Time activity patterns: a case of south Durban, South Africa

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INTRODUCTION

Exposure modelling in south Durban is constrained by a lack of population specific time-activity patterns data. We argue that the application of time-activity patterns from elsewhere in the world in exposure modelling in south Durban would be insufficient to adequately represent the time-activity patterns of the south Durban population. Particular factors include, among others, the amount of time spent in varying microenvironments and the drivers for time spent in these microenvironments. Therefore, the objective of this study was to determine time-activity patterns for an adult population in south Durban, South Africa, to inform air pollution exposure modelling.

METHODS

A questionnaire was administered to a sample of 381 adults in south Durban between January and June 2007. The questionnaire comprised a set of questions on demographics, potential air pollution exposure sources and a time-activity diary. The diary was divided into three microenvironments, namely indoor, outdoor and in-vehicle. The first two microenvironments were subdivided into indoor at home, indoor other and indoor at work, and outdoor at home, outdoor other and outdoor at work, respectively. Data cleaning process resulted in 291 complete questionnaires which were analysed using STATA 10. Robust regression with Huber-M estimation was used to determine drivers for time spent in microenvironments by the study population. Due to the limited number of weekend days, as a result of data collection constraints on weekend days, the analysis was confined to weekdays.

RESULTS

Descriptive statistics

The proportion of females was slightly higher at 59% compared to that of males at 41%. A large proportion of adults (90%) had a high school qualification while those with no education and those with tertiary education accounted for ~5% each. The majority of the respondents (60%) were also unemployed.

Time Spent in microenvironments

The frequency distribution of time spent in various microenvironments did not follow a normal distribution. None of the various transformations explored could approximate a normal distribution. On average participants spent approximately 21.2 ± 1.51 hrs/day in indoor environments, 2.20 ± 1.32 hrs/day in outdoor environments and 1.03 ± 0.41 hr/day on transportation activities. The home indoor microenvironment accounted for a large portion (82.5%) of time spent indoors. Table 1 indicates that significant gender, employment, educational and family type differences in the distributions of the time spent in microenvironments were confined largely to 'indoor at home' and 'outdoor at home' microenvironments. Employment status also had a significant effect on distributions of time spent outdoors in other locations. There were no seasonal differences or precipitation influences on distributions of mean time in all microenvironments (result not shown).

Table 1: Time spent in microenvironments on weekdays

Location	Gender	Mean (hrs)	SD	p-value
Indoor-home	Female	18.86	4.22	<0.001
	Male	16.00	4.29	
	Unemployed	20.45	2.39	<0.001
	Employed	13.45	2.75	
	<High school	16.66	4.40	0.002
	≥ High School	17.77	4.17	
	No child	17.60	4.24	0.018
	<18 year old child	16.75	4.38	
Outdoor home	Female	0.98	1.01	0.009
	Male	0.76	0.76	
	Unemployed	1.06	1.11	0.001
	Employed	0.69	0.61	
Outdoor other	Unemployed	0.96	0.90	0.007
	Employed	1.01	0.62	

Determinants of time spent in microenvironments: home indoor, total indoor and total outdoor

The statistically significant drivers for time spent indoors at home on weekdays were gender, occupational status, and temperature (Table 2). Time indoors at home increased significantly with being male and when temperatures were high. However, being employed resulted in participants spending significantly less time indoors at home. Significantly reduced time spent in other outdoor microenvironments was evident with a unit change in temperature. Those who were employed spent significantly more time in other outdoor environments. Only employment status remained a significant driver for time spent indoors at other locations. None of the factors evaluated were statistically significant drivers for time spent on transportation activities (results not shown). Education, family type, season and precipitation were not statistically significant drivers of time spent in any of the microenvironments considered in this study (results not shown).

Table 2: Determinants of time spent in microenvironments on weekdays

Variables	Home Indoor (hrs)	Indoor other (hrs)	Outdoor other (hrs)
	Coefficient (95% CI)	Coefficient (95% CI)	Coefficient (95% CI)
Male[a]	0.32* (0.01 – 0.64)	-0.14 (-0.33 – 0.04)	-0.14** (-0.25 – -0.03)
Age	-0.01 (-0.02 – -0.003)	-0.01 (-0.002 – 0.01)	0.003 (-0.001 – 0.01)
≥High School[b]	0.15 (-0.19 – 0.48)	-0.07 (-0.29 – 0.13)	0.05 (-0.06 – 0.16)
Employed[c]	-8.16*** (-8.51 – -7.80)	0.28** (-0.27 – 0.13)	0.23*** (0.12 – 0.34)
Children[d]	0.24 (-0.1 – 0.58)	-0.11 (-0.31 – 0.09)	-0.04 (-0.15 – 0.07)
Summer[e]	0.38 (-0.001 – 0.76)	-0.06 (-0.28 – 0.16)	-0.01 (-0.14 – 0.11)
Temperature	0.07* (0.01 – 0.13)	-0.01 (-0.04 – 0.02)	-0.02* (-0.04 – -0.0003)
Precipitation	0.26 (-0.17 – 0.69)	-0.05 (-0.31 – 0.21)	-0.08 (-0.22 – 0.06)

Key: * = p < 0.05; ** = p < 0.01; *** = p < 0.001; a = female = 0; b = ≤primary school = 0; c = unemployed = 0; d = No children = 0; e = other season = 0

DISCUSSION

Our data suggest that adults spent more time in indoors and largely at home. Females spent significantly more time indoors at home relative to their male counterparts. Although other studies indicate gender differences in time spent in other indoor and outdoor locations, our data did not reveal any such differences.

Of the many drivers for time spent in various microenvironments, our study found employment status, gender and temperature to be the main drivers of time spent in various microenvironments in south Durban. While temperature is a significant driver for time spent in microenvironments, it should be noted that Durban has mild winters which may not affect time-activity patterns greatly. This is supported by the non-significance of the seasonal variable in the regression models. Contrary to findings from other studies, variables such as age, education, family type, season and precipitation did not have a significant influence on the amount of time spent in various microenvironments.

When taking into account the limited number of studies considered in this evaluation (Klepeis, 1999; Leech *et al.*, 2002; Briggs *et al.*, 2003; Chau *et al.*, 2004; Sexton *et al.*, 2007; Wang *et al.*, 2008; Kornartit *et al.*, 2009; Yang *et al.*, 2010), the present study suggests that time spent in various microenvironments by the study population differs substantially for the home indoor (by ~13–24%), outdoor at home (38–68%), indoor other (30–114%), outdoor other (32–329%), and on transportation activities (27–70%) when compared to internationally generated data. This confirms our postulation that time-activity patterns generated elsewhere cannot be applied effectively to the south Durban population to inform exposure modelling.

It should, however, be noted that differences in time spent in various microenvironments could be due to a number of reasons, among others, sample size, methods of data collection and analysis, types of populations assessed, socio-economic status, and demographic profiles and definitions ascribed to explanatory variables used in the models.

SUMMARY

Study results suggest that time-activity patterns for elsewhere in the world would not sufficiently represent local, south Durban conditions. Therefore, their usage in exposure modelling would result in poor exposure estimates for the Durban population. Consequently, exposure modelling in south Durban needs to be informed by population-specific time-activity patterns. In addition, gender, employment status and temperature need to be considered in exposure modelling studies in Durban.

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