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Artificial light at night: a neglected population health concern of the built environment

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Research inquiries of links between the built environment and population health have largely focused on physical activity and social connectedness, associated health risks or benefits, and resultant chronic diseases[1,2]; as well as access to healthy food, exposure to green views or green space, blue space, noise abatement, air pollution[3] and biodiversity.[4] Artificial light at night (ALAN) is mentioned as disturbing sleep[5] but appears absent as a future challenge for urban design and health; indeed one 'healthy by design' brochure[6] shows light as merely provision for pedestrians, and depicts a bright light as ecological and astronomical pollution. This Commentary draws the attention of the population health community to the health risks of ALAN from streetlights, lighted signage, and lit buildings. ALAN has increased exponentially since the adoption of public lighting ~130 years ago, with more than half the world's population now living with a night sky brighter than a full moon.[7]

ALAN is a growing, major concern for human health through disruption of the production of the neuro-hormone melatonin;[8] changes to melatonin alter circadian entrainment (synchronization) in the body,[9] leading to increased cancer risks,[10] altered sleep[11] and cognitive problems.[12] The American Medical Association has suggested that other diseases which may be exacerbated by circadian disruption due to ALAN are obesity, diabetes, depression and reproductive disorders.[13] These concerns about ALAN are a challenge to our way of thinking about light[8] and will require concentrated public health action in a highly political arena, particularly in the realm of crime and perceived crime. Knowledge and action on ALAN is of particular urgency in Australia because many councils are currently revising their street-lighting, and their focus has been on energy saving, not human health, because Australian Local Governments allocate as much as 50% of their energy budgets to streetlighting.[14] It is essential that knowledge of the links between ALAN and health are known to both local government and the public, and that the type of light allocated, the degree to which it permits light trespass, and the impacts of the spectrum (colour or wavelength) of the light exposure on human health be considered.

The health concerns of artificial light at night: light trespass and spectrum

Medical concern about exposure to ALAN has grown since it was shown that light suppressed melatonin secretion,[15] since melatonin is a powerful oncostatic agent for a variety of tumours.[16] Disruption of melatonin production is associated with increased levels of breast and prostate cancer,[17,18] and with 'eveningness' amongst adolescents (circadian phase delay, or late rising, late to bed).[19] In 2007 the World Health Organization declared that ALAN is a carcinogenic risk factor for shift-workers who are exposed to light during normal sleeping hours, which disrupts their circadian rhythm.[20] An extensive overview of known impacts of ALAN on human health suggests caution in the use of ALAN[21] and a strong need for communication between chronobiologists, urban designers and planners, population health researchers and practitioners, and members of governance.

A major agent leading to health implications of ALAN on urban and suburban populations is light trespass, which is defined as light intruding to where it is not wanted, or where it is wasted. Light trespass occurs when streetlights illuminate above the ground-level of the street and into bedrooms, even though most people are asleep, with their own house lights off. Bright light suppresses melatonin more than dull.[21]

The wavelength (or spectrum) of light is also important in melatonin production, with light at the blue end of the spectrum more disruptive than the red end.[21] Normal melatonin production occurs from ~21.00hrs to 07.00hrs, and is suppressed with the light of day. Blue light encourages the body to think that it is daytime (dawn light is blue), while red light suggests the end of the day. Thus of greatest concern are luminaires (the lamps) with a strong blue emission, such as white or blue LED and metal halide luminaires, as these disrupt circadian rhythm more than those at the red end.

While recommendations have been made internationally that exterior lighting should not be in the range of visible spectrum under 540nm (nanometers) (towards the blue),[22] streetlighting issues are rarely simple. Current streetlight replacement in Australia can lead to

old sodium lights which lie in the red-spectrum being replaced with whiter or bluer LED. While LED tends to have less upward glare than sodium lamps, LED might possibly expose the public to the spectrum closest to melatonin suppression.

Working in new ways with streetlights in built environment research

Research on the impacts of ALAN on human health is growing in the medical literature. For designers and councils new ways to consider ALAN is an expanding global focus,[23] with the trialing of dimming and spectrum changes of luminaires in streets and roads largely reported in the grey literature, such as on council websites. For example, in England almost a third of local authorities are switching off street lighting, either permanently or as a trial.[24] Even in Paris, new legislation will require lights on all facades, including neonlights, to be turned off after 1am.[25] Besides dimming and part-night lighting strategies—such as on the M1 in England and Kwinana Freeway in Perth—road illumination is being re-imagined. In Smart Highway proposals, designer Daan Rosengaarde is trialing the embedding of lighted strips in roads, rather than traditional streetlighting on poles.[26] While cost saving is an essential concern in new streetlighting ambitions, experiments and changes have been increasingly driven by knowledge of the impacts of ALAN on human health.

ALAN is new imperative for urban design and population health

There is an abundance of experimental insights that suggest a great need for precautions to be taken in order to reduce ALAN and chronodisruption to urban populations.[27] In contrast to many issues of creating healthier built environments, changes to streetlighting can be carried out rapidly, with the installation of shields to prevent or reduce light trespass into bedrooms, dimming or part-night lighting (e.g. lights off at 1am), and changes away from the blue end of the spectrum to the red, whether for new installations or in existing suburbs.

Since Australia's street-lights carry much old stock, and many councils are examining or carrying out replacement, we are in the midst of opportunities to address spectrum, light trespass, and part-night lighting for improved population health. This is an urgent imperative because once changes have been made to streetlights, the lamps are likely to remain for 20–25 years. Artificial light at night and its trespass and spectrum raises the question of how we regard risk to communities. It is important that the human health risks of ALAN are considered equally in regard to crime, and that the real and perceived risks of dimming streets after 1am for example, are publically untangled. Current part-night lighting trials in Germany[28] are enabling streetlights to turn on in response to late-night walkers, and then turn off once they have passed; such photometric and sensory systems will reduce the risks of light trespass for human health, and provide concomitant energy saving.[29] This example shows the importance of a close working together of designers, police, engineers, the lighting industry, urban planners, and health professionals. We thus need promulgation of best practice in ALAN for human health in the population health research community and the wider community, enabling mitigation of this comparatively new urban health penalty.

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