2019 Childhood Leukemia International Consortium (CLIC) and CLIC+ Scientific Annual Meeting
November 18-20, 2019 – Lyon

Proximity to petrol station and risk of childhood leukemia: systematic review and meta-analysis

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Background

Motorized traffic exposure and particularly benzene have been associated to childhood leukemia. In particular, living next to a petrol station or repair garage may increase the opportunity for benzene exposure. In this review, we investigated the extent to which living in proximity to petrol stations is associated with risk of childhood leukemia.

Methods

We searched all observational studies that have investigated the risk of childhood leukemia in relation to exposure to petrol station using either proximity of children residence or modelled exposure. We performed online database search up to October 10, 2019, including also snowballing methods to retrieve all possible eligible studies. We carried out a highest versus lowest exposure meta-analysis of all eligible studies using a random effect model, and we performed stratified analysis whenever possible according leukemia subtype, and exposure assessment method.

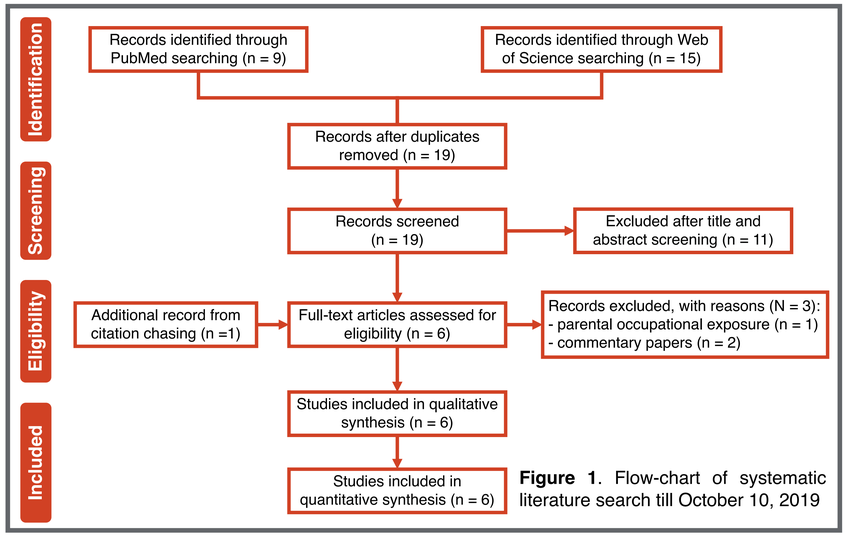

Figure 1. Flow-chart of systematic literature search till October 10, 2019

Table 1. Characteristics of included studies.

Study	Design	Region	Cases/non cases	Age (years)	Diagnosis	Assessment	Risk estimate	Adjusting factors
Abdul Rahman 2008	Case-control	Klang Valley, Malaysia	128/128	<15	2001-2007 all leukemia	Questionnaire: distance of residence at the time of diagnosis from a petrol station ≤1 km vs. >1 km	OR: 0.84 (95% CI 0.50-1.41)	Crude
Brosselin 2009	Case-control	France	765/1681	<15	2003-2004 all leukemia	Questionnaire: Ever (vs. never) lived in proximity (not described in detail) to a petrol station and/or automotive repair garage. Validated using georeferencing data	OR: 1.9 (95% CI 1.2-3.0)	Age, sex, number of children <15 years living in the household, and stratification variables
					ALL		OR: 2.0 (95% CI: 1.0-4.0)	
					AML		OR: 2.5 (95% CI: 0.7-8.8)	
Harrison 1999	Case-control	West Midlands, UK	130/251	0-15	1990-1994 all leukemia	Geoferencing data: petrol station proximity (≤100 m vs. >100 m)	OR: 1.99 (95% CI 0.73-5.43) IR: 1.48 (95% CI 0.65-2.93)	Crude
Mazzei-Abba 2019	Case-control	Swiss	1880/18800	<16	1985-2015 all leukemia	Georefencing data: petrol station distance (<50 m vs. ≥500 m)	OR: 1.13 (95% CI 0.52-2.47)	Not reported
Steffen 2004	Case-control	Nancy, Lille, Lyon and Paris, France	280/285	0-14	1995-1999 all leukemia	Face-to-face interview: vicinity (<50 m for traffic) of dwellings neighboring including petrol station or repair garage. Exposure during childhood.	OR: 4.0 (95% CI 1.5-10.3) During pregnancy: OR: 2.2 (95% CI 0.9-5.7)	Age, sex, centre, and ethnic origin
					ALL		OR: 7.7 (95% CI 1.7-34.3)	
					AML		OR: 3.6 (95% CI 1.3-9.9)	
Weng 2009	Case-control	Taiwan	729/729	0-14	1996-2006 all leukemia	Petrol station density (n/km^2) in tertiles: T1: ≤0.149 (median 0.065) T2: 0.150-0.395 (0.225) T3: 0.399-2.692 (0.585)	T2 - OR: 1.45 (95% CI 1.06-1.98) T3 - OR: 1.91 (95% CI 1.29-2.82)	Sex, year of birth, year of death, and urbanization level

Results

Legend: The area of each red square is proportional to the inverse of the variance of the estimated log RR. Black diamonds represent point estimates of RR and horizontal lines represent their 95% confidence intervals (CIs). The open red diamonds represent the combined RR for each subgroup and the overall RR for all studies. The solid line represents RR=1. The dash line represents the point estimate of overall RR for all studies.

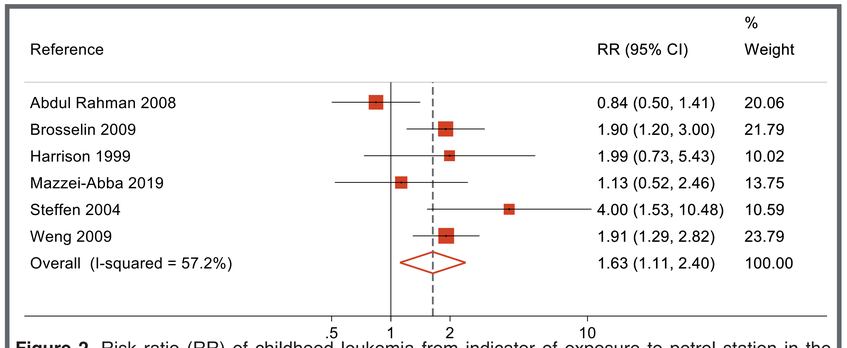

Figure 2. Risk ratio (RR) of childhood leukemia from indicator of exposure to petrol station in the highest versus lowest exposure category in all studies.

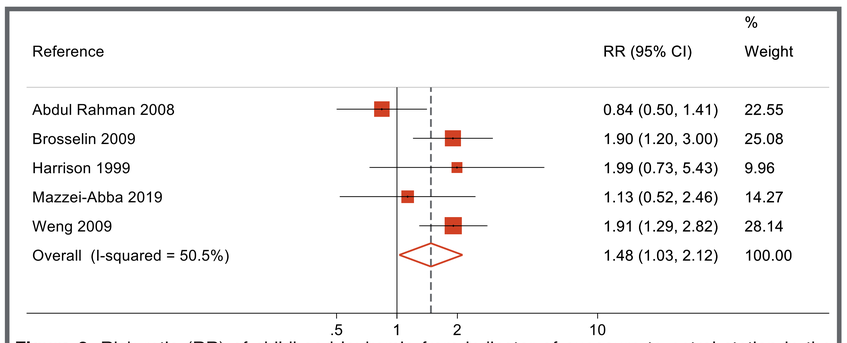

Figure 3. Risk ratio (RR) of childhood leukemia from indicator of exposure to petrol station in the highest versus lowest exposure category excluding one study assessing any petrol station and repair garage.

We found six studies eligible to be included in our review published from 1999 to 2019 and all with all with a case-control design (**Table 1**). We identified two additional studies compared to the last published systematic review, including one conference abstract (**Figure 1**). Exposure assessment was performed using questionnaire or face-to-face interview asking for distance of residence to petrol station in three studies (in one case with external validation), while georeferencing method was used through measurement of either distance (two studies) or petrol station density (one study). We eventually included 3632 cases and 21874 controls in the analysis. Summary relative risk (sRR) was 1.63 (95% CI 1.11 to 2.50) (**Figure 2**). After exclusion of one study in which exposure to either petrol station and automotive repair was considered, we still found an increased sRR of 1.48 (95% CI 1.03 to 2.12) (**Figure 3**). Estimates were slightly higher for ALL (sRR = 3.31, 95% CI 0.92 to 11.86) compared with AML (sRR = 3,12, 95% CI 1.41 to 6.89), although based on only two studies (**Figure 4**). We found substantially comparable estimates in studies using questionnaire and georeferencing methods for exposure assessment (**Figure 5**).

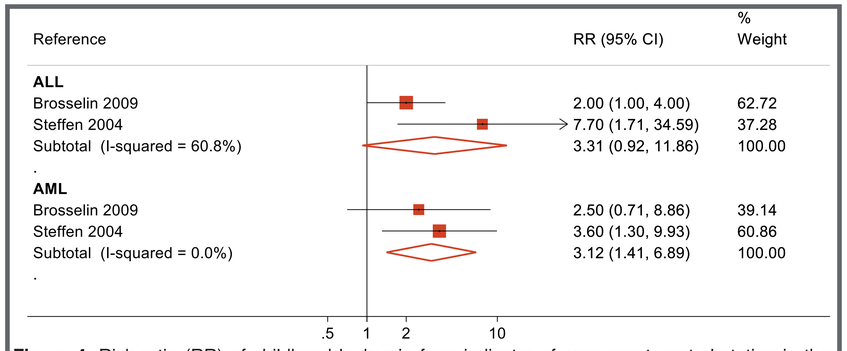

Figure 4. Risk ratio (RR) of childhood leukemia from indicator of exposure to petrol station in the highest versus lowest exposure category by leukemia subtype.

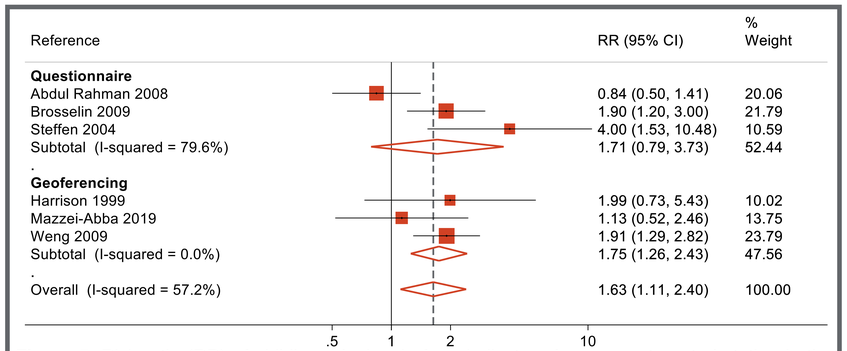

Figure 5. Risk ratio (RR) of childhood leukemia from indicator of exposure to petrol station in the highest versus lowest exposure category by exposure assessment method.

Conclusions

Overall, the epidemiologic literature appears to demonstrate an association between living in proximity to petrol station and childhood leukemia risk, supporting previous findings regarding motorized traffic and benzene.

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