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## **A review of the literature on the effect of the built environment on five chronic disease risk factors for Public Health Professionals interested in surveillance: A Summary Report**

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On behalf of the APHEO-Core Indicators Project Built Environment Sub-group

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# **A Review of the Literature on the Effect of the Built Environment on Five Chronic Disease Risk Factors for Public Health Professionals interested in Surveillance: A Summary Report**

## **INTRODUCTION:**

The Ontario Chief Medical Officer of Health report in 2004 acknowledged the link

between health and the built environment. It was one of the first

Ontario publications to highlight the need for public health

professionals to work with land-use planners. Bergeron (2006)

found in her literature review on the role of health care professionals

in increasing health through community design that there was

limited Canadian data available. Moreover, Bergeron (2006)

The built environment is an important aspect of the physical environment and is comprised of urban and building design, land use, the transportation system and the infrastructure that support them

(MOHLTC, 2008b, p.10).

observed that most of the journals reviewed identified that the research topic was in its

infancy. The purpose of this report is to: 1) identify the requirements of public health

practitioners in Ontario to conduct surveillance activities of the built environment and 2)

to conduct a review of the literature on the effect of the built environment on five chronic

disease risk factors\* (physical activity, healthy weights, tobacco use, alcohol consumption

and exposure to ultraviolet radiation) to inform the work of the Association of Public

Health Epidemiologists in Ontario (APHEO).

## ***Requirements of Public Health Practitioners in Ontario to Conduct Surveillance***

### ***Activities of the Built Environment***

A report titled “Chronic Disease in Ontario and Canada: Determinants, Risk Factors and

Prevention Priorities” highlighted epidemiological data on chronic disease and made

recommendations for a comprehensive chronic disease prevention framework in Canada

(Haydon et al., 2006). Within this report, the built environment was acknowledged as a

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\* The author acknowledges that these risk factors could also be preventative factors for some chronic diseases. Within the context of this report, they are considered chronic disease risk factors.

distal (indirect) risk factor for chronic diseases, particularly for the consumption of food and engagement of physical activity (Haydon et al., 2006). The report also acknowledged that “research and surveillance activities will be able to feed into the process of developing effective programs and policies” and the “need to look beyond what has been traditionally done and look to the expansion of policy into multiple domains” (Haydon et al., 2006, p.28). The Ministry of Health and Long-Term Care (MOHLTC) addressed these issues when it released its revised Ontario Public Health Standards (OPHS) in 2008. The Health Promotion and Policy Development requirements of the Chronic Disease Prevention Standards of the OPHS state:

*The board of health shall work with municipalities to support healthy public policies and the creation or enhancement of supportive environments in recreational settings and the built environment regarding the following topics:*

- *Healthy eating;*
- *Healthy weights;*
- *Comprehensive tobacco control;*
- *Physical activity;*
- *Alcohol use; and*
- *Exposure to ultraviolet radiation.*

(MOHLTC, 2008, p.20).

Therefore, the MOHLTC openly states that the built environment needs to be considered to decrease chronic disease risk factors. As part of the release of the OPHS, the MOHLTC (2008) released its *Population Health Assessment and Surveillance Protocol* which provides “direction on population health assessment and surveillance activities as defined in the OPHS so that local public health practice can effectively and efficiently identify and address current and evolving health issues” (MOHLTC, 2008b, p.1). The Protocol relates to many OPHS requirements, including the following assessment and surveillance requirement within the Chronic Disease and Injuries Program Standards:

*The board of health shall conduct epidemiological analysis of surveillance data, including monitoring trends over time, emerging trends, and priority populations, in accordance with the Population Health Assessment and Surveillance Protocol, 2008 (or as current), in the area of:*

- *Healthy eating;*
- *Healthy weights;*
- *Comprehensive tobacco control;*
- *Physical activity;*
- *Alcohol use; and*
- *Exposure to ultraviolet radiation.*

(MOHLTC, 2008b, p.2).

Within the operational roles and responsibilities section there are specific requirements not previously identified and may pose a challenge for public health professionals. The data access, collection and management section requires boards of health to collect or access specific types of population health data and information, including physical environment factors (MOHLTC, 2008b). Within the data analysis and interpretation section the Protocol states:

*The board of health shall make comparisons by person, place, and time and consider the relationships among these elements:*

- i) **Person:** *This includes analysis by socio-demographic variables and can be used to determine who is at risk;*
- ii) **Place:** *This includes analysis of health units data and how data is spatially distributed. Geographic comparisons may be limited by the data available. As such, comparisons within and among other health units and the province should also be undertaken when applicable; and*
- iii) **Time, including trends:** *This includes analysis of population health data and information for any given point in time, as well as across time periods.*

(MOHLTC, 2008b, p.8).

The lack of standardized indicators on the built environment prevents the understanding of how the built environment influences factors that are related to

#### **Physical Environment:**

The physical, chemical, and biological factors within the home, the neighbourhood, and/or the workplace, which are beyond the immediate control of the individual that affect health.

(MOHLTC, 2008b, p.10).

chronic disease. Health professionals, especially public health epidemiologists are challenged to: 1) identify indicators for the built environment relevant to the specified chronic disease factors; 2) identify data sources that are available at the health unit or neighbourhood level and 3) standardize indicators so comparisons can be made across public health units in Ontario. These challenges provide an opportunity for APHEO.

APHEO was formed in the early 1990s with the mission to advance and promote the discipline and professional practice of epidemiology in public health units in Ontario. One of the ways that they accomplish their mission is through the creation of working groups on public health topics.

***Overview of the APHEO-Core Indicators Project Built Environment sub-group  
(CIPBE)***

The APHEO-Core Indicators for Public Health in Ontario was formed in 1998 as a working group of APHEO. This project develops key indicators through the work of sub-groups focusing on specific public health topics. It is worth noting that the indicators referenced in the *Population Health Assessment and Surveillance Protocol* were developed by these sub-groups.

In February 2009, the APHEO-CIP Built Environment sub-group (CIPBE) was formed based on the outcome of a strategic direction session held in December 2008 by the APHEO- Core Indicators for Public Health in Ontario. The purpose of this sub-group is to develop public health indicators relevant to the built environment.

## ***A Review of the Literature on the Effect of the Built Environment on Five Chronic Disease Risk Factors***

### **Purpose of the Literature Review:**

The purpose of this report is to conduct a review of the literature on the effect of the built environment on five chronic disease risk factors to help inform the work of the CIPBE.

Therefore, this review does not provide specific micro details from the literature but provides a summary of information to provide direction for the future work of the CIPBE.

This review summarizes and synthesizes: 1) the evidence on the effect of the built environment for the five chronic disease risk factors; 2) measurement indicators and 3) implications for public health practice. The five proximal risk factors included in this review are: 1) physical activity, 2) healthy weight, 3) alcohol consumption, 4) tobacco exposure and 5) ultraviolet radiation exposure.

### **METHODS:**

#### **Literature Search**

The literature search criteria used:

- Limited to peer reviewed journals.
- Priority was given to secondary source articles\* (i.e. meta-analysis, systematic reviews or literature reviews) for inclusion over primary research studies (research conducted by the author).
- Articles that discussed the link between the built environment and one or more of the chronic disease risk factors of interest.

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\* Secondary sources are summaries of original works. Primary sources are the original works of the researchers who conducted the investigation.

- Focus was on finding articles about the population in general and not on specific target populations such as children, youth or older adults.
- Inclusion of articles from 2002 to present with preference given to more recently published articles.
- Key words used to search for relevant literature were a combination of built environment terms: “built environment”, “neighborhood”, “community design” *AND* at least one chronic disease risk factor term: “physical activity”, “healthy weights”, “obesity”, “access to healthy foods”, “alcohol consumption”, “access to alcohol”, “tobacco exposure”, “access to tobacco”, “ultraviolet radiation exposure”, “shade from the sun”, “sun safety” or “sun protection”.
- Articles that had in their title or abstract the words “evidence”, “indicators” or “measurement” were further investigated for relevance.
- References of articles deemed relevant were reviewed to identify other relevant articles.
- Articles available as full text.
- Articles that met all of the above criteria were included regardless of geography.

### **Search Strategy**

Online databases (i.e. Cochrane Collaborative, Proquest Nursing and Google Scholar) were searched. An appraisal of “Linking Health and the Built Environment: An annotated bibliography of Canadian and other related research” (Tucs & Dempster, 2007) was also conducted to identify physical activity and healthy weights literature. The search criteria listed above was used to evaluate relevant articles.

A summary table of relevant articles found was provided for review to the CIPBE prior to writing the final report.

## **RESULTS AND KEY FINDINGS FROM THE LITERATURE**

Results and key findings from the search for literature are presented in this section. An overview of the types of articles found is provided along with tables highlighting the author, year and title of the article, purpose of the article and the effect of the built environment on specific chronic disease risk factors. A directive from the CIPBE was to identify the *evidence available* and when possible the *strength of the evidence*, therefore, the key findings includes this type of information, where available.

Over 50 articles were found in the initial search. Upon further review of each article 21 articles met the inclusion criteria for this literature review. Articles are identified as secondary or primary source articles. Priority was to be given to secondary sourced articles as they are summaries of original works and can provide a greater scope on the topic of interest.

Physical activity, healthy weights and healthy eating were so intimately tied to each other within the literature; it was decided to presents the results together. This approach of presenting the effects of the built environment on physical activity, healthy eating and healthy weights together has been modeled by the Chronic Disease Prevention Alliance of Canada in its background paper “National Scan on Actions to Address the Relationships between Built Environments, Physical Activity and Obesity”. Moreover, a number of studies included in this review discussed these risk factors together when investigating the built environment.

## ***Evidence of the Effect of the Built Environment on Physical Activity and Healthy Weights***

Thirteen articles were reviewed. Seven were secondary source articles (i.e. systematic reviews or literature reviews) and six were primary source articles (original research conducted by the authors of the article). Table 1 provides an overview of the information found, listing the most recent articles first.

**Table 1: Evidence of the effect of the built environment on Physical Activity, Healthy Eating and Healthy Weights (PA HE HW)**

<b>Author, Year and Title</b>	<b>Purpose</b>	<b>Key Findings: Risk Factor (PA HE HW)</b>
<p>Raine, K. et al. (2008). State of the Evidence Review on Urban Health and Healthy Weights <i>secondary</i></p>	<p>To review and synthesize evidence regarding structural and community-level characteristics of urban environments that promote or inhibit the healthy weights and the effectiveness of interventions to assist urban populations in achieving healthy weights.</p>	<p><i>This article used several methods for data collection including: review of the evidence, talking with experts and review of policy documents.</i></p> <p><i>Review of the Evidence:</i> Found probable evidence for association between economic settings and obesity. A lower individual SES was often associated with increased obesity among adults and children.</p> <p>The urban built environment was associated with both physical activity and healthy body weight. Studies consistently showed that factors that promote obesity (for example, urban sprawl, low intersection density, low residential density, and low land-use mix) tend also to favour sedentary behaviour and lower physical activity levels.</p> <p>The strongest levels of evidence for association between environments and obesogenic behaviour or body weight were observed for physical (diet), socio-cultural (diet, sedentary behaviour, obesity/healthy weights) <i>settings</i> and physical, economic and socio-cultural <i>sectors</i>.</p> <p>Very little evidence existed for the effectiveness of interventions in achieving healthy weights.</p> <p><i>Talking with Experts:</i> Felt that the more immediate built environment (e.g. bike trails, walking paths) has a greater impact on healthy weights than broader societal trends. When asked whether changes could be made to the built environment to address the issue of obesity, nearly all respondents said yes.</p> <p><i>Review of Policy Documents:</i> Implicit in the evidence is an increasing recognition of the complexity of the issue and the need for the coordinated involvement of a range of policy actors across sectors and settings to link independent policies and processes.</p>

<b>Author, Year and Title</b>	<b>Purpose</b>	<b>Key Findings: Risk Factor (PA HE HW)</b>
Forsyth et al. (2007)  Does Residential Density Increase Walking and Other Physical Activity?  <i>primary</i>	Primary research study on the findings of an empirical study of walking among 715 people living in different densities.	<p>The correlations for overall walking and overall physical activity (measured by IPAQ, travel diary and accelerometer) were so uniformly low that they indicate basically no linear relationship between density and overall physical activity for the total study population.</p> <p>The researchers identified their findings were inconclusive and demonstrate the complexity of analyzing such relationships as the one between the built environment and physical activity.</p>
McGinn et al. (2007)  Exploring the Associations between Physical Activity and Perceived and Objective Measures of the Built Environment  <i>secondary</i>	To examine and describe the association between perceptions and objective measures of the built environment (using GIS) and their association with leisure, walking and transportation activity.	<p>Cross-sectional study conducted in 2003 in two geographic locations was used as the source for perception data.</p> <p>Little agreement was found between perceptions of the built environment and the objectively measured built environment.</p> <p>More research is needed to sort out the causal mechanism between the built environment and physical activity, as well as how and why individual's perceptions are formed and influenced, before any such interventions are undertaken.</p>
Papas et al. (2007)  The Built Environment and Obesity  <i>secondary</i>	To summarize existing empirical research relating the built environment to obesity.	<p>84% of articles included in this study reported a statistically significant positive association between some aspect of the built environment and obesity.</p> <p>Methodological issues of concerns included: inconsistency of measurements of the built environment across studies, the cross-sectional design of most studies, and the focus on aspects of either diet or physical activity but not both.</p> <p>Evidence tends to support the notion that one aspect of the built environment, namely access to affordable, healthy foods, is constrained within low-income communities in the United States. This partially explains the higher rates of obesity seen in low-income communities.</p> <p>Consideration of the built environment needs to include residential space and activity space, as well as the connection between these spheres.</p> <p>Research on the built environment's effect on adults has not distinguished between the stages of adulthood. However, there is evidence that the built environment has a unique impact on older adults</p>
Robeson, P. (2007)  The effectiveness of urban design and land use	Summary review of the systematic review article written by Heath, Brownson, Kruger et al*, 2006 aimed to determine the effectiveness of environmental and	<p>This review covered three environmental and policy approaches.</p> <p>Interventions reviewed were 1) community-scale urban design and land use policies and practices to increase physical activity, 2) street-scale urban design and land use policies to increase physical activity, and 3) transportation and travel policies and practices.</p> <p>Recommend with strong evidence the creation of enhanced access to places for</p>

<b>Author, Year and Title</b>	<b>Purpose</b>	<b>Key Findings: Risk Factor (PA HE HW)</b>
transportation policies and practices to increase physical activity. Evidence and implications for public health <i>secondary</i>	policy interventions, such as community-scale urban design and land use policies and practice to increase physical activity.	<p>physical activity combined with informational outreach activities.</p> <p>Recommended with sufficient evidence are community-scale and street-scale urban design and land use policies and practices to promote physical activity.</p> <p>The recommendations alone provide relatively little information on how to implement effective interventions.</p>
Brownson, R.C. et al. (2006)  Shaping the Context of Health : A Review of Environmental and Policy Approaches in the Prevention of Chronic Diseases  <i>secondary</i>	To describe effective and promising interventions to address tobacco use, physical activity, and healthy eating and lessons learned from the literature and practical experience in applying environmental and policy approaches.	<p>17 interventions were reviewed across 3 domains: physical environment/access, economic and communication environment.</p> <p><b>Physical Activity:</b> increased access to fitness centres or community centres, building walking/biking trails, focus on recreational activity (strong evidence); urban planning and policy: zoning regulations and building codes, improved street lighting, infrastructure projects that increase ease and safety of street crossing and polices that ensure sidewalk continuity (sufficient evidence);</p> <p><b>Transportation policy:</b> changing roadway design standards, expanding public transportation services, subsidizing public transportation (insufficient evidence); point of decision prompts: signs placed by elevators and escalators to motivate people to use nearby stairs and messages that focus on health benefits or weight loss (sufficient evidence)</p> <p>14 of the studies consistently showed increased walking and cycling when neighbourhoods have higher residential density, a mixture of land uses and connected streets.</p> <p>There is considerable evidence showing environmental and policy interventions are effective in preventing chronic disease risk factors. The evidence is strongest for tobacco use reduction.</p>
Curran et al. (2006)  Indicators for Community Action: Built Environment and Community Health  <i>primary</i>	To describe a process of identifying indicators that would assist communities in determining whether their built environment promotes active recreation and active transportation.	<p>This was a Canadian study (Nova Scotia).</p> <p>This was a large-scale interdisciplinary research project with a component that explored the role of the built environment in enabling community health was conducted. This project entailed developing indicators that could help community members identify whether their spaces could promote health with a focus on active recreation and active transportation. The study was led by researchers from the School of Planning at Dalhousie University, Nova Scotia. They began by identifying built environment indicators linked to community health in the literature and then evaluated the indicators for suitability in the local context.</p> <p>Valuable experience in the development of indicators by working with “Community Counts” a new division of the Nova Scotia’s Department of Finance established to develop a statistical infrastructure system of information about Nova Scotia communities and their local United Way office.</p>

<b>Author, Year and Title</b>	<b>Purpose</b>	<b>Key Findings: Risk Factor (PA HE HW)</b>
Lake, A & Townshend, T. (2006)  Obesogenic environments: exploring the built and food environments <i>secondary</i>	To explore the built environment and the food environment and their relationship with obesity. (literature review)	<p>A body of evidence suggests there is a link between the built environment, physical activity, obesity and chronic diseases.</p> <p>Research suggests a number of factors within the built environment appear to correlate with the tendency to undertake physical activity and thereby increase health outcomes. These factors include increased residential densities; neighbourhood design features, (i.e. historical structures; land-use mix; local shops, services and schools within residential neighbourhoods; quality of pavements and footpaths, enjoyable scenery; perception of safety; and the presence of others. All of these factors have been cited as encouraging walking and cycling.</p> <p>This article presented evidence to support the existence of an obesogenic environment.</p>
Lopez-Zetian, J. et al. (2006)  The link between obesity and the built environment. Evidence from an ecological analysis of obesity and vehicle miles traveled in California <i>primary</i>	To explore the association between transportation data (Vehicle Miles of Travel, VMT) at the county level as it relates to obesity and physical inactivity in California.	<p>This analysis found obesity to be associated with urban transportation indicators related to automobile use.</p> <p>This study did not identify a correlation between physical inactivity and the transportation variables examined.</p> <p>First report to provide a preliminary analysis of obesity, physical inactivity and ecological indicators of transportation data in California using county specific population based estimates.</p> <p>Also provides preliminary evidence supporting the notion that the ecological urban design in California, defined by excessive dependence on the automobile, is associated with high levels of obesity and physical inactivity.</p>
Transportation Research Board Special Report 282 (2005)  Does the Built Environment Influence Physical Activity? Examining the Evidence <i>secondary</i>	Examine the built environment as an important factor to reduce the levels of physical activity in the U.S. population.	<p>The available examined evidence shows a link between the built environment and physical activity.</p> <p>Physical activity can be categorized into four categories: 1) leisure time or recreational, 2) transportation, 3) household, and 4) occupational. This review was interested in the effect of the built environment on overall physical activity (total daily physical activity regardless of purpose).</p> <p>This review confirmed that the role of the built environment on physical activity levels is a new area of inquiry and that:</p> <ul style="list-style-type: none"> <li>• The built environment can facilitate or constrain physical activity;</li> <li>• The relationship between the built environment and physical activity is complex and operates through many mediating factors (i.e. sociodemographic characteristics, personal and cultural variables);</li> <li>• Causal relationship has not been demonstrated between the built environment and physical activity;</li> <li>• Characteristics of the built environment most closely associated with physical activity remains to be determined;</li> <li>• Weakness of the current literature reviewed includes the lack of a sound theoretical framework, inadequate research designs and incomplete data.</li> <li>• Appropriate measures of the built environment are still being developed and efforts to link such measures to travel and health databases are at an early stage.</li> </ul>

Author, Year and Title	Purpose	Key Findings: Risk Factor (PA HE HW)
		<ul style="list-style-type: none"> <li>Geocoding the data on physical activity and health collected in large survey's (i.e. Behavioral Risk Factor Surveillance System) could help link these rich data sets with information on the built environment and the specific locations where physical activity is occurring.</li> </ul> <p>Measures of the built environment and travel patterns are important predictors of obesity across gender and ethnicity, yet relationships among the built environment, travel patterns, and weight may vary across gender and ethnicity.</p> <p>Land-use mix had the strongest association with obesity.</p> <p>Each additional hour spent in the car per day was associated with a 6% increase in the likelihood of obesity.</p> <p>Each additional kilometer walked per day was associated with 4.8% reduction in the likelihood of obesity.</p> <p>As a continuous measure, BMI was significantly associated with urban form for white cohorts. Urban form is measured by connectivity and mixed land use.</p> <p>Relationships among urban form, walk distance, and time in a care were stronger among whites than black cohorts.</p>
Frank, L.D. et al. (2004)  Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars  <i>primary</i>	To evaluate the relationship between the built environment around each participant's place of residence and self-reported travel patterns, body mass index and obesity for specific gender and ethnicity classifications.	<p>Urban form could be significantly associated with some forms of physical activity and some health outcomes.</p> <p>Those living in sprawling counties are likely to walk less in their leisure time, weigh more, and have greater prevalence of hypertension than those living in more compact places.</p>
Ewing, R. et al. (2003)  Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity.  <i>primary</i>	To determine the relationship between urban sprawl, health, and health-related behaviors.	<p>The available evidence lends itself to the argument that a combination of urban design, land use patterns, and transportation systems that promote walking and cycling will help create active, healthier and more livable communities.</p> <p>Many questions remain about the interconnectedness of the built environment, travel behavior and public health.</p> <p>To provide more conclusive evidence researchers must address the following issues: 1) an alternative to the derived-demand framework must be developed for walking (<i>derived demand framework</i> is the idea that travel is a derived demand behaviour that is applicable to car travel but less applicable to walking or active transportation), 2) measures of the built environment must be refined, and 3) more-complete data on walking must be developed.</p> <p>Detailed data on the built environment must be spatially matched to detailed data on travel behavior.</p>

### ***Evidence of the Effect of the Built Environment on Tobacco Exposure***

Two primary articles were found that discussed tobacco exposure in terms of access to outlets that sell tobacco products. One of the articles (Brownson et al., 2006) was included in Table 1. Table 2 provides an overview of the information found.

**Table 2: Evidence of the effect of the built environment on access to tobacco outlets**

<b>Author and Year</b>	<b>Purpose</b>	<b>Key Findings: Risk Factor (tobacco exposure)</b>
Brownson, R.C. et al. (2006)  Shaping the Context of Health : A Review of Environmental and Policy Approaches in the Prevention of Chronic Diseases	To describe effective and promising interventions to address tobacco use, physical activity, and healthy eating and lessons learned from the literature and practical experience in applying environmental and policy approaches.	17 interventions were reviewed across 3 domains: physical environment/access, economic and communication environment.  Only physical environment/access results were reviewed and included:  Tobacco: reduce opportunities to obtain and use tobacco products (strong evidence); retailer or community education about youth access (insufficient evidence); restriction of advertising by media (i.e. billboards) (promising evidence)
Scheider, J.E. et al. (2005)  Tobacco Outlet Density and Demographics at the Track Level of Analysis in Iowa : Implications for Environmentally Based Prevention Initiatives	To assess the geographic association between tobacco outlet density and three demographic correlates-income, race and ethnicity.	The relationship between retail density and tobacco consumption has been established.  Geographic areas characterized as low-income or that have relatively high proportions of African Americans and Latinos are likely to have a higher density of tobacco outlets.  To the extent that travel costs are reduced in areas with a higher density of outlets, theory and evidence suggest that consumption will increase.  Findings from the study show support and extend other findings showing a geographic link between tobacco outlet concentration and particular demographic variables.

### ***Evidence of the Effect of the Built Environment on Alcohol Consumption***

Four primary articles were found that discussed the effect of the built environment on alcohol consumption in terms of access to alcohol outlets and neighbourhood characteristics. Table 3 provides an overview of the information found.

**Table 3: Evidence of the effect of the built environment on access to alcohol outlets**

<b>Author, Year &amp; Title</b>	<b>Purpose</b>	<b>Key Findings: Risk Factor (alcohol consumption)</b>
Bernstein, K.T., et al. (2007)  The Built Environment and Alcohol Consumption in Urban Neighbourhoods	Examines the relation between characteristics of the neighbourhood built environment and alcohol use in a large urban area.	<p>Multilevel analysis found that while few characteristics of the neighbourhood built environment were associated with any drinking, several characteristics of both the internal and the external built environment were associated with increased episodes of recent heavy drinking.</p> <p>The association between characteristics of the built environment and heavy alcohol use was independent of individual characteristics (i.e. income). This suggestion that quality of the local neighbourhood may be associated with vulnerability to adverse health among all persons in such neighbourhoods, independent of individual resources such as income.</p> <p>Relationship between alcohol outlet density at the neighbourhood level and alcohol use, suggests that alcohol outlets mediate (intercede) at least some of the relation between contextual characteristics of neighbourhoods and alcohol use.</p>
Romley, J. A. et al. (2006)  Alcohol and Environmental Justice: The Density of Liquor Stores and Bars in Urban Neighborhoods in the United States	To study the association between residential socio demographic characteristics and alcohol outlet density. In order to answer the question “to what extent the perceptions that minorities and low-income individuals face higher densities of two less desirable types of alcohol outlets (bars and liquor stores) in their neighborhood and does outlet density differs for youth across racial/ethnic groups” (p.49).	<p>Blacks face higher densities of liquor stores than do whites.</p> <p>Minorities in lower-income neighbourhoods have more liquor stores in their neighbourhoods than whites in lower- and higher-income neighbourhoods.</p> <p>Minority youth have more liquor stores in their neighbourhoods than do white youth.</p> <p>The density of liquor stores and bars decreases with increased income, especially for minorities.</p> <p>The results suggest that there is an environmental injustice for minorities and lower-income persons (more alcohol outlets in their neighborhood).</p>
Dent, C.W. et al. (2005)	To examine the relationship between use of environmental strategies (restricting access and enforcement of	<p>The rate of illegal merchant sales in the communities directly related to all four alcohol-use outcomes. The four alcohol-use outcomes were: <i>During the past 30 days:</i> 1) how many days did you have at least one drink of alcohol? 2) on how many days did you have five or more drinks of alcohol in a row, that is, within a couple of hours? 3) how many times did you have at least one drink of alcohol on school property? And 4) how many times did you drive a car or other vehicle when you had been drinking</p>

<b>Author, Year &amp; Title</b>	<b>Purpose</b>	<b>Key Findings: Risk Factor (alcohol consumption)</b>
	possession laws) and the frequency of youth alcohol use and related problems.	<p>alcohol?</p> <p>The use of various sources (i.e. grocery stores, convenience stores, drug stores and gas stations) to obtain alcohol in a community expanded and contracted somewhat depending on levels of access and enforcement.</p> <p>This evidence provides empirical support for the potential utility of local efforts to maintain or increase alcohol access control and possession enforcement.</p>
Scribner, R.A. et al. (2000)	To examine if alcohol outlet density influences individual drinking behavior.	<p>Individual distance to alcohol outlets was unrelated with drinking norms and alcohol consumption. However, the higher the mean distance to the closest alcohol outlet, the lower the mean drinking norms score and mean level of alcohol consumption.</p> <p>The findings suggest that the effect of alcohol outlet density on alcohol-related outcomes functions through an effect at the neighbourhood level rather than at the individual level.</p> <p>Problem drinkers tend to be grouped in neighbourhoods, an effect predicted by alcohol outlet density.</p> <p>The data supports studies which suggest that alcohol outlet density or the “wetness” of a neighbourhood is associated with alcohol consumption as well as drinking norms.</p> <p>The data also suggests that the ecological effects associated with alcohol outlet density are due to structural effect. Structural effects was defined as “residents with similar drinking patterns and drinking norms tend to aggregate in neighborhoods predicted by alcohol outlet density” (p.194)</p>

### ***Evidence of the Effect of the Built Environment on exposure to ultraviolet radiation***

#### ***(access to tanning facilities and shade structures)***

Three primary articles were found for inclusion in this review. One article (Patel et al., 2007) conducted a study on the correlations of tanning facility prevalence within San Diego County, California using county level census tract data. Two articles (Turnball & Parisi, 2006, Turnball & Parisi, 2004) were found that examined the effectiveness of man-made shade structures. Table 4 provides an overview of the information found.

**Table 4: Evidence of the effect of the built environment on exposure to ultraviolet radiation (access to shade and tanning facilities)**

Author and Year	Purpose	Key Findings: Risk Factor (exposure to ultraviolet radiation)
Patel, M.R, et al. (2007)  Correlates of Tanning Facility Prevalence within San Diego County, California Census Tracts.	Examined the number of tanning facilities within each census tract of San Diego, California through geographic information systems (GIS) mapping.	<p>This study identified themselves as one of the first to address health risks and indoor tanning facilities through the use of geographic information systems mapping.</p> <p>The researchers predicted that tanning facilities were more likely to be located within certain neighbourhoods based on the neighbourhood's distribution of demographic factors, including income, educational attainment, race/ethnicity, age and sex.</p> <p>Income was not found to be significantly correlated with the number of tanning facilities. This result was different from other studies listed in their introduction.</p> <p>Educational attainment was not found to be significantly correlated with the number of tanning facilities.</p> <p>Fitness centers were found to be positively correlated to the number of tanning facilities, suggest that as the number of fitness centers increases, the number of tanning facilities increase.</p> <p>Tanning facilities are more likely to be built in neighbourhoods with a higher percentage of women aged 15-29. This relationship was identified but strength of association was not stated.</p> <p>Cities with a higher density of whites had a higher density of tanning facilities.</p>
Turnball, D.J. & Parisi, A.V. (2006)  Effective Shade Structures.	Examines the insufficient protection of shade structures. The amount of protection offered by a shade structure varies with the angle of the sun.	<p>Large portions of shade structures provide insufficient protection against the sun's ultraviolet light.</p> <p>Community organizations that need to provide effective shade are hindered by cost and building regulations.</p> <p>Appropriate positioning and the addition of side-on protection (sides attached to the structure) can significantly reduce scattered UV light in the shade by about 89%.</p>
Turnball D.J and Parisi, A.V (2004)  Increasing the Ultraviolet Protection Provided By Shade Structures	Show how scattered UV levels in the shade are influenced by side-on protection for a range of solar zenith.	<p>When polycarbonate sheeting was used it showed a decrease in exposure to ratios of the eyes, bridge of nose, forehead, and cheeks and of the head.</p> <p>The side openings of a shade structure have a direct influence on where the shade is located and the level of scattered UV in the shaded area.</p> <p>When polycarbonate sheeting was added, it showed significant decreases in scattered UV levels of up to 65% less for summer and 57% less for winter.</p>

***Measurement Indicator Results***

Numerous measurement indicators were identified from this literature review. The indicators used within the reviewed literature to measure features of built environment are presented in Table 5. This is not an exhaustive list of possible measurements.

**Table 5: Measurement Indicators**

intersection density
% of area within a mile of commercial use
jobs per square mile or persons per acre or jobs
ratio of commercial floor space to land area
residential density
density of play space/recreation facilities
# of service outlets such as food premises, alcohol outlets, tanning facilities, gym's
proximity of residences to services listed above
# of units (residential, commercial, industrial) in a defined area (municipality, neighbourhood)
rate of decline in density with distance from downtown
measurement of rural, urban and suburban areas
distance from house to nearest store
share of total area for different uses
# of sidewalks available
ratio of sidewalk/path km to street centre line km
# of blocks
average block length
# of cul-de-sacs
% of blocks > 90% bike lane coverage
width of bike lanes
neighbourhood walkability (subjective tools available)
# street segments/street nodes
# and type of traffic calming measures such as speed bumps, reduced speeds, narrowing the road, crossing lights
traffic speed in residential areas, school areas, highways adjacent to residential areas
intersection per square mile of area
# of traffic crashes (car to car, car to pedestrian, car to bike)
location of traffic crashes (arterial road, neighbourhood road)
local neighbourhood characteristics (i.e. # of festivals, # of tourism attractions)
# of locations with graffiti per square mile
% of ground shade in public spaces
number of structural fires
% of buildings in neighbourhood observed to:
<ul style="list-style-type: none"> <li>• be in dilapidated condition</li> <li>• be in deteriorating condition</li> <li>• have any external wall problems</li> <li>• have any window problems</li> <li>• have any interior or exterior stairway problems</li> </ul>

## DISCUSSION

This section provides a summary and synthesis of the information found for consideration by the CIPBE.

### ***Evidence of the Effect of the Built Environment on Physical Activity, Healthy Eating and Healthy Weights***

#### **Summary of key findings of the evidence from secondary source articles:**

From the articles reviewed there is evidence to suggest that there is a link between the built environment, physical activity, obesity and chronic diseases. McGinn et al. (2007) recommend that both objective and perceived measures of the built environment are necessary when examining the relationship between the built environment and physical activity. The urban built environment was also associated with both physical activity and healthy body weight (Raine et al., 2008). Moreover, Lake et al. (2006) found that there are a number of factors within the built environment that appear to correlate with people's tendency to undertake physical activity and thereby increase health outcomes. The Handy et al. (2002) review found that the available evidence lends itself to the argument that a combination of urban design, land use patterns, and transportation systems that promote walking and cycling will help create active, healthier and more liveable communities.

There is evidence that supports the existence of an obesogenic environment (Raine et al., 2008, Papas et al., 2007, Lake et al., 2006). The strongest levels of evidence for association between environments and obesogenic behaviour or body weight were observed for physical (diet), socio-cultural (diet, sedentary behaviour, obesity/healthy weights) settings and physical, economic and socio-cultural sectors (Raine et al., 2008).

Furthermore, it was found that socioeconomic status has an impact on obesogenic environments. Papas et al. (2007) found that there is statistically significant positive association between some aspect of the built environment and obesity with evidence to support that access to affordable, healthy foods is constrained within low-income communities.

“Obesogenicity of an environment has been defined as “the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations” (Swinburn et al, 2002 as cited in Lake et al., 2006, p262).

There is a body of evidence showing that environmental and policy interventions are effective in preventing chronic disease risk factors (Brownson, 2006). Robeson (2007) review suggests that there was sufficient evidence for community-scale and street-scale urban design and land-use policies and practices to promote physical activity. She recommends with strong evidence the creation of and enhanced access to places for physical activity combined with informational outreach activities. Brownson et al. (2006) also found: 1) strong evidence for increased access to fitness centres or community centres, building walking/biking trails, focus on recreational activity, 2) sufficient evidence for improved street lighting, infrastructure projects that increase ease and safety of street crossing and polices that ensure sidewalk continuity, 3) insufficient evidence for changing roadway design standards, expanding public transportation services, subsidizing public transportation and 4) sufficient evidence for point of decision prompts: signs placed by elevators and escalators to motivate people to use nearby stairs and messages that focus on health benefits or weight loss. Implicit in the evidence is an increasing recognition of the complexity of the issue and the need for the coordinated involvement

of a range of policy actors across sectors and settings to link independent policies and processes (Raine et al, 2008). Moreover, the Transportation Research Board Special Report 282 (2005) identified that appropriate measures of the built environment are still being developed and efforts to link such measures to travel and health databases are at an early stage.

### **Summary of Primary Research Articles:**

The primary research articles were often referenced in the secondary articles included above. These articles provide some understanding of other factors and indicators that need to be considered when looking at the effect of the built environment on physical activity and healthy weights. Curran et al. (2006), Canadian researchers found that there was a positive experience working with other community stakeholders to develop indicators that would let communities identify whether their built environment promotes active recreation and active transportation. Lopez-Zetian et al. (2006) found there is a need for interdisciplinary research between urban planners, public health researchers and policy makers. In their study to address the question “Does residential density increase walking and other physical activity?”, Forsyth et al. (2007) found that higher density alone does not appear to be the solution to increase physical activity as their findings were inconclusive and demonstrated the complexity of analyzing such relationship. Ewing et al. (2003) found that those living in sprawling communities are likely to walk less in their leisure time, weigh more, and have greater prevalence of hypertension than those living in more compact places. Frank et al. (2004) found that measures of the built environment and travel patterns were important predictors of obesity across gender and ethnicity, yet relationships among the built environment, travel patterns, and weight may

vary across gender and ethnicity. Handy et al., (2002) in their review of how the built environment affects physical activity found that more questions remain about the interconnectiveness of the built environment, travel behaviour and public health. Therefore, one can conclude that more primary research is needed to measure the effect of the built environment on engaging in physical activity and the role of density. Forsyth et al. (2007) did acknowledge that density is a particularly important dimension because it is easy to measure and is a built environment feature that is regulated. Lopez-Zetian et al. (2006) found obesity to be associated with urban transportation indicators related to automobile use.

### ***Evidence of the Effect of the Built Environment on Tobacco Exposure***

#### **Summary of Key Findings for access to tobacco outlets:**

There does not appear to be evidence regarding the relationship between the built environment and tobacco use and exposure. The two studies (Brownson et al., 2007, Scheider et al., 2005) reviewed show that there is a relationship between retail density and consumption for tobacco use. Brownson et al. (2006) found in their review of environmental and policy approaches in the prevention of chronic disease that: 1) there is strong evidence to reduce opportunities to obtain and use tobacco products, 2) insufficient evidence for community education to retailers about youth access, and 3) promising evidence on restriction of advertising by media (i.e. billboards). Findings from the study by Scheider et al. (2005) show a geographic link between tobacco outlet concentration and particular demographic variables such as low-income thus supporting that geographic areas characterized as low-income are likely to have a higher density of tobacco outlets. Scheider et al. (2005) also found that relatively high proportions of African Americans

and Latinos are likely to live in neighbourhoods that have a higher density of tobacco outlets.

### ***Evidence on the Effect of the Built Environment on Alcohol Consumption***

#### **Summary of Key Findings for access to alcohol outlets:**

A causal relation between exposure to neighbourhood environment and use of alcohol has not been established. Moreover, the quality of the neighbourhood is a factor to determine access to alcohol outlets. Bernstein et al. (2007) findings suggest an association between heavy alcohol use and the urban built environment. These researchers further identify that the quality of the neighbourhood may be associated with vulnerability to adverse health among all persons in such neighbourhoods. The relation between alcohol outlet density at the neighbourhood level and alcohol use suggests that alcohol outlets mediate some of the relation between contextual characteristics of neighbourhoods and alcohol use (Bernstein et al., 2007). Romley et al. (2006) investigated specific alcohol outlets (bars and liquor stores) finding that lower-income neighbourhoods with a higher proportion of ethnic minorities compared to whites have more liquor stores. This highlights the imbalance in alcohol retailing that needs to be taken into consideration when investigating alcohol access in lower-income neighbourhoods. Alcohol outlet density is associated with alcohol consumption as well as drinking norms. The effect of alcohol outlet density on alcohol-related outcomes functions through an effect at the neighbourhood level rather than at the individual level (Scribner et al., 2000). Dent et al. (2005) found community level availability and enforcement of possession laws to be predictors of youth drinking and that there was evidence to support the usefulness of local efforts to maintain or increase alcohol access control and possession enforcement.

### ***Implications for Public Health Practice***

The information presented in this report has many implications for public health practice including impacting the work of the CIPBE. This review identified that more research is needed on:

- Developing effective program and policy interventions within the built environment to have an effect on the chronic disease risk factors included in this report;
- Developing appropriate measures of the built environment as a variety of methods are being used with very little overlap or consistency;
- Overcoming the challenge of measuring the built environment in settings other than urban areas. There appears to be a lack of peer reviewed research that address the issue of measuring the built environment in rural or suburban settings;
- The impact of density. Studies within this review present differing views on the impact that density has on chronic disease risk factors, most notably within the literature on access to alcohol;
- How diverse professionals (i.e. land-use planners, public health, transportation engineer) can work together to increase the health of the population through the built environment.

As stated at the beginning of this review, research on this topic is in its early stages but there are some lessons to be shared that could help guide the work of the CIPBE. They include:

- Reviewing the Curran et al. (2006) to learn more about the process these Canadian researchers engaged in to identify indicators that would assist

communities in determining whether their built environment promotes active recreation and active transportation. Perhaps this process could be applied to other chronic disease risk factors;

- The advantages of using both objective and subjective methods to measure the built environment in order to examine the relationship between the built environment and physical activity;
- The benefits of measuring the built environment at local or neighbourhood or regional characteristics as the socioeconomic status of the “neighbourhood” (where people live) has an impact on access to physical activity opportunities, food choices, access to tobacco and alcohol outlets and tanning facilities;
- Those working in this area are forging new ground. There is not a “right” path to follow due to the complexities of examining the effect of the built environment on chronic disease risk factors;
- The need for more Canadian published material on what is being done to increase health through the built environment.

### ***Knowledge Gaps***

There is no clear directive on what to measure and specifically what to change within the built environment to decrease the chronic disease risk factors discussed in this report.

From this review, there appears to be more evidence on the effect of the built environment and physical activity and healthy weights and limited evidence on the other chronic disease risk factors discussed. Urban neighborhoods appear to be studied more so than rural areas, thus there is a gap in the knowledge on the effect of the built environment in settings that are not urban. Overall, there appears to be insufficient

evidence to guide the work of public health professionals. More research is needed, particularly Canadian research.

### ***Limitations of this Review***

There are several limitations of this review. They are:

- Lack of Canadian studies on this topic. Although there are two Canadian references, one focuses on United States research (Robeson, 2007) and the other (Curran et al., 2006) discusses developing indicators within the community. Moreover, Canada is a four season country and none of the articles included in this review discuss the impact of winter when investigating the effect of the built environment on chronic disease risk factors. The effect of weather needs to be considered as Canadians may be more motivated or de-motivated to engage in physical activity due to the weather (Cragg, Cameron & Craig, 2006). Furthermore, there is uncertainty that the findings from this review can be transferable to Ontario as our tobacco and alcohol policies may differ from those discussed in the literature;
- Lack of systematic reviews found on tobacco exposure, alcohol consumption and exposure to ultraviolet radiation. This could be due to the criteria chosen for this report;
- Lack of literature found regarding rural areas. A large portion of Ontario includes rural areas. As none of the studies included in this review discussed the effects of the built environment on chronic disease risk factors in rural settings it is difficult to translate the strength of the evidence presented to rural settings;

- There appears to be different terminology used by different professions when describing the built environment. Therefore, it is not clear if the search words used in this review would identify studies from different professional journals;
- The search terms used were not an exhaustive list. The search terms used were at the “macro” level (i.e. physical activity, healthy weights, neighborhood) as oppose to using more “micro” level search terms (i.e. walking, cycling or land-use planning). This could have limited the number of articles found;
- The definitions for evidence used in each article are defined differently. This is a limitation as the levels of evidence found could not be compared to draw conclusions on the strength of the evidence overall;
- The effect of the built environment on the chronic disease risk factors discussed in this report is a new area of research. This appears to limit the amount of literature to review.

### ***Suggestions for Future Reviews***

Suggestions for future reviews include:

- Specifically look at the literature both academic and community-based on rural communities to see if the effect of the built environment on the chronic disease risk factors discussed in this report has been investigated;
- As minimal Canadian research was found in academic literature, the CIPBE could consider conducting a review of Canadian “grey literature” (non-published work), especially on the effect of the built environment on tobacco use, alcohol consumption and exposure to ultraviolet radiation, as there appears from this review to be limited research. This review could also include contacting

organizations (provincial, regional and local) working in the field of physical activity, healthy weights, tobacco control, alcohol consumption and exposure to ultraviolet radiation to investigate what they have learned about measuring the built environment.

## **CONCLUSION:**

This report provided an overview of the requirements of public health practitioners in Ontario to conduct surveillance activities of the built environment as outlined by the Ontario Public Health Standards of the Ontario Ministry of Health and Long-Term Care. A review of the literature on the effect of the built environment on five chronic disease risk factors (physical activity, healthy weights, tobacco use, alcohol consumption and exposure to ultraviolet radiation) was conducted and the results summarized in tables. The discussion section included a summary of key findings of the effect of the built environment on each of the chronic disease risk factors and implications for public health practice were discussed. Knowledge gaps in the research, limits of the review and suggestions for future reviews were identified. All sections of this report were written to inform the future work of the Association of Public Health Epidemiologists in Ontario, Core Indicators Project-Built Environment sub-group.

## References

1. Bergeron, K. (2006). Designing active communities: The role for health care professionals. *@ heart*, Heart Health Resource Centre, Toronto, Ontario.
2. Bernstein, K.T., Galea., S., Ahern, J., Tracey, M. & Vlahov, D. (2007). The built environment and alcohol consumption in urban neighbourhoods. *Drug and Alcohol Dependence*, 91, 244-252
3. Brownson, R.C, Haire-Joshu, D. & Luke, D.A. (2006). Shaping the context of health: A review of environmental and policy approaches in the prevention of chronic diseases. *Annual Review of Public Health*, 27, 341-370.
4. Chief Medical Officer of Health (Ontario) (2004). *Chief medical officer of health report: Healthy weights, Healthy lives*. Ministry of Health Promotion, [http://www.mhp.gov.on.ca/english/health/HEAL/healthy\\_weights\\_112404.pdf](http://www.mhp.gov.on.ca/english/health/HEAL/healthy_weights_112404.pdf)
5. Chronic Disease Prevention Alliance of Canada Steering Committee. (2006). Background Paper: National scan of actions to address the relationship between built environments, physical activity and obesity. *Chronic Disease Prevention Alliance of Canada*, Ottawa, Ontario.
6. Cragg, S., Cameron C. & Craig, C.L. (2006) 2004 National Transportation Survey. Ottawa, ON: *Canadian Fitness and Lifestyle Research Institute*. Ottawa, Ontario.
7. Curran, A., Grant, J. & Wood, M.E. (2006). Indicators for community action: Built environment and community health. *Journal of Rural and Community Development*, 2, 59-74
8. Dent, C.W., Grube, J.W. & Biglan, A. (2004). Community level alcohol availability and enforcement of possession laws as predictors of youth drinking. *Preventive Medicine*, 24, 355-362.
9. Ewing, R., Schmid, T., Killingsworth, R., Zlot, A. & Raudenbush, S. (2003). Relationship between urban sprawl and physical activity, obesity and morbidity. *American Journal of Health Promotion*, 18(1), 47-57.
10. Forysth, A., Oakes, J.M., Schmitz, K.H. & Hearst, M. (2007). Does residential density increase walking and other physical activity? *Urban Studies*, 44(4), 679-697.
11. Frank, L.D., Andresen, M.A. & Schmid, T.L. (2004). Obesity relationships with community design, physical activity, and time spent in cars. *American Journal of Preventive Medicine*, 27(2), 87-96.

12. Haydon, E., Roerecke, M., Giesbrecht, N., Rehm, J. & Kabus-Matthews. (2006). Chronic disease in Ontario and Canada: Determinants, risk factors and prevention priorities: Summary of full report. *Ontario Chronic Disease Prevention Alliance & the Ontario Public Health Association*, Toronto, Ontario.
13. Handy, S.L., Boarnet, M.G., Ewing, R. & Killingsworth, R.E. (2002). How the built environment affects physical activity. Views from urban planning. *American Journal of Preventive Medicine*, 23(2S), 64-73
14. Heath, G.W., Brownson, R.C., Kruger J., Miles, R., Powell, K.E., Ramsey, L.T & The Task Force on Community Preventive Services. (2006) The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review. *Journal of Physical Activity and Health*, 3(1), S55-S76.
15. Lake,A. & Townsend, T. (2006). Obesogenic environments: Exploring the built and food environments. *The Journal of the Royal Society for the Promotion of Health*, 126(6), 262-268.
16. Lopez-Zetina, J., Lee, H. & Friis, R. (2006). The link between obesity and the built environment. Evidence from an ecological analysis of obesity and vehicle miles of travel in California. *Health and Place*, 12, 656-664.
17. McGinn, A.P., Evenson, K.R., Herring, A.H., Huston, S.L. & Rodriguez, D.A. (2007). Exploring associations between physical activity and perceived and objective measures of the built environment. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 84(2), 162-184
18. Ministry of Health and Long-Term Care. (2008). *Ontario Public Health Standards 2008*. Toronto, Ontario.
19. Ministry of Health and Long-Term Care. (2008b). *Population Health Assessment and Surveillance Protocol*. Toronto, Ontario.
20. Papas, M.A., Alberg, A.J., Ewing, R., Helzlsouer, K.J., Gary, T.L. & Klassen, A.C. (2007). The built environment and obesity. *Epidemiologic Reviews*, 29, 129-143.
21. Patel, M.R., Mayer, J.A., Slymen, D.J., Weeks, J.R. & Hurd, A.L. (2007). Correlates of tanning facility prevalence within San Diego county, California census tracts. *Journal of Community Health*, 32, 391-400.
22. Raine, K., Spence, J.C., Church, J., Boule, N., Slater, L., Marko, J., Gibbons, K. & Hemphil, E. (2008). State of the evidence on urban health and healthy weights. *Canadian Institute for Health Information*.

23. Robeson, P. (2007). Summary statement title: The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review. *Health-evidence.ca*.
24. Romley, J. A., Cohen, D., Ringel, J. & Strum, R. (2007). Alcohol and environmental justice: The density of liquor stores and bars in urban neighbourhoods in the United States. *J. Stud. Alcohol Drugs*, 68, 48-55.
25. Schneider, J.E., Reid, R.J., Peterson, N.A., Lowe, J.B. & Hughey, J. (2005). Tobacco outlet density and demographics at the tract level of analysis in Iowa: Implications for environmentally based prevention initiatives. *Prevention Science*, 6(4), 319-325
26. Scribner, R.A., Cohen, D.A. & Fisher, W. (2000). Evidence of a structural effect for alcohol outlet density: A multilevel analysis. *Alcoholism: Clinical and Experimental Research*, 24(2), 188-195.
27. Transportation Research Board. (2005). Special report 282. Does the built environment influence physical activity? Examining the evidence. *The National Academies*, 24.
28. Tucs, E. & Dempster, B. (2007). Linking health and the built environment: An annotated bibliography of Canadian and other related research. *Ontario Healthy Communities Coalition*, Toronto, Ontario.
29. Turnball, D.J. & Parisi, A.V. (2004). Increasing the ultraviolet protection provided by shade structures. *Journal of Photochemistry and Photobiology*, 78, 61-67.
30. Turnball, D.J. & Parisi, A.V. (2006). Effective shade structures. *MJA*, 184(1), 13-15.