

Australian childcare centres are too close to car parks exposing children with developing lungs to high levels of traffic pollution

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Combustion engines in vehicles produce a number of pollutants that are released into the air including: nitrogen dioxide, sulphur dioxide, carbon monoxide, ozone, and ultrafine, fine and coarse particulate matter.¹ Car parks present additional issues as they attract increased traffic and high levels of pollutants generated by idling cars and cold starts of engines.²⁻⁴ The slow speeds of vehicles, stop-start nature of movement and high degrees of braking also generate higher levels of emissions, with cars generally being most efficient when at a constant/cruising speed.⁵ There is currently no evidence that a safe level of exposure to traffic-related air pollution (TRAP) exists – any level of exposure may have adverse effects.⁶

The link between exposure to vehicle pollutants and respiratory disease in both children and adults is strongly supported.⁷ Children are especially vulnerable to these pollutants as their lungs are undergoing development. Nitrogen dioxide exposure can acutely cause shortness of breath and coughing and is chronically associated with an increased incidence of asthma and a reduction of lung function in children and adults alike.⁸⁻¹⁰ Sulphur dioxide exposure can lead to lung damage and through the creation of secondary particulate matter can cause respiratory and cardiovascular disease.¹¹ Ozone exposure is strongly associated with laboratory-confirmed Influenza in those under fourteen years of age.¹² Ozone also increases the susceptibility

Abstract

Objective: To examine the co-location of childcare centres and their outdoor play spaces with car parks in Melbourne and Sydney, Australia.

Methods: The co-location of childcare centre outdoor play spaces and car parks was examined through measurement of horizontal and vertical distances using Google Earth Pro satellite imagery.

Results: One hundred and forty-two childcare centres were studied in Melbourne, with 133 accompanying car parks identified. Eighty-one (57.0%) centres had a significant size car park within 150 m and 43.7% had a car park within 100 m. Twenty car parks (15.0%) were found within 10 metres of childcare centres, of which 12 (9.0%) had more than 100 spaces. Twenty centres were examined in Sydney, with 31 associated car parks identified. Eighteen childcare centres (90.0%) had car parks within 150 m and 17 (85.0%) had car parks within 100 m.

Conclusion: Australian childcare centres are located too close to car parks exposing children to pollution and likely impacting the development of chronic respiratory disease. Traffic pollution is an avoidable risk that must be considered when planning childcare centre location.

Implications for public health: The co-location of childcare centres with large-scale car parks may have long-term impacts on the respiratory health of Australian children under the age of five.

Key words: Air pollution, respiratory disease, paediatric, public health

to lung infections and can exacerbate conditions such as asthma and chronic obstructive pulmonary disorder (COPD).¹³ Furthermore, early life exposure to particulate matter is associated with a reduction in lung function and lung growth, leading to a reduction in long-term function.¹⁴

Many children under the age of five spend a significant amount of time in childcare centres (42% of children in 2017).¹⁵ The siting of childcare centres and placement of their outdoor play spaces in proximity to pollution from roads and nearby car parks is, therefore,

a significant health hazard. While small car parks (fewer than 25 spaces) are needed to enable parents to drop off or collect their children from childcare, co-location with larger commercial car parks is concerning. Nevertheless, there has been no investigation into the magnitude of the problem of the co-location of major car parks and childcare centres.

This study aimed to determine the spatial relationship between childcare centres and car parks in two Australian cities: Melbourne and Sydney.

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Methods

Online registers were used to identify all childcare centres and car parks within a six-kilometre radius of each city's centre. Horizontal and – where relevant – vertical distances between each centre and all nearby car parks were measured using Google Earth Pro satellite imagery. The presence of outdoor play spaces and the size of each car park (number of parking spaces) were recorded. A significant size car park was categorised as either greater than 25 spaces (public/commercial parking) or greater than 50 spaces (private/residential parking). Car parks smaller than these capacities are unlikely to pose significant risk and are required to aid parents or carers to safely drop off and collect children. Car park capacity and distance were sub-categorised so that risks related to exposure could be considered. Childcare centres with no outdoor play space were excluded from the data.

Results

Melbourne

In Melbourne, of one hundred and fifty-six centres identified within six kilometres of the city centre, 14 were excluded due to having no outdoor play space (5 centres) or insufficient car park data (nine centres). For the remaining 142 centres included, 133 car parks were identified. Eighty-one centres (57.0%) had a significant size car park within

150 m and 43.7% had a car park within 100 m (Table 1).

Proximity and spatial relationships – Melbourne

Twenty car parks (15.0%) were found within 10 metres of childcare centres, of which 12 (9.0%) had more than 100 spaces (Figure 1). In total, seventy-nine (59.4%) car parks were found to be larger than 100 spaces, with 40 (30.1%) of these found within 50 metres of a childcare centre. Twelve childcare centres had play spaces above ground level, of which 11 had car parks within 100 metres. Forty-one car parks surrounded these elevated play spaces, with 10 being situated under the childcare centre (vertical co-location).

Childcare centres related to institutions

Four childcare centres co-located with hospitals were studied and all had major car parks within 100 m (Table 2). Eleven car parks were found surrounding these centres, with eight having more than 200 spaces and three having more than 800 spaces at an average distance of 59.8 metres. One hospital-associated childcare centre had six car parks within 100 metres, of which four were greater than 100 spaces. Three of the six university-associated childcare centres had a car park within 100 metres for a total of six car parks, with three having more than 100 spaces at an average distance of 51.7 metres.

Sydney

Online registry data for Sydney were limited to commercial car parks within the central business district, thus significantly restricting data collection. Thirty-one childcare centres in Sydney's central business district were examined, with 11 subsequently excluded due to lack of an outdoor play area. For the remaining twenty childcare centres, 31 car parks were identified. Eighteen childcare centres (90.0%) had car parks within 150 m and 17 (85.0%) had car parks within 100 m.

Proximity and spatial relationships – Sydney

Six car parks (19.4%) were found within 10 metres of childcare centres, of which five (16.1%) had more than 100 spaces (Table 1). In total, twenty-seven (87.1%) car parks were larger than 100 spaces, with 17 (54.8%) of these found within 50 metres of a centre. A significantly higher number of centres in Sydney were situated above ground level, with fifteen (75.0%) of the outdoor centres being organised in this way. Fourteen of these centres had a car park within 100 metres, totalling 26 car parks being co-located with these centres. Of these 26 car parks, six were located directly under the centre's outdoor play space.

Discussion

This is the first study to investigate the spatial relationship between childcare centres and car parks in Australia. We found children attending the majority of childcare centres in central Melbourne and Sydney are potentially exposed to significant traffic pollution from nearby large car parks, thus increasing their risk of chronic respiratory disease. Importantly, the small but significant number of childcare centres either built on top of multi-storey car parks or associated with major institutions (such as hospitals and universities) and co-located in extreme proximity with large car parks, is concerning. Institutions such as hospitals and universities,

Distance between Childcare Centre and carpark (metres)	Number of Car parks	Car park size – number of spaces					
		25-49	50-99	100-199	200-399	400-799	>800
Melbourne							
0-10	20	7	1	9	0	2	1
10-20	12	2	6	0	2	1	1
20-30	11	3	1	2	3	0	2
30-40	19	3	3	4	2	5	2
40-50	8	2	2	1	2	0	1
50-70	17	1	8	5	1	2	0
70-90	32	1	9	5	12	3	2
90-110	14	2	3	2	5	0	2
Sub-total	133	21	33	28	27	13	11
Sydney							
0-10	6	0	1	4	1	0	0
10-20	2	0	0	1	0	1	0
20-30	4	0	1	2	0	1	0
30-40	6	1	0	1	0	3	1
40-50	2	0	0	1	0	1	0
50-70	4	0	0	3	0	1	0
70-90	3	0	0	0	0	2	1
90-110	4	1	0	0	1	1	1
Sub-total	31	2	2	12	2	10	3
Total	164	23	35	40	29	23	14

Institution	Number of co-located centres	Carparks	Mean distance
University	6	5	51.75
School	4	3	49.6
Hospital	4	11	59.82
Private	1	2	58.49
Government	1	2	38.5
Total	16	23	51.63

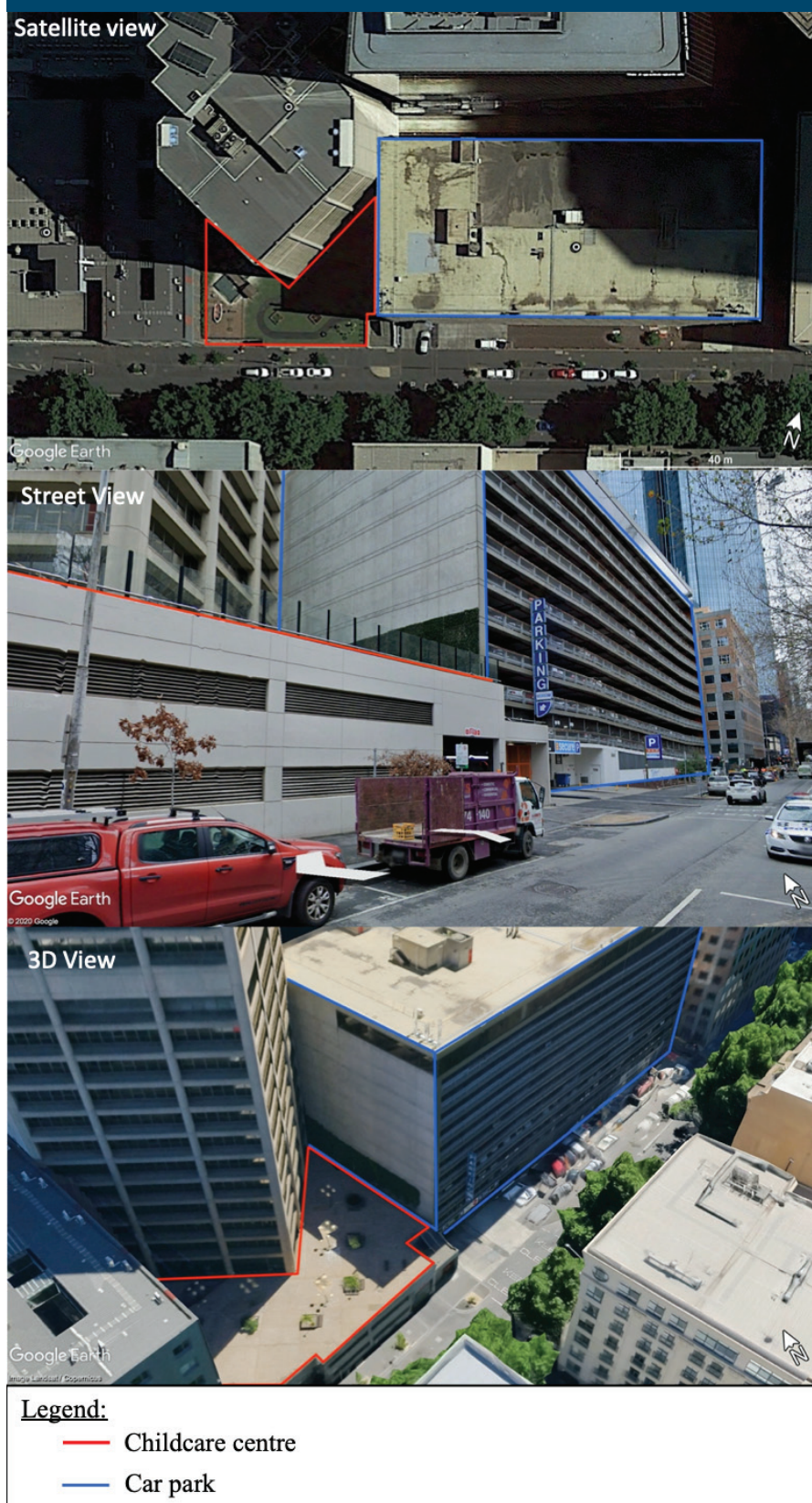
which are leaders in health and research, should be at the forefront of reducing TRAP exposure to children in their co-located childcare centres. Furthermore, the current Federal Government review of ambient air standards for nitrogen dioxide, sulphur dioxide and ozone indicates that Australian standards are significantly more lenient than WHO guidelines.¹⁶ The Australian standard for NO₂ is 120 ppb compared to 97 ppb set by WHO.¹⁶ Considering an increase of only 4.0 ppb leads to a 24% increase in the chance of the development of asthma,¹⁷ any increase in emissions levels caused by co-located car parks should be addressed during development and planning.

Physical pollution barriers are one option to reduce exposure to TRAP and have shown some positive mitigation effects in international studies.¹⁸⁻¹⁹ In order to be effective, pollution barriers must be purpose-built and generally consist of vegetation.¹⁸ However, such barriers are not commonly used in Australia, with no discernible purpose-built barriers identified for the car parks in this study.

While working parents need to be able to access childcare options close to either their work or home environments, the long-term health and safety of children are paramount. As many parents are probably unaware of the risks of TRAP from roads or car parks near outdoor play spaces, greater awareness of this issue within the community is required. Furthermore, the planning of future childcare centres must take into consideration the location and size of nearby car parks. Walter and Schneider-Futschik et al.,²⁰ in studying the vicinity of childcare centres to major roads, suggested the implementation of strategies to move childcare centres away from pollution flow movements, to avoid scheduled outdoor playtime occurring during times of the day that coincided with peak traffic conditions, and to create 'buffer zones' between childcare centres and roads. Additionally, they recommended increased community use of public transport and reduced idling of vehicles.

These recommendations are equally pertinent when considering the co-location of car parks with childcare centres. Given the potentially more concentrated nature of TRAP from car parks, the positioning of future childcare centres away from the flow of emissions is particularly relevant. Notably, current planning guidelines for minimising TRAP exposure to childcare centres are limited, particularly in Australian state of

Figure 1: Co-location of a childcare centre outdoor play space and an adjacent car park with >800 parking spaces.



Victoria, which lacks guidance at a state level. Consequently, rules and regulations regarding childcare centre location vary by council, with the focus being on residential disruption and with little attention to health risks. This can result in councils mandating the siting of childcare centres on major arterial roads to reduce disruption to local residents, which increases children's exposure to TRAP.²¹ The local council for the City of Melbourne (where most childcare centres were located in this study) requires that an environmental audit is undertaken during the planning and development of a childcare centre, however, consideration of possible TRAP exposure is not included within the audit.²² In New South Wales, an air quality assessment report must be generated for a proposed childcare centre.²³ However, only major roads and industrial developments are mentioned as specific sources of TRAP, with no discussion regarding car parks.

Notably in this study, more than double the number of childcare centres in Sydney's central business district had no outdoor play space when compared with childcare centres in Melbourne. While the sample size for Sydney was much smaller, this finding may reflect the different planning approach to the location of childcare centres, or the difficulty in providing outdoor play spaces in major cities where land prices are at a premium. While the absence of open-air spaces may reduce children's exposure, it is likely that to some degree vehicle emissions will penetrate indoor environments. Consideration of ventilation options and the provision of indoor air purifiers containing HEPA filters may be a useful strategy to reduce exposure. This study examined co-location of large car parks and childcare centres, therefore real-time use of car parks and TRAP levels in childcare centres' outdoor play spaces could not be measured or monitored. However, future research including such measurements is important and could enable childcare centre staff to schedule outdoor play according to weather and traffic patterns. Quantifying children's daily exposure to and risks from TRAP is thus an important step in addressing this issue.

Online data regarding car parks and childcare centres were limited for Sydney and other major Australian cities, preventing the study of this issue more widely. Nevertheless, the small sample of childcare centres in Sydney included in this study suggests the issue of large car parks being co-located with childcare centres is not confined to

Melbourne. Importantly, while nine childcare centres in Melbourne were excluded due to lack of data, a sensitivity analysis (in which it was assumed these centres had no car parks nearby) did not significantly alter the overall findings of this study.

In summary, we found Australian childcare centres are located too close to car parks, exposing children to potentially high levels of traffic pollution at a time when their lungs are developing, which has implications for the development of future chronic respiratory disease. This traffic pollution is an avoidable risk that must be considered when planning childcare centre location. The close proximity between childcare centres and large-scale car parks is an issue that needs to be considered and addressed through multiple strategies that will reduce children's emissions exposure. Future planning and construction of childcare centres need to take TRAP exposure from both roadways and car parks into consideration.

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