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3.4 Environmental Statement Appendix 13.3 Health Evidence Literature Review

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3.4 ENVIRONMENTAL STATEMENT APPENDIX 13.3 HEALTH EVIDENCE LITERATURE REVIEW

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13.3 Health Evidence Literature Review

13.3.1 Introduction

13.3.1.1 This document presents a review and summary of evidence on the links between the health determinants considered in the human health assessment and the resulting effects on health and wellbeing. Publicly available sources are used to provide an overview of the scientific consensus on the potential health outcomes associated with each health determinant. The evidence presented underpins the qualitative judgements on health outcomes made in the assessment.

13.3.2 Methodology

Scope of review

13.3.2.1 The literature search has reviewed relevant secondary sources from 2015 to 2022. In some cases, novel studies published prior to 2015 are included if they are deemed important for the context of the review.

13.3.2.2 The review is mainly focused on secondary sources that reflect a scientific consensus on the available evidence, such as systematic literature reviews or meta-analyses. Primary sources such as peer-reviewed journal articles may also be used.

13.3.2.3 The health determinants covered in the review correspond to the determinants included in the human health assessment for the A66 Northern Trans-Pennine project. These are:

- Environmental quality
- Noise environment
- Landscape and visual environment
- Air quality
- Lighting
- Traffic and road safety
- Severance and accessibility
- Community services and facilities
- Social networks
- Green space
- Employment and income

Literature sources

13.3.2.4 The following search engines and databases were used in conducting this review:

- Biomed Central
- JSTOR
- NICE Evidence Search
- Pubmed;
- ScienceDirect
- Scientific American
- Google and Google Scholar

Search terms

13.3.2.5 The search terms used include 'health' OR 'wellbeing' OR 'well-being' AND:

13.3.2.6 noise / traffic AND noise / road AND noise / construction AND noise;

- landscape / visual / rural AND environment;
- air AND quality / traffic AND emissions / construction AND emissions;
- light AND pollution;
- local AND services OR facilities;
- social AND capital / social AND networks / isolation;
- green AND space / greenspace / open AND space / nature;
- employment / unemployment / income / low AND income / social AND deprivation.

Evaluating the strength of evidence

13.3.2.7 The amount of research on links to health outcomes varies between the determinants. The strength of evidence for health outcomes associated with health determinants has been evaluated and classified as follows:

- **strong**: a wide range of peer-reviewed research studies showing similar associations. The association is widely accepted by the public health community and there is consensus on the specific causal factors, the mechanism of effect and the strength of association;
- **moderate:** a range of peer-reviewed research studies showing similar associations. The association is widely accepted by the public health community, though there may be debate about the specific causal factors, the mechanism of effect and/or the strength of association; or
- **weak:** a few peer-reviewed / non-peer reviewed research studies found to suggest an association between health determinants and outcomes, or studies showing conflicting findings.

13.3.2.8 It should be noted that weak evidence does not necessarily indicate an absence of association between a health determinant and a health outcome but shows that there is uncertainty in the assessment of the likely effect.

13.3.3 Summary of evidence

Noise environment

13.3.3.1 There is a wealth of evidence to suggest that excessive noise has a negative impact on human health and that, conversely, those living in quiet locations have a better quality of life.

13.3.3.2 According to the World Health Organization (WHO) (World Health Organization, 2017)[1], 'excessive noise seriously harms human health and interferes with people's daily activities at school, at work, at home and during leisure time. It can disturb sleep, cause cardiovascular and

[1] World Health Organization (2017) Noise

psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour'.

13.3.3.3 The 2018 WHO guidelines on *Environmental Noise for the European Region* (World Health Organization, 2018)[2] undertook a series of systematic reviews synthesising exposure and associated impacts on health in order to develop a set of guidelines on how to protect human health. Recommendations were formulated based on the strength of evidence from various noise sources, which were road traffic noise, railway noise, aircraft noise, wind turbine noise and leisure noise. The systematic reviews concluded that there was evidence for an association between road traffic noise and cardiovascular disease (CVD), sleep disturbance, annoyance and cognitive impairment, with suggestive but weaker evidence (often due to lack of studies) for effects on mental health and birth weight.

13.3.3.4 A review commissioned in 2020 by the Department of Environment, Food and Rural Affairs (Defra) (Clark et al., 2020)[3] considered how evidence has changed since the publication of the WHO Environmental Noise Guidelines. This found associations between road traffic noise and medication use and interview measures of depression and anxiety. Associations between road traffic noise and some cancer outcomes were also observed, although the quality of evidence across studies remains low for these outcomes.

13.3.3.5 A similar conclusion was made in a literature review of transportation noise and the wider determinants of health by Peris and Fenech (2020)[4]. This study noted that noise and health guidance to date has largely focused on the direct links between noise and health outcomes such as annoyance, sleep disturbance, cardiovascular and metabolic disease, and cognitive impairment in schoolchildren. However, as noise is a psychological stressor, the authors believe that health may be affected through interactions with wider determinants such as physical activity, use of green spaces and social interaction.

13.3.3.6 A report published by European Environment Agency in 2020 (European Environment Agency, 2020)[5] suggests that shift workers, noise sensitive individuals, pregnant women, and socio-economically disadvantaged individuals are particularly vulnerable to noise. This builds on an earlier report by van Kamp and Davies in 2013[6] which provided an initial analysis into health impacts of vulnerable groups. This included assessing the impact of environmental noise on primary school children,

[2] World Health Organization (2018) Environmental Noise Guidelines for the European Region
[3] Clark, C., Crumpler, C., & Notley, A. H. (2020) Evidence for Environmental Noise Effects on Health for the United Kingdom Policy Context: A Systematic Review of the Effects of Environmental Noise on Mental Health, Wellbeing, Quality of Life, Cancer, Dementia, Birth, Reproductive Outcomes, and Cognition. International journal of environmental research and public health, 17(2), 393
[4] Peris, E. and Fenech, B. (2020) Associations and effect modification between transportation noise, self-reported response to noise and the wider determinants of health: A narrative synthesis of the literature, Science of the Total Environment.
[5] European Environment Agency (2020) Environmental Noise in Europe
[6] Van Kamp, I. and Davies, H. (2013) Noise and Health in Vulnerable Groups: A Review. Noise and Health.

young adolescents, preschool children, the elderly, and children with autism, asthma and attention deficit hyperactivity disorder. Both reviews agree that, while vulnerable groups of people may be more at risk from exposure to environmental noise than healthy adults, there is not enough research focusing on the adverse health effects of noise on vulnerable people.

13.3.3.7 A 2019 evidence review (Kamp and Davies, 2013)[7] of social inequalities in environmental noise exposure in the WHO European region found higher noise exposures in groups within more disadvantaged socioeconomic group.

13.3.3.8 Based on the criteria set out in Section 2.4 above, the evidence linking environmental noise to health and wellbeing is considered to be **strong.**

Landscape and visual environment

13.3.3.9 There are numerous studies that demonstrate the benefits that scenic landscapes and well-designed neighbourhoods can have of human cognition and wellbeing.

13.3.3.10 A study by Li and Sullivan (2016)[8] tested the effect of window views on the attention and stress of high school students using a randomised controlled experiment. The study found that views to green landscapes promoted high school students' attention restoration and recovery from stress. Their conclusions found that exposure to daylight alone did not improve student performance, suggesting that the quality of the landscape was integral.

13.3.3.11 A 2018 paper published by the UK Collaborative Centre for Housing Evidence (UK Collaborative Centre for Housing Evidence, 2018)[9] reviewed the evidence surrounding the benefits of good design and how this relates to people's experience of living in well-designed homes and neighbourhoods. The UK Centre for Collaborative Housing argued that value can be found in the user experience of a new place or neighbourhood by sustaining them in healthy and socially rich environments. Such places promote wellbeing and enable healthy and active lifestyles.

13.3.3.12 A study (Seresinhe et al, 2015)[10] sought to quantify the relationship between environmental aesthetics and human health by comparing geographic data against self-rated health as well as core socioeconomic deprivation indicators such as income, employment, and access to services. This found that inhabitants of more scenic environments across urban, suburban and rural areas reported better health compared with those in less scenic areas.

[7] Dreger, S., Schüle, S. A., Hilz, L. K., & Bolte, G. (2019) Social Inequalities in Environmental Noise Exposure: A Review of Evidence in the WHO European Region. International Journal of Environmental Research and Public Health. 16(6), 1011.
[8] Li, D. and Sullivan, D. L. (2016) Impact of views to school landscapes on recovery from stress and mental fatigue, Landscape and Urban Planning
[9] UK Collaborative Centre for Housing Evidence (2018) Design value at the neighbourhood scale
[10] Seresinhe, C., Preis, T. and Moat, H. (2015) Quantifying the impact of scenic environments on health, Scientific Reports.

13.3.3.13 A literature review (Luo and Wu, 2020)[11] assessed the association between neighbourhood aesthetics and childhood obesity (body mass index, obesity/overweight status), physical activity and active transport to school in individuals aged <18 years from 25 studies. Two thirds (75%) of studies reported non-significant associations between neighbourhood aesthetics and physical activity and weight whereas half (50%) of studies showed that neighbourhood aesthetics is associated with active transport to schools. This suggests that the findings are mixed, and more research is needed to understand the epidemiological relationship.

13.3.3.14 A literature review (Bonaccorsi et al., 2020)[12] assessing the association between the built environment and physical activity in the elderly found that aesthetically pleasing scenery such as greenery is positively associated with physical activity in the individuals over 65 years of age.

13.3.3.15 Based on the criteria set out in section 2.4 above, the evidence linking the landscape and visual environment to health and wellbeing is considered to be **moderate.**

Air quality

13.3.3.16 There is a large body of evidence to demonstrate the negative effects of poor air quality on human health, including increased risk of disease and mortality.

13.3.3.17 The WHO recognises outdoor air pollution as a major environmental health problem for all countries, including high-income countries (World Health Organization, 2018)[13]. There is a large body of evidence showing the association of nitrogen dioxide and particulate matter on poor health outcomes. Epidemiological studies have shown that long-term exposure to air pollution (over years or a lifetime) reduces life expectancy, due to increased cardiovascular and respiratory diseases and lung cancer. Short-term exposure (over hours or days) to increased levels of air pollution can have a range of health effects, including effects on lung function, asthma, increases in respiratory and cardiovascular hospital admissions, and mortality (Public Health England, 2018)[14]. Outdoor air pollution can influence productivity and contribute to social costs such as increased days off work and school due to poor health[15].

13.3.3.18 A 2019 review by Public Health England (PHE) (now Office for Health Improvement and Disparities (OHID)) (Public Health England, 2019)[16] of interventions to improve outdoor air quality and public health concluded

[11] Qu, P, Luo, M, Wu, Y, et al. (2020) Association between neighborhood aesthetics and childhood obesity. Obesity Reviews. 1– 199
[12] Bonaccorsi G, Manzi F, Del Riccio M, Setola N, Naldi E, Milani C, Giorgetti D, Dellisanti C, Lorini C. (2020) Impact of the Built Environment and the Neighborhood in Promoting the Physical Activity and the Healthy Aging in Older People: An Umbrella Review. International Journal of Environmental Research and Public Health. 17(17):6127.
[13] World Health Organization (2018) Ambient (outdoor) air quality and health
[14] Public Health England (2018) Health Matters: air pollution
[15] IOM Working for a Healthier Future (2015) Air Quality, Health, Wellbeing and Behaviour,
[16] Public Health England (2019) Review of interventions to improve outdoor air quality and public health

that air pollution is the largest environmental risk to the health of the public in the UK. The review found that:

- It is estimated that between 28,000 and 36,000 deaths each year are attributed to humanmade air pollution
- There is a close association with cardiovascular and respiratory disease, including lung cancer
- There is emerging evidence that other organs may also be affected, with possible effects on dementia, low birth weight and diabetes.

13.3.3.19 It concluded that the most impactful interventions would be those that reduce emissions of air pollution at source.

13.3.3.20 A PHE (now OHID) report (Public Health England, 2019) has stated that children, older people, and people with chronic health problems such as pre-existing cardiovascular and respiratory conditions are the most vulnerable to air pollution.

13.3.3.21 According to the Lancet Commission on pollution and health (The Lancet, 2018)[17], children are at high risk of pollution related disease. Their 2018 study identified that even extremely low-dose exposures to pollutants during vulnerable stages (in utero and early infancy) can increase the risk of disease, disability and death in childhood and adulthood. Research has shown that exposure to particulate matter affects children's lung development, including reversible deficits in lung function, chronically reduced lung growth rates and a deficit in long-term lung function.

13.3.3.22 In chapter 7 of the recently published book, *'Transport and Children's Wellbeing'* (Boothe and Baldauf, 2020)[18] Boothe and Baldauf discuss traffic emission impacts on child health and well-being. This chapter identifies that children (from infancy to age 14) are especially susceptible to the health effects of traffic emissions due to their rapidly developing immune, neurologic and lung systems. They highlight scientific evidence that suggests prenatal and childhood exposure to traffic emissions can cause the onset and exacerbation of asthma, delayed lung function development and childhood leukaemia. Evidence also links traffic emission exposure to autism spectrum disorder, delayed cognitive development and childhood obesity. These findings are similar to recent research published by Kelly et al. (2021)[19] and Stenson et al. (2021)[20].

13.3.3.23 Based on the criteria set out in Section 2.4 above, the evidence linking air quality to health and wellbeing is considered to be **strong.**

[17] The Lancet (2018) Commission on pollution and human health
[18] Boothe V. L. and Baldauf R. W. (2020) Traffic emission impacts on child health and well-being, Transport and Children's Wellbeing.
[19] Kelly et al., (2021) Air Pollution and Asthma: Critical Targets for Effective Action. Pulm Ther. 2021 Jun;7(1):9-24. doi: 10.1007/s41030-020 00138-1
[20] Stenson et al., 2021. The impact of Traffic – Related air pollution on child and adolescent academic Performance: A systematic review. Environ Int. 2021 Oct;155:106696. doi: 10.1016/j.envint.2021.106696. Epub 2021 Jun 15.

Lighting

13.3.3.24 There is a growing body of literature that seeks to understand the effects of light pollution on human health and wellbeing.

13.3.3.25 A 2021 review by Rajput et al[21] found that artificial light at night (ALAN) has been linked to a wide range of negative health impacts including cancer, *'disrupted circadian rhythm, disturbances in sleep pattern, obesity, stress, alterations in the rhythmicity of gut microbiota and free radical damage'*. Similar results were observed by Dominoni et al. (2016)[22] who noted that electric lights modify the natural light environment dramatically, causing the disruption of circadian rhythms. This disruption has consequences for human health, such as reducing immunity and increasing the occurrence of metabolic syndromes and cancer.

13.3.3.26 A 2020 cross-sectional study by Helbich et al (Helbich et al, 2020)[23] in the Netherlands theorised that artificial light at night (ALAN) may be an anthropogenic stressor for mental health disturbing humans' natural day-night cycle. The authors assessed ALAN exposures at people's home addresses and within 100 metre and 600 metre buffers, before assessing participants (aged 18-65) for depressive symptoms using the Patient Health Questionnaire (PHQ-9). The results showed that participants in the higher ALAN quintiles showed significantly higher PHQ-9 scores than those in the lower ALAN quintiles. However, when adjusting for nitrogen dioxide (NO_2), the results showed that it was air pollution rather than outdoor ALAN that correlated with depressive symptoms.

13.3.3.27 Similarly, to the work of Helbich et al, Walker et al (2020)[24] authored a review, examining the evidence between ALAN and several disorders such as increased incidence of cancer, metabolic disorders and mood disorders. The evidence reviewed suggested a significant association between ALAN and breast cancer and a modest relationship between ALAN and other cancers.

13.3.3.28 Based on the criteria set out in section 13.3.2 above, the evidence linking the artificial light at night to health and wellbeing is considered to be **moderate.**

Community services and facilities

13.3.3.29 There is a developing argument for the role of community services and facilities to support human health and wellbeing. Much of the research in

[21] Rajput, S., Naithani, M., Meena, K. and Rana, S. (2021) Light pollution: hidden perils in light and links to cancer. Sleep and Vigilance.
[22] Dominoni, D., Borniger, J. C. and Nelson, R. J. (2016) Light at night, clocks and health: from humans to wild organisms, Biology Letters.
[23] Helbich, M. Browning, H. E. M., and Huss, A. (2020) Outdoor light at night, air pollution and depressive symptoms: A cross-sectional study in the Netherlands, Science of The Total Environment.
[24] Walker, W., Bumgarner, J. R., Walton, J. C., Liu, J. A., Hecmarie, M., Nelson, R. J., DeVries A. C., (2020) Light Pollution and Cancer, International Journal of Molecular Science

this field focuses on the benefits that can arise from 'social infrastructure'.

13.3.3.30 An article by Davern et al (2018)[25] defined social infrastructure as 'lifelong social service needs related to health, education, early childhood, community support, community development, culture, sport and recreation, parks and emergency services'. Using geocoded health survey data linked to spatial social infrastructure measures, the authors found that both accessibility and mix of social infrastructure were associated with higher subjective wellbeing.

13.3.3.31 PHE (now OHID) (Public Health England, 2015)[26], in partnership with NHS England, published *'A guide to community-centred approaches for health and wellbeing'*. The report included evidence gathered to show the benefits of community-centred approaches for health and wellbeing. The report discussed the health assets of communities as well as their health needs and identified the following community assets that can support positive health and wellbeing:

- the skills, knowledge, social competence and commitment of individual community members;
- friendships, intergenerational solidarity, community cohesion and neighbourliness within a community;
- local groups and community and voluntary associations, ranging from formal organisations to informal, mutual aid networks such as babysitting circles;
- physical, environmental and economic resources within a community; and
- assets brought by external agencies – public, private and third sector.

13.3.3.32 In 2018, PHE (now OHID) (Public Health England, 2018)[27] published the professional guidance, 'Health matters: community centred approaches for health and wellbeing'. The guidance focused on the concept and practice of community-centred approached for health and wellbeing. The report states that *'community life, social connections and having a voice in local decisions are all factors that have a vital contribution to make to health and wellbeing'*. Such community determinants *'build control and resilience and can help buffer against disease and influence health-related behaviour'*.

13.3.3.33 An Australian study (Davern et al., 2018)[28] compared spatial data on social infrastructure with subjective wellbeing (assessed using indicators from the Personal Wellbeing Index[29]) in over 7,000 residents and found

[25] Davern, M., Gunn, L., Whitzman, C., Higgs, C., Giles-Corti, B., Simons, K. (2018) Using spatial measures to test a conceptual model of social infrastructure that supports health and wellbeing, Cities and Health.
[26] Public Health England (2015) A guide to community-centred approaches for health and wellbeing
[27] Public Health England (2018) Health matters: community-centred approaches for health and wellbeing
[28] Davern M, Gunn L, Whitzman C, Higgs C, Corti B, Simons K, Villanueva K, Mavoa S, Roberts R, Badland H. (2018) Using spatial measures to test a conceptual model of social infrastructure that supports health and wellbeing, Cities & Health, 1:2, 194-209
[29] International Wellbeing Group (2013). Personal Wellbeing Index: 5th Edition. Melbourne: Australian Centre on Quality of Life, Deakin University

evidence that increases in both the accessibility and mix of social infrastructure were associated with better health and wellbeing outcomes. The types of infrastructure considered in the study included community centres, sports, recreation and leisure centres, places of culture such as cinemas, libraries, museums and art galleries, educational establishments and early years and out of school child care facilities, and a range of health and social care amenity centres.

13.3.3.34 A publication on the health of rural communities by the Local Government Association and PHE (now OHID) (Local Government Association, Public Health England, 2017)[30] stated that *'Many of the factors contributing to health risks in rural communities relate to the wider social determinants of health as well as to access to health and care services'*. This document notes that rural areas have worse access in terms of distance to health, public health and care services, and that service use decreases with increasing distance.

13.3.3.35 Based on the criteria set out in section 2.4 above, the evidence linking access to services to health and wellbeing is considered to be **moderate**.

Social networks

13.3.3.36 Many researchers have sought to understand the potential benefits that social networks bring to the lives of individuals and to understand whether they can lead to improved health outcomes.

13.3.3.37 A review by Du-Leong et al (2020)[31] attempted to frame the benefits children receive from social relationships as a positive social determinant of health. Social relationships help children exposed to adversity achieve healthy outcomes across their life course. The authors describe how social capital is enhanced through social support, which is embedded in a social network, which is a structure through which social cohesion can be observed.

13.3.3.38 A study by Tough et al (2017)[32] reviewed quantitative studies exploring the associations between social relationships and mental health and wellbeing in people with disabilities. The authors found that social relationships play an important role in mental health and wellbeing in people with disabilities, although the findings are less consistent that in general populations.

13.3.3.39 A study by Algren et al. (2020)[33] compared loneliness in deprived neighbourhoods in Denmark against loneliness in the general population. The authors developed this study by using data from the

[30] Local Government Association, Public Health England (2017) Health and wellbeing in rural areas.
[31] Duh-Leong, C., Dreyar, B. P., T-K Huang, T., Katzow, M., Gross, R. S., Fierman, A. H., Tomopoulos, S., Di Caprio, C. and Yin, S. (2020) Social capital as a positive social determinant of health: a narrative review, Academic Paediatrics.
[32] Tough, H., Siegrist, J. and Fekete, C. (2017) Social relationships, mental health and wellbeing in physical disability: a systematic review, BMC Public Health.
33 Algren, M. H., Ekholm, O., Nielson, L. and Ersboll, A. K. (2020) Social isolation, loneliness, socioeconomic status, and health-risk behaviour in deprived neighbourhoods in Denmark: A cross-sectional study. SSM Population Health.

Danish Health and Mobility Survey as a comparison group. They concluded that residents of deprived neighbourhoods had higher odds of loneliness. Furthermore, both social isolation and loneliness were significantly associated with higher odds of health-risk behaviours (poor diet, smoking, high-risk alcohol intake and low levels of physical activity).

13.3.3.40 Esham et al. (2019)[34] undertook a 'systematic review of systematic reviews' on social capital and health. The exercise demonstrated that there is a positive correlation between social capital and mental and physical health, and that social capital contributes to lower mortality. Similar results were observed by Perez et al. (2020)[35] and Xue et al. (2020)[36] who found positive associations between social capital and several population health outcomes including physical activity, mortality, disease/illness, healthy weight and depression.

13.3.3.41 Based on the criteria set out in section 2.4 above, the evidence linking social networks to health and wellbeing is considered to be **moderate.**

Green space

13.3.3.42 Numerous studies have found links between health and wellbeing and access to green space.

13.3.3.43 A report by the WHO (World Health Organization, 2016)[37] provided a review of evidence surrounding the concept of '*benefits of urban green space on health*' by drawing on a large body of evidence in support of the Global Sustainable Development Goals. The report found that access to green spaces lead to health benefits through stress alleviation, increased physical activity and reduced exposure to pollutants. Consequently, the report found that urban green spaces improve mental health, reduce cardiovascular morbidity, obesity and risk of type two diabetes, as well as improving pregnancy outcomes.

13.3.3.44 A systematic review of observational evidence by Keijezer et al (2016)[38] showed an association between long-term exposure to green space and cognition (intellect and cognisance) over the life course.

13.3.3.45 An evidence review by Natural England (Natural England, 2016)[39] showed that access to natural environments promotes physical activity including walking, gardening and children's play. The review shows evidence that people with poorer health tend to benefit more from

[34] Ehsan, A., Klaas, H. S., Bastianen, A., Spini, D. (2019) Social capital and health: A systematic review of systematic reviews, SSM Population Health.
[35] Pérez E, Braën C, Boyer G, Mercille G, Rehany É, Deslauriers V, Bilodeau A, Potvin L. (2020). Neighbourhood community life and health: A systematic review of reviews. Health Place. 61:102238. doi: 10.1016/j.healthplace.2019.102238. Epub 2019 Nov 14. PMID: 31735517.
[36] Xue, XW. ReedR ., Menclova A.,(2020). Social capital and health: a meta-analysis, Journal of Health Economics, Volume 72, 102317, ISSN 0167-6296,.
[37] World Health Organisation (2016) Urban green spaces and health: a review of evidence
[38] Keijezer, C., Gascon, M., Nieuwenhuijsen, M. J. and Dadvand, P. (2016) Long-term Green Space Exposure and Cognition Across the Life Course: A Systematic Review, Current Environmental Health Reports.
[39] Natural England (2016) Links between natural environments and physical activity: evidence briefing

physical activity in natural environments. In addition, a systematic review of physical activity and green spaces concluded that, compared with indoor activities, physical activity in natural environments is associated with greater feelings of revitalisation, increased energy and positive engagement, and decreases in tension, confusion, anger and depression.

13.3.3.46 A UK study by Houlden et al. (2019)[40] examined whether the amount of greenspace within a radius of individuals' homes was associated with mental wellbeing, testing the UK Government guideline that greenspace should be available within 300m of homes. Findings showed that an increase in one hectare of greenspace within 300m of homes was associated with a statistically significant increase in life satisfaction, worth and happiness.

13.3.3.47 A systematic review by Zhang et al. (2020) based on fourteen studies found a positive association between exposure to green space and mental health and wellbeing in adolescents, suggesting that improving accessibility, availability and quality of green space is likely to generate a positive impact on adolescents' mental well-being[41]. Positive associations between accessibility and exposure to green space and mental health were also found in women[42] and older adults[43], although change in green space (i.e. increase or decrease in green space exposure upon moving) was not associated with mental health in the latter.

13.3.3.48 A review by Jia et al. (2020)[44] found a positive association between access to green space and physical activity and a negative association between access to green space and television watching time, body mass index and weight status among children. Green space exposure was also positively associated with sleep in a systematic review by Shin et al. (2020)[45] which revealed that eleven out of thirteen studies found an association between green space exposure and sleep quality and quantity.

[40] Houlden V., Albuquergue, J. P., Weich, S. and Jarvis, S. (2019), A spatial analysis of proximate greenspace and mental wellbeing in London, Applied Geography.
[41] Zhang Y, Mavoa S, Zhao J, Raphael D, Smith M. (2020) The Association between Green Space and Adolescents' Mental Well-Being: A Systematic Review. Int J Environ Res Public Health. Sep 11;17(18):6640.
[42] Torres Toda M, Anabitarte Riol A, Cirach M, Estarlich M, Fernández-Somoano A, González-Safont L, Guxens M, Julvez J, Riaño-Galán I, Sunyer J, Dadvand P. (2020) Residential Surrounding Greenspace and Mental Health in Three Spanish Areas. Int J Environ Res Public Health. Aug 5;17(16):5670..
[43] Noordzij JM, Beenackers MA, Oude Groeniger J, Van Lenthe FJ. (2020) Effect of changes in green spaces on mental health in older adults: a fixed effects analysis. J Epidemiol Community Health.74(1):48-56. doi: 10.1136/jech-2019-212704. PMID: 31630120; PMCID: PMC6929698.
[44] Jia, P, Cao, X, Yang, H, et al. (2020) Green space access in the neighbourhood and childhood obesity. Obesity Reviews. 1– 12
[45] Jong Cheol Shin, Kaustubh Vijay Parab, Ruopeng An, Diana S. Grigsby-Toussaint. (2020). Greenspace exposure and sleep: A systematic review. Environmental Research. Volume 182: 109081. ISSN 0013-9351

13.3.3.49 Based on the criteria set out in Section 2.4 above, the evidence linking access to green space to health and wellbeing is considered to be **moderate.**

Employment and income

13.3.3.50 There is a large body of evidence linking employment and income levels with health.

13.3.3.51 The WHO identifies a list of health determinants (World Health Organization. 2017)[46] that combine to affect the health of individuals and communities. Included in this list is: *'income and social status - higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health'*.

13.3.3.52 The Health Foundation commissioned the Institute of Health Equity to investigate health inequalities in England in 2020 (Institute of Health Equity, 2020)[47]. The report found that the health gap has grown between wealthy and deprived areas in the last 10 years and improvements in live expectancy have stalled (and declined for the poorest 10% of women). The report noted that '*those with a lower socio-economic position, younger people, those in lower paid jobs and non-white people are all more likely to experience poor quality work with attendant impacts on health and health inequalities*.' This builds on the previous Marmot Review, published in 2010[48] commissioned by the Department of Health which focused on correlations between health and wellbeing and the socio-economic status of communities. The report identified six evidence-based policy objectives to reduce health inequalities, one of which was to create fair employment and good work for all. The Review stated that '*being in good employment is protective of health. Conversely, unemployment contributes to poor health'*.

13.3.3.53 Reports that young people are particularly vulnerable to the negative health effects resulting from unemployment are also observed in studies by Vancea et al. (2017)[49] and Bartelink et al., 2019. Particularly, the latter systematic review (Bartelink, 2019)[50] commissioned by the Public Health Agency of Sweden found an association between unemployment among young people and poor mental health.

13.3.3.54 Much of the literature relating to unemployment and health outcomes is focused on the increased likelihood of poor health among the unemployed and low-income groups. A large-scale study by Wapner (2015)[51] showed that disadvantaged adolescents reported lower levels of physical activity and higher levels of bodily aches and pains, sleeplessness and emotional difficulties, such as nervousness and

[46] World Health Organization (2017) Health Impact Assessment - The determinants of health
[47] Institute of Health Equity (2020) Health equity in England; The Marmot Review 10 years on,
[48] The Marmot Review (2010) Strategic review of health inequalities in England post 2010
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irritability, than more advantaged teenagers. A Spanish study undertaken in 2015[52] found that the impact of unemployment, particularly long-term unemployment, had a negative impact on self-reported health and mental health. A literature review by Kim et al. in 2015 identified higher incidence of poor self-rated health, mental illness, physical complaints such as coronary heart disease, and higher all-cause mortality in unemployed people compared with those in employment.

13.3.3.55 A study by Clark and Lepinteur (2019)[53] explored the causes and consequences of early-adult unemployment. Findings showed that past unemployment can negatively impact on life satisfaction later in life. A Policy Brief for the LEAD Centre (Goodman, 2015)[54] presented evidence to suggest a positive correlation between employment and health for working age people with disabilities.

13.3.3.56 Based on the criteria set out in section 2.4 above, the evidence linking income and employment to health and wellbeing is considered to be s**trong.**

13.3.4 Strength of evidence summary

13.3.4.1 Table 1: Strength of evidence summary for each health determinant shows the strength of evidence linking each health determinant to health and wellbeing based on the criteria set out in section 13.3.2.

Table 1: Strength of evidence summary for each health determinant

Health Determinant	Strength of Evidence
Noise environment	Strong
Landscape and visual environment	Moderate
Air quality	Strong
Lighting	Moderate
Community services and facilities	Moderate
Social networks	Moderate
Green spaces	Moderate
Employment and Income	Strong

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