postulated to mould child and adolescent wellbeing. The use of such data also biases how neighbourhoods are defined; the boundaries of census districts may not correspond in a meaningful way to the social networks and interactions that people – and children- have in their daily lives.

Added to this is the fact that many of the mechanisms which have been suggested as underpinning neighbourhood effects (e.g. social capital, norms, institutional resources) tend to go together; they are correlated. While some studies attempt to isolate the effects of neighbourhood from other important contexts in children’s lives, others have argued that this overlooks the ways in which different dimensions of individual’s social environments are linked together in space and over time⁴² and recommend thinking about neighbourhood effects as multiplicative as well as considering at what stage of their lives and how much time children spend in the neighbourhood.

Some have suggested that much neighbourhood research is still a “black box”, indicating that neighbourhoods are important to child health and wellbeing, but not why. Precisely how the various neighbourhood attributes – both positive and negative – affect child development is still a matter of some conjecture, but among the major candidates for investigation have been various aspects of the physical environment – pollution, housing density, traffic flows, the amount of green space, both in private homes and public parks and playing fields⁴³ – and the social environment – local norms, social cohesion, resource availability and socio-economic advantage or disadvantage. There is little doubt that in most societies, including our own, the distribution of these social and environmental benefits and risks, is not distributed equally. This phenomenon is sometimes captured under the broad concept of “locational disadvantage”.

³⁷ Noble, K.G., Engelhardt, L.E., Brito, N.H., Mack, L.I., Nail, E.J., Angal, J., Barr, R., Fifer, W.P.& Elliott, A.J.(2015). Network Socioeconomic disparities in neurocognitive development in the first two years of life. *Developmental Psychobiology*. 57, 535-551.

³⁸ Mitchell, C., Hobcraft, J., McLanahan, S.S., Siegel, S.R., Berg, A., Brooks-Gunn, J., Garfinkel, I., & Notterman, D. (2014) Social disadvantage, genetic sensitivity, and children's telomere length. *Proceedings of the National Academy of Sciences, USA*, 111, 5944-5949.

³⁹ Sampson, R.J., Morenoff, J.D., Gannon-Rowley, T., (2002). Assessing "neighbourhood effects": social processes and new directions in research. *Annual Review of Sociology*, 28, 443–478.

⁴⁰ Jencks C, Mayer S. (1990). The social consequences of growing up in a poor neighborhood. In *Inner-City Poverty in the United States*, ed. L Lynn, Jr., MGH McGeeary, pp. 111– 85. Washington, DC: National Academic Press.

⁴¹ Mayer S, Jencks C. (1989). Growing up in poor neighborhoods: How much does it matter? *Science* 243: 1441– 45.

⁴² Sharkey, P. & Faber, J. (2014). Where, When, Why, and For Whom Do Residential Contexts Matter? Moving Away from the Dichotomous Understanding of Neighborhood Effects. *Annual Review of Sociology*, 40:1, 559-579.

⁴³ Christian, H. Zubrick, S. Foster, S. GilesCorti, B. Bull, F. Wood, L. Knuiman, M. Brinkman, S. Houghton, S. Boruff, B. (2015).The influence of the neighborhood physical environment on early child health and development: A critical review and call for research. *Health & Place*, 33, 25-36.

4.1 Locational disadvantage

There is identifiable locational/spatial disadvantage in Australia as in other parts of the world⁴⁴ and it shapes children's lives. In Perth, as in the other major cities in Australia, studies of locational disadvantage have shown both a concentration of disadvantage (defined in various ways) and significant differences in amenity both between regions and suburbs. In a series on the topic undertaken by the Australian Housing Urban Research Institute (AHURI), research into spatial (locational) disadvantage was described as incorporating three main interacting elements: poverty concentration, disadvantage of resource access, and spatial concentration of social problems.

In a study of public housing in Perth⁴⁵, AHURI researchers focused on the second and third of these elements, measuring amenity across suburbs and local government areas: access to schools, tertiary education and training, shops, health facilities, public transport, public open space, sports facilities, entertainment and cultural facilities, community facilities, employment, distance to CBD, crime rates and property value growth. They found not only significant variation in amenity between suburbs, but also that amenity diminished with distance from the centre of the city. Although they did not report amenity by socio-economic status, the low scoring suburbs appear to be of low socio-economic status. The researchers reported that the groups most likely to be located within poorer amenity areas were those taking part in the housing assistance program, Keystart, sole parent households with young children, and households with young children.

Research on housing disadvantage in Australia more broadly, conducted by McNamara and her colleagues using ABS data⁴⁶, indicates that the areas with the highest proportions of children living in high housing disadvantage, including overcrowded homes, are clustered in remote areas of the Northern Territory and Western Australia. However, they also found that housing disadvantage is not exclusive to these remote areas, with areas scattered around the northern and southern fringes and some eastern suburbs of Perth also identified as having concentrations of high housing disadvantage.

While overcrowding may not be a problem for most Western Australian households, it is for Aboriginal households. The 2016 Productivity Commission report on overcoming indigenous disadvantage noted that, while the proportion of Indigenous people living in overcrowded households had declined from earlier levels, it was still 20.6% overall in 2014-15 and 49.4% in remote communities.

4.2 Regional and remote areas

Limited access to services is routinely reported by people living in outer regional and remote Australia. The ABS General Social Survey of 2014 found that people over 15 years of age living in outer regional and remote Australia were more likely (33%) than people living in major

⁴⁴ Wiesel, I., Liu, F., & Buckle, C. (2018) Locational disadvantage and the spatial distribution of government expenditure on urban infrastructure and services in metropolitan Sydney (1988–2015). *Geographical Research*, 56: 285–297.

⁴⁵ Newman, P., Thorpe, A., Grieve, S., Armstrong, R. (2003) *Locational advantage and disadvantage in public housing, Rent Assistance and Housing Loan Assistance in Perth*, AHURI Final Report No. 52, Australian Housing and Urban Research Institute Limited, Melbourne, <https://www.ahuri.edu.au/research/final-reports/52>.

⁴⁶ McNamara, J., Tanton, R., Phillips, B. (2007) *The regional impact of housing costs and assistance on financial disadvantage*, AHURI Final Report No. 109, Australian Housing and Urban Research Institute Limited, Melbourne, <https://www.ahuri.edu.au/research/final-reports/109>.

cities (23%) to experience difficulty accessing service providers. The main services nominated were access to doctors, dentists, telecommunication services and government services such as Centrelink. The lack of adequate health and dental services, in particular, is likely to harm children, although specific data on younger children's access were not collected.

In addition, the survey showed that people living in outer regional or remote Australia were less likely to have participated in sport or recreational activities than their city counterparts in the previous 12 months. They were also less likely to attend cultural events and venues such as movie theatres, public libraries, botanic gardens, zoos or aquariums, and museums or art galleries. Use of communication services was also more restricted, possibly due to lower income levels precluding purchase of services.

However, on the positive side, people living in outer regional or remote Australia had greater levels of involvement with their communities: they were more likely than their urban counterparts to participate in a community support group, and to feel they could have a say on important issues within their communities. They were also more likely than people in major cities to have daily face-to-face contact with family or friends outside the household.

In remote and very remote Indigenous communities, there is clear evidence that housing and infrastructure do not meet adequate standards. An audit in 2009-10 of municipal and essential services in 86 remote Aboriginal and Torres Strait Islander communities and 14 non-Indigenous communities reported that "the level of infrastructure in remote Indigenous communities does not meet the standard generally available in non-Indigenous communities of a similar size and location, and ... services are consistently unreliable and suffer major disruptions"⁴⁷. In Aboriginal communities, particularly those in remote and very remote areas, a higher proportion of families reported reduced access to working household facilities and were more likely to report major structural problems with their houses.

Although these data are Australia wide, there is no obvious reason to think that they would not be broadly applicable in Western Australia.

4.3 Green space, backyards and public open space

Locational disadvantage is also evident in the access to green space and public open space. A specific example is provided by the findings in the distribution of Shanahan and colleagues on the distribution of green space in Brisbane⁴⁸. Using spatial regression models, they found that tree cover and remnant vegetation varies with socio-economic status, with more cover in more advantaged areas, in both public and private spaces.

Perth's expansion is reducing the amount of green space, including native vegetation which is readily available for children's use. Bolleter⁴⁹ has documented some of these shifts. He notes that clearing for urban development from 1998-2004 resulted in 900 hectares of native

⁴⁷ DSS (Department of Social Security) 2013, National Partnership Agreement on Remote Indigenous Housing — Progress Review (2008–2013), Canberra, <http://www.dss.gov.au/sites/default/files/files/indigenous/Final%20NPARIH%20Review%20May%2020132.pdf>.

⁴⁸ Shanahan, D. F., Lin, B. B., Gaston, K. J., Bush, R. & Fuller, R. A. (2014) Socio-economic inequalities in access to nature on public and private lands: a case study from Brisbane, Australia. *Landscape and Urban Planning* 130, 14–23.

⁴⁹ Bolleter, J. (2017). Fringe benefits? A review of outer suburban development on Perth's fringes in relation to state government goals concerning the natural environment and efficient transport connectivity. *Australian Planner*, 54(2), 93-114.

vegetation per year being cleared, with 1500 hectares approved in 2005-6 alone⁵⁰. He also highlights the fact that despite urban planning goals designed to protect remnant bushland and wetlands, urban development often occurs outside areas not designated as growth corridors. In addition, he notes that there is likely to be future loss of such vegetation in attempts to reduce the risks of fire by cutting the fuel load in outer metropolitan areas, and loss is also likely because of predicted increases in the frequency and severity of bushfires due to climate change.

Maps of the city today show that new suburbs in outer suburban areas are reasonably well served by public open space within a 3 kilometre walk, but typically have smaller parks nearby, meaning that there is a lower percentage of space available for active recreation. One set of calculations⁵¹ shows that middle ring suburbs provide 1.38% area for active recreation compared to just 0.70% in outer suburbs.

At the same time, in many of these new housing developments on the metropolitan fringes there is little private space. A large number of blocks are less than 300 metres squared and some are even smaller; this, coupled with large houses and reduced residual space, means that space for children to play outdoors within their home's boundaries is much reduced. Since housing in these outer urban areas are cheaper than those closer to the city's centre, this is where people on low incomes are locating.⁵²

In addition, in suburbs with limited space, urban forests are unlikely to form as developments mature - some 60% trees which comprise urban forests are on private land. As many have suggested, the lack of urban forests is potentially serious problem for a range of reasons; not only do they help maintain day-to-day connection with nature, maintain biodiversity, produce energy consumption by reducing temperatures, but they also help purify air and stormwater, and buffer noise. The heat effects are of particular concern because of increasing urban temperatures with climate change adding to heat island effects; Perth is predicted to become hottest capital city, with consequent effects on activity levels and on heat related deaths. In more established suburbs, poorly planned in-fill is leading to a further loss of backyard trees, with the attendant losses of the psychological benefits of having a private garden⁵³.

4.4 Transport

Locational disadvantage is often evident too in transport. Long commutes by residents on the urban fringes are currently a necessity – and in Perth there are more cars per capita than any other Australian capital city: 83 per 100 people. Access to public transport is poor in the outer suburbs, making children's and young people's independent mobility particularly difficult. Opportunities for recreation and socialising are limited too by the fact that there are few shops and facilities within a comfortable walk. Buses are infrequent and bicycle networks still poorly developed. Children in the inner and middle suburbs are somewhat better served,

⁵⁰ Weller, Richard. (2009). *Boomtown 2050*. Perth: University of Western Australia Press.

⁵¹ Middle, G., & Tye, M. (2011). *Emerging Constraints for Public Open Space in Perth Metropolitan Suburbs*. Perth: Department of Sport and Recreation, Centre for Sport and Recreation Research, Curtin University

⁵² Burke, T. & Hulse, K. (2015). Spatial disadvantage: Why is Australia different? Australian Housing and Urban Research Institute, https://www.ahuri.edu.au/data/assets/pdf_file/0020/3098/AHURI_Research_Paper_Spatial-disadvantage-why-is-Australia-different.pdf

⁵³ Syme, G., Fenton, m., & Coakes, s. (2001). "Lot Size, Garden Satisfaction and Local Park and Wetland Visitation." *Landscape and Urban Planning* 56: 161–170.

although in some areas increased traffic flows may act as a barrier to mobility for young people.

Systematic research on the separate influence of the dimensions of locational disadvantage outlined above and those characteristics of place which appear to contribute to child health and wellbeing is reviewed in the following sections, incorporating findings from Australian studies when they are available.

5. THE IMPORTANT ATTRIBUTES OF PLACE

5.1 Socio-economic status and neighbourhood disadvantage

Of the many attributes of neighbourhoods, the most often studied has been socio-economic disadvantage. Generally speaking, the social and economic circumstances of children's families and neighbourhoods are a potent influence on their lives. While there are varied research approaches across a range of disciplines, a clear consensus has emerged: that neighbourhood disadvantage is linked to poorer health outcomes, lower educational achievement, diminished wellbeing and more behaviour problems among children of all ages, even after controlling for parental and family factors^{54 55}. In fact while the individual levels of education, income and employment of parents, which typically make up SES indicators, are significant influences in children's lives, the SES profile of the neighbourhood – the concentration of advantage or disadvantage - makes an independent contribution.

The evidence that low socio-economic status (SES) is related to poor health is incontrovertible, and those who are more economically advantaged have lower rates of illness and longer life-expectancy. The gradient of health related to socio-economic status found in adults also occurs among children^{56 57}; differences in socioeconomic status translate into inequalities in health. Even in relatively affluent societies, like Australia, the most advantaged have better health status than those less well off⁵⁸. The latest AIHW report, "Australia's Health, 2018" showed a clear gradient for illness in Australian adults; for children too, inequalities are linked to the level of disadvantage⁵⁹. As Pickett and Pearl remind us⁶⁰, the association of health status with socioeconomic status has been so widely demonstrated

⁵⁴ Carpiano RM, Lloyd JEV, Hertzman C. (2009). Concentrated affluence, concentrated disadvantage, and children's readiness for school: a population-based, multi-level investigation. *Social Science and Medicine*, (3):420–432.

⁵⁵ Martens, P. J., Chateau, D. G., Burland, E. M., Finlayson, G. S., Smith, M. J., Taylor, C. R., ... PATHS Equity Team (2014). The effect of neighborhood socioeconomic status on education and health outcomes for children living in social housing. *American journal of public health*, 104(11), 2103–2113.

⁵⁶ Case A, Lubotsky D, Paxson, C.(2002). Economic status and health in childhood: the origins of the gradient. *American Economic Review*, 92:1308– 1334.

⁵⁷ Starfield B, Robertson J, Riley AW. (2002).Social class gradients and health in childhood. *Ambulatory Pediatrics*,2 :238–246

⁵⁸ Macintyre S. (1994) Understanding the social patterning of health: the role of the social sciences. *Journal of Public Health and Medicine*,16: 53–9.

⁵⁹ Moore, T., McDonald, M. & McHugh-Dillon, H. (2014). Early childhood development and the social determinants of health inequities: A review of the evidence. Parkville, Victoria: Centre for Community Child Health at the Murdoch Children's Research Institute and the Royal Children's Hospital, https://www.rch.org.au/uploadedFiles/Main/Content/ccch/151014_Evidence-review-early-childhood-development-and-the-social-determinants-of-health-inequities_Sept2015.pdf.

⁶⁰Pickett KE, Pearl M (2001) Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology & Community Health*, 55:111-122.

across so many populations that adjustment for socioeconomic status is now mandatory in epidemiological analyses which attempt to partial out other significant influences.

A similar pattern is seen in educational achievement and cognitive development. One of the most frequently reported consequences of low SES is educational underachievement⁶¹, a problem which seems to be growing with increasing segregation by income in the Australian school system. The social stratification of our school system is sharper than in other countries: in 2009, the OECD noted that, on average, differences in students' backgrounds accounted for some 55 per cent of the performance differences between schools while the figure for Australia is around 68 per cent; children from low SES background who attend low SES (mostly government) schools are, on average three years behind children from high SES backgrounds attending high SES (mostly private) in their average achievement⁶².

These negative outcomes have been shown to be related to inequities in funding, resourcing, teacher shortages and the learning environments: there are substantial teacher shortages and poorer educational resources generally available to low SES schools in Australia⁶³ and Australia is rare in the OECD (one of three) countries in having substantially better resources in high SES schools.

The Australian surveys of children outlined in Section 3 confirm these findings for children's behaviour and cognitive development in broad terms, while studies using the survey data with appropriate statistical controls for potential confounding variables reinforce the conclusion. Brinkman and others⁶⁴ analysed the AEDI data obtained from the entire Australian population of children in their first year of full-time schooling. They examined area socio-economic, group and jurisdictional differences in physical wellbeing, social competence, emotional maturity, language and cognitive skill and communication skills and general knowledge. Suburb and area socio-economic advantage and disadvantage were measured using the ABS Socio-Economic Indices for Areas (SEIFAs) composite Index of Relative Socio-Economic Disadvantage (IRSAD) to indicate, for each area, people's access to material and social resources and their ability to participate in society. They found that for every 10% increase in status, as measured by SEIFA IRSAD, there was a decrease in the odds of a child being developmentally vulnerable. The largest inequalities, described as "striking", and the highest levels of developmental vulnerability were found in Western Australia and Queensland. The results also confirmed that across all the domains measured, Aboriginal and children for whom English was second language (ESL) were more likely to be vulnerable than non-Indigenous and non-ESL children.

A study of the same survey data for Perth using a similar methodology⁶⁵, confirmed the finding that area-level social disadvantage is associated with child developmental vulnerability. The researchers examined the cross sectional relationships between the child

⁶¹ Review of funding for schooling: Final Report, 2011, <https://docs.education.gov.au/system/files/doc/other/review-of-funding-for-schooling-final-report-dec-2011.pdf>.

⁶² Perry, L., McConney, A., (2013), School socioeconomic status and student outcomes in reading and mathematics: A comparison of Australia and Canada, *Australian Journal of Education*, 57 (2), 124 - 140.

⁶³ Perry, L.B. & McConney, A. (2013) *Mapping educational inequalities by school socioeconomic composition in Australia*. In: Ladwig, J.G. and Albright, J., (eds.) *On the within school stratification of social inequities of learning and achievement: The current state of knowledge and affairs in Australian and New Zealand schools*. Sense Publisher.

⁶⁴ Brinkman SA, Gialamas A, Rahman A, et al. (2012). Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2:e001075.

⁶⁵ 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 & Place*, 48 (Suppl. C): 90–101.

development data (AEDI) and a selection of characteristics of suburbs and localities with average populations of 10,000 persons (derived from ABS Area 2 digital boundaries⁶⁶). Objective measures were constructed for the natural and built environment - street connectivity, residential density, traffic volumes, proximity to goods, services and child-relevant destinations, green space and home outdoor space. After adjusting for socio-demographic factors they found that children living in communities with the most home yard space (the top 20%) had significantly lower odds of developmental vulnerability on the Emotional Maturity domain and those living in communities with fewer main roads were less likely to exhibit developmental vulnerability on the Social Competence domain.

Across all the domains of the AEDI, the likelihood that children would show developmental vulnerability increased with the proportions within communities of: 4 year olds who were of Aboriginal or Torres Strait Islander background, single parent households, and parents with low levels of education and on low incomes (< \$3000 AUD/fortnight). Children living in areas where parents were of high socio-economic status were less likely to display developmental vulnerability. Overall, they concluded that sociodemographic factors were the most important factors in explaining variation between local communities in the developmental vulnerability of children at this stage of their lives.

Another investigation⁶⁷ of the relationships between a range of socio-demographic and family variables measured in the Longitudinal Study of Australian Children, found that socio-economic area disadvantage was the only risk factor associated with a lower rate of receptive vocabulary growth – the number of words children know- critical for school readiness and achievement.

A substantial literature also links neighbourhood poverty and social disadvantage with childhood and adolescent behaviour problems and mental health⁶⁸. Evidence from U.S “residential mobility programs” such as the court-ordered Gautreaux de-segregation program in Chicago allows quasi-experimental assessment of the effects of poverty on children’s development. Families were moved from concentrated areas of public housing and scattered throughout suburbs with varying levels of poverty. Boys, but not girls, whose families were moved to low poverty, less segregated suburbs were significantly less likely to commit crimes and become involved in the criminal justice system than those moved to other areas.⁶⁹

Fifty five studies, published in English or German between 1990 and 2011 and using validated measures of SES and health, were reviewed by Riess to determine the relationship between SES and mental health problems of children and adolescents, mostly measuring externalising and internalising behaviours using the SDQ. He found that socioeconomically disadvantaged children were two to three times more likely to develop mental health problems and persistent low SES was strongly related to mental health problems. Cross sectional and longitudinal studies revealed a negative impact of low financial status on children’s mental

⁶⁶ <https://www.abs.gov.au/websitedbs/D3310114.nsf/home/ABS+Geography+Publications>

⁶⁷ Taylor, C.L., Christensen, D., Lawrence, D., Mitrou, F., Zubrick, S.R. (2013). Risk factors for children's receptive vocabulary development from four to eight years in the Longitudinal Study of Australian Children. *PLOS One* 8, e73046.

⁶⁸ McGrath, P.J. & Elgar, F. (2015) Effects of socioeconomic status on behavioral problems in D. Wright (Ed.), *International Encyclopedia of the Social and Behavioral Sciences*, Elsevier, New York, NY.

⁶⁹ Keels, M. (2008) Second-generation effects of Chicago's gautreaux residential mobility program on Children's participation in crime *Journal of Research Adolescence*, 18, 305-352.

health. Australian population data showed similar results⁷⁰. Low household income and low parental education were the strongest predictors of children's mental health.

Whether neighbourhood level socioeconomic variables act independently of individual SES on child behaviour has not often been investigated with suitable data from individual, family and neighbourhood models and appropriate statistical treatment. One study⁷¹ demonstrated that neighbourhood economic conditions and poverty status remain powerful influences on children's behaviour even after accounting for family structure and maternal education. Another Dutch study⁷², investigated child behaviour problems in over 700 5-7 year olds. Using multilevel regression analysis they found that while child behaviour problems were more frequent in families with low SES, the effect of neighbourhood level deprivation remained after adjustment for individual level SES. In other words, living in a deprived neighbourhood increases the risk of childhood problem behaviour, irrespective of the individual's socioeconomic standing. The wealth or poverty of the neighbourhood matters. Indeed, a review of the research evidence from the US and Europe concluded that there was a 'convincing' case that disadvantaged individuals are significantly harmed by the presence of sizeable disadvantaged groups in their neighbourhood, likely due to negative peer/role modelling, weak social norms/control, limited resource-networks, and stigmatisation mechanisms'⁷³ (p.25).

The processes and pathways through which socioeconomic status might influence the likelihood of children developing behaviour problems are complex and difficult to unpick. Many of the possible routes through which socioeconomic status affects health relate to environmental and neighbourhood conditions and are likely to be found together –adequate access to quality food sources; pollution; access to green space and community spaces; poor housing; danger from crime and traffic; and the provision of health services. Even in Australia with universal health insurance, socioeconomic status still predicts access to adequate health care and support services for people in need and areas differ significantly in the quantity and quality of such services.

In addition, those living in areas which are relatively poor compared to the surrounding community, may experience psychosocial stress which erodes social supports and increases mental distress – the social causation hypothesis⁷⁴. The latter path may help explain why children whose families have the same income or parental education may differ in their mental health when one child is surrounded by more affluent people and the other by less⁷⁵. Support for this thesis is provided by the finding that societies and communities with greater

⁷⁰ Davis, E., Sawyer, M.G., Lo, S.K., Priest, N. & Wake, M. (2010). Socioeconomic risk factors for mental health problems in 4–5-Year-Old children: Australian population study. *Academic Pediatrics*, 10 (1), 41-47.

⁷¹ Duncan GJ, Brooks-Gunn J, Klebanov P.K. (1994) Economic deprivation and early childhood development. *Child Development*, 65:296–318.

⁷² C. Kalf, M. Kroes, J.S.H. Vles, J.G.M.Hendriksen, F.J.M. Feron, J.G.P. Steyaert, T.M.C.B. Van Zeven, J. Jolles, J. Van Os (2001) Neighbourhood level and individual level SES effects on child problem behaviour: a multilevel analysis. *Journal of Epidemiology and Community Health*, 55 (4), 246-250.

⁷³ Galster, G. *Neighbourhood social mix: Theory, evidence and implications for policy and planning*, Paper presented at International Workshop at Technion University 'Planning For/with People', Haifa, Israel, June 2009.

⁷⁴ Wilkinson, R., Marmot, M., 2001. Psychosocial and material pathways in the relation between income and health: a response to Lynch. *British Medical Journal* 322, 1233–1236.

⁷⁵ Vine, M., et al., 2012. Associations between household and neighborhood income and anxiety symptoms in young adolescents. *Depression and Anxiety* 29, 824 – 832.

inequality, greater disparities in SES, have higher rates of mental illness, substance abuse and childhood problems.⁷⁶

The concept of locational or spatial disadvantage, outlined in Section 4.1 was developed to capture these processes. The AHURI studies outlined above, sought to examine “the geography of socio-economic disadvantage”, and revealed significant locational disadvantage across Australian cities, including Perth⁷⁷. They showed that, contrary to some international data, socio-economically disadvantaged residents in Australia’s major cities are clustered into suburbs now predominantly located in middle and outer metropolitan areas. Such clustering trends appeared to have accelerated between 2006 and 2011. Other characteristics which either amplify or moderate the effects of living in a socioeconomically disadvantaged neighbourhood and which may contribute to locational disadvantage are reviewed in the following sections.

5.2 Pollution

Exposure to toxins and air and noise pollution are known to be detrimental to children’s development. But some children are more at risk than others, because of where they live. It is clear that the amount of toxic substances and pollution to which children are exposed depends on their local built environment, the location of their neighbourhood and their socioeconomic status. It is one of the dimensions of locational disadvantage: people who suffer various forms of disadvantage, including low SES, are more likely to live near heavy industry, busy roads and airports and to live in dilapidated and poorly designed housing, where the risks of exposure to various contaminants is greater. As a 2016 European Commission report on pollution and socioeconomic status⁷⁸ points out, “it is often society’s poorest who live and work in the most polluted environments” and that they may be more susceptible to pollution’s damaging effects than more advantaged groups in society. This is sometimes described as the “double-burden of geography”⁷⁹; exposure to polluting substances is not equally distributed. In Australia, there is evidence too of inequalities in exposure to traffic derived air pollution. Using ABS data⁸⁰ from major urban areas socioeconomic status was calculated using several indices of disadvantage and nitrogen dioxide (NO₂) estimates were derived from a variety of sources, Knibbs and Barnett⁸¹ found that locations with the lowest IER (Index of Economic Resources) scores – that is the most economically disadvantaged - had higher NO₂ across the majority of urban areas.

⁷⁶Pickett, K.E., Wilkinson, R.G. (2007). Child wellbeing and income inequality in rich societies: ecological cross sectional study. *British Medical Journal*, 24 (7629), 1080.

⁷⁷ Pawson, H., Hulse, K. and Cheshire, L. (2015) *Addressing concentrations of disadvantage in urban Australia*, AHURI Final Report No.247. Melbourne: Australian Housing and Urban Research Institute. Available from: <<http://www.ahuri.edu.au/publications/projects/myrp704>>.

⁷⁸http://ec.europa.eu/environment/integration/research/newsalert/pdf/air_noise_pollution_socioeconomic_status_links_IR13_en.pdf.

⁷⁹ Crouse DL, Ross NA, Goldberg MS. (2009). Double burden of deprivation and high concentrations of ambient air pollution at the neighbourhood scale in Montreal, Canada. *Social Science and Medicine*, 69 (6):971–81.

⁸⁰ Australian Bureau of Statistics (ABS). Australian Statistical Geography Standard (ASGS): Volume 1 – Main structure and greater capital city statistical areas; 2011. <http://www.abs.gov.au/ausstats/abs@.nsf/mf/1270.0.55.001>.

⁸¹ Knibbs, L., & Barnett, A. (2015) Assessing environmental inequalities in ambient air pollution across urban Australia, *Spatial and Spatio-temporal Epidemiology*, 13, 1-6.

When children grow up or go to school in neighbourhoods with high levels of toxins, their health and cognitive and behavioural development are compromised⁸², whether it is from particulate matter (PM_{2.5}), polycyclic aromatic hydrocarbons⁸³ (PAHs), diesel exhaust particulate, nitrogen oxide, pesticides, home allergens (dust mite, mouse, cockroach), environmental tobacco smoke, or lead and other metals. Exposure to toxins during the prenatal and early post-natal phases of a child's development are of particular concern because of the heightened susceptibility of foetuses and infants to pollutants at this time⁸⁴⁸⁵. In addition to their more-immediate health effects, certain prenatal exposures may modify epigenetic programming and immune, metabolic, and neurologic functions, with life-long consequences.⁸⁶

Most of us are, perhaps, most familiar with the impact of lead exposure on infants and young children, in whom significant cognitive delays – including in IQ, reading and maths skill and memory - have been found even among those who are exposed to relatively low levels⁸⁷⁸⁸. Since lead is a neurotoxin, it affects the development of the child's nervous system, particularly during foetal development and in the first five years. Its effects are irreversible.

A 2015 Australian study of children living in mining and smelting towns who are exposed to arsenic, cadmium and lead level contamination, revealed that they showed poorer performance on developmental and educational indices than the national average. In one mining community, Broken Hill, the proportion of children from the area with highest contamination were found, after taking account of SES, to have the highest levels of vulnerability, indicated by their AEDI scores (see Section 3) and the lowest scores on NAPLAN compared to children in less contaminated areas and with the relevant national averages. Comparable data on children living in mining and smelting areas in WA, such as Kalgoorlie and Karratha, do not appear to be on the public record.

We know that air pollution exacerbates chronic respiratory and heart disease and increases early deaths across affected populations. It worsens asthma and chronic obstructive pulmonary disease; increases the risk of cardiac arrhythmia, heart attack, stroke, and lung cancer in adulthood and hinders lung development in children. There is also evidence that high levels of air pollution can damage children's cognitive abilities⁸⁹⁹⁰.

⁸² Perera, F. P., Li, Z., Whyatt, R., Hoepner, L., Wang, S., Camann, D., et al. (2009a). Prenatal airborne polycyclic aromatic hydrocarbon exposure and child IQ at age 5 years. *Pediatrics*, 124(2), e195–e202.

⁸³ Polycyclic aromatic hydrocarbons (PAHs) are released into the air during incomplete combustion and/or pyrolysis of fossil fuel, tobacco, and other organic material.

⁸⁴ Perera FP, Tang D, Jedrychowski W, et al. (2004) Biomarkers in maternal and newborn blood indicate heightened fetal susceptibility to procarcinogenic DNA damage. *Environmental Health Perspectives*, 112, (10):1133– 1136.

⁸⁵ World Health Organization. *Principles for Evaluating Health Risks From Chemicals During Infancy and Early Childhood: The Need for a Special Approach*. Geneva, Switzerland: World Health Organization; 1986. Environmental Health Criteria 59.

⁸⁶ Barker DJ. (2004). The developmental origins of adult disease. *Journal of the American College of Nutrition*, 23 (6 suppl):588S– 595S.

⁸⁷ Surkan PJ, Zhang A, Trachtenberg F, Daniel DB, McKinlay S, Bellinger DC. (2007). Neuropsychological function in children with blood lead levels < 10 µg/dL. *Neurotoxicology*, 28(6):1170–117.

⁸⁸ Levin, R., Brown, M. J., Kashtock, M. E., Jacobs, D. E., Whelan, E. A., Rodman, J., ... Sinks, T. (2008). Lead exposures in U.S. Children, 2008: implications for prevention. *Environmental Health Perspectives*, 116(10), 1285–1293.

⁸⁹ M. Guxens, I. Aguilera, F. Ballester, M. Estarlich, A. Fernández-Somoano, A. Lertxundi, et al. (2012) Prenatal exposure to residential air pollution and infant mental development: modulation by antioxidants and detoxification factors *Environmental Health Perspectives*, 120, 144-149.

⁹⁰ A. Lertxundi, M. Baccini, N. Lertxundi, E. Fano, A. Aranbarri, M.D. Martinez, et al. (2015) Exposure to fine particle matter, nitrogen dioxide and benzene during pregnancy and cognitive and psychomotor developments in children at 15 months of age. *Environment International*, 80, 33-40.

In a comprehensive 2018 review of the effects of air pollution on children's health⁹¹, the Columbia Center for Children's Environmental Health aggregated and evaluated the research on various outcomes, including adverse birth outcomes, cognitive and behavioural problems and asthma incidence. Their focus was on air pollution resulting from combustion of fossil fuels, which account for 80% of air pollutants. They assembled the results from 205 peer-reviewed studies published between 2000 and mid 2018 which provided information on the relationship between the health outcomes and exposure to air pollutants, including fuel combustion by-products, such as particulate matter (PM_{2.5}), polycyclic aromatic hydrocarbons (PAH), and nitrogen dioxide (NO₂). They surveyed papers from six continents, including Australia, showed that the direct health impacts on children of air pollution from fossil fuel combustion include preterm birth; low birth weight; impairment of cognitive and behavioural development, including changes in brain function and increased rates of autism and ADHD; respiratory illness, and possibly childhood cancer. Studies in the south metropolitan area of Perth, have also shown that increases in locally derived traffic emissions are associated with a two fold increase in the odds of foetal growth restriction⁹². These studies⁹³ have pointed to elevated risks in pregnancy of conditions conducive to preterm birth among women exposed to combustion emissions. This is significant because children born prematurely are at greater risk for subsequent illnesses, including poor respiratory function, and neurodevelopmental impairment than their full term counterparts^{94 95}.

The Australian Child Health and Air Pollution Study⁹⁶ of children living in Australian cities, including Perth, has confirmed the international findings on lung health. The national cross-sectional study of 2630 children aged 7-11 years found that greater exposure to nitrogen dioxide (an indicator of traffic-related air pollution) was associated with poorer lung function and higher rates of asthma, even in our cities, which have relatively low levels of pollution compared to more polluted cities around the world where most studies have been conducted.

With respect to ADHD (Attention Deficit Hyperactivity Disorder), an analysis of 4745 German children's development found that hyperactivity/inattention was significantly associated with increased exposure to air pollution⁹⁷. Magnetic Resonance Imaging (MRI) in a cohort of more than 700 children reinforced this association; exposure to fine particles during foetal life was associated with a thinner cortex in regions of the brain which are known to be linked to

⁹¹ F. Perera, A. Ashrafi, P. Kinney, D. Mills. (2018) Towards a Fuller Assessment of Benefits to Children's Health of Reducing Air Pollution and Mitigating Climate Change Due to Fossil Fuel Combustion. *Environmental Research*,

⁹² Pereira et al (2012) Locally derived traffic-related air pollution and fetal growth restriction: A retrospective cohort study. *Occupational and Environmental Medicine*, 88, 815-822.

⁹³ Pereira, G. and Bell, M. and Belanger, K. and de Klerk, N. 2014. Fine particulate matter and risk of preterm birth and pre-labor rupture of membranes in Perth, Western Australia 1997-2007: A longitudinal study. *Environment International*. 73: pp. 143-149.

⁹⁴ F. Groenendaal, J.U.M. Termote, M. van der Heide-Jalving, I.C. van Haastert, L.S. de Vries Complications affecting preterm neonates from 1991 to 2006: what have we gained? *Acta Paediatrica*, 99 (3) (2010), pp. 354-358.

⁹⁵ R.M. Ward, J.C. Beachy (2003) Neonatal complications following preterm birth *British Journal of Obstetrics and Gynaecology*, 110 (Suppl. 20), 8-16.

⁹⁶ Luke D. Knibbs, Adriana M. Cortés de Waterman, Brett G. Toelle, Yuming Guo, Lyn Denison, Bin Jalaludin, Guy B. Marks, Gail M. Williams, (2018). The Australian Child Health and Air Pollution Study (ACHAPS): A national population-based cross-sectional study of long-term exposure to outdoor air pollution, asthma, and lung function, *Environment International*, 120, 394-403,

⁹⁷ Fuertes, M. Standl, J. Fornes, D. Berdel, J.Garcia-Aymerich, I. Markevych, *et al.* (2016). Traffic-related air pollution and hyperactivity/inattention, dyslexia and dyscalculia in adolescents of the German GINIplus and LISAPLUS birth cohorts *Environment International*, 97, 85-92

inhibitory control. An investigation⁹⁸ of otherwise healthy children in Mexico City also found white matter lesions in the brains of those growing up in high-pollution areas and significant deficits in their performance on cognitive tasks.

The adverse consequences for children's IQs of exposure to air pollutants have also been highlighted by a major study⁹⁹ of the children of African-American and Dominican-American New York City women. The mothers' exposure during pregnancy was measured using personal air monitors and their children were followed up at age five. Higher prenatal PAH exposure predicted 3.5 point lower total IQ (WPPSI-R)¹⁰⁰ scores and 3.9 point lower verbal scores, a gap which remained even after adjustments for various neighbourhood characteristics. It may be that one of the reasons for these cognitive deficiencies is reduced school attendance – students with respiratory problems triggered by air pollution are more likely to miss school because of illness.¹⁰¹ Data from school districts in Texas¹⁰² indicated that reductions in exposure to carbon monoxide at school reduced the number of absences.

The effects of general air pollution on mental illness have only recently garnered attention. A study of children who grew up in neighbourhoods with high air pollution showed positive associations between air pollution and neighbourhood-level juvenile criminal activity as well as schizophrenia later in life¹⁰³.

The effects of air pollution on children are of particular relevance to the location of schools and child care centres, as well as where children live. In the U.S. it appears that one in three public schools are located in "air pollution danger zones"¹⁰⁴ – defined as being within 400 metres of major highways that serve as main truck and traffic routes – making them more susceptible to respiratory diseases and possibly cognitive impairment. When children also live in proximity to these pollution sources, the risk is obviously elevated. Similarly in the UK, it has been reported that a third of London's schools are located in areas with nitrogen dioxide concentration levels above legal limits¹⁰⁵. In Australia, judging by the number of day care centres and schools located near busy roads, it seems that little serious attention is paid to children's health when planning decisions are made about where to build roads or where to locate schools and child care centres.

⁹⁸ Lilian Calderón-Garcidueñas, Antonieta Mora-Tiscareño, Esperanza Ontiveros, Gilberto Gómez-Garza, Gerardo Barragán-Mejía, James Broadway, Susan Chapman, Gildardo Valencia-Salazar, Valerie Jewells, Robert R. Maronpot, Carlos Henríquez-Roldán, Beatriz Pérez-Guillé, Ricardo Torres-Jardón, Lou Herrit, Diane Brooks, Norma Osnaya-Brizuela, Maria E. Monroy, Angelica González-Maciél, Rafael Reynoso-Robles, Rafael Villarreal-Calderon, Anna C Solt, Randall W. Engle, Air pollution, cognitive deficits and brain abnormalities: A pilot study with children and dogs, *Brain and Cognition*, Volume 68, Issue 2, 2008, Pages 117-127,

⁹⁹ Lovasi, G.S., Eldred-Skemp, N., Quinn, J.W., Chang, H.-W., Rauh, V.A., Rundle, A., Orjuela, M.A., Perera, F.P. Neighborhood Social Context and Individual Polycyclic Aromatic Hydrocarbon Exposures Associated with Child Cognitive Test Scores (2014) *Journal of Child and Family Studies*, 23 (5), pp. 785-799.

¹⁰⁰ Wechsler Preschool and Primary Scale of Intelligence-Revised.

¹⁰¹ Currie J, Ray SH, Neidell M. 2011. Quasi-experimental studies suggest that lowering air pollution levels benefits infants' and children's health. *Health Affairs*, 30(12):2391–99.

¹⁰² Currie J, Hanushek E, Kahn EM, Neidell M, Rivkin SG. 2009. Does pollution increase school absences? *Review of Economic Statistics*, 91(4):682–94.

¹⁰³ J. Lam, P. Sutton, A. Kalkbrenner, G. Windham, A. Halladay, E. Koustas, et al. A systematic review and meta-analysis of multiple airborne pollutants and autism spectrum disorder *PLoS One*, 11 (2016), p. e0161851.

¹⁰⁴ Alexandra S. Appatova, Patrick H. Ryan, Grace K. LeMasters & Sergey A. Grinshpun (2008) Proximal exposure of public schools and students to major roadways: a nationwide US survey, *Journal of Environmental Planning and Management*, 51:5, 631-646.

¹⁰⁵ <https://www.theguardian.com/uk-news/2017/feb/24/revealed-thousands-of-children-toxic-air-london-nitrogen-dioxide>

Although many of the international studies have been conducted in environments that are more polluted than is typical in Australia, the local evidence broadly confirms the findings that children's healthy development is compromised when they live in neighbourhoods with relatively high levels of pollution, particularly from traffic emissions. Increasing traffic flows and relatively weak vehicle emission standards and an inadequate compliance regime are likely to intensify these problems¹⁰⁶.

5.3 Noise

High levels of noise in children's environments are also important threats to their health and learning. Transport noise from aircraft and motor vehicles is now a common feature of most urban environments. While the damaging effects of high levels of sound energy on human hearing are well established, there is relatively little systematic evidence on the effects of persistent noise – viewed as a general stressor - on children's health, wellbeing, and cognitive development. It is possible that noise affects children in several ways. Acute noise exposure may increase heart rate, blood pressure and the levels of stress related hormones. If noise is persistent, it may result in chronic activation of these physiological responses and subsequent illness. The same responses may be triggered by feelings of annoyance which children experience when noise interferes with communication and other desired activities. Habituation of these responses is also possible.

A 2007 review of studies on transport noise effects¹⁰⁷, noted that annoyance was the most commonly reported response and that the evidence for increased risk of hypertension and heart disease to long-term noise exposure was strengthening. The same review indicated that the epidemiological evidence for the effects of noise on coronary risk in children was mixed, due in part to methodological problems in the studies surveyed. However, a German study of a random sample of over 1000 children aged between 8 and 14 found the lowest blood pressure readings among those children whose rooms at home faced streets with low traffic and the highest were among those with rooms facing streets of high or extremely high traffic volumes¹⁰⁸.

The effects of noise, whether from road traffic or airports, on cognitive performance seem more consistent and robust, both for exposure at school and at home. Environmental noise exposure at home was found to be critical in one German study¹⁰⁹ of primary school age children. Children exposed to the highest noise levels from traffic had higher total scores on the SDQ, more emotional symptoms and more conduct problems, including hyperactivity. More recently, a large Norwegian study¹¹⁰ of noise exposure effects on children's attention found an association between inattention, as determined from maternal reports, and road traffic noise exposure at eight years and the average over the previous five years. The

¹⁰⁶ <https://theconversation.com/australias-weaker-emissions-standards-allow-car-makers-to-dump-polluting-cars-48172>

¹⁰⁷ Clark, C. and Stansfeld, S.A. (2007). The effect of transportation noise on health and cognitive development: a review of recent evidence, *International Journal of Comparative Psychology*, 20, 145– 158.

¹⁰⁸ Babisch, W., Neuhauser, H., Thamm, M. and Seiwert, M. (2009) Blood pressure of 8–14 year old children in relation to traffic noise at home — Results of the German Environmental Survey for Children (GerES IV), *Sci. Total Environment*, 407, 5839– 5843.

¹⁰⁹ Stefanie Dreger, Nicole Meyer, Hermann Fromme, Gabriele Bolte, Environmental noise and incident mental health problems: A prospective cohort study among school children in Germany, *Environmental Research*, Volume 143, Part A, 2015, 49-54,

¹¹⁰ Weyde KV, Krog NH, Oftedal BM, Magnus P, Øverland SØ, Stansfeld SA, Nieuwenhuijsen MJ, Vrijheid M, Pascual, Aasvang GM. Road traffic noise and children's inattention. *Environmental health*. 2017;16:127

negative effect was amplified if their mothers were less well educated. The results also suggested that air pollution may have contributed to the effects observed, but did not account for all of the variance.

Cognitive performance and health were found to be impaired in a study¹¹¹ comparing 452 children (8-11) who were attending ten schools in high aircraft noise areas in London with children attending ten matched control schools exposed to lower noise levels. The results confirmed that, after adjusting for age, main language spoken and household deprivation, noise exposure was associated with impaired reading of difficult items and increased annoyance. There were weaker associations with hyperactivity and psychological distress. The most extensive study of road traffic and aircraft noise exposure on children's psychological health (the RANCH study)¹¹² replicated the finding on hyperactivity, but not psychological distress. Supporting the results of those from cross-sectional studies, are the results of a naturalistic experiment¹¹³ made possible when the old Munich airport was closed and a new one opened. The long-term memory, short-term memory and reading of the children who lived near the old airport improved, while these skills deteriorated among the children living close to the new airport. As in many other parts of the world the data also showed that there was a relationship, corrected for in the analysis, between increased road traffic and lower household incomes.

In summary, exposing children to persistently high noise levels at home or at school during critical periods is a threat to their healthy development and may diminish cognitive performance and educational attainment. It may be that such exposures also initiate a sequence of events leading to psychological disorders later in life.

5.4 Community safety and violence

Exposure to violence is also a threat to children's healthy development, not only when there is violence in the home, but also if children are regularly exposed to violence in their neighbourhoods¹¹⁴. And neighbourhoods in Australia, as elsewhere, differ significantly in levels of violence and crime levels overall¹¹⁵. In the U.S., in any given year, more than 60% of children and young people are estimated to be exposed to some form of violence¹¹⁶. Similar data do not appear to be available in Australia, although a 2017 ABS survey indicates that 13% of adults reported experiencing violence before the age of 15. For Indigenous children the rates are higher. The ABS reported that in 2014-15, over 22% of Indigenous Australians aged over 15 had experienced physical violence or been threatened with violence in the previous

¹¹¹ Haines, M.M., Stansfeld, S.A., Brentnall, S., Head, J., Berry, B., Jiggins, M., & Hygge, S. (2001b). The West London Study: The effects of chronic aircraft noise exposure on child health. *Psychological Medicine*, 31, 1385-1396.

¹¹² Stansfeld, S.A., Berglund, B., Clark, C., Lopez Barrio, I., Fischer, P., Öhrström E., Haines, M.M., Head, J., Hygge, S., van Kamp, I., & Berry, B.F. (2005). Aircraft and road traffic noise and children's cognition and health: A cross-national study. *The Lancet*, 365, 1942-1949

¹¹³ Hygge, S., Evans, G.W., & Bullinger, M. (2002). A prospective study of some effects of aircraft noise on cognitive performance in school children. *Psychological Science*, 13, 469-474.

¹¹⁴ Theall KP, Shirtcliff EA, Dismukes AR, Wallace M, Drury SS. (2017). Association Between Neighborhood Violence and Biological Stress in Children. *JAMA Pediatrics*, 171(1):53-60.

¹¹⁵ Cheshire, L., Pawson, H., Easthope, H. and Stone, W. (2014) *Living with place disadvantage: community, practice and policy*, AHURI Final Report No.228. Melbourne: Australian Housing and Urban Research Institute. Available from: <<http://www.ahuri.edu.au/publications/projects/myrp704>>.

¹¹⁶ Anna Maria Santiago & George C. Galster (2014). The Effects of Childhood Exposure to Neighborhood and Community Violence: Impacts on the Safety and Wellbeing of Low-Income, Minority Children, *Journal of Community Practice*, 22:1-2, 29-46.

12 months. Communities marked by high rates of violent crime are typically those where poverty, property crime and drug abuse are also prevalent.

Exposure to neighbourhood violence may have particularly detrimental effects on children's mental health. Extensive research on this issue has been conducted, much of it with a focus on post-traumatic stress (PTS) outcomes^{117 118}. A meta-analysis of 114 studies¹¹⁹ of the effects of exposure to community violence in the U.S. found the strongest effects were for post-traumatic stress disorder and deviant and aggressive behaviour, with the most severe effects following from being a victim of violence. However, both witnessing and hearing about violence also resulted in more symptoms of PTS.

There are several studies which point to a relationship between community violence and poorer school performance¹²⁰ such as poorer scores on standardised tests and school attendance. Several recent investigations^{121 122} have indicated that such deficiencies seem to be mediated by PTS symptomatology – hyperarousal leads to distraction, preventing full engagement in the school situation. In Detroit, it was found that students performed significantly worse on cognitive tests when they were administered within four to seven days of a homicide occurring near their homes¹²³, and the effects were strongest, the closer it was to their homes. The authors speculated that the pattern of results suggested that impaired cognitive functioning results from the stress and trauma experienced by the children when exposed to or made aware of extreme violence near their homes.

Whether similar findings would apply in Australia is less certain, given the much lower rates of violent crime and extreme violence compared to the United States. Some groups of Indigenous children, however, who are witnesses to and victims of much higher rates of violence than the general population, will be adversely affected by that exposure. Data show that Aboriginal children are more likely to be exposed to family violence¹²⁴, a known risk factor for later psychological health and cognitive performance.

Whether parents and children think their neighbourhood is safe (perceived safety) has also been shown to influence children's health and wellbeing, independent of the actual rates of violent crime. Indeed the relationship between objective and perceived measures of crime appears to be weak¹²⁵. Much of the research has focused on the link between perceived safety

¹¹⁷ Turner HA, Shattuck A, Hamby S, Finkelhor D.(2013). Community disorder, victimization exposure, and mental health in a national sample of youth. *Journal of Health and Social Behavior*, 54(2):258–7510.

¹¹⁸ Fowler PJ, Tompsett CJ, Braciszewski JM, Jacques-Tiura AJ, Baltés BB.(2009). Community violence: a meta-analysis on the effect of exposure and mental health outcomes of children and adolescents. *Developmental Psychopathology*, 21(1):227.

¹¹⁹ Hurt H, Malmud E, Brodsky NL, Giannetta J. (2001). Exposure to violence: psychological and academic correlates in child witnesses. *Archives of Pediatric Adolescent Medicine*, 155(12):1351.

¹²⁰ Henrich CC, Schwab-Stone M, Fanti K, Jones SM, Ruchkin V. (2004). The association of community violence exposure with middle-school achievement: a prospective study. *Journal of Applied Developmental Psychology*, 25(3):327–4810.

¹²¹ McGill, T. M., Self-Brown, S. R., Lai, B. S., Cowart-Osborne, M., Tiwari, A., Leblanc, M., & Kelley, M. L. (2014). Effects of Exposure to Community Violence and Family Violence on School Functioning Problems among Urban Youth: The Potential Mediating Role of Posttraumatic Stress Symptoms. *Frontiers in public health*, 2, 8.

¹²² Mathews T, Dempsey M, Overstreet S. (2009). Effects of exposure to community violence on school functioning: the mediating role of posttraumatic stress symptoms. *Behavior Research Therapy*, 47(7):586.

¹²³ Sharkey P. (2010). The acute effect of local homicides on children's cognitive performance. *Proceedings of the National Academy of Sciences*. USA107:11733–38.

¹²⁴ Twizeyemariya, A., Guy, S., Furber, G. and Segal, L. (2017), Risks for Mental Illness in Indigenous Australian Children: A Descriptive Study Demonstrating High Levels of Vulnerability. *The Milbank Quarterly*, 95: 319-357.

¹²⁵ McGinn AP, Evenson KR, Herring AH, Huston SL, Rodriguez DA. (2008). The association of perceived and objectively measured crime with physical activity: a cross-sectional analysis. *Journal of Physical Activity and Health*, 5(1):117–31.

(including 'stranger danger' and traffic risks) and physical activity in outdoor spaces^{126 127}. When questioned about safety in the context of reporting their attitudes to their children walking or riding away from home, 88% of Australian parents of 5–6-year-olds and 81% of parents of 10–12-year olds reported that 'stranger danger' was of concern to them¹²⁸. However, a recent longitudinal study¹²⁹ of nearly 4000 Australian children assessed at 10 years of age and again two years later, found that, while there were effects on children's behaviour of neighbourhood factors, perceived community safety was not among them.

Negative effects of concern about safety have been documented. Investigation of a nationally representative sample of children from 257 neighbourhoods across Australia¹³⁰, for instance, showed that conduct problems among 4-5 year olds (assessed by the SDQ) were associated with parental perceptions of neighbourhood safety, after taking account of a range of other socio-demographic and neighbourhood variables. Comparable results were obtained in a large scale U.S study¹³¹ of the neighbourhood features associated with children's general health status. Parents' reports of poor neighbourhood safety and various environmental threats (e.g. vandalism) were associated with poorer health outcomes for children.

5.5 Social capital

Among the attributes which can ameliorate the effects of neighbourhood crime and disorder are those captured by the concept, "social capital". While research on social capital is prolific, social capital is not always precisely defined. In an attempt to capture the key elements of the concept, the OECD has defined it as "*networks together with shared norms, values and understandings that facilitate co-operation within or among groups*"¹³². This mirrors the approach taken by the sociologist Robert Putnam¹³³ who defines social capital as those "*features of social life – networks, norms and trust – that enable participants to act together more effectively to pursue shared objectives*" (pp 64-65) and that of Neil Adger¹³⁴ who similarly argues that, "*At its core, social capital describes relations of trust, reciprocity, and exchange; the evolution of common rules; and the role of networks*" (p 389). According to this conception, a community rich in social capital will have effective civic institutions which ensure greater prosperity and order; social capital is seen as "*a collective dimension of society external to the individual*"¹³⁵, potentially providing an explanation of how people use their

¹²⁶ Burdette HL, Wadden TA, Whitaker RC. (2006). Neighborhood safety, collective efficacy, and obesity in women with young children. *Obesity*, 14(3):518–25.

¹²⁷ Carver, A., Timperio, A., Crawford, D., (2008). Playing it safe: The influence of neighbourhood safety on children's physical activity - A review. *Health & Place*, 14(2), 217-227.

¹²⁸ A. Timperio, D. Crawford, A. Telford, J. Salmon Perceptions of the local neighborhood and walking and cycling among children. *Preventive Medicine*, 38 (1) (2004), pp. 39-47.

¹²⁹ Susan L. Rowe, Melanie J. Zimmer-Gembeck, Michelle Hood (2016). From the child to the neighbourhood: Longitudinal ecological correlates of young adolescents' emotional, social, conduct, and academic difficulties, *Journal of Adolescence*, 49, 218-231,

¹³⁰ B. Edwards, L.M. Bromfield Neighborhood influences on young children's conduct problems and pro-social behavior: evidence from an Australian national sample *Child Youth Services Review*, 31 (3) (2009), pp. 317-324.

¹³¹ Y. Fan, Q. Chen (2012). Family functioning as a mediator between neighborhood conditions and children's health: evidence from a national survey in the United States *Social Science and Medicine*, 74 (12) . 1939-1947.

¹³² <http://www.oecd.org/insights/37966934.pdf>

¹³³ Putnam, R. D. (1995). Bowling Alone: America's Declining Social Capital. *The Journal of Democracy*, 6(1), 65-78.

¹³⁴ Adger, W. N. (2003). Social Capital, collective action, and adaptation to climate change. *Economic Geography*, 79, 387-404.

¹³⁵ Lochner, K., Kawachi, I., & Kennedy, B. (1999). Social capital: A guide to its measurement.. *Health and Place*, 5(4), 259-270.

relationships with one another for the collective good. It may well provide a buffer against other social ills.

It is possible to categorise social capital as having two major dimensions: the structural aspects of social relations (e.g. size, density, type of networks) and the quality of social relations (norms of trust and the reciprocity arising from them, including exchanges or favours that people do for one another). Research has linked social capital to positive outcomes in a variety of areas - schooling and education, health, the quality of community life, work and organisations, democracy and governance, collective action and economic development¹³⁶¹³⁷. Conversely, the absence of social capital has been linked to community deterioration¹³⁸ and poor public health.

Social capital has increasingly been investigated as a possible explanation for differences in health that are found between places, or between groups of people¹³⁹. As well, some research has focused on the associations between social capital and health and health related problems such as violence¹⁴⁰. The beneficial effects of social capital appear to derive from the support and skills provided by dense and varied social networks based on trust and a willingness to participate in community activities and solve common problems. The spread of information and community expectations is also facilitated by the networks which underpin social capital – people talk to one another.

Sampson has argued that community social capital should be thought of, not as the aggregation of individual characteristics but as the properties which emerge when certain conditions are present. He identified and measured four key indicators of “social capital”: Social Ties or Networks, Collective Efficacy, Organizational Involvement, and Conduct Norms. His concept of “collective efficacy” emphasised shared beliefs in a community’s capability for action to achieve an intended effect and captured the link between trust and shared expectations for action. It is this element of social capital which appears to have been the most commonly investigated in research into neighbourhood health outcomes.

Variations in neighbourhood social capital have been shown to affect children’s health and behavioural outcomes¹⁴¹. Children in more cohesive neighbourhoods appear to be more active and less likely to be at risk for obesity and mental illness than those in less cohesive neighbourhoods¹⁴². In their longitudinal, multilevel study of individual and neighbourhood influences on child mental health, Xue and colleagues sampled 80 communities each with approximately 1000 children from birth to 18 years and assessed them using the Child

¹³⁶ Brunie, A. (2009). Meaningful distinctions within a concept: Relational, collective and generalized social capital. *Social Science Research*, 38, 251-265.

¹³⁷ Grootaert, C., & van Bastelaer, T. (2002). Social capital: From definition to measurement. In C. Grootaert & T. van Bastelaer (Eds.), *Understanding and Measuring Social Capital*. (pp. 1-16). Washington DC: The World Bank.

¹³⁸ Sampson, R. J. (2004). Neighbourhood and community: Collective efficacy and community safety. *New Economy, IPPR*, 106-113.

¹³⁹ I. Kawachi, B.P. Kennedy, R.G. Wilkinson (1999). *The society and population health reader—income inequality and health* The New Press, New York.

¹⁴⁰ R.J. Sampson, J.D. Morenoff, F. Earls (1999). Beyond social capital: spatial dynamics of collective efficacy for children *American Sociological Review*, 64 (5), 633-660.

¹⁴¹ Drukker, M., Buka, S. L., Kaplan, C., et al. (2005). Social capital and young adolescents’ perceived health in different sociocultural settings. *Social Science and Medicine*, 61(1), 185–198.

¹⁴² Meltzer, H., Vostanis, P., Goodman, R., & Ford, T. (2007). Children’s perceptions of neighborhood trustworthiness and safety and their mental health. *Journal of Child Psychology and Psychiatry*, 48(12), 1208–1213.

Behaviour Checklist¹⁴³. They found that a substantial proportion of the variance in children's mental health problems could be attributed to between neighbourhood differences. Collective efficacy and the presence of social organisations were both associated with better mental health in children. They also confirmed that concentrated disadvantage was associated with poorer child mental health.

The systematic review¹⁴⁴ of international research findings on the role and impact of family and community social capital on mental health/behavioural problems in children undertaken in 2014 assessed 55 eligible studies, the majority cross-sectional. The results overall supported the conclusion that in diverse populations and with a variety of measures, poor community social capital is associated with mental health/behavioural problems in children and adolescents. Conversely, wider social support networks of high quality with peers and non-familial adults appeared to be particularly beneficial to children. There were also indirect benefits of their parents having wider and higher quality social support networks.

These findings may be particularly relevant in understanding some of the difficulties experienced by families moving to newly developed suburbs or taking up residence in high-rise apartments.

5.6 The natural environment – Exposure to nature/greenness

There is now a strong body of evidence derived from research in several disciplines - psychology, medicine, human geography, sociology, urban planning, human movement - that green space is particularly beneficial to people's health and wellbeing. These so-called "salutogenic" effects of green space have long been recognised, but are now more rigorously established after a couple of decades of research, principally on adults.

Most of the research has examined the benefits of exposure to natural elements such as plants and other living things, natural areas including coastlines and mountains, managed environments such as parks and forests and wildlife sanctuaries, and undeveloped landscapes, seascapes and, in some cases, even agricultural lands. Many of these studies have been conducted in cool temperate climates, and comparatively few studies have looked at the effect of spending time (safely) in deserts, mountainous or shoreline landscapes. Nature tends to be equated with greenness, although there are good reasons for supposing that the aesthetic and awe inspiring aspects of what look like less hospitable terrains may be no less effective in generating beneficial effects.

¹⁴³ Achenbach, TM (1992). Manual for the Child Behavior Checklist/2-3 and 1992 Profile. Burlington Dept of Psychiatry, University of Vermont.

¹⁴⁴ McPherson KE, Kerr S, McGee E, Morgan A, Cheater FM, McLean J, et al. (2014). The association between social capital and mental health and behavioural problems in children and adolescents: an integrative systematic review. *BMC Psychology*, 2(1):7.

Several recent reviews^{145 146 147 148 149 150 151} have summarised and evaluated the developing research base, indicating a wide range of benefits flowing from exposure to nature (green space) including: reduced stress, better sleep, improved mental health, reduced depression and anxiety, greater happiness, wellbeing and life satisfaction, reduced aggression, reduced ADHD symptoms, increased pro-social behaviour and social connectedness, lower blood pressure, improved postoperative recovery, birth outcomes and pain control, improved child development (cognitive and motor), reduced congestive heart failure, reduced obesity and diabetes, better eyesight, improved immune function, improved general health, reduced mortality, and both exacerbation and improvement of asthma and other allergies (see Frumkin et al, 2017 for a summary¹⁵²). In addition, some studies, mainly in psychology, have focused on cognitive outcomes, showing improved attentiveness and short term memory and improved brain function^{153 154}.

While there are fewer studies of children, and the research designs and conceptual frameworks vary considerably, the results generally support the same conclusion: that children's health and wellbeing are improved when they live in and have access to natural, green spaces, that the size of the benefit increases with the amount of green space available and that the longer the exposure, the greater the benefit. The effects are evident at both the individual and community level.¹⁵⁵

The findings of benefit are compelling, not least because they derive from such a variety of approaches, methods and places. The research methodologies traverse controlled field trials; cross sectional correlational (epidemiological) studies; longitudinal correlational investigations; laboratory based interventions and observational studies. Measures of health and wellbeing have included both objective indices such as illness rates and more subjective measures, such as self-reports and ratings of health status and life satisfaction. An array of outcomes have been investigated, including detailed measures of brain function; performance on cognitive tests; the quality of social interaction; behavioural problems such

¹⁴⁵ Bowler DE, Buyung-Ali L, Knight TM, Pullin AS. (2010). Urban greening to cool towns and cities: a systematic review of the empirical evidence. *Landsc Urban Plan* 97:147–155.; Bowler DE, Buyung-Ali LM, Knight TM, Pullin AS. 2010. A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health* 10:456.

¹⁴⁶ Hartig T, Mitchell R, de Vries S, Frumkin H. (2014). Nature and health. *Annual Review of Public Health* 35:207–228.

¹⁴⁷ James P, Banay RF, Hart JE, Laden F. (2015). A review of the health benefits of greenness. *Current Epidemiology Report*, 2(2):131–142.

¹⁴⁸ Lee ACK, Maheswaran R. (2011). The health benefits of urban green spaces: a review of the evidence. *Journal of Public Health (Oxf)* 33(2):212–222.

¹⁴⁹ Martens D, Bauer N. (2013). *Natural environments: a resource for public health and wellbeing? A literature review. In: Psychology of Wellbeing: Theory, Perspectives and Practice.* Noehammer E, ed. Hauppauge, NY: Nova Science Publishers, 173–217.

¹⁵⁰ Russell R, Guerry AD, Balvanera P, Gould RK, Basurto X, Chan KMA, et al. 2013. Humans and nature: how knowing and experiencing nature affect wellbeing. *Annual Review of Environmental Resources*, 38:473–502.

¹⁵¹ Seymour V. 2016. The human–nature relationship and its impact on health: A critical review. *Frontiers in Public Health*, 4:260.

¹⁵² Howard Frumkin, Gregory N. Bratman, Sara Jo Breslow, Bobby Cochran, Peter H. Kahn Jr, Joshua J. Lawler, Phillip S. Levin, Pooja S. Tandon, Usha Varanasi, Kathleen L. Wolf, and Spencer A. Wood (2017) Nature contact and human health: A research agenda, *Environmental Health Perspectives*, 125:7.

¹⁵³ Berman MG, Jonides J, Kaplan S. (2008). The Cognitive Benefits of Interacting With Nature. *Psychological Science*, 19 (12):1207.

¹⁵⁴ Kaplan S, Berman MG. (2010). Directed Attention as a Common Resource for Executive Functioning and Self-Regulation. *Perspectives on Psychological Science*, 5(1):43.

¹⁵⁵ Bell, S., Hamilton, V., Montarzano, A., Rothnie, H., Travlou, P., & Alves, S. (2008). Green space and quality of life: a critical literature review. Green space Scotland. <http://www.greenspacescotland.org.uk/default.asp?page=465> (Volume 4)

as inattention and impulsivity; rates of psychiatric disorder; activity levels and obesity; as well as rates of crime and disorder within neighbourhoods.

Some studies have simply measured the relationships between the quantum of green space and contemporaneous indices of health and wellbeing. Others have attempted to assess the cumulative effects of the amount of green space exposure over time. In some cases there have been attempts to measure how children interact with and make use of green spaces near their homes and schools. Others have sought to assess the quality of the green space and to ascertain which elements of the space underpin the benefits observed and which are associated with other factors which are important influences on child development.

A further group of studies have examined the effects of interventions which provide controlled exposure to nature over relatively short periods. Typically such studies measure cognitive function, stress indicators and subjective wellbeing. The results reinforce those reported from correlational studies, showing that even short term exposure produces measurable improvements in cognition and behaviour.¹⁵⁶

Postulated mechanisms for these effects include the stress reducing impacts of spending time in nature, possibly related to our evolutionary past (Stress Reduction Theory); the restorative effects, particularly for attention (Attention Reduction Theory); the specific physical effects of vegetation in filtering air pollution, buffering noise pollution and reducing heat island effects; increased physical activity associated with the provision of suitable spaces for active outdoor recreation; the positive social benefits likely to accompany spending time in attractive settings with others, leading to improved social interaction and community function.

5.6.1 Population studies

Population studies in several countries^{157 158 159 160}, including Australia¹⁶¹, have already indicated that more greenery within neighbourhoods is associated with better child health and wellbeing. Some of these studies have examined the benefits of access to green space for children's overall health and some have examined specific health indices, such as obesity and stress levels. A second group of studies relate green space to cognitive development and behavioural problems and a third group, the largest, has explored the mental health and wellbeing benefits. Many contain elements of all three types.

A note of caution: in all of the studies which attempt to establish whether there is a causal association between green space (the independent variable) and health and wellbeing (the dependent variable) it is important that appropriate controls for potential confounding

¹⁵⁶ Kuo FE, Faber Taylor A. (2004). A potential natural treatment for Attention-Deficit/Hyperactivity Disorder: Evidence from a national study. *American Journal of Public Health*, 94(9): 1580-86.

¹⁵⁷ Markevych I, Tiesler CM, Fuertes E, et al. Access to urban green spaces and behavioural problems in children: results from the GINIplus and LISApplus studies. *Environ Int*. 2014;71:29–35. <https://doi.org/10.1016/j.envint.2014.06.002>.

¹⁵⁸ Balseviciene B, Sinkariova L, Grazuleviciene R, et al. Impact of residential greenness on preschool children's emotional and behavioural problems. *Int J Environ Res Public Health*. 2014;11(7):6757–6770.

¹⁵⁹ Amoly E, Dadvand P, Fornis J, et al. Green and blue spaces and behavioral development in Barcelona schoolchildren: the BREATHE Project. *Environ Health Perspect*. 2014;122(12):1351.

¹⁶⁰ Flouri E, Midouhas E, Joshi H. The role of urban neighbourhood green space in children's emotional and behavioural resilience. *J Environ Psychol*. 2014;40:179–186. <https://doi.org/10.1016/j.jenvp.2014.06.007>.

¹⁶¹ Feng X, Astell-Burt T. The relationship between neighbourhood green space and child mental wellbeing depends upon whom you ask: multilevel evidence from 3,083 children aged 12–13 years. *Int J Environ Res Public Health*. 2017;14(3):235. <https://doi.org/10.3390/ijerph14030235>.

variables are undertaken. A confounding variable is one that influences both the independent and dependent variables, resulting in spurious conclusions about causation if this is not taken into account. For example, previous research in Australia and elsewhere has shown that socioeconomically disadvantaged neighbourhoods are likely to have smaller quantities of green space¹⁶² and poorer scores on measures indicative of green space “quality”¹⁶³. At the same time, the association between poorer health and wellbeing and socioeconomic disadvantage population groups is well established. Hence, any correlations between the amount of green space and health and wellbeing indicators must control for socio-economic status, typically by using statistical techniques.

5.6.2 Physical health

A major epidemiological study, including both adults and children from the Netherlands,¹⁶⁴¹⁶⁵ found a strong relationship between the amount of green space and health. The researchers examined morbidity data derived from the electronic medical records of around 200 GPs in approximately 100 Dutch practices to establish patterns of illness among the population and whether there was any consistent pattern of relationship with the amount of green space. The GPs classified morbidity using the International Classification of Primary Care and the authors calculated the percentage of green space within 1km and 3km of people’s homes using the Netherlands National Land Cover Classification database. When broken down by age, and controlling for demographic and socioeconomic characteristics, the annual illness prevalence rates overall were found to be lower in those living in environments with more green space within 1 km of their homes.

The relationship between green space and illness was stronger for children under 12 (and the elderly) and for those of lower SES status. The associations with a few disease clusters were noted as especially strong for children – vertigo, severe intestinal complaints and depression; the strongest effect was found for depression. In explaining their findings, the authors noted that it was those who spent most time in the vicinity of their homes (young children and the elderly) who benefited most from nearness to green space – or suffered from its absence. They speculated that, given the strong relationship they found for anxiety and depression, recovery from stress and fatigue might well be the key benefit of access to green space, along with facilitation of social contacts.

Other benefits for physical health have been noted. For example, much international research points to links between lack of access to green space and obesity in children, a problem which has been accelerating over recent decades and which is predictive of other health problems

¹⁶² Astell-Burt T, Feng X, Mavoa S, Badland HM, Giles-Corti B. Do lowincome neighbourhoods have the least green space? A cross-sectional study of Australia’s most populous cities. *BMC Public Health*. 2014;14:292. <https://doi.org/10.1186/1471-2458-14-292>.

¹⁶³ Crawford D, Timperio A, Giles-Corti B, et al. Do features of public open spaces vary according to neighbourhood socio-economic status? *Health Place*. 2008;14(4):889–893. <https://doi.org/10.1016/j.healthplace.2007.11.002>.

¹⁶⁴ Maas J, Verheij RA, de Vries S, Spreeuwenberg P, Schellevis FG, Groenewegen PP. (2009). Morbidity is related to a green living environment. *Journal of Epidemiology and Community Health* 63(12):967–973.

¹⁶⁵ Maas, J.; Verheij, R.A.; Groenewegen, P.P.; de Vries, S.; Spreeuwenberg, P. (2006). Green space, urbanity, and health: How strong is the relation? *Epidemiology and Community Health*, 60, 587–592.

such as type 2 diabetes, asthma, hypertension, sleep apnoea and emotional problems^{166 167 168 169 170}. In Davdand and associates' 2014 study of over 3000 Spanish children¹⁷¹, greenness was estimated (using the satellite-derived Normalised Difference Vegetation Index, NDVI) within 100, 250, 500 and 1000 metres of children's homes and logistic regression used to test the relationship between greenness and sedentary behaviour, obesity, current asthma and an allergic condition, rhinoconjunctivitis. After taking account of a range of potentially confounding variables (SES, housing, exposure to smoke at home) analyses showed that higher residential surrounding greenness was associated with lower Body Mass Index (BMI) scores, lower rates of overweight/obesity (11-19% lower) and less excessive screen time, but was not associated with elevated asthma or allergic rhinoconjunctivitis.

Since children often spend a considerable amount of time away from home in child care centres and at school, the impact of these physical environments also needs to be considered. Using parental diaries to assess children's general wellbeing and any symptoms of illness as well as objective measures of weight (BMI) and cortisol levels, children at preschools with different levels and qualities of outdoor environments were compared by Sonderstrom and colleagues¹⁷². They found that exposure to high quality outdoor environments was associated with a healthier body shape, longer night sleep and better wellbeing in the children. Children were more likely to spend time outdoors in the high quality environments.

A longitudinal study¹⁷³, which avoids some of the problems of assessing causal relationships from cross-sectional, correlational studies, also reported lower weight associated with more residential green space. The association between residential greenness (and density) and changes in BMI of 3831 children aged 3-16 years was examined over a two year period. The results showed that higher greenness, as measured by the amount of vegetation (NDVI) within 1 kilometre of their homes, was associated with lower odds of children and youth having increased BMI scores over the two year period. Account was taken in the analysis of potential confounders – racial/ethnic group; gender and health insurance status as a proxy for socio-economic status. The effect of the amount of vegetation was substantial – equating to lower weights ranging from 1.6 kgs for 4 year old girls (2 kg for boys) to 5.1 kg for 16 year old girls (5.9 kg for boys) and independent of residential density. The finding was assessed by the authors as “clinically meaningful and biologically plausible”. They argued that one obvious pathway to the observed effects was the amount of physical activity, since the greenness was likely indicative of proximity to parks and playing fields which enable physical activity and outdoor play.

¹⁶⁶ Sanders T, Feng X, Fahey PP, Lonsdale C, Astell-Burt T. (2015). Greener neighbourhoods, slimmer children? Evidence from 4423 participants aged 6 to 13 years in the Longitudinal Study of Australian Children. *International Journal of Obesity*, 39, 1224-1229.

¹⁶⁷ D.S. Freedman, W.H. Dietz, S.R. Srinivasan, G.S. Berenson (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa heart study *Pediatrics*, 103 (6Pt1), 1175-1182.

¹⁶⁸ C.B. Ebbeling, D.B. Pawlak, D.S. Ludwig (2002). Childhood obesity: public-health crisis, common sense cure *Lancet*, 360 (2002), pp. 473-482.

¹⁶⁹ M. Trent (2002). Adolescent obesity: identifying a new group of at-risk youth *Pediatric Annals*, 31, 559-564.

¹⁷⁰ D. Young-Hyman, M. Tanofsky-Kraff, S.Z. Yanovski, *et al.* (2006). Psychological status and weight-related distress in overweight or at-risk-for-overweight children *Obesity*, 14, 2249-2258.

¹⁷¹ P. Davdand, C.M. Villanueva, L. Font-Ribera, D. Martinez, X. Basagaña, J. Belmonte, M.J. Nieuwenhuijsen, *et al.* (2014) Risks and benefits of green spaces for children: a cross-sectional study of associations with sedentary behavior, obesity, asthma, and allergy Environmental Health Perspectives, 122, 1329-1335.

¹⁷² Soderstrom, M., Boldemann, C., Sahlin, U., Martensson, F., Raustorp, A., Blennow, M. 2013. “The Quality of the Outdoor Environment Influences Children's Health—A Cross-sectional Study of Preschools.” *Acta Paediatrica* 102 (1): 83–91.

¹⁷³ Bell

This proposition is supported by several investigations. In one U.S study¹⁷⁴, boys aged between 5 and 18 living in Atlanta were found to be 2.3 times more likely to have walked recently when they had access to at least one green space (the odds ratio for girls was lower at 1.7). Although a small number of studies have not found such effects, Lachowycz and Jones, in their review of studies up to 2011¹⁷⁵, identified six rigorous studies of children and adolescents in which there were positive associations between green space and physical activity. A more recent study by Akpinar¹⁷⁶ of Turkish children between 1 and 18 years of age confirmed these findings. After taking account of the children's sex, age and parents' income, results showed that the closer children lived to urban green spaces (parks and gardens), the more they were physically active and the less time they spent on screens. This was, in turn, associated with better general health. Lachowycz and colleagues' own study of the extent to which children actually make use of green environments shows that they are a valuable resource in children's lives. They studied a relatively deprived group of 902 English school children aged 11-12 and used global positioning systems (GPS) and accelerometers to measure where and how much physical activity took place. They found that approximately half of all activity took place in green space at the weekend, regardless of the season, and that the children used both public spaces and private gardens.

In their review of the effects of the neighbourhood physical environment on early childhood health and development, Christian and associates found that the majority of studies reported that the greater the amount of green space, the higher the levels of play and physical activity. For example, a New York study¹⁷⁷ of over 400 pre-school children found that those living in areas with the most street trees were more physically active and those living in areas with better park access had lower skinfold thickness, indicative of lower weight. These results are broadly similar to those obtained in a series of Australian studies¹⁷⁸. The longitudinal RESIDE study, for example, of people in the Perth metropolitan area has shown that children's independent mobility decreased as the distance to local parks increased¹⁷⁹.

Some of the benefit may derive from the fact that children are simply more likely to spend time outdoors and play in greener spaces. In one U.S investigation¹⁸⁰ children from 64 urban public housing areas in Chicago with low (27) and high vegetation (37) (as assessed from aerial photographs), were observed. Children's activities were coded by trained local people on four separate occasions. Of the 262 children observed, most (73%) were involved in some type of play. In relatively barren spaces, however, levels of play were approximately half those found

¹⁷⁴ Kerr J, Frank L, Sallis JF, Chapman J. Urban form correlates of pedestrian travel in youth: differences by gender, race-ethnicity and household attributes. *Transp Res Part D Transp Environ* 2007; 12 : 177–182.

¹⁷⁵ Lachowycz, K., Jones, A.P., 2011. Green space and obesity: a systematic review of the evidence. *Obesity Reviews* 12, e183–e189.

¹⁷⁶ Akpinar A. Urban green spaces for children: A cross-sectional study of associations with distance, physical activity, screen time, general health, and overweight. *Urban For Urban Green* 2017;25:66-73.

¹⁷⁷ G.S. Lovasi, J.S. Jacobson, J.W. Quinn, K.M. Neckerman, M.N. Ashby-thompson, A. Rundlels the environment near home and school associated with physical activity and adiposity of urban preschool children? *J. Urban Health*, 88 (6) (2011), pp. 1143-1157.

¹⁷⁸ B. Giles-Corti, S.F. Kelty, S.R. Zubrick, K.P. Villanueva Encouraging walking for transport and physical activity in children and adolescents: how important is the built environment? *Sports Med.*, 39 (2009), pp. 995-1009.

¹⁷⁹ Christian, H, Klinker, C, Villanueva, K, Knuiaman, M, Foster, S, Zubrick, S, Divitini, M, Wood, L and Giles-Corti, B 2015, 'The effect of the social and physical environment on children's independent mobility to neighborhood destinations', *Journal of Physical Activity and Health*, vol. 12, no. S1, pp. S84-S93.

¹⁸⁰ A.F. Taylor, A. Wiley, F.E. Kuo, W.C. Sullivan Growing up in the inner city – green spaces as places to grow *Environ. Behav.*, 30 (1) (1998), pp. 3-27.

in spaces with more trees and grass, and the incidence of creative play was significantly lower in barren spaces than in relatively green spaces.

It is generally accepted that the evidence confirms that green spaces such as tree-lined streets and parks increase the likelihood that children will exercise and play outdoors, with the attendant benefits known to flow from these activities. However, it is also important to note that in studies which have examined age differences, there appears to be a decline in the use of green spaces for teenagers and young adults. It is also important to note that parents' perceptions of safety may influence the extent to which young children can take advantage of green space¹⁸¹, although it seems that in areas with more green space crime rates are actually lower and parental perceptions of children's safety better¹⁸².

5.6.3 Mental health and psychological wellbeing

One of the key benefits of exposure to nature appears to be improvements in children's mental health. For example, a study of 10 year olds in Munich, assessed the benefits of green space using the Strengths and Difficulties Questionnaire (see above - a multidimensional measure of children's wellbeing often used in population studies of child development¹⁸³ and covering their behaviour, emotions, and peer relations) and objective measures of green space (the Bavarian land use dataset). After correcting for the potential influence of a number of possible confounding variables including sex, parental education, single parent status, maternal age, time spent in screen activities and time spent outdoors, the (logistic regression) analyses showed that children living more than 500 metres away from green space had more problems overall than those living closer, and males living further from green space exhibited more hyperactivity and inattention problems in particular.

Work by Bezold and her associates¹⁸⁴ shows that adolescents' mental health is also better when they live in areas with more green space. They studied the presence of depressive symptoms in over 9000 young people between 12 and 18 years of age sampled as part of the U.S. "Growing Up Today" study. Again, objective measures of vegetation were used (NDVI) to determine the degree of exposure to greenness, and the McKnight Risk Factor Survey (MRFS) was used to indicate depressive symptoms. As in the Munich study, the authors identified potential confounding variables – age, race/ethnicity, age, grade level, gender, pollution levels (PM2.5) parental income, father's education and maternal history of depression – and took them into account in the statistical analyses. They found that higher levels of both peak seasonal and average greenness within 1250 metres of the adolescent's home were associated with lower odds of depressive symptoms; the effect was present, but less marked within 250 metres. These associations were largest among the middle school children, 6th to 8th grade (a reduction of 19%) than for older high school students (8%).

¹⁸¹ Weiss CC, Purciel M, Bader M, Quinn JW, Lovasi G, Neckerman KM, Rundle AG. Reconsidering access: park facilities and neighborhood disamenities in New York City. *J Urban Health*. 2011;88:297–310.

¹⁸² Kuo FE, Bacaicoa M, Sullivan WC. Transforming inner-city landscapes: trees, sense of safety, and preference. *Environ Behav*. 1998;30:28–59.

¹⁸³ Goodman R. (1997). The Strengths and Difficulties Questionnaire: a research note. *J Child Psychol Psychiatry*, 38(5):581–586.

¹⁸⁴ Achenbach TM, Becker A, Döpfner M, Bezold, C.P., Banay, R.F., Coull, B.A., Hart, J.E., James, P., Kubzansky, L.D., Missmer, S.A., Laden, F., (2018). The association between natural environments and depressive symptoms in adolescents living in the United States. *Journal of Adolescent Health*, 62 (4), 488-495.

Similar results were reported in a Lithuanian study¹⁸⁵ of younger, preschool children, 4-6 years old. The effects of the proximity to city parks and the amount of residential greenness on the children's emotional and behavioural problems were assessed using reports from 1468 mothers on their parenting stress and their children's mental health using a local version of the Strengths and Difficulties Questionnaire. Exposure to nature was measured objectively (NDVI) within 300 metres of each home address and proximity to city parks. Statistical analyses, taking account of maternal education, revealed that children's mental health problems (total difficulties, hyperactivity and peer relationship problems) were lower among children who lived closer to parks, particularly if maternal education was low, an indicator of low SES. This finding of an enhanced benefit for children of lower SES is consistent with results from other similar studies.

Even stronger support is provided for the proposition that access to green space is beneficial for children by a recent and significant Australian study¹⁸⁶. Feng and Astell-Burt examined various associations and interactions between wellbeing, green space quantity and quality across childhood. In one of the very few longitudinal studies undertaken to date, the researchers studied a representative sample of children and parents from urban, rural and regional communities taking part in the ¹⁸⁷Longitudinal Study of Australian Children (LSAC). A total of 9893 parents were randomly selected and invited to participate, and approximately half of them agreed to take part. Children, from 4-5 years old to 12-14 years old, and their parents were then followed up every two years, with most of the data supplied by their parents, but some from others, such as school teachers. The investigators used three outcome measures derived from the Strengths and Difficulties Questionnaire, covering children's behaviour, emotions, and peer relations. The measures used were the total difficulties scores (TDS) and two subscale scores, the "internalising subscale" and the "externalising subscale", the former covering negative emotional states such as nervousness, worry, anxiety, depression and the latter such as fidgetiness, impulsiveness lack of concentration.

Within each statistical area where children lived, the percentage of land use classified as parkland by the Australian Bureau of Statistics (ABS) was used to measure green space quantity. Parental views about the quality of green space was gauged by asking parents how much they agreed with the statement: "there are good parks, playgrounds and play spaces in this neighbourhood". To control for the potentially confounding effects of socio economic disadvantage, Feng and Astell-Burt used the Socio Economic Index For Areas Relative Index of Advantage and Disadvantage 2006¹⁸⁸, to make sure socioeconomic variables like education, employment, and income were not responsible for any observed effects.

Their overall results showed that higher percentages of local green space and better quality green space were associated with better wellbeing in children, and parents who lived in areas with more green space were more likely to rate the quality higher, regardless of the socio-economic status of the area. Using appropriate statistical techniques (multilevel linear

¹⁸⁵ Balseviciene B, Sinkariova L, Grazuleviciene R, et al. (2014). Impact of residential greenness on preschool children's emotional and behavioral problems. *Int J Environ Res Public Health*, 11:6757–70.

¹⁸⁶ Feng, X., Astell-Burt, T. (2017). Residential Green Space Quantity and Quality and Child Wellbeing: A Longitudinal Study. *American Journal of Preventive Medicine*, 53(5), 616-624

¹⁸⁷ Sanson A, Nicholson J, Ungerer J, Zubrick S, Wilson K. Introducing the Longitudinal Study of Australian Children-LSAC Discussion Paper No. 1. 2002.

¹⁸⁸ Trewin D. Socio-Economic Indexes for Areas (SEIFA). Canberra, Australia: Australian Bureau of Statistics, 2001.

regression) to take account of potential confounding variables, the investigators found that favourable wellbeing (i.e. lower scores on total difficulties, and both the internalising and externalising subscales) was associated with larger quantities of green space, and that this effect followed a dose-response relationship and seemed to plateau at around 21%-40% of green space. In addition, the benefits of the quantity of green spaces were consistent across all ages, while the benefits of the quality of the space appeared to intensify as children matured. The authors concluded that both the quantity and quality of green space influenced wellbeing in childhood and that as children grow older, access to higher quality green space became even more important.

Some results indicate that stress reduction may be implicated in producing benefits such as these. For example, one investigation of a sample of mainly African American adolescents measured the momentary association between urban green space, as indicated by the NDVI, and psychological stress, captured using Geographic Ecological Momentary Assessment (GEMA) - a technique that involves repeated sampling of people's behaviours, moods, and experiences in real time, and in their natural environments¹⁸⁹. After taking account of neighbourhood disadvantage, and whether the observation occurred at home or elsewhere, the results indicate that urban green space was associated with lower stress when subjects were away from home. The authors speculated that this was probably due to stress reduction and attention restoration effects known to be associated with exposure to natural areas. It is also possible that their subjects sought out urban green spaces when they were not stressed.

The general benefits to mental health of access to green space were also reported in the Millennium Cohort Study in the United Kingdom¹⁹⁰, a longitudinal study which found that a greater percentage of neighbourhood green space was associated with better emotional outcomes for young aged 3, 5, and 7 years. Over 6000 children were assessed for emotional and behavioural problems using the Strengths and Difficulties Questionnaire and neighbourhood green space was measured using the U.K's Generalised Land Use Database. The investigators defined neighbourhood green space as the percentage of green space (excluding gardens) within each census statistical division (about 1500 residents). Data were also collected about family socio-economic disadvantage, overcrowding, home ownership, income support and income poverty; neighbourhood disadvantage, as indicated by the Index of Multiple Deprivation (IMD); life adversity (using the Adverse Life Events Scale) and several child and family characteristics, including children's use of parks, and maternal health and psychological distress.

Using Hierarchical Linear Modelling¹⁹¹, which enables individual and neighbourhood variables to be assessed for their separate influences, they found that children living in areas with a higher percentage of green space had fewer emotional problems from age 3 to 5 relative to those living in less green areas. The amount of green space also influenced resilience – poor children living in areas with a higher percentage of green space had fewer emotional problems than their peers in less green neighbourhoods. Somewhat similar results were

¹⁸⁹ Shiffman, S., Stone, A. A., & Hufford, M. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, 4, 1–32.

¹⁹⁰ Flouri E, Midouhas E, Joshi H. (2014). The role of urban neighbourhood green space in children's emotional and behavioural resilience. *J Environ Psychol*, 40:179–186.

¹⁹¹ S.W. Raudenbush, A.S. Bryk (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.), Sage, Newbury Park, CA.

obtained by Wells and Evans¹⁹² who found that green space buffered the effect of life stress, although not poverty. A possible explanation of this difference may be the way green space was measured in the two studies – one by self-report and the other using a more objective measure of greenness.

Despite the fact that it appears that neighbourhood green space may be particularly helpful to the emotional wellbeing of urban children living in poor families, this study, like many undertaken in cities in the developed world, found that, on average there was less neighbourhood green space in poor and deprived areas than in wealthy ones.

Benefits also appear to accrue in reducing serious mental illness among those who live in areas with the highest levels of green space. There is evidence that the risk of schizophrenia is linked to urbanisation, and the authors of a Danish study¹⁹³ hypothesised that underlying mechanisms might include green space exposure, perhaps because green space mitigates noise and air pollution, relieves stress or provides other unspecified benefits. They used satellite data to quantify green space in Denmark for the years between 1985 and 2013, and estimated the effect of green space at different distances on schizophrenia on a very large longitudinal population-based sample (943,027 persons). After adjusting for known risk factors for schizophrenia (urbanisation, age, sex, SES), they found that those who lived in areas with the lowest amount of green space had a 1.52-fold increased risk of developing schizophrenia compared to persons living at the highest level of green space. The strongest protective effect was observed when the exposure was in the earliest childhood years and when closest to place of residence.

A selective review of 35 studies of the mental health benefits for children and teenagers of interactions with nature undertaken by Tillman et al¹⁹⁴ noted substantial diversity in the specific elements of nature considered, the methods used to assess children's interaction with nature and the indices of health and wellbeing studied, making strict comparisons difficult. Nonetheless, they concluded that the evidence pointed to significant benefits of nature for all mental health outcomes, with the most consistent results being obtained for attention related disorders and overall mental health and stress levels.

5.6.4 Cognitive benefits

For adults, there is now a substantial body of literature demonstrating the short term cognitive benefits, typically to attention and memory, which flow from exposure to natural environments. For example, Berman and his colleagues¹⁹⁵ found that adults' attention improved significantly following a nature walk but not an urban walk. Similarly, in one recent study¹⁹⁶, participants were required to walk in a quiet residential urban area, a green park, and a park with water. Improved cognitive function compared to baseline measures was

¹⁹² N.M. Wells, G.W. Evans (2003). Nearby nature: A buffer of life stress among rural children *Environment and Behavior*, 35, pp. 311-330

¹⁹³ Kristine Engemann, Carsten Bøcker Pedersen, Lars Arge, Constantinos Tsirogiannis, Preben Bo Mortensen, Jens-Christian Svenning, Childhood exposure to green space – A novel risk-decreasing mechanism for schizophrenia?, *Schizophrenia Research*, Volume 199, 2018, Pages 142-148,

¹⁹⁴ Tillmann S, Tobin D, Avison W, et al. *J Epidemiol Community Health* 2018;72:958–966.

¹⁹⁵ Berman, M. G., Jonides, J., & Kaplan, S. (2008). The Cognitive Benefits of Interacting With Nature. *Psychological Science*, 19(12), 1207–1212.

¹⁹⁶ Gidlow, C. J., Jones, M. V., Hurst, G., Masterson, D., Clark-Carter, D., Tarvainen, M. P., . . . Nieuwenhuijsen, M. (2016). Where to put your best foot forward: Psycho-physiological responses to walking in natural and urban environments. *Journal of Environmental Psychology*, 45, 22-29.

evident for walks in both the natural environments, but not the urban area. A meta-analysis of research in the field up to 2016¹⁹⁷ found that attention, as measured by a variety of tasks, improved for those exposed to natural environments but not to other settings.

The extent to which this is true for children is less certain because there has been less research on the short term effects of exposure to nature on attention and cognitive function in children. The best known study is that of Taylor & Kuo,¹⁹⁸ which systematically examined the impacts of three settings on children with ADHD; each child experienced each of three treatments (environments) in single blind controlled trials (i.e. those who conducted the assessments did not know which condition the children had experienced). Children with attention deficits concentrated better and performed better on cognitive tasks after walking in a park than after either of two other settings – a downtown area and a residential area. The effect of a dose of green was substantial—roughly as large as the deficit due to ADHD; as large as the peak effect of extended-release methylphenidate.

Other observational studies of school age children have found that green surroundings to their homes appear to facilitate impulse control in 7–12-year-old girls¹⁹⁹, and children diagnosed with a variety of attentional disorders experience less severe symptoms when their after-school and weekend activities took place in green outdoor settings²⁰⁰. In a survey of over 400 children with ADHD in the U.S.,²⁰¹ parents were asked a series of questions, including about the severity of their children's symptoms and their children's exposures to green space, experienced in their usual play settings. The findings suggested that children with ADHD who played regularly in green play settings had milder symptoms than those who played in built outdoor and indoor settings.

The same effects have been observed in children and adults without obvious health problems. Several experiments show that walking in nature can improve cognitive performance, and the effects among adults appear to be larger in species-rich environments. This research has bolstered the idea that the directed attention, important for working and surviving in the modern world, is a limited resource, regularly depleted. Long hours in front of a computer or studying can leave us feeling fatigued and less able to focus. Spending time in natural settings appears to activate involuntary attention, giving the brain's directed attention time to rest.

In Sweden, the restorative potential of green outdoor environments for children in preschool settings was investigated²⁰² by measuring the attention of children playing in settings with different environmental features. The outdoor environments of 198 preschool children between 4.5 and 6.5 years old were assessed and the children were rated by the staff for

¹⁹⁷ Heather Ohly, Mathew P. White, Benedict W. Wheeler, Alison Bethel, Obioha C. Ukoumunne, Vasilis Nikolaou & Ruth Garside (2016) Attention Restoration Theory: A systematic review of the attention restoration potential of exposure to natural environments, *Journal of Toxicology and Environmental Health, Part B*, 19:7, 305-343

¹⁹⁸ Faber Taylor, A., & Kuo, F. E. (2009). Children With Attention Deficits Concentrate Better After Walk in the Park. *Journal of Attention Disorders*, 12(5), 402–409.

¹⁹⁹ A. Faber Taylor, F.E. Kuo, W.C. Sullivan Views of nature and self-discipline: evidence from innercity children *Journal of Environmental Psychology*, 22 (2001), pp. 49-63.

²⁰⁰ F.E. Kuo, A. Faber Taylor A potential natural treatment for attention-deficit/hyperactivity disorder: evidence from a national study. *Research and practice American Journal of Public Health*, 94 (9) (2004), pp. 1580-1586.

²⁰¹ Faber Taylor, A. and Kuo, F. E. (2011), Could Exposure to Everyday Green Spaces Help Treat ADHD? Evidence from Children's Play Settings. *Applied Psychology: Health and Well-Being*, 3: 281-303.

²⁰² F. Mårtensson, C. Boldemann, M. Söderström, M. Blennow, J.-E. Englund, P. Grahn, Outdoor environmental assessment of attention promoting settings for preschool children, *Health & Place*, Volume 15, Issue 4, 2009, Pages 1149-1157.

inattentiveness, hyperactivity and impulsivity. Those children who played in outdoor settings containing large areas of trees, shrubbery and a hilly terrain were less likely to be inattentive.

Some studies have taken advantage of planned changes in children's environments to conduct naturalistic experiments on the effects of greenness: before and after assessments or comparisons of modified environments with those that are not changed. A group of Austrian researchers investigated the influence of the greening of a schoolyard on pupils' physiological stress, psychological wellbeing, and executive functioning. One hundred and thirty three middle school pupils ($M = 14.4$ years) from three rural middle schools were assessed: children at one school were monitored before and after the construction of a green school yard; children from two comparison schools, where no changes were made to their schoolyards, were measured over the same period. Children who experienced the renovated schoolyard showed lower levels of stress and improved psychological wellbeing compared with their peers who experienced no changes. It is not clear which elements of the schoolyard redesign influenced these outcomes. In another study, for a small group of 7-12 year old children, the relocation to a greener residential area was associated with improved cognitive functioning²⁰³.

There are now several epidemiological studies which point to similar effects. A series of well-designed studies, part of a major investigation of the effects of air pollution in Barcelona on children's brain development, have also shown positive associations between children's contact with green spaces and indices of cognitive and behavioural development. In a 2014 paper²⁰⁴, the authors reported results from a study of over 2000 children between 7 and 10 years of age from 36 schools in the city. Based on parents' reports, they assessed the time children spent in green spaces and their emotional wellbeing and behaviour using the Strengths and Difficulties Questionnaire. They also measured the amount of green space (using NDVI) at distances of 100, 200 and 500 metres from children's home and whether or not children lived within 300 metres of a major green space. They found that the more time children spent playing in green space, the better their scores on SDQ total difficulties, emotional symptoms, and peer relationship problems. Similarly, higher levels of greenness surrounding children's homes was related to lower total difficulties, less hyperactivity/inattention and fewer diagnoses of ADHD.

In an associated longitudinal study of over 2200 Barcelona school children (7–9 year olds), Davdand and his colleagues²⁰⁵ found that over a 12-month period, children who attended schools with higher outdoor greenness had greater increases in working memory and larger reductions in inattentiveness than children who attended schools with less surrounding greenness. Changes in cognitive development were assessed every three months, employing measures of working memory, superior working memory, and inattentiveness. Exposure to green space by assessed in the same way as described in their earlier studies for both their residential area and around the schools they attended. Greenness in and around their schools was associated with enhanced 12-month progress in working memory and superior working memory, and a greater 12-month reduction in inattentiveness. Adding a traffic-related

²⁰³ N.M. Wells At home with nature: effects of "greenness" on children's cognitive capacity *Environment and Behavior*, 32 (2000), pp. 775-795.

²⁰⁴ Amoly E, Davdand P, Forns J, et al. Green and blue spaces and behavioral development in Barcelona schoolchildren: the BREATHE project. *Environ Health Perspect* 2014;122:1351–8.

²⁰⁵ Davdand P, Nieuwenhuijsen MJ, Esnaola M, Forns J, Basagaña X, Alvarez-Pedrerol M. 2015a. Green spaces and cognitive development in primary schoolchildren. *Proc Natl Acad Sci U S A* 112(26):7937–7942.,

measure of air pollution to their statistical models explained 20–65% of the estimated associations between school greenness and 12-month cognitive development. This suggests that part of the demonstrated beneficial association between exposure to green space and cognitive development is the result of a reduction in exposure to air pollution.

A later paper²⁰⁶, using data from a subset of the same population of children, reports an investigation of the links between children’s lifelong exposure to residential greenness (using NDVI) and results from 3-dimensional MRI images of their brains, as well as their scores on working memory and attention tests. Lifelong exposure to greenness was positively linked to grey matter volume in the left and right prefrontal cortex and in the left premotor cortex and with white matter volume in the right prefrontal region, in the left premotor region, and in both cerebellar hemispheres. The grey matter clusters they found to be associated with greenness were also positively associated with working memory and inversely with inattentiveness. In interpreting their results, the authors draw on Wilson’s Biophilia hypothesis²⁰⁷, that humans have important evolutionary bonds with nature, to speculate that such contact is likely essential for brain development. Advocates of the Biophilia hypothesis argue that green space provides children with a range of opportunities: for engagement, creativity, risk-taking, mastery and control; to bolster the sense of self; to generate positive emotions; and to enhance psychological restoration. These in turn are hypothesised to influence brain development.²⁰⁸ The authors also point to the possibility that the effects might be mediated by the fact that children in greener areas may be less exposed to traffic related air pollution and noise, more exposed to enriched microbial input and may be more physically active. All of these variables could be beneficial to brain development^{209 210 211}.

5.6.5 Crime

In addition to these effects on the individual child’s wellbeing, there are community-wide benefits of green space which are likely to promote better health and wellbeing in children. Recent innovative and multidisciplinary research points to urban green space facilitating decreased crime and violence. Controlled field trials, for example, have demonstrated the effects of green environments in improving community cohesion and reducing general crime rates. In the Chicago greening experiments, researchers have found²¹² less graffiti, vandalism, and littering in outdoor spaces with natural landscapes than in comparable plant-less spaces.

²⁰⁶ Payam Dadvand, Jesus Pujol, Dídac Macià, Gerard Martínez-Vilavella, Laura Blanco-Hinojo, Marion Mortamais, Mar Alvarez-Pedrerol, Raquel Fenoll, Mikel Esnaola, Albert Dalmau-Bueno, Mónica López-Vicente, Xavier Basagaña, Michael Jerrett, Mark J. Nieuwenhuijsen, and Jordi Sunyer. (2018). The Association between Lifelong Green space Exposure and 3-Dimensional Brain Magnetic Resonance Imaging in Barcelona Schoolchildren. *Environmental Health Perspectives*, 126:2 CID: 027012.

²⁰⁷ Kahn PH, Kellert SR. 2002. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. Cambridge, MA: MIT Press.

²⁰⁸ Kahn PH. 1997. Developmental psychology and the biophilia hypothesis: children’s affiliation with nature. *Dev Rev* 17(1):1–61.

Kahn PH, Kellert SR. 2002. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. Cambridge, MA: MIT Press.

²⁰⁹ Fedewa AL, Ahn S. 2011. The effects of physical activity and physical fitness on children’s achievement and cognitive outcomes. *Res Q Exerc Sport* 82(3):521–535.

²¹⁰ Rook GA. 2013. Regulation of the immune system by biodiversity from the natural environment: an ecosystem service essential to health. *Proc Natl Acad Sci USA* 110(46):18360–18367.

²¹¹ Sunyer J, Esnaola M, Alvarez-Pedrerol M, Forn J, Rivas I, López-Vicente M, et al. 2015. Association between Traffic-related air pollution in schools and cognitive development in primary school children: a prospective cohort study. *PLoS Med* 12(3):e1001792.

²¹² Kuo, F. E., & Sullivan, W. C. (2001). Environment and Crime in the Inner City: Does Vegetation Reduce Crime? *Environment and Behavior*, 33(3), 343–367.

In these “natural experiments”, applicants for public housing were assigned to individual apartments without regard to the level of nearby vegetation. For low-rise public housing projects with similar residents, police reports indicated that those areas with nearby trees and natural landscapes, had 25% fewer acts of domestic aggression and violence, 52% fewer total crimes, 48% fewer property crimes, and 56% fewer violent crimes than buildings with low amounts of vegetation. The researchers’ subsequent multiple regression analyses, taking account of other potential predictors of crime rates, confirmed that vegetation levels remained a significant predictor of crime.

In Philadelphia, a policy of greening vacant lots produced significant reductions in gun assaults and vandalism, while residents reported less stress and higher exercise levels. These findings resulted from a decade long follow-up study²¹³ analysing differences in crime rates in areas surrounding matched groups of randomly selected treated and untreated vacant lots. Some of the beneficial effects reported are almost certainly due to improved social relations and the attendant social cohesion promoted by regular use of shared spaces. Conversely, a shortage of green space has been linked to feelings of loneliness and lack of social support.

Several similar interventions to increase the amount of vegetation in blighted urban spaces have provided the opportunity for researchers to compare crime rates before and after greening or areas with and without such treatments. An evaluation of a program in the U.S. city of Portland to increase “green infrastructure” was conducted²¹⁴ using appropriate statistical techniques to determine whether an increase street trees resulted in reduced violent crime in the years following the plantings. After taking account of possible confounding variables - results indicated that the more trees that were planted the lower the rates of violent crimes in the following years. The effect was more marked in low income neighbourhoods, suggesting that increasing tree cover in disadvantaged neighbourhoods may be on means of reducing crime.

The “Lots of Green” program in Youngstown, U.S., a city suffering from the effects of de-industrialisation, involved two types of vacant lot treatments: a cleaning and greening ‘stabilisation’ treatment and a ‘community reuse’ treatment, mostly involving community gardens. In the former case, the treatment involved removal of debris, the addition of topsoil and grading, grass seeding and tree planting, a split rail fence and regular maintenance. The community reuse initiative required resident groups to apply for funding to establish community gardens, urban farms and orchards in addition to native plantings or setting up sporting fields. The effectiveness of these greening treatments was evaluated²¹⁵ by comparing crime rates in and around newly treated lots and the rates around randomly selected and matched, untreated vacant lot controls. After adjusting for various socio-demographic factors, the results showed significant and widespread reductions in all types of crime, except motor vehicle thefts. Of note, is the fact that the community re-use treatment resulted in a consistent reduction in violent crimes.

²¹³ Branas, C. C., Cheney, R. A., MacDonald, J. M., Tam, V. W., Jackson, T. D., Ten Have, T. R. (2011). A difference-in-differences analysis of health, safety, and greening vacant urban space. *American Journal of Epidemiology*, 174, 1296–1306.

²¹⁴ Donovan, H. G., Prestemon, P. J. (2010). The effect of trees on crime in Portland, Oregon. *Environment and Behavior*, 20(10), 1–28.

²¹⁵ Kondo, M., Hohl, B., Han, S., & Branas, C. (2016). Effects of greening and community reuse of vacant lots on crime. *Urban Studies*, 53(15), 3279– 3295.

Whether there are similar benefits to greening neighbourhoods in Australia is not clear, since there appear to be no comparable studies. However, a Perth study²¹⁶ of the influence of compliance with planning guidelines designed to increase “walkability” found that higher tree density on footpaths and better park access were linked to lower crime rates overall. Violent crime rates were not separately reported.

A cross sectional, epidemiological study²¹⁷ in a midsized U.S city confirms the relationship between vegetation and reduced crime. The authors used spatial lag analyses to test the link between tree canopy coverage, measured through high-resolution aerial imagery, and rates of violent (murder, rape, robbery and assault), property (burglary, theft, motor vehicle theft and arson) and total crimes. They found that greater tree canopy coverage was associated with lower rates of violent, property and total crime, independent of block group level educational attainment, median household income, racial and ethnic composition, population density, vacancies and renter-occupied housing.

A recently published systematic review²¹⁸ of studies in the field confirmed that, despite differences in study design and measurement which made direct comparisons difficult, the evidence supports the finding of a positive impact of green space in reducing violence and crime.

Among the suggested reasons for these reductions in crime is the possibility that greener spaces mean more people are spending time outdoors – “eyes on the street”. Children, for example, have been found to be more likely to play and to have adult supervision in green inner-city neighbourhood spaces than in similar, barren areas²¹⁹. Also at work may be the mitigation of some of the psychological precursors of violence, such as stress and mental fatigue, which potentiate outbursts of violence. Supportive of this thesis is the finding that aggressive behaviour in adolescents is most likely in environments with the least green space²²⁰. Younan and her colleagues sampled a multi-ethnic cohort of children aged 9-18 years and had parents report the children’s aggressive behaviours over several years. The amount of vegetation to which each child was exposed was assessed using the NDVI, deriving both short term and cumulative measures. The study showed that both short term (1-6 month) and long term (1-3 year) exposures to green space within 1000 metres of the children’s homes were associated with reduced aggressive behaviour, and sociodemographic factors, neighbourhood quality and local temperature did not modify these associations.

²¹⁶ Sarah Foster, Paula Hooper, Matthew Knuiman, Fiona Bull, Billie Giles-Corti, Are liveable neighbourhoods safer neighbourhoods? Testing the rhetoric on new urbanism and safety from crime in Perth, Western Australia, *Social Science & Medicine*, Volume 164, 2016, Pages 150-157,

²¹⁷ K. Gilstad-Hayden, L.R. Wallace, A. Carroll-cott, S.R. Meyer, S.Barbo, C. Murphy-Dunning, *et al.* Research note: Greater tree canopy cover is associated with lower rates of both violent and property crime in New Haven, CT *Landscape and Urban Planning*, 143 (2015), pp. 248-253.

²¹⁸ Bogar, S., & Beyer, K. M. (2016). Green Space, Violence, and Crime: A Systematic Review. *Trauma, Violence, & Abuse*, 17(2), 160–171.

²¹⁹ Taylor, A. F., Wiley, A., Kuo, F. E., & Sullivan, W. C. (1998). Growing up in the inner city: Green spaces as places to grow. *Environment and Behavior*, 30, 3-27

²²⁰ Diana Younan, Catherine Tuvblad, Lianfa Li, Jun Wu, Fred Lurmann, Meredith Franklin, Kiros Berhane, Rob McConnell, Anna H. Wu, Laura A. Baker, Jiu-Chiuan Chen, Environmental Determinants of Aggression in Adolescents: Role of Urban Neighborhood Green space, *Journal of the American Academy of Child & Adolescent Psychiatry*, Volume 55, Issue 7, 2016, Pages 591-601,

5.6.6 Summary

It seems that exposure to natural environments is particularly important for children's development, since such environments provide children with unique opportunities for engagement, discovery, risk-taking, creativity, mastery, and control, and for strengthening the child's sense of self; in addition, they also may trigger emotional states (including a sense of wonder and joy) and enhance psychological restoration, all of which may positively influence cognitive development and attention.

Proximity to green spaces may also benefit cognitive development through *indirect* mechanisms involving increased physical activity, reduced exposure to air and noise pollution as well as through exposure to an enriched microbial environment. Generally speaking, for children as for adults, contact with the natural environment reduces stress, improves social behaviour and increases wellbeing. Spending time in nature appears to foster social skills, confidence and self-esteem in children²²¹ and may make them calmer and less aggressive²²². There is also evidence that they may, in the future, be more likely to take environmentally responsible actions²²³.

The surveys suggest that fewer and fewer children play in nature and the area around homes where children are allowed to play, work and explore has declined dramatically in the last 40 years. More backyards are being built over and trees removed including in our cities, making local parks and bushlands that much more important.

When children have easy access to areas such as parks, playgrounds and bush that can be used by for play and physical activity, multiple benefits accrue – children can interact with nature, play creatively, socialise with others and develop independence and confidence in being in an outdoors environment and independent of their parents²²⁴. Converging bodies of evidence make clear that these opportunities result in better physical and mental health than when children have little opportunity to spend time in nature.

6. THE BUILT ENVIRONMENT

The design of the built environment is an important influence on children's health. In addition to the features already outlined above, a major Australian review of the relevant literature on the nature and extent of the influence of the built environment identified the impacts on activity levels, social interactions and healthy food options as most important outcomes to consider in designing urban environments which reduce the risk of chronic diseases in adults. Similar factors are likely to influence children's wellbeing and development.²²⁵

²²¹ Weinstein, N., Przybylski, A. K., & Ryan, R. M. (2009). Can nature make us more caring? Effects of immersion in nature on intrinsic aspirations and generosity. *Personality & social psychology bulletin*, 35(10), 1315–29.

²²² Kuo F.E and Sullivan WC (2001). Aggression and Violence in the inner city: Effects of Environment via Mental Fatigue. *Environment and Behaviour* 33(4): 543-571;.

²²³Every Child Outdoors. *RSPB*, http://www.rspb.org.uk/Images/everychildoutdoors_tcm9-259689.pdf97.

²²⁴ Muñoz, S. A. (2009). Children in the outdoors: a literature review. Sustainable Development Research Centre. <http://www.countrysiderecreation.org.uk/Children%20Outdoors.pdf> (Volume 4)

²²⁵ Christian, H., Zubrick, S., Foster, S., Giles-Corti, B., Bull, F., Wood, L., Knuiman, M., Brinkman, S., Houghton, S., Boruff, B., (2015). The influence of the neighborhood physical environment on early child health and development: A critical review and call for research. *Health & Place* 33, 25–36.

There is a well-established link between the composition of the built environment and children's activity levels, which are in turn predictive of their general health. Reviews of the influences on children's physical activity and play indicate that features of the built environment such as walk and bicycle paths, the presence of cul de sacs, traffic flows and public transport are all important to varying degrees^{226 227}. Similarly, the design of the built environment can either help or hinder social interaction. For example, in neighbourhoods with high street traffic, children's opportunities for independent play and interaction with other children may be seriously compromised, with the attendant diminution in their social-emotional development²²⁸.

6.1 Housing

For most people, their home is a special place. Not only is it where people typically spend most of their time; it is also where they interact with their families and friends. Unsurprisingly, the quality of housing is a key determinant of children's health and wellbeing^{229 230}. Since they spend a large proportion of their time at home, young children seem to be acutely vulnerable to the type and quality of their housing. Poor child health and compromised development have been found to be associated with: overcrowding, insecure tenancy, poor ventilation and air quality, exposure to pollutants, structural deficiencies, hazards and noise^{231 232 233 234}.

6.1.1 Housing quality

The importance of 'stable, adequate shelter' for children's health and wellbeing is broadly recognised and is one of the Australian Headline Indicators (Section 3) designed to capture and monitor the 'health, development and wellbeing' of Australian children. Despite the fact that the relationships between housing and wellbeing are complex and the dynamics of housing's effects on wellbeing are still poorly understood, there have been many studies both locally and internationally which attempt to quantify the importance of 'adequate' housing.

Clearly, adequacy is multi-dimensional. For example, in their approach, McNamara and her colleagues in Australia²³⁵ identified four main characteristics of adequate housing from the relevant research literature: overcrowding; housing stress (based on the percentage of a household's income spent on housing); dwelling type; and public housing tenure. Past research has pointed to all of these features being important for child health and wellbeing.

²²⁶ K. Pont, J. Ziviani, D. Wadley, S. Bennett, R. Abbott Environmental correlates of children's active transportation: a systematic literature review *Health Place*, 15 (3) (2009), pp. 849-862.

²²⁷ G.W. Heath, R.C. Brownson, J. Kruger, R. Miles, K.E. Poewll, L.T. Ramsey, *et al.* The built environment: designing communities to promote physical activity in children *Pediatrics*, 123 (6) (2009), pp. 1591-1598.

²²⁸ A.D. Pellegrini Research and policy on children's play *Child Dev. Perspect.*, 3 (2) (2009), pp. 131-136.

²²⁹ Bonnefoy, X., 2007. Inadequate housing and health: an overview. *International Journal of Environment and Pollution*, 30 (3-4), 411-429.

²³⁰ Wells, N.M., Evans, G.W. and Yang, Y. (2010). Environments and Health: Planning Decisions As Public-Health Decisions, *Journal of Architectural and Planning Research*, 27(2), 124-143.

²³¹ Leventhal, T., and Newman, S., 2010. Housing and child development. *Children and Youth Services Review*, 32, 1165-1174.

²³² Ormandy, D., 2013. Housing and child health. *Paediatrics & Child Health*, 24 (3), 115-117.

²³³ Gascon, M., Vrijheid, M., and Nieuwenhuijsen, M.J., 2016. The built environment and child health: an overview of current evidence. *Current Environmental Health Reports*, 3 (3), 250-257.

²³⁴ Weitzman, M., et al., 2013. Housing and child health. *Current Problems in Pediatric and Adolescent Health Care*, 43, 187-224.

²³⁵ Justine McNamara, Rebecca Cassells, Philippa Wicks & Yogi Vidyattama (2010) Children in Housing Disadvantage in Australia: Development of a Summary Small Area Index, *Housing Studies*, 25:5, 625-646.

For instance, poor design and construction of housing appears to generate a range of direct and indirect health effects, including accidents, placing children at particular risk. Poor heating, insulation, ventilation and plumbing are all associated with poorer health and higher illness rates²³⁶. When children live in poor housing, the spread of infection is accelerated, whether as a result of unhygienic or poorly functioning water supplies and sanitation technology; poor ventilation; damp and mould; and extremes of temperature²³⁷. Housing in poor repair also provides more breeding sites for disease causing vermin, and the absence of places to safely store and prepare food safely puts children at greater risk of diarrhoeal diseases.

In an Australian study²³⁸, Dockery and his colleagues, using LSAC data, examined the association between housing quality and various child developmental outcomes - physical and socio-emotional health and cognition. They found that children's physical health and socio-emotional functioning was worse when their family moved frequently, were renters, when the condition of the houses were poor and when they lived in areas of high disadvantage. Children living on farms were significantly healthier, as were children who resided in "liveable" neighbourhoods with adequate facilities. For the cognitive measures, renting, poor condition of the house, living in public housing and a poorer neighbourhood environment – including low SES – were associated with diminished cognitive performance. However, the authors concluded, that given the relatively small effect sizes, "the role of housing in shaping children's development and wellbeing is really quite modest" (p 51).

However, the authors stressed that housing does seem to play an important role in the disadvantage faced by particular groups, such as the children of sole parents and Indigenous children. Separate analysis of Indigenous children's health and wellbeing, showed generally poorer outcomes for the children. The main contributors to poorer physical health were lower levels of liveability in their neighbourhoods and poorer condition of their houses. Living in public housing and overcrowding contributed to both poorer social and emotional functioning and learning. Inadequate housing is contributing to poor indigenous health in Australia, with both degraded housing conditions and overcrowding clearly being implicated. However, it should be noted that among Indigenous people, larger households may sometimes increase social connectivity and have been associated with better behavioural and emotional outcomes for children²³⁹.

Generally, including in international studies, overcrowding is identified as damaging to children's health²⁴⁰. Overcrowding means increased contact between residents, boosting the spread of infections, especially respiratory disease and scabies. It also contributes directly to

²³⁶ Bridge, C., Flatau, P., Whelan, S., Wood, G. & Yates, J. (2007). How does housing assistance affect employment, health and social cohesion? Australian Housing and Urban Research Institute Research and Policy Bulletin, Issue 87, March.

²³⁷ Shaw M. Housing and Public Health. (2004). *Annual Review Public Health*, 25:397–418.

²³⁸ Dockery, A. M., Ong, R., Colquhoun, S., Li J. H., & Kendall, G. (2013). *Housing and children's development and wellbeing: evidence from Australian data* (AHURI Final Report No. 201). Melbourne: AHURI, www.ahuri.edu.au/_data/assets/pdf_file/0015/2067/AHURI_Final_Report_No2.

²³⁹ Zubrick, S.R., Silburn, S., De Maio, J., Shepherd, C., Griffin, J., Dalby, R., Mitrou, F., Lawrence, D., Hayward, C., Pearson, G., Milroy, H., Milroy, J. and Cox, A. (2006). *The Western Australian Aboriginal Child Health Survey: Improving the Educational Experiences of Aboriginal Children and Young People*, Curtin University of Technology and Telethon Institute for Child Health Research, Perth.

²⁴⁰ Marsh, A., Gordon, D., Heslop, P. & Pantazis, C. (2000) Housing deprivation and health: a longitudinal analysis, *Housing Studies*, 15(3), pp. 411–428.

psychological distress and compromised cognitive development and learning in children²⁴¹. Overcrowding may also affect children's health and wellbeing via their parents – increasing tensions and family arguments and fighting²⁴². Increased contact is likely to raise the stress levels among those living in close quarters²⁴³, resulting in poor mental health overall (see above). In many communities, the effects of overcrowding and poor household infrastructure may combine to produce poorer outcomes than each effect considered in isolation.

6.1.2 High-rise living

It has been argued that high-rise living too may be inimical to children's health and wellbeing, although the extent of the harm may hinge on the design of the buildings and the availability of nearby open space. It is still relatively unusual for families raising children to live in private, high-rise, housing in Australian cities; however, all the signs are that this phenomenon will increase, including in Perth. In 2011, approximately 50,000 families with children lived in high-rise apartments in Australia. By 2016, the number had increased to 79,000 families (an increase of over 56% in the five years between censuses). It perhaps needs to be pointed out, that most of these dwellings were designed for professionals and retirees without children and have been said to ignore the needs of children and families²⁴⁴.

It is not yet clear what effects such high-rise living is having and will have on children in Australia. There is relatively little research on the impact of high-rise living on children and their families and much of it has been undertaken in Asian cities²⁴⁵, which are not directly comparable with Australia, and much of the focus has been on disadvantaged families in high-rise public housing, not necessarily typical of all those who will, in future, live in high-rise. Nonetheless, evidence is indicative of detrimental effects to both physical and mental health. Children living in high-rise, for example, are more prone to falls and show more mental health problems, perhaps because they are more socially isolated.

A 2001 review of 63 studies, up to that date, of children living in high-rise buildings found both direct and indirect effects on the children's mental health. Children in high-rise housing exhibited more behavioural problems and had less access to outdoor play spaces, the latter being a strong predictor of children's stress and poor-socio-emotional development.²⁴⁶ The author described high-rise, multiple dwelling units as being "inimical" to the psychological wellbeing of mothers with young children and possibly to the young children themselves. These effects were reported to be particularly marked among low-income families. These conclusions are consistent with Gifford's²⁴⁷, after he reviewed a sample of studies: that

²⁴¹ Phibbs, P. & Young, P. (2005) Housing Assistance and Non-Shelter Outcomes. Australian Housing and Urban Research Institute Final Report No. 74, Melbourne.

²⁴² Robinson, E. & Adams, R. (2008) Housing stress and the mental health and wellbeing of families. AFRC Briefing Number 12, 2008. Australian Family Relationships Clearinghouse.

²⁴³ Lepore SJ, Evans GW, Palsane MN. (1991) Social hassles and psychological health in the context of chronic crowding. *Journal of Health and Social Behavior*, 32:357–367.

²⁴⁴ Whitzman, C. and Mizrahi, D. (2009). Vertical living kids: creating supportive high rise environments for children in Melbourne, Australia. Melbourne: VicHealth, A report for the Victorian Health Promotion Foundation.

²⁴⁵ Yeh, A. and Yuen, B., 2011. Introduction: high-rise living in Asian cities. In: B. Yuen and A. Yeh, eds. *High-rise living in Asian cities*. Netherlands: Springer, 1–8.

²⁴⁶ Evans, G.W., Saltzman, H., and Cooperman, J.L., (2001). Housing quality and children's socioemotional health. *Environment and Behavior*, 33 (3), 389–399.

Evans, G.W., Wells, N.M., and Moch, A., (2003). Housing and mental health: a review of the evidence and a methodological and conceptual critique. *Journal of Social Issues*, 59 (3), 475.

²⁴⁷ Robert Gifford (2007) The Consequences of Living in High-Rise Buildings, *Architectural Science Review*, 50:1, 2-17

behaviour problems were more common among children living in high-rise apartments than among children living in other housing types.

While most of the studies which have been conducted are cross-sectional in design and based on parental (usually maternal,) self-report, there are some studies which were natural experiments, taking the opportunities provided by situations in which tenants were randomly assigned to dwellings. In one such study, families were assigned to housing on the basis of their position on a waiting list. Those children who moved to a large 14-story public housing showed more behavioural problems than their counterparts living in three-story public housing²⁴⁸.

Some of the characteristics of high-rise living which might account for these problems were investigated in a Glasgow study²⁴⁹ which compared health and social outcomes for high-rise residents in deprived social housing areas with similar residents in other dwelling types. Over 5000 participants from high-rise flats (6 storeys or more), other flats and houses, were interviewed. Statistical analysis (logistic regression), controlling for a variety of socio-demographic characteristics, was undertaken. While the study did not specifically focus on children, overall, outcomes were better for those living in houses than flats of any kind; those living in low rise flats were better off than those in high-rise. For all the indices of housing quality (e.g. dissatisfaction, space, noise, security, condition), the outcomes were worse for those living in high-rise than in other flats and houses. When results for the flat occupants on the fifth floor and below were examined, poor outcomes were still more likely for high-rise than for other flats. Anti-social behaviour was more often reported by high-rise residents and occupants of high-rise were twice as likely to perceive poor social cohesion in their local area, to have infrequent contact with their neighbour and to be without social support of any kind.

Several investigators have speculated that mental health problems of both the mothers and children may be due to such isolation and diminished social interaction; it is difficult to let children play outside without supervision and playgrounds and public spaces normally serve as important gathering places for young children and their families. In studies conducted in the Western Australia, parents of young children in high-rise have been found to keep their children indoors more than other parents, apparently due to their concerns about safety difficulties of supervision at a distance. This has been suggested to result in heightened family conflict; slower social development of the children; and more isolation for parents, unable to get to know their neighbours (or other parents). On the other hand, when parents in poor neighbourhoods in Melbourne were asked about the health-impairing aspects of where they lived, those living on high-rise estates were more likely than those living in low-rise to nominate being unable to avoid the habits and incivilities of others in close, proximal, shared spaces and to report generally feeling unsafe²⁵⁰.

An attempt to throw light on this question was undertaken by researchers in Melbourne, where high-rise apartment living for children has been increasing. The study was supported by the City of Yarra where high-rise housing had increased significantly (from 6% of dwellings in 2006 to 37% in 2016). The City had noted that, over the same period, children's health in

²⁴⁸ Saegert S (1982) Environments and children's mental health: Residential density and low income children. In A Baum and JE Singer (Eds.), *Handbook of psychology and health*. Hillsdale, NJ: Erlbaum, pp. 247-271.

²⁴⁹ Ade Kearns, Elise Whitley, Phil Mason & Lyndal Bond (2012) 'Living the High Life'? Residential, Social and Psychosocial Outcomes for High-Rise Occupants in a Deprived Context, *Housing Studies*, 27:1, 97-126.

²⁵⁰ Warr, D., Tacticos, T., Kelaher, M. & Klein, H. (2007) 'Money, stress, jobs': residents' perceptions of health-impairing factors in 'poor' neighbourhoods, *Health & Place*, 13(3), pp. 743-756.

the City seemed to be declining: the Australian Early Development Census data noted that 11% of those of school starting age were developmentally at risk in 2012, rising to 6% in 2015 contrary to the general trend in Victoria.

The study was designed to examine parents' and children's experiences of high-rise living and to examine the implications of their findings for children's health. The situation of parents and their preschool age children living in private, high-rise housing (three storeys or more) was explored using a participatory research method, Photovoice. This entailed parents (ten) photographing those aspects of the neighbourhood and their situation which they perceived as having both positive and negative effects on how they were able to raise their children. In order to determine the key themes depicted in the photographs, parents were then interviewed, both individually and in groups. Three themes emerged from the interviews and photographs: (1) space (2) density and (3) design of housing complexes. As well as worry about safety - potentially dangerous design of features in car parks, apartment windows and balconies were highlighted- many parental concerns related to the lack of dedicated, child friendly outdoor play and communal spaces, excessive noise and limited access to daylight, all of which have been associated with poor child health²⁵¹. As outlined in Section 5.3, exposure to noise pollution has been linked to hyperactivity, emotional and conduct problems in children, while a lack of exposure to natural light is linked to obesity, myopia and contributes to low Vitamin D levels²⁵².

6.2 Density

In Australia, over 90% of us live in urban neighbourhoods; and around 74% of West Australian children live in cities. This number is expected to increase in the coming decades. To accommodate growing populations, cities can either spread out (expanding housing in the outskirts), and/or become denser (e.g. build more houses per block, more apartment buildings and high-rises within the current boundaries). Systematic evidence which enables a comparison of the effects of high and low density urban development is, unfortunately, sparse. Density in this context typically refers to the number of dwellings or people per unit of land area, although the precise boundaries of high, medium and low density are rarely specified in the research.

Low density urban sprawl has been suggested as one of the contributors to modern life-style diseases such as obesity. Low density is typically associated with reduced access to public transport, local shops and services compared to denser, typically inner-city areas. In Australia, those who live on the outskirts of our cities also tend to have lower incomes and are more likely to suffer various forms of disadvantage – the so-called “suburbanisation” of disadvantage. Adults have to spend more money and time to travel the longer distances from home to get to work and the services they need. In the absence of adequate public transport, getting around necessarily means driving by car, which has serious long-term implications for adult's health, with extended sitting in a confined space and less time for exercise. For children, long commutes mean their parents may be less available, tired and stressed, making less quality time available for the family, including to prepare nutritious meals. It has been

²⁵¹ Ergler, C.R., Kearns, R.A., and Witten, K., (2013). Seasonal and locational variations in children's play: implications for wellbeing. *Social Science & Medicine*, 91, 178–185.

²⁵² A. Pirrone, T. Capetola, E. Riggs, A. (2013). Renzaho Vitamin D deficiency awareness among African migrant women residing in high-rise public housing in Melbourne, Australia: a qualitative study *Asia Pac. J. Clin. Nutr.*, 22 (2): 292-299

estimated that in many cities each week 10% parents spend more time commuting than they do with their children^{253 254}.

Making cities more dense has been seen as the antidote to these, and other, problems associated with urban sprawl. Some have argued for the need for ‘compact cities’, with “short distances that promote increased population density, mixed land use, proximate and enhanced public transport, and an urban form that encourages cycling and walking”²⁵⁵. Denser neighbourhoods may be associated with increased active transport (e.g. walking, cycling) due to the closer proximity of shops, facilities, work and schools which result in benefits to the incidence of major “lifestyle” diseases²⁵⁶.

The relationships between density levels and patterns of children’s activity and play are less certain, although the evidence on high-rise living points to reduced levels of independent activity and play with high-rise density. However, some studies have found that children are more independently mobile, including walking to school, in more “walkable” neighbourhoods²⁵⁷, although higher perceived traffic levels may reduce this effect²⁵⁸. The availability of other facilities and services in the area may also influence children’s activity levels; nearby public transport, schools, shops, services and open space are important.

There is, in addition, continuing debate about the effects of increasing density on such things as noise, air pollution, traffic accidents and perceived safety. Paradoxically, urban intensification may lead to increased concentrations of traffic, worsening the local environment in those locations where it occurs²⁵⁹. Many of the high density developments in Australia are located along busy and polluted roads (a drive along Perth’s Mitchell Freeway is informative) which are clearly a threat to health, particularly for children. There is some evidence²⁶⁰ of increased risk of pedestrian injuries for children in higher density areas and asthma rates appear to be higher²⁶¹.

Living in close proximity with others may also increase urban stress, (e.g. noise pollution, vandalism, crime, lower quality housing), producing poorer health outcomes. For children and adolescents, closer proximity to shops and facilities includes increased proximity to tobacco and alcohol outlets which might stimulate smoking or drinking behaviour²⁶². Although Australian cities are markedly less dense than those in Europe, evidence from densely populated areas in Europe suggests negative health consequences from increased population density for several health outcomes, including increased mortality from heart disease, lung

²⁵³ Flood, M., & Barbato, C. (2005). *Off to work. Commuting in Australia*. Sydney: The Australia Institute.

²⁵⁴ Strazdins, L., Shipley, M., & Broom, D. H. (2007). What does family-friendly really mean? Wellbeing, time, and the quality of parents’ jobs. *Australian Bulletin of Labour*, 33 (2), 202 -225.

²⁵⁵ Giles-Corti, B., Vernez-Moudon, A., Reis, R., Turrell, G., Dannenberg, A.L., Badland, H., Foster, S., Lowe, M., Sallis, J.F., Stevenson, M., Owen, N., 2016. City planning and population health: a global challenge. *Lancet* 388, 2912–2924.

²⁵⁶ Sallis, J.F., Bull, F., Burdett, R., Frank, L.D., Griffiths, P., Giles-Corti, B., Stevenson, M., 2016. Use of science to guide city planning policy and practice: how to achieve healthy and sustainable future cities. *Lancet* 388, 2936–2947.

²⁵⁷ Kerr J, Rosenberg D, Sallis JF, Saelens BE, Frank LD, Conway TL. Active commuting to school: associations with environment and parental concerns. *Med Sci Sport Exer* 2006; 38(4):787-793.

²⁵⁸ Giles-Corti B, Wood G, Pikora T, Learnihan V, Bulsara M, Van Niel K, et al. School site and the potential to walk to school: the impact of street connectivity and traffic exposure in school neighborhoods. *Health Place* 2011; 17(2):545-550.

²⁵⁹ Melia, S., Parkhurst, G., Barton, H., 2011. The paradox of intensification. *Transp. Policy*,18, 46–52.

²⁶⁰ Frumkin H, Frank L, Jackson R. *Urban sprawl and public health. Designing, planning and building for healthy communities*. Washington, DC: Island Press, 2004.

²⁶¹ Broms K, Norback D, Eriksson M, Sundelin C, Svardsudd K. Effect of degree of urbanisation on age and sex-specific asthma prevalence in Swedish preschool children. *BMC Public Health* 2009; 9:303-313.

²⁶² Finan, L.J., Lipperman-Kreda, S., Abadi, M., Grube, J.W., Kaner, E., Balassone, A., Gaidus, A., 2018. Tobacco outlet density and adolescents’ cigarette smoking: a meta-analysis. *Tob. Control*.

cancer and chronic obstructive pulmonary disease²⁶³ ²⁶⁴ and mental health²⁶⁵. Similar epidemiological data for children's health appears not to be available.

It has been suggested that higher density development may benefit children through increased opportunities for social interaction and better access to amenities and services. Conversely, it has been argued that greater density may also restrict children's play because of the lack of private and public indoor and outdoor space²⁶⁶. Increasing density usually means reduced private open space – backyards – which, like public open space, confer health and social benefits. Private backyards and gardens are important sites for child rearing, offering children opportunities for physical activity and play, as well as for reducing sedentary behaviour. Active play is important because it develops children's problem solving, creativity, environmental literacy, social skills, physical and cognitive development; and sense of their belonging and identity²⁶⁷ ²⁶⁸. Quite apart from the effects of the environment, limitations to active play have been linked to increases in childhood obesity, cardiovascular disease and diabetes and being overweight later in life²⁶⁹.

At the time of a review by Christian and colleagues in 2015, only five studies had assessed the impact of residential density on young children's outdoor play and physical activity with mixed results, and there were no studies on the effects of residential density (either high density living or urban sprawl) on any areas of early child development. Indeed, it is only recently that planners appear to be asking questions about the effects of various dimensions of housing and urban development on children, how any proposed changes might affect physical activity, independent mobility and active play. The UN push for "Child Friendly" cities is motivated by concern that many cities are "toxic" for children²⁷⁰, failing to nurture them and instead damaging their emotional, cognitive and physical development²⁷¹. What is clear is that urban design and planning practice in countries like Australia have not routinely taken the specific needs of children into account²⁷², and have been described as 'child blind', while also excluding children from any meaningful participation in the planning process itself²⁷³.

²⁶³ Chaix, B., Rosvall, M., Lynch, J., Merlo, J., 2006. Disentangling contextual effects on cause-specific mortality in a longitudinal 23-year follow-up study: impact of population density or socioeconomic environment? *Int. J. Epidemiol.* 35, 633–643.

²⁶⁴ Meijer, M., Keijs, A.M., Stock, C., Bloomfield, K., Ejstrud, B., Schlattmann, P., 2012. Population density, socioeconomic environment and all-cause mortality: a multilevel survival analysis of 2.7 million individuals in Denmark. *Health Place* 18, 391–399.

²⁶⁵ Sundquist, K., Frank, G., Sundquist, J., 2004. Urbanisation and incidence of psychosis and depression: follow-up study of 4.4 million women and men in Sweden. *Br. J. Psychiatry* 184, 293–298.

²⁶⁶ G.W. Evans Child development and the physical environment *Annu. Rev. Psychol.*, 57 (2006), pp. 423-451.

²⁶⁷ http://soac.fbe.unsw.edu.au/2009/PDF/Mizrachi%20Dana_Whitzman%20Carolyn.pdf.

²⁶⁸ Ergler, C. R., Kearns, R., & Witten, K. (Eds.). (2017). *Children's health and wellbeing in urban environments*. Abingdon, UK: Routledge.

²⁶⁹ Schoeppe, S., Duncan, M., Badland, H., Oliver, M., & Browne, M. (2014). Associations between children's independent mobility and physical activity. *BMC public health*, 14(91), 1-9.

²⁷⁰ Gleeson, B., and N. Sipe. 2006b. "Reinstating Kids in the City." In *Creating Child Friendly Cities*, edited by B. Gleeson and N. Sipe. London: Routledge

²⁷¹ Spencer, C., and H. Woolley. 2000. "Children and the City: A Summary of Recent Environmental Psychology Research." *Child: Care, Health and Development* 26 (3): 181–198. McDonnell, J.R. 2007. "Neighborhood Characteristics, Parenting, and Children's Safety." *Social Indicators Research* 83 (1): 177–199.

²⁷² Gleeson, B., and N. Sipe, eds. 2006a. *Creating Child Friendly Cities: Reinstating Kids in the City*. London: Routledge
Randolph, B. 2006. *Children in the Compact City: Fairfield as a Suburban Case Study*. Sydney: Australian Research Alliance for Children and Youth.

²⁷³ Freeman, C., and P. Tranter. 2011. *Children and their Urban Environment: Changing Worlds*. London: Earthscan.

7. PLACE ATTACHMENT

Children, like adults can become attached to the places in which they live, and such attachments may be an important part of the process of identity formation. Conversely, the disruption of such attachments may be detrimental to their psychological functioning. The sense of belonging to a particular place is fundamental to how they understand who they are: the country, region, city, neighbourhood or town where they grew up; the house(s) in which they lived; the schools they attended; the shops they visited; and the 'special' places where they played and developed friendships are all likely to form essential components of their identity and to underpin their feelings of security and belonging.

The concept of "place attachment" was developed to describe these bonds, and while there is no single, agreed definition of place attachment, it is broadly characterised as an emotional bond between people and their environments^{274 275}. It is seen as multidimensional, with a distinction often being made between emotional or symbolic attachments to a place - place identity - and functional or physical attachments – place dependence²⁷⁶.

It is thought that children's attachment to place develops when their attachments to their caregivers (usually parents) are generalised to their nearby physical environments such as their homes and neighbourhood²⁷⁷. It is supposed that as children explore their environments and become more mobile and self-sufficient the scale of these attachments will expand²⁷⁸.

Attachments to place formed during childhood may also be stronger than those formed later in life, but are only possible when children live long enough in one place. Common themes which emerge when children are asked about their valued places indicate a clear preference for natural over manmade environments, for exploration and play. Places to which children become attached include outdoor nature spaces, built structures (e.g., a porch or shed) adapted by children for their own uses, their bedrooms and homes, community service and retail settings (e.g., libraries), and places built intentionally for play (e.g., tree house, sport settings, playgrounds, and parks)²⁷⁹.

Research with children and young people has repeatedly shown that place, identity and wellbeing are often closely connected^{280 281 282}, and disruptions to place attachment either through moving home or natural disasters can cause significant emotional difficulties. Feelings of belonging tend to be strongest amongst young people who perceive that they

²⁷⁴ Brown G, Raymond C (2007). The relationship between place attachment and landscape values: towards mapping place attachment. *Appl Geogr* 27:89–111.

²⁷⁵ Jorgenson BS, Stedman RC (2001) Sense of place as an attitude: lakeshore owner's attitude towards their properties. *J Environ Psychol* 21:233–248.

²⁷⁶ Williams DR, Vaske JJ (2003). The measurement of place attachment: validity and generalizability of a psychometric approach. *For Sci* 49:830–841.

²⁷⁷ Jack, G. 2008. "Place Matters: The Significance of Place Attachments for Children's Wellbeing." *British Journal of Social Work* 40: 755–771.

²⁷⁸ Hay, R. (1998). Sense of place in developmental context. *Journal of Environmental Psychology*, 18, 5– 29.

²⁷⁹ Korpela, K.M., Kytta, M., & Hartig, T. (2002). Children's favorite places: Restorative experience, self-regulation and children's place preferences. *Journal of Environmental Psychology*, 22, 387– 398.

²⁸⁰ Chawla, L. (1992). Childhood place attachments. *Human Behavior & Environment: Advances in Theory & Research*, 12, 63– 86.

²⁸¹ Green A. E., White R. J. (2007). *Attachment to Place: Social Networks, Mobility and Prospects of Young People*. York Joseph Rowntree Foundation.

²⁸² Irwin L. G., Johnson J. L. Henderson, A. Dahinten, V. S., Hertzman C. (2007). Examining how contexts shape young children's perspectives of health. *Child: Care, Health and Development*, 23 (4), 353 – 9.

have been fully included and accepted within their local community, or who have close connections through local ancestry.

7.1 Place disruption – Natural disasters

Disruption from natural disasters, in particular, can cause disorientation and distress and in some, long-term psychological consequences^{283 284}. Most disasters, by definition, destroy valued places and those most at risk live in country areas and on the urban fringes. Losing their homes, schools, natural and built recreation areas, and other community places, can be particularly painful for children. In Australia assessment of children's wellbeing following catastrophic bushfires has indicated increases in depression, separation anxiety and concerns about safety as well as a tendency to re-experience the events. In adolescents, additional problems are evident: substance abuse, increased risk-taking, aggressive behaviour and incoherent thinking.²⁸⁵ A small number of studies have also documented cognitive deficits in children exposed to natural disasters²⁸⁶. For example, following the Victorian bushfires, comparisons were made between the achievement levels of children in high, medium and low-disaster affected primary schools. In reading and numeracy, the expected gains from years 3 to year 5 scores were lower in schools with higher levels of bushfire impact. To what extent these adverse consequences follow from the trauma inherent in experiencing such a disaster and how much to the disruption of place attachment is almost impossible to determine because of the lack of information about place attachment among these children prior to the disaster.

Follow up interviews with children, young people and their parents four to five years after these same bushfires Victoria in 2009 revealed significant dislocation and disruption in every aspect of their lives²⁸⁷. Although the conclusion is based on informal interpretation of the content of the interviews, the authors claimed that among these interviewees, a strong sense of place made attempts to restore familiar social and physical environments more likely.

Some disruptions to place attachment are more gradual than those which occur in catastrophic natural disasters; for example, in the landscape changes due to mining or development or because of severe drought. One in-depth exploration among Canadian First Nations young people living in an intensive oil and gas extraction area revealed considerable distress because of the changes to the physical environment and the attendant disruption of their relationships and cultural practices (Spyce reported in Scannell). The young people were particularly concerned about the loss of habitat and wild animals, the impacts of forestry, and the effects of climate change, and saw these changes as disrupting their place attachments. They reported that they were less able to practice their traditional food-gathering and cultural practices, resulting in a loss of traditional knowledge. Similar sentiments are often expressed

²⁸³ Fothergill, A., & Peek, L. (2015). *Children of Katrina*. Austin: University of Texas Press.

²⁸⁴ Scannell, L., Cox, R. S., Fletcher, S. and Heykoop, C. (2016), "That was the Last Time I Saw my House": The Importance of Place Attachment among Children and Youth in Disaster Contexts. *American Journal of Community Psychology*, 58: 158-173.

²⁸⁵ Fullerton, C., & Ursano, R. (2005). Psychological and psychopathological consequences of disasters. In J. J. López-Ibor, G. Christodolou, M. Maj, N. Sartorius, & A. Okasha (Eds.), *Disasters and mental health* (pp. 13-36). West Sussex: Wiley.

²⁸⁶ Parslow, R. A., & Jorm, A. F. (2007). Pretrauma and posttrauma neurocognitive functioning and PTSD symptoms in a community sample of young adults. *American Journal of Psychiatry*, 164, 509–515.

²⁸⁷ Gibbs, L., Block, K., Harms, L., MacDougall, C., Baker, E., Ireton, G., Forbes, D., Richardson, J. Waters, E. (2015). Children and young people's wellbeing post-disaster: Safety and stability are critical. *International Journal of Disaster Risk Reduction*, 14, (2)015, 195-201.

by Indigenous Australians, although I could find no research focused on children and young people's responses.

7.2 Place disruption – Dispossession

Although it is difficult to separate the many influences on the poorer health and mental health documented in many Indigenous communities and Indigenous majority communities in Australia, part of the explanation lies in the historic dispossession and the continuing disruption of connection to valued places. We know that forced removal from place and land and the destruction of heritage have been and are catastrophic for Australia's Indigenous peoples²⁸⁸. For them, people and place are inseparably intertwined. Belonging to Country is fundamental and the loss of Country results in deep harm: depression and grief. They view their world as an interconnected whole: they make no intrinsic distinction between the lands, waters, the plants and animals and the culturally significant sites and objects linked to the traditional knowledge, which lie at the heart of Indigenous culture and identity handed down through the generations. Such traditional knowledge – and identity – can only be kept alive through use and application in the Country to which it is tied. Protecting land and places and promoting cultural practices (especially languages and creative expression) are both crucial for the maintenance of traditional knowledge and wellbeing.

Connection to land and the associated cultural practices and kinship networks have been identified as important as sources of strength and protection from the many stressful circumstances which Aboriginal children experience²⁸⁹. Local research has shown that the happiest and healthiest young Indigenous Australians, with low arrest rates and good educational attainment, are those who have been able to retain a strong attachment to their culture and have a strong Aboriginal identity.²⁹⁰

Using data from the 2002 ABS National Aboriginal and Torres Strait Islander Social Survey (NATSISS) Dockery²⁹¹ investigated the link between culture, which included assessment of connections to land, and indicators of socio-economic outcomes - self-assessed health, risky behaviour and contact with the justice system. Although the study only sampled adults, the results point clearly to the likely importance of continued cultural practice and connection to Country for children. After appropriate statistical adjustment, the analysis provided strong evidence for positive effects of cultural attachment: those with strong attachment had better self-assessed health, were less likely to have consumed alcohol at risky levels or to have had contact with the justice system. The effects were most pronounced in outer regional and remote Australia.

7.3 Place disruption – Drought

The accumulated losses associated with drought appear to be similar to those resulting from fast-onset natural disasters, threatening livelihoods and incomes, but also home, lifestyle and identity. Correspondingly, adult psychological responses to drought resemble the long-term

²⁸⁸ Paradies, Y. (2016) Colonisation, racism and indigenous health, *Journal of Population Research*, 33 (1), 83-96.

²⁸⁹ Working Together: Aboriginal and Torres Strait Islander Mental Health and Wellbeing Principles and Practice (eds Pat Dudgeon, Helen Milroy and Roz Walker).2014.

²⁹⁰ West Australian Aboriginal Child Health Survey, Kalinga Research Network Report, 2004.

²⁹¹ Dockery, A. M. 2010. "Culture and wellbeing: the case of indigenous Australians." *Social Indicators Research: an international and interdisciplinary journal for quality-of-life measurement* 99 (2): 315-332.

chronic conditions which result from fast-onset disasters²⁹², particularly anxiety and depression²⁹³. Financial hardship at such times often means more work for everyone and women seeking off-farm employment, with the result that parents are less available to their children and more stressed when they are available²⁹⁴. As might be expected with any trauma, the stress related to drought is likely to flow on to families and intimate relationships.

There is little current or archival research into the specific impacts of drought on children and young people, but a recent study by UNICEF²⁹⁵ of children in drought affected areas of NSW traced some of the effects of the prolonged drought on them and their families. UNICEF reported that the everyday lives of children and young people had changed “rapidly and dramatically” increasing their workloads and leaving them too little time for schoolwork and for play, sport or other recreation. Their days were described as long and stressful and children said they felt that there was no escape from the drought since it dominated all the conversations in their families and communities.

The authors of the report were concerned at what they perceived to be the cumulative toll on the physical and mental wellbeing of the children and young people the interviewed and observed, despite their evident maturity and capacity to cope.

7.4 Summary

There are continuing and growing threats to the wellbeing of children living in rural areas and on our urban fringes. Since it is forecast that there will be more severe natural disasters and extended periods of drought, it is likely that these effects will be more noticeable in future and require careful planning by emergency and health services.

8. CONCLUSIONS

The evidence is unarguable – the environments in which children and young people live and grow up shape their lives, and not just their immediate wellbeing, but their physical and mental health and cognitive capacity in the long term²⁹⁶. Some have described many modern cities as toxic²⁹⁷ because they fail to nurture children; the built form and the resulting social dynamics of cities can restrict play and independent mobility, constrain children's social interactions²⁹⁸ and expose them to toxic physical and social environments. Children need safe, green, outdoor spaces where they can be physically active, independently mobile and play easily with their friends and families.

²⁹² Zamani, G., Gorgievski-Duijvesteijn, M., & Zarafshani, K. (2006). Coping with drought: Towards a multilevel understanding based on conservation of resources theory. *Human Ecology*, 34, 677-692.

²⁹³ Sartore, G., Kelly, B., Stain, H. J., Albrect, G., & Higginbotham, N. (2008). Control, uncertainty, and expectations for the future: A qualitative study of the impact of drought on a rural Australian community. *Rural and Remote Health Journal*, 8(3).

²⁹⁴ Alston, M., & Kent, J. (2004). *Social impacts of drought*. Wagga Wagga, NSW: Centre for Rural Social Research, Charles Sturt University.

²⁹⁵ <https://www.unicef.org.au/Upload/UNICEF/Media/Documents/Drought-Report-2019.pdf>

²⁹⁶ Sothorn, M., M. Loftin, R. M. Suskind, J. N. Udall, and U. Blecker. 1999. “The Health Benefits of Physical Activity in Children and Adolescents: Implications for Chronic Disease Prevention.” *European Journal of Pediatrics* 158 (4): 271–274.

²⁹⁷ Gleeson, B., and N. Sipe. 2006b. “Reinstating Kids in the City.” In *Creating Child Friendly Cities*, edited by B. Gleeson and N. Sipe. London: Routledge.

²⁹⁸ Spencer, C., and H. Woolley. 2000. “Children and the City: A Summary of Recent Environmental Psychology Research.” *Child: Care, Health and Development* 26 (3): 181–198. McDonnell, J.R. 2007. “Neighborhood Characteristics, Parenting, and Children's Safety.” *Social Indicators Research* 83 (1): 177–199.

Many of the adverse influences identified in this review are amenable to modification and others could be anticipated and prevented. Policy attention to the concentration of disadvantage in our outer suburbs and in some regional areas is clearly warranted. For children in urban areas, neighbourhood planning which incorporates generous public green space, adequate public transport and other recreational amenities is crucial. Building open space into residential development and routinely considering children's needs for space and play are vital in ensuring children are able to reach their full potential and enjoy their lives. For children living outside metropolitan areas, improvement in basic amenities and services would assist in improving their health and wellbeing.

Toxic environmental exposures are detrimental to children's health, yet they do not appear to enjoy priority in planning for roads and freeways or in decisions about where to locate child care centres and schools. Allowing housing developments, both public and private, to be situated in close proximity to major roads and freeways shows little regard for the known impact of noise and air pollution on children's (and adult's) health and wellbeing. Overcrowding and poor quality housing continue to limit Aboriginal children's lives and compromise their health; policy responses based on an understanding of the significance of these attributes are essential.

In Auckland, the city's stated aim for some time has been to "put children and young people first and consider their wellbeing in everything that we do". Involving children and young people in the planning process has become a major part of their planning agenda. When asked about what makes a 'good' neighbourhood, children, including in Australia, almost universally nominate having places to meet and play with friends and the ability to move safely around their neighbourhoods²⁹⁹. Across eight countries surveyed in one project, children identified places where they could play and socialise, independent mobility, and environments safe from crime and traffic risks as the most important³⁰⁰. Similarly, in the UK, having places to play was the top priority, followed by feeling safer, traffic measures, and clearing up rubbish and graffiti³⁰¹.

The research shows that when children can safely get out and about, this helps promote a sense of place, of belonging and personal identity³⁰². They can grow in independence and build up relationships in their neighbourhoods, developing the social capital which improves the quality of life for everyone³⁰³, increasing personal safety and reducing violence and victimisation.

For children and their families living in rural areas, climate change is already changing their lives. As the earth heats up, the changes resulting from climate change which make life more difficult - drought and associated conditions such as soil erosion, increasing salinity and more intense fires - are likely to occur more often (Intergovernmental Panel on Climate Change [IPCC], 2007). The hotter temperatures and persistent dryness, together with the inevitable adjustments in the agricultural sector and nearby townships, will place rural families under increasing stress. More attention to country children's vulnerability would seem warranted.

²⁹⁹ Nordstrom, M. 2010. "Children's Views On Child-friendly Environments in Different Geographical, Cultural and Social Neighbourhoods." *Urban Studies* 47 (3): 514–528.

³⁰⁰ Chawla, L., ed. 2002. *Growing up in an Urbanising World*. London: Earthscan.

O'Brien, M. 2003. "Regenerating Children's Neighbourhoods: What Do Children Want?" In *Children in the City, Home, Neighbourhood and Community*, edited by P. Christensen and M. O'Brien, 142–161. London: Routledge Falmer.

³⁰² Proshansky, H., and N. Gottlieb. (1989). The Development of Place Identity in the Child. *Zero to Three* 10 (2): 18–25.

³⁰³ Offer, S., and B. Schneider. 2007. "Children's Role in Generating Social Capital." *Social Forces* 85 (3): 1125–1142. .

For Aboriginal children, policies based on a better recognition of the importance of place and culture in promoting their health and wellbeing have been called for and are long overdue.

If we were to consider children's needs and their health and wellbeing in all the decisions we make about our places – our houses, our neighbourhoods, our natural environment and our economy - we would all be better off, leading healthier and more satisfying lives.

Acronyms

ABS: Australian Bureau of Statistics

ADHD: Attention Deficit Hyperactivity Disorder

ACWP: Australian Child Wellbeing Project

AEDI: Australian Early Development Index

AEDC: Australian Early Development Census

ARACY: Australian Research Alliance for Children and Youth

AIHW: Australian Institute for Health and Welfare

BMI: Body Mass Index

CHI: Children's Headline Indicators

CSDH: Commission on the Social Determinants of Health

DISC-IV: The Diagnostic Interview Schedule for Children

HWSS: The WA Health and Wellbeing Surveillance System

IRSAD: Index of Relative Socio-Economic Disadvantage

LSAC: Longitudinal Study of Australian Children

NDVI: Normalised Difference Vegetation Index

SDQ: Strengths and Difficulties Questionnaire

SES: Socioeconomic Status

SEIFA: Socio-Economic Indices for Areas

WHO: World Health Organization