Putting Children’s Health on the Map with GIS

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**Organization Overview:**
Human Environments Analysis Lab @ Western

**HEAL:**
- Multi-disciplinary
- Community-focused
- Heavy on GIS!

**Team:**
- 20+ Student RAs
- 20+ Faculty
- 1 GIS Project Manager!

Established 2003
Organization Overview:
Human Environments Analysis Lab @ Western

A few of our clients/collaborators…

London Health Sciences Centre
Child & Youth Network
ML Health Unit
Old East Village
Oxford County
Chatham-Kent

and funders

Western University Canada
Green Shield Canada
Children’s Health Foundation
CHRI
Children’s Health Research Institute
CIHR
IRSC
Social Sciences and Humanities Research Council of Canada

Finding answers. For life. À la conquête de solutions.
Outline

1. Problem: Children’s Health

2. Putting Children’s Health on the Map!

3. Discussion: The Benefits of GIS
1. Problem: Obesity Trends Among Canadian Children

1981
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1994

1. Problem: Obesity Trends Among Canadian Children

Today!
Critical Paediatric Health Issues

Obesity-related issues:

• 1/5 to 1/3 of children in Canada, US, UK & NZ are overweight or obese\(^1\)

• Link to physical health & socio-psychological problems\(^3\)

\(^1\)NZHS 2006/7; CCHS 2004; HSE 2008; Ogden et al, 2006; \(^2\)He & Beynon 2006; Gilliland et al 2011; HEHPA 2010ab; CCHS 2004; \(^3\)Must et al, 1999; Pi-Sunyer 1991
Critical Paediatric Health Issues

Injury:

• Leading cause of child death in industrialized world\(^1\)

• Accounts for >11k ED visits/yr at Children’s Hospital SWO\(^2\)

\(^1\)UNICEF 2001; \(^2\) LHSC 2002-7; Charyk Stewart et al 2011
Asthma:

• Most common chronic disease in childhood & prevalence rising (CA:11% girls, 16% boys)\(^1\)

• Leading cause of school absences & major cause of hospitalization\(^3\)
Critical Paediatric Health Issues

Mental health:

- ADHD most common neurological disorder in childhood (~5-16%)\(^1\)

- Psychostimulant use by school children worldwide ↑ 700% in 90s\(^2\)

\(^1\)AAP 2000; Faraone et al 2003; \(^2\)Mackey & Kipras 2001
Shifting Focus: “you are where you live”

Geography matters!
Shifting Policy:

The "Healthy Communities" Movement

On the Agenda for Children?

Healthy eating
Active recreation / travel
Injury prevention
Air quality & health
Mental health
2. Putting Children’s Health on the Map

Opportunities for Healthy Living in Southwestern Ontario:
A Focus on Children’s Environments
Linking Foodscapes & Healthy Eating

• Obesity linked to diet of ‘fast’ foods, esp. in low-income populations\(^1\)

• High density of fast-food outlets linked to unhealthy diet, obesity, & related diseases\(^2\)

• Fast-food more prevalent in poor neighbourhoods & supermarkets more scarce\(^3\)

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\(^1\) Ebbeling et al, 2002; Zive et al, 2002; Bowman et al, 2004; \(^2\) Alter & Eny 2005; He et al, 2010; \(^3\) Reidpath et al, 2002; Block et al, 2004; Austin et al, 2005; Larsen & Gilliland 2008
Junk food & children’s environments

Median Household Income
- High >$55,000
- Moderate $40,000-$55,000
- Low <$40,000

Junk food proximity & density:
- highest around low SES schools
- influences purchasing & consumption & BMI

Gilliland 2010; He et al 2011ab
Exploring Urban “Food Deserts”

Neighbourhoods with poor access:
• households pay more for healthy food
• higher levels of food insecurity
• poorer diets, poorer health

A) London, 1961

- Supermarkets
- City hall

- Service area
- London, 1961
- Urban neighbourhoods, 2005
- Suburban neighbourhoods, 2005
- Non residential

B) London, 2005
Mapping access to healthy food

Patterns
Our Children’s Health and Environment

Access to Healthy Food

Modelled distance to Nearest Grocery Store, in km
- High: 5
- Low: 0
- Within Walking Distance (<500m)
- Greater than 1km

Sadler, Gilliland & Arku 2011

Chatham, Ontario

Gilliland 2012
Active Living & Public Recreation Spaces

• 2/3 NA children not active enough for optimal growth and development\(^1\)

In North American cities:

• Access to public parks & rec facilities linked to ↑ PA & ↓ obesity, especially for youth\(^2\)

• Parks are typically of poorer quality in low-income areas\(^3\) and poor quality parks are *rarely used*\(^4\)

\(^1\) CLFI 2010; \(^2\) CLFI 2009; Tucker et al, 2008; Huston et al., 2006; \(^3\) Wolch et al. 2005; Coen & Ross, 2005; \(^4\) Gilliland et al 2010
Patterns
Our Children’s Health and Environment

Access to Recreational Opportunities

Modelled distance to Nearest Public Recreation Space, in km

- High: 12
- Low: 0
- Greater than 1 km

Lake Erie

HEAL
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v. Jan 2012
Relationships among the *accessibility, quality and use* of public parks

**Play Space Needs Index:**
- household income
- lone-parenthood
- household crowding
- dwelling type mix
- youth density

**Park Quality Index:**
- playground facilities
- sporting facilities
- comfort facilities
- aesthetics

- Greater access to public rec opps linked to more time spent on MVPA & lower BMI

**Planning Districts**
- Play Space Needs Level
  - High
  - High-Med
  - Med
  - Med-Low
  - Low
  - City Hall
  - Sub-sample Parks

*N=235*

Gilliland et al 2006; Gilliland et al 2008; Tucker et al 2009
How much time do children spend in public parks?
Active Travel & Journey to School

• Increased walking linked to reduction in health problems\(^1\)

• Active travel to school in US ↓ from 42% in 1969 to 16% in 2001\(^2\)

• Likelihood of walking/biking linked to built environment\(^3\)

\(^1\) Sesso et al, 1999; Lacroix et al, 1995; Oja et al, 1998;
\(^2\) NPTS 1969; NHTS 2001; \(^3\) Gilliland, 2010
Active Travel & Journey to School

Method of travel to school

- Walk: 48%
- School bus: 25%
- Driver in vehicle: 21%
- Bike or scooter: 3%
- City bus: 2%

n=810 students (11-14yrs)

Larsen et al 2009; Larsen, Gilliland & Hess 2011
Environmental correlates of active travel

Environmental indicators:

- Distance between home & school
- Land use mix
- Density of street trees
- Intersection density (‘connectivity’)
- Number major streets crossed
- Traffic volume
- Retail density
- Residential density
- Dwelling type mix
- Number railroads crossed
- Sidewalk coverage
- Pathway coverage
- Streetlight coverage
- Route directness
- Crime along route

Larsen et al 2009; Larsen, Gilliland & Hess 2011
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Larsen et al 2009; Larsen, Gilliland & Hess 2011
Modelling ‘Walkability’

Neighbourhood Walkability
Elgin County 2009

Walkability Score
- 1 Lowest
- 2
- 3
- 4
- 5 Highest

Created by the Human Environments Analysis Laboratory
DAS09-001
Urban Form & Paediatric Injury

• 51% severe paediatric injuries at LHSC due to MVC\(^1\)

• Before & after intervention studies indicate traffic calming can ↓ traffic injuries (avg 11%)\(^2\)

\(^1\)LHSC 2002-7; Charyk Stewart et al 2011; \(^2\)Bunn et al, 2003
‘Hotspots’ for Motor Vehicle Collisions

Mapping “hotspots” for MVCs identifies where children are at heightened risk

Highest concentrations of MVCs found in the central core and major intersections

City of London 2008; Gilliland et al (preliminary analysis)
Urban Form, Air Quality & Health

• Children are more susceptible to adverse health effects of air pollutants\(^1\)

• Pollution, asthma & mortality rates significantly higher in neighbourhoods close to major roads and highways\(^2\)

\(^1\text{Kim 2004; }^2\text{Finkelstein et al, 2004; Lindgren et al 2009;}\)
Urban Form & Air Quality

Portable GPS + PM$_{2.5}$ monitoring + GIS

Hypothetical example

- Identifying environmental correlates of air pollutants and how children’s use of their neighbourhood environment influences their exposure
Children’s exposure to nature in the city:

- ↓ ADD symptoms\(^1\) & stress\(^2\)

- Enhances peace, self-control & self-discipline, esp. for girls\(^3\)

\(^1\)Kuo & Taylor 2004; \(^2\)Wells & Evans 2003; \(^3\)Taylor et al 2001
Natural Environments & Mental Health

Patterns

Our Children’s Environment and Health

Street Tree Distribution and Socio-economic Distress

London Street Tree Density
Number of Trees per sq km

- 1 - 250
- 251 - 500
- 501 - 1000
- 1001 - 1500
- >1500

Socio-Economic Distress by 1.6km School Zone
- Low
- Moderate-Low
- Moderate
- Moderate-High
- High

London, Ontario

Micro-scale intervention studies ongoing (Paddle, Gilliland, McCans, Loebach)
3. The Benefits of GIS
3. The Benefits of GIS

• Data management impossible without GIS!
3. The Benefits of GIS

- Raising and testing hypotheses on the fly!
3. The Benefits of GIS

- Powerful analyses to discover, visualize and quantify spatial patterns!

- Model Builder helps us manipulate large sets of data and re-test hypotheses
3. Recommendations

• GIS is necessary for decision-makers in planning & public health!

• Always plan ahead!

• Promote collaboration ... hire a geographers!
3. Future Plans

• Continue *healthy communities* work ...

• Continue to build collaborations with municipal and community organizations...

• Continue to support and lobby for policies and interventions aimed at making healthier communities for all!
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