Sampling Design and Data Collection for the NEWPATH Survey: assessing health, diet, physical activity and travel in mid-sized urban municipalities

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Abstract

The design of sampling and data collection for the NEWPATH survey, conducted in the Region of Waterloo, Ontario, are presented as a case study in design of a complex survey of health behaviors, including travel patterns, objectively- and subjectively-measured physical activity behaviors, diet-related behaviors, and health outcomes. Features of this design include stratification of the sample with respect to neighborhood walkability, household income and household size with allocation to achieve high statistical power, and carrying out sampling in phases to achieve cost efficiencies. The final data set is approximately representative of the population in terms of demographic measures, and survey weights compensate for biases introduced by oversampling of high- and low-walkability areas as well as differential non-response.

Keywords

built environment, dietary assessment, health behaviour, physical activity assessment, travel diary, urban health

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INTRODUCTION

The NEWPATH study is a cross-sectional survey of households in the Region of Waterloo,
Ontario, that has broken new ground in collecting data on travel patterns, activity and diet simultaneously. In brief, the objectives of the NEWPATH project are the following: to establish a model to integrate dietary, transportation, physical activity, built environment, and body weight data; to evaluate the impact of dietary behavior (energy in) versus physical activity levels (energy out) in explaining obesity across a range of income, age, and walkability levels; and to use the model to inform policy development within land use and transportation planning in the Region of Waterloo.

Key questions include whether neighborhood walkability is associated with activity levels and transportation choices, and whether access to healthy food is associated with diet quality, and thus whether aspects of the built environment can predict overweight and obesity.

Thus, besides the survey itself, two important ingredients of this study are constructed measures of the environment. One is a walkability surface, in which each six-digit postal code is associated with a walkability index score which takes into account residential density, connectivity (road and pedestrian), land use mix and ratio of retail floor area (Fisher et al, 2013). The other is a set of objective measures of food access, food availability, food affordability, and food quality, obtained from a census of food stores and restaurants. A variety of food environment assessment tools were applied in one outlet of each chain restaurant, convenience store, gas station and pharmacy; in every grocery store; and in every independently-owned restaurant, convenience store, gas station and pharmacy in the three cities that comprise the Region of Waterloo (Kitchener, Cambridge, and Waterloo) (Minaker et al, 2013a; Minaker et al, 2013b).

In addition to the unique combination of travel, activity and diet data, the study has two notable features in its sampling design and methodology. The first is the stratification of the population, and the allocation of the sample among strata defined by walkability and other variables, in order to ensure high statistical power to detect the hypothesized effects of walkability. The second is a process akin to that of a responsive design in the sense of (Groves and Heeringa, 2006), in which the progress of fieldwork was monitored for sample composition and productivity, and sampling was carried out in phases corresponding to changes in protocol designed to keep costs within budget and increase representativity of the sample.

The organization of this paper is as follows. The survey data collection protocols and the measures collected for households and individuals are described. Then the study population and the sampling design are specified, and the principles for the allocation of the sample to strata are justified. The division of the sampling design into phases and the consequences for the computation of survey weights are described. The results of the sampling design are presented in terms of conditional response rates and the representativity of the sample. The final section contains discussion and conclusions.

2 MATERIALS AND METHODS

2.1 SURVEY DATA COLLECTION PROTOCOLS AND INSTRUMENTS

Each respondent household was assigned to one of two groups, in a manner to be described in Section 3. In the first group (the Complex group) every member of the household was asked to complete a travel diary which included food records, for two days; one household member wore an accelerometer during the same two days. Households in the second group (the Simple group) were to complete diary information pertaining to travel only, without including food eaten, and no
one was assigned to wear an accelerometer. Both types of households completed a recruitment questionnaire and attitude and behavior questionnaires which asked about neighborhood preferences and food shopping patterns. The remuneration was $25 for the Complex group households (later increased to $30 for larger households) and $15 for the Simple group households. Remuneration was pre-paid for the Simple group, since pre-payment generally increases response rates (Singer et al, 2000), but post-paid for the Complex group, to increase the chances of retrieving the accelerometers.

The telephone recruitment questionnaire contained questions pertaining to all members of the household; this was responded to by an available adult knowledgeable about the household, often the person who had answered the telephone. This informant was labeled Person #1 in the household. The paper neighborhood preference questionnaire was also filled out by Person #1. The paper food shopping questionnaire was completed by the person in the household responsible for the majority of food purchases. The two-day diary, either Simple or Complex, was to be filled out for every individual aged 11 or older in the household. The two days for a household were randomly chosen from pairs of consecutive days of the week. In Complex group households, Person #1 was asked to wear the accelerometer.

The questionnaire and diary materials were sent to recruited households by courier, with instructions for mailing them back. One reminder call was made to each recruited household just before the diaries were to be used, and follow-up calls were made after the diaries were to be used.

Household-level background measures included data on income, number of persons, language, ethnicity, detailed information on household vehicles, ownership or rental of dwelling, factors in the decision to move into the neighborhood, whether or not moving is being considered, aspects of neighborhood walkability, and other local characteristics.

Household-level measures related to food included a fruit and vegetable frequency questionnaire (adapted from the Canadian Community Health Survey, Cycle 2.2), perceptions of the neighborhood food environment (related to food access, food availability, food quality, and food affordability), frequency of different type of food outlet use (stores and restaurant) and respondents’ reasons for patronizing different kinds of food outlets, and the Rapid Risk Factor Surveillance Survey (RRFSS) food security questionnaire (www.rrfss.ca).

Individual-level measures included sex and age, length of time living in Canada, possession of a driver’s license, work situation and primary occupation, work or school address, educational achievement, and presence of a medical condition affecting travel habits; chronic conditions and self-perceived health were also obtained for Person #1. Data were collected on travel and physical activity (habitual and over the previous 7 days for Person #1, and over the two diary days for everyone).

Self-reported body mass index (BMI=kg/m$^2$) and waist circumference (WC) have been considered adequate proxies for measured BMI and WC in previous studies (Dekkers et al, 2008). In both Simple and Complex diaries, participants were asked their height and weight, and were provided with a paper tape measure and explicit instructions to measure WC. BMI was calculated from self-reported height and weight. Participants reported two replicate measures of WC; mean WC (cm) was used as an individual-level outcome variable. For participants who completed Complex diaries, the Healthy Eating Index adapted for Canada (HEI-C) (Garriguet, 2009) was used to define diet quality. Participants’ food record data were entered into the ESHA Food Processor SQL program, which analysed micro- and macro-nutrient content of the food reportedly eaten. The
Canadian Nutrient File database (2007) was linked to the micro- and macro-nutrient datafile to determine the number of servings of different food groups based on Canada’s Food Guide to Healthy Eating. The HEI-C reflects Canadian food intake recommendations based on participants’ age and sex, and ranges from 0 to 100, where scores less than 50 represent a poor diet; scores between 50 and 80 represent a diet in need of improvement, and scores above 80 represent a good quality diet (Garriguet, 2009). Mean HEI-C over the two days was used as an individual-level indicator of dietary quality. Finally, Complex participants also reported each time they bought food prepared away from home for immediate or for home consumption.

The diary data for each individual are organized by “place”. That is, there is a line of data for each place in which the respondent could be found during the two-day diary period, containing the location of the place, the mode of travel taken to arrive at the place, the arrival and departure times, the activity at the place, and what food if any was purchased or consumed at the place.

###  2.2 STUDY POPULATION AND SAMPLE

The survey was undertaken to document travel, food environment, food purchasing patterns, dietary consumption, body weight, urban form, and demographic measures, for an initial target of approximately 2400 households, 1400 in the Simple group and 1000 in the Complex group. In the end, budget constraints forced the reduction of the intended Complex group sample size to 750. At the completion of fieldwork, diary data were obtained from 2228 households: 1473 in the Simple group and 755 in the Complex group.

The sample was stratified by variables known to be predictors of the outcomes and relationships of interest, and allocated in such a way as to give high power to comparisons across walkability levels. The design was similar to the “orthogonal” approach for neighborhood level sampling in (Frank et al, 2010), where high- and low-walkability and high- and low-income categories were crossed to form strata of “blockgroups” (the building blocks of “neighborhoods”).

The household population consisted of households defined to be families and one-person units living alone or with unrelated people, in the three major cities of the Region of Waterloo, Ontario: Cambridge, Kitchener and Waterloo. The walkability index and surface were used to classify postal codes in the three cities as being of high, medium and low walkability. The high- and low-walkability areas consisted, respectively, of postal codes with walkability scores more than one standard deviation higher than, and more than one standard deviation lower than, the mean of the walkability scores for postal codes. At the time of the 2006 Census of Canada, the proportions of households in the Region of Waterloo in the high-, medium- and low-walkability areas were 4%, 85% and 11%. The sampling scheme was designed to oversample the high- and low-walkability areas, and within each walkability area, to allocate sample proportionally to three ranges of household income (< $35K, $35K-$85K, >$85K), and three levels of household size (1 person, 2 persons, 3+persons).

If dependence of outcomes on walkability is linear, maximum power to detect associations with walkability would be obtained from a design where the other explanatory variables are orthogonal to walkability, and walkability takes only extreme values (high and low), each with equal probability (Box et al, 1978). This consideration would suggest allocating all of the sample to high and low walkability areas. However, the assumption of linear dependence may not hold for all outcomes. For example, there may be thresholds of walkability below which no dependence of (say) vehicle use on walkability exists. Thus in the survey a substantial number of households in the Simple
group were eventually recruited from medium-walkability areas. This feature of the allocation also meant that, with appropriate weighting, results of the survey could be generalized to the whole population of the cities in the Region of Waterloo. For the Simple group, the allocations to low-, medium- and high-walkability areas were 400, 600 and 400 households respectively. For the Complex group, the allocations to low- and high-walkability areas were to be equal, with 500 households in each; these target allocations were later reduced to 375 households in each.

Once the walkability scores for postal codes were available, the Region of Waterloo obtained tabulations from the 2006 Census of Canada by city and income group, by walkability level and income group, by city and household size, and by walkability level and household size. (Three-way cross tabulations were not available.) Within walkability areas, targets were set proportional to sizes of the income group and household size strata from the 2006 census. The low-, medium- and high-income group target proportions were approximately 25%, 41% and 34% in each of the walkability areas, and thus the walkability and income group allocations were approximately orthogonal.

Because the targets were not available at the beginning of fieldwork, and because it typically took two to four weeks to determine whether a recruited household would become a completely responding household, the targets were not achievable precisely; continual assessments of the sample composition resulted in the phased structure of the design discussed in Section 4, and survey weights were constructed to calibrate the sample to the 2006 Census of Canada tabulations.

The target and achieved numbers of households are given in Tables 1 to 4.

TABLE 1  Sample sizes (upper) and targets (lower) for the Simple group, by walkability area and income group

<table>
<thead>
<tr>
<th>Walkability</th>
<th>Income Groups</th>
<th>&lt;$35K</th>
<th>% of Target</th>
<th>$35K-$85K</th>
<th>% of Target</th>
<th>&gt;$85K</th>
<th>% of Target</th>
<th>TOTAL</th>
<th>% of Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
<td>71</td>
<td>177.5%</td>
<td>178</td>
<td>107.9%</td>
<td>235</td>
<td>120.5%</td>
<td>484</td>
<td>121.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>165</td>
<td>195</td>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td>131</td>
<td>93.5%</td>
<td>264</td>
<td>101.5%</td>
<td>214</td>
<td>107.0%</td>
<td>609</td>
<td>101.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>140</td>
<td>260</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
<td>105</td>
<td>63.6%</td>
<td>174</td>
<td>108.8%</td>
<td>101</td>
<td>134.7%</td>
<td>380</td>
<td>95.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>165</td>
<td>160</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>OVERALL</td>
<td></td>
<td>307</td>
<td>89.0%</td>
<td>616</td>
<td>105.3%</td>
<td>550</td>
<td>117.0%</td>
<td>1473</td>
<td>105.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>345</td>
<td>585</td>
<td>470</td>
<td></td>
<td></td>
<td></td>
<td>1400</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 2  Sample sizes (upper) and targets (lower) for the Simple group, by walkability
### Area and Household Size

<table>
<thead>
<tr>
<th>Walkability</th>
<th>Household Size</th>
<th>1 person</th>
<th>% of Target</th>
<th>2 person</th>
<th>% of Target</th>
<th>3+ person</th>
<th>% of Target</th>
<th>TOTAL</th>
<th>% of Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
<td>58</td>
<td>145.0%</td>
<td>180</td>
<td>144.0%</td>
<td>246</td>
<td>104.7%</td>
<td>484</td>
<td>121.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td></td>
<td>125</td>
<td></td>
<td>235</td>
<td></td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td>153</td>
<td>102.0%</td>
<td>207</td>
<td>103.5%</td>
<td>249</td>
<td>99.6%</td>
<td>609</td>
<td>101.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150</td>
<td></td>
<td>200</td>
<td></td>
<td>250</td>
<td></td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
<td>148</td>
<td>72.2%</td>
<td>139</td>
<td>120.9%</td>
<td>93</td>
<td>116.3%</td>
<td>380</td>
<td>95.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>205</td>
<td></td>
<td>115</td>
<td></td>
<td>80</td>
<td></td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>OVERALL</td>
<td></td>
<td>359</td>
<td>90.9%</td>
<td>526</td>
<td>119.5%</td>
<td>588</td>
<td>104.1%</td>
<td>1473</td>
<td>105.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>395</td>
<td></td>
<td>440</td>
<td></td>
<td>565</td>
<td></td>
<td>1400</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3 Sample sizes (upper) and eventual targets (lower) for the Complex group, by walkability area and income group

<table>
<thead>
<tr>
<th>Walkability</th>
<th>Income Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;$35K</td>
</tr>
<tr>
<td>Low</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>38</td>
</tr>
<tr>
<td>High</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>154</td>
</tr>
<tr>
<td>OVERALL</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>192</td>
</tr>
</tbody>
</table>

### TABLE 4 Sample sizes (upper) and eventual targets (lower) for the Complex group, by walkability area and household size

<table>
<thead>
<tr>
<th>Walkability</th>
<th>Household Size</th>
<th>1</th>
<th>% of Target</th>
<th>2</th>
<th>% of Target</th>
<th>3+</th>
<th>% of Target</th>
<th>TOTAL</th>
<th>% of Target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The reduction in Complex group target sample size from 1000 to 750 resulted in some reduction of expected statistical power, illustrated in the following examples. Suppose standardized measures of physical activity variables are used as the predictors in a logistic regression of obesity, having overall prevalence of about 23%. With walkability included as a variable, and the use of weights which sum to sample size within walkability areas, assume a survey design effect of 1.3 (factor by which variances are inflated over those for a simple random sample, using the variance inflation factor described in (Kalton and Flores-Cervantes, 2003)). From power calculations using simulations of the logistic regression model, a sample size of 750 individuals from different households should give 80% power to detect an effect size (increase in log odds of obesity vs 1 unit increase in a predictor) of 0.28 (odds ratio 1.32), using a two-sided hypothesis test of size 5%. The corresponding effect size for 1000 individuals is 0.24. Using Complex and Simple groups combined, a sample size of 2150 individuals from different households would give 80% power to detect an effect size of 0.170 (odds ratio 1.19), using a two-sided test of size 5%. The corresponding effect size for 2400 individuals is 0.155.

The achieved allocation of the sample to high- and low-walkability areas is close to equal: it includes 895 households in the low-walkability areas and 724 households in the high-walkability areas. Assuming an average of 1.7 respondents per household, this division yields 80% power to detect a difference of 5.8 percentage points in the overweight/obesity rates of the two groups, with a two-sided hypothesis test of size 5%, and assuming a survey design effect of 1.5. If the sample had been allocated in proportion to the numbers of households in the walkability areas, the numbers of households would have been about 90 for high walkability and 245 for low walkability, and the power to detect such a difference would have been about 22%.

### 2.3 RESPONSIVE DESIGN OF THE SURVEY

Complex household surveys are planned using assumptions of response rates and respondent effort which may not be realized in practice. Often, preliminary costing of the fieldwork is required before the instruments are fully developed, or before the sampling frames are available. Once fieldwork is underway, it is necessary to monitor the progress of fieldwork carefully, keeping track not only of sample sizes in categories (for households and for individuals) but also of productivity.
of field staff, and costs being incurred. At certain points, the frames, the targets, and sometimes the protocols, may need to be adjusted. These decisions divide the survey fieldwork into phases (Groves and Heeringa, 2006), which must later be taken into account in estimation, principally through calculation of the weights.

In the NEWPATH study, it was initially expected that data collection would occur in a spring wave and a fall wave, but the complexity of the data collection and the time required to develop the walkability surface meant that the time period had to be extended significantly. Difficulty in recruiting in certain categories resulted in the adjustment of targets in the last part of the time period. Thus the NEWPATH study had six phases in all.

Data collection began in the Spring of 2009, and was suspended for the summer months. Through the periods of May 14 – June 16, 2009 and August 28 – November 27, 2009, recruitment for the Simple form and the Complex form of the survey was carried on using a randomly ordered telephone sampling frame (listed numbers with postal codes). Complex group recruitment was also carried out February 23 – April 11, 2010. Finally, a University of Waterloo student sample was added using the university’s student email address frame, to address an under-representation of the student-age population. The student group was recruited from March to May, 2010.

The six phases may be termed Spring 2009 Simple, Spring 2009 Complex, Fall 2009 Simple, Fall 2009 Complex, Winter-Spring 2010 Complex General, and Winter-Spring 2010 Complex Student.

In the Spring 2009 Simple phase, sampling began before final targets were set for the quota cells, since determination of the walkability areas and calculations with census data to determine the characteristics of their populations were ongoing. Accordingly, households were recruited effectively randomly for the Simple version of the questionnaire and diary package.

Recruitment for the Spring 2009 Complex phase was intermittent, being subject to the availability of accelerometers. Only 30 devices were available during the short recruitment period before the middle of June.

By the beginning of the Fall 2009 Simple phase, the boundaries of the walkability areas had been delineated, and it became apparent that more of the remaining households for the Simple questionnaire package would have to be recruited from the medium-walkability areas. Where it appeared that quota cells were becoming full, those quotas were closed to recruitment.

In the Fall 2009 Complex phase, households were recruited randomly from high- and low-walkability areas. A serious shortfall in the numbers of larger households in low-walkability areas meant that the Winter-Spring 2010 Complex General phase focused on this group, and the compensation was increased for larger households.

Under-representation of the high-walkability area student-age population in Waterloo led to the introduction of the Winter-Spring 2010 Complex Student phase, in which students were selected randomly from the University of Waterloo frame of student email addresses, and recruited by email. A total of 34,601 students were invited. To be eligible, they had to be living alone or with unrelated roommates, in a high-walkability area. (To assess whether they would have been contactable through the telephone frame, they were asked where they lived in each phase of the recruitment, and whether the dwelling was cell-only, or had a landline connection.) In all, 79 students completed the survey.

Survey weights were constructed for participating households and for individuals. They include
“inflation weights”, which are the reciprocals of inclusion probabilities, calibrated to sum to totals in geographic and age-sex categories cities in the Region of Waterloo from the 2006 Census of Canada. The purpose of the inflation weights is to make estimators of population means and proportions approximately unbiased by correcting for unequal selection probabilities of households; the calibration improves the efficiency of estimation when the underlying variables are associated with age and sex.

Since the design deliberately under-sampled medium-walkability areas, the inflation weights in those areas are much larger than in the areas of low and high walkability. In regression analyses, if the inflation weights were used, the sample points in the medium-walkability areas would dominate, making inference very inefficient. At the same time, use of the weights within the walkability areas can correct for biases when the dependent variable is somehow related to probabilities of selection (Korn and Graubard, 1999). Thus for regression and logistic regression analyses in which walkability is an explanatory variable (as well as age and sex), so-called “analytic weights” were also constructed, to sum to sample size within walkability area.

There are separate inflation and analytic weights for each of the instruments in the used in the survey. For example, there are household recruitment weights (inflation and analytic), individual travel diary weights, and so on. Details of their construction and advice on their uses are provided in the technical report of the study, available on request. The basis for the calculation of weights, taking into account the phase structure, is illustrated for the household recruitment inflation weights in the Appendix.

3 RESULTS

3.1 SAMPLE CHARACTERISTICS

For a household to be eligible to be recruited for the survey, the informant had to assert that the household would be willing and able to complete the survey tasks in the required time frame. Thus in absolute terms, response rates were low, as is common for recruitment by random digit dialing (RDD). Conditional response rates were measured in terms of the number of households which completed the survey, once recruited. These rates can be summarized as follows.

The conditional response rates for households varied little across the six phases, ranging from 56% in the Fall 2009 Complex phase to 64% in the Winter-Spring 2010 Complex General phase (where compensation was increased for larger households). The rates were highest for Waterloo and lowest for Cambridge. They were fairly consistent across walkability levels. Before the Winter-Spring 2010 Complex General phase, they tended to be lower for households with 3+ persons than for households of smaller size. The conditional response rates also tended to be higher for households of low-walkability areas and high income, and for households of high-walkability areas.

The composition of the sample of individual respondents who completed the travel diaries was compared with composition of the population of residents of the three cities combined (the Kitchener Census Metropolitan Area) from the 2006 census. The census population numbers and percentages are given in Table 5, along with the unweighted percentages (equivalent to sample percentages) from the NEWPATH sample. (The weighted percentages from the NEWPATH sample are equivalent to the census percentages.) The unweighted percentages are fairly close to the census percentages, with some underrepresentation in the younger age groups, particularly...
for males.

**TABLE 5** Population numbers and percentages from the 2006 Census of Canada, and [unweighted percentages] from the NEWPATH study

<table>
<thead>
<tr>
<th>Age group</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-17</td>
<td>21489 5.5%</td>
<td>20533 5.3%</td>
</tr>
<tr>
<td>18-24</td>
<td>23730 6.1%</td>
<td>22979 5.9%</td>
</tr>
<tr>
<td>25-34</td>
<td>31865 8.2%</td>
<td>31880 8.2%</td>
</tr>
<tr>
<td>35-44</td>
<td>35815 9.2%</td>
<td>36270 9.3%</td>
</tr>
<tr>
<td>45-54</td>
<td>32515 8.4%</td>
<td>33435 8.6%</td>
</tr>
<tr>
<td>55-64</td>
<td>22105 5.7%</td>
<td>23105 6.0%</td>
</tr>
<tr>
<td>65+</td>
<td>22365 5.8%</td>
<td>29900 7.7%</td>
</tr>
</tbody>
</table>

4 DISCUSSION

This paper has described a case study in complex household data collection with emphasis on two features of the sampling design and their implications.

The first feature was a considerable oversampling of households in high- and low-walkability areas, with enough sampling of households in medium-walkability areas to produce general population estimates. The oversampling in high- and low-walkability areas allows for more powerful statistical analyses of differences in outcomes at extremes of walkability, controlling for important confounders related to socioeconomic status and household composition. The oversampling also renders the “inflation weights” (needed for estimation of descriptive attributes of the general population) very highly variable. For regression and logistic regression analyses, “analytic weights” which are rescaled to sum to walkability level sample sizes are required, and with the use of these weights walkability level must always be included in the regression model.

The second feature was the conduct of the survey in phases, defined in effect by the two types of task (simple and complex), the timing of availability of walkability data and targets, the length of time required to recruit, the need to adjust effort and compensation to reach larger households in the last few months of the survey, and the decision to recruit a separate sample of students. As indicated in Section 4, it is still possible under such circumstances to calculate basic and calibrated weights to support a wide variety of analyses.

As originally envisaged, the survey would have taken place over two periods, one in the spring and one in the fall, avoiding the “atypical” summer months, and the harsh conditions of winter. Ultimately, there were effectively three periods, with Simple group surveys being carried out approximately half in Spring 2009 and half in Fall 2009, and Complex group surveys being carried out approximately two-thirds in Spring and Fall 2009 and one third in late Winter and early Spring of 2010. Fortunately, the period in the Winter of 2010 was relatively mild, with very little snow, and March of 2010 was warmer than average.
5 CONCLUSIONS

This paper provides a concrete example of theoretical bases for designing studies on the built environment. Built environment research is becoming more popular, as urban planners and public health practitioners are increasingly interested in creating livable and healthy communities, with ample opportunities for physical activity and healthy eating. This kind of research is important because the built environment can be modified, or designed to incorporate improvements. Studies like the NEWPATH survey can provide an evidence base for planning healthy livable communities.

References


