Associations between neighbourhood design, neighbourhood socioeconomic status and sleep in adults

UNIVERSITY OF CALGARY CUMMING SCHOOL OF MEDICINE

BUILT ENVIRONMENT AND HEALTHY LIVING LAB

Ryan Lukic, BHSc[1]; Dana Lee Olstad, PhD[1,2] RD; Patricia K. Doyle Baker, Dr. PH[2,3]; Melissa L. Potestio, PhD[1]; Gavin R. McCormack, PhD[1,2,3s]

[1]Department of Community Health Sciences, Cumming School of Medicine; [2]Faculty of Kinesiology, University of Calgary; [3]School of Architecture, Planning and Landscape, University of Calgary, Calgary, Canada

Background

➢ Sleep is a risk factor for obesity and chronic disease[1]
➢ Only about half of Canadian adults achieve the 7-9 hours per night recommended for optimal health[2]
➢ Built environment characteristics such as overall walkability and destination density may influence sleep duration[3]
➢ Neighbourhood noise, traffic and noise produced from nearby destinations may increase sleep disturbances and delay sleep initiation[4,5]
➢ Neighbourhoods with similar street patterns (e.g., grid, warped-grid, or curvilinear) tend have common built characteristics (e.g., population density, destination density, pedestrian connectivity)[6]

Aim

➢ Estimate the association between neighbourhood street pattern, neighbourhood socioeconomic status (SES) and sleep duration in adults.
➢ Test the interactive effect of neighbourhood street pattern and neighbourhood SES on sleep duration and odds of long or short sleep

Method

Sample:
➢ A random stratified sample of 12 Calgary neighbourhoods characterized by three distinct street patterns (grid, warped grid, and curvilinear) and four neighbourhood SES quartiles (most advantaged, somewhat advantaged, somewhat disadvantaged, and most disadvantaged)[7]
➢ In April 2014 a sample of n=10 500 households from these neighbourhoods were invited to participate in a survey to be filled by the adult (>20 years of age); response rate=10.8%.[7]
➢ N=805 was available for analysis, after removing missing data

Measures:
➢ Self-reported sleep duration: "On average, how many hours of sleep do you get in a 24-hour period?" and was recorded in hours and minutes.
➢ Neighbourhood street pattern typologies were developed elsewhere[6]
➢ Socioeconomic deprivation index used to estimate neighbourhood SES; assessed proportions of single-parent families, adults with less than high school education, unemployment, those divorced or separated from a spouse, rented dwellings, value of dwellings and household income[7]

Analysis:
➢ Covariate-adjusted linear regression was used to estimate the relationship between neighbourhood street pattern, SES and sleep duration, while multinomial logistic regression estimated the impact of these on the odds of sleeping less than or greater than a 7 to 8 hour sleep duration

Results

Variable	Model 1	Model 2	Model 3
Neighbourhood type			
Curvilinear	REF	REF	REF
Warped Grid	-0.01 (-0.17, 0.16)	0.02 (-0.15, 0.18)	-0.16 (-0.37, 0.04)
Grid	0.07 (-.10, 0.25)	0.09 (-0.09, 0.27)	-0.05 (-0.26, 0.16)
Neighbourhood SES			
High SES	REF	REF	REF
Low SES	-0.07 (-0.21, 0.08)	-0.08 (-0.23, 0.08)	**-0.50 (-0.78, -0.21)***
Age in Years		-0.005 (-0.01, 0.001)	-0.01 (-0.01, 0.001)
Sex			
Male		REF	REF
Female		-0.03 (-0.17, 0.11)	-0.02 (-0.16, 0.12)
Ethnicity			
Non-White		REF	REF
White		-0.12 (-0.33, 0.09)	-0.12 (-0.32, 0.09)
Marital status			
Single/Other		REF	REF
Married/Common-Law		0.04 (-0.13, 0.22)	0.05 (-0.13, 0.22)
Dependents in home under age 18 years		-0.13 (-0.21, -0.04)*	-0.12 (-0.20, -0.04)*
Employment Activity			
Non-sitting main activity		REF	REF
Sitting is main activity		0.03 (-0.12, 0.17)	0.03 (-0.11, 0.18)
Total hours worked per week		-0.01 (-0.01, -0.002)*	-0.01 (-0.01, -0.002)
Highest level of education attained			
University postgraduate degree		REF	REF
University undergraduate degree		-0.14 (-0.30, 0.03)	-0.14 (-0.30, 0.03)
College, vocation, or trade		-0.16 (-0.36, 0.06)	-0.15 (-0.36, 0.06)
High School or Less		-0.04 (-0.34, 0.25)	-0.02 (-0.31, 0.28)
Gross household income			
$120,000 +		REF	REF
$0 - $119,999		0.03 (-0.14, 0.20)	0.03 (-0.13, 0.20)
Don't Know/Rather Not Say		-0.05 (-0.27, 0.17)	-0.07 (-0.29, 0.15)
Residential relocation in past 12 months			
Moved in past 12 months		REF	REF
Did not move in past 12 months		0.07 (-0.16, 0.29)	0.83 (-0.14, 0.30)
Survey type administered			
Online		REF	REF
Hard Copy		0.29 (0.07, 0.50)*	0.28 (0.06, 0.50)*
Interaction Terms			
Warped grid# low SES			0.59 (0.23, 0.94)*
Grid# low SES			0.53 (0.14, 0.92)*
R-squared	0.0025	0.0377	0.0517

Table 1: Linear regression estimates (b and 95% CI) for association between neighbourhood street pattern and mean self-reported hours of sleep in a typical 24-hour period (n=805). Model 3 adjusted for all variables, but tested for interaction between neighbourhood street pattern and neighbourhood SES; Bold values indicate statistically significant differences, *p < 0.05

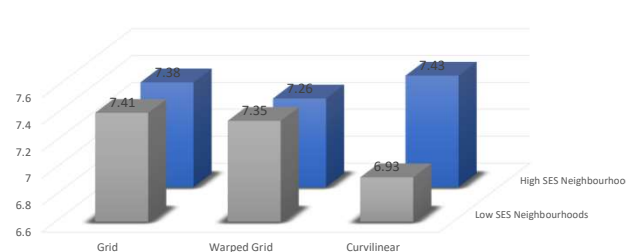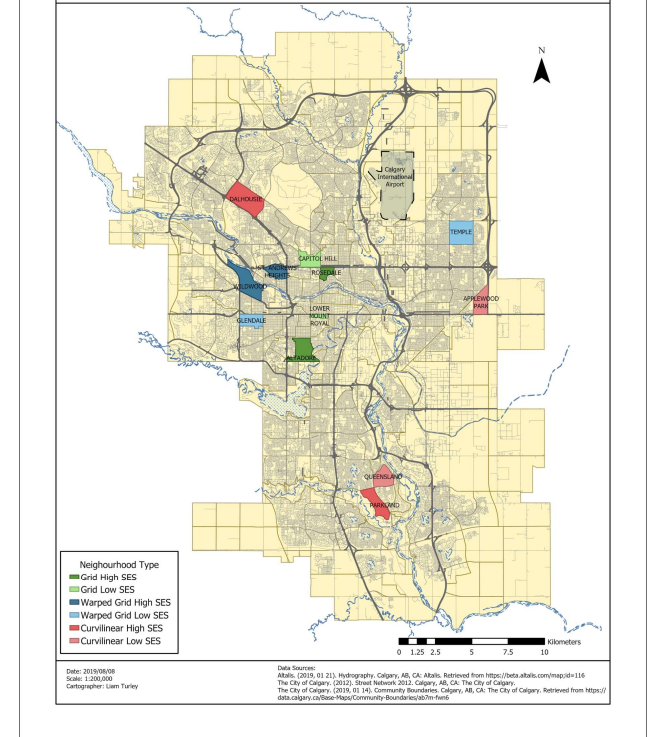**Marginal Mean Sleep Duration in Hours by Neighbourhood Type**

Figure 1: Marginal mean sleep durations in hours per 24 hour period, produced from linear regression b estimates produced in model 3.

Neighbourhood Street Pattern and SES Typologies

Conclusions

➢ Residents in curvilinear low SES neighbourhoods, particularly on the periphery of the city, may experience longer commute times and have less time available for sleep
➢ Those in grid and warped grid neighbourhoods in the study may benefit from central location and lower commute times, increasing time available for sleep
➢ High SES appears to mitigate affects of the built environment on participants sleep in curvilinear neighbourhoods

Results

➢ Mean sleep duration was 7.3 hours (SD 0.98); 65.3% slept 7-8 hours/24h
➢ Sample was predominantly female (62.9%), white (88.2%), married/common-law (77.4%), highly educated (73.9% university or higher)
➢ Interaction of neighbourhood street pattern and SES was associated with longer mean sleep duration in grid and warped-grid low SES neighbourhoods compared to high SES curvilinear neighbourhoods (Table 1); Curvilinear low SES neighbourhoods showed the lowest marginal mean sleep duration of 6.53 hours (Figure 1)
➢ Neighbourhood street pattern and SES were not related to odds of short or long sleep durations, relative to a 7 to 8 hour recommended duration

Contact
Ryan Lukic
Department of Community Health Sciences
Cumming School of Medicine, University of Calgary
rplukic@ucalgary.ca
403-607-8614

References

1. Ogilvie, R. P., & Patel, S. R. (2017). The epidemiology of sleep and obesity. Sleep Health, 3(5), 383-388. doi:https://dx.doi.org/10.1016/j.sleh.2017.07.013
2. Chaput, J. P., Wong, S. L., & Michaud, I. (2017). Duration and quality of sleep among Canadians aged 18 to 79. Health Rep, 28(9), 28-33.
3. Johnson, D. A., Hirsch, J. A., Moore, K. A., Redline, S., & Diez Roux, A. V. (2018). Associations Between the Built Environment and Objective Measures of Sleep: The Multi-Ethnic Study of Atherosclerosis. American journal of epidemiology, 187(5), 941-950.
4. Chum AOC, P.: Matheson, F. The impact of urban land uses on sleep duration and sleep problems. Can Geogr. 2015;59(4):404-18
5. Griefahn, B. (2002). Sleep Disturbances Related to Environmental Noise. Noise & Health, 4(15), 57-60.
6. Sandalack, B. A., & Nicolai, A. (2006). The Calgary project: urban form/urban life: Calgary: University of Calgary Press.
7. McInerney, M., Csizmadi, I., Friedenreich, C. M., Uribe, F. A., Nettel-Aguirre, A., McLaren, L., . . . McCormack, G. R. (2016). Associations between the neighbourhood food environment, neighbourhood socioeconomic status, and diet quality: An observational study. BMC Public Health, 16, 984. doi:https://dx.doi.org/10.1186/s12889-016-3631-7