INEQUITIES IN HEALTH:

EVALUATION OF AREA-BASED MEASURES AS INDICATORS OF HEALTH INEQUALITIES

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SUMMARY

The literature on inequalities in health provides convincing evidence that lower socioeconomic groups have poorer health when compared to higher socioeconomic groups. Since conventional measures of socioeconomic status such as occupation, income and education have a number of weaknesses which limit their ability to describe and explain health inequalities, alternatives in the form of area-based measures have been recommended. These use small area statistics derived from the census and other sources to classify neighbourhoods on the basis of their sociodemographic and socioeconomic characteristics. Evidence suggests that these area-based classifications are as good as or better than conventional measures of socioeconomic status at differentiating groups based on health status.

This report describes a study in which, a conventional measure, household income, and two area-based measures of socioeconomic status were compared in terms of their ability to identify inequalities in oral health, general health and use of and accessto dental services. The data used in the analysis were taken from a telephone interview survey of the oral health of older adults in the province of Ontario, Canada.

While household income proved to be a marginally better predictor of these inequalities than the area-based measures, the latter had a number of distinct advantages from an epidemiological and planning perspective. Moreover, they identified variations in measures of oral and general health and use of dental services that were independent of household income, and the region of the province in which subjects lived.

While the area-based measures performed well, further evaluations need to be undertaken using a broader array of measures of health and need for health services.

INTRODUCTION

Inequities in health have been adopted as a major policy issue by the Governments of Canada and Ontario. The federal document **Achieving Health for All** (1) identified the reduction of income inequities in health as the first challenge facing the Canadian health care system. This was reiterated in the Spasoff report which defined health goals for the Province of Ontario (2). In order to address this policy issue, inequities and inequalities in health must be identified, described, explained and targeted by interventions designed to modify the social and environmental factors responsible.

The literature on inequalities in health provides convincing evidence that the health of lower socioeconomic groups is worse than that of higher socioeconomic groups. This relationship exists no matter what indicator of health is used (3). While Canadian studies are not extensive, those that are available confirm the findings from studies in other industrialized countries that socioeconomic status is a powerful predictor of health status (4-6). Studies of older adults in Ontario, for example, show a clear relationship between household income, oral health status, access to and use of dental services (7-9).

The Canadian research that is available typifies international studies of health inequalities which divide a population of interest into groups on the basis of individual or household level measures such as occupation, education and income, and compare the health experience of these groups. However, these conventional indicators of social inequality, although powerful predictors of both general and oral

health status, have a number of theoretical and methodological weaknesses which limit their ability to fully describe and explain health inequalities (10-12).

For example, married women, the long-term unemployed, the elderly and single parents not in the labour force can be difficult to classify on the basis of occupation, while data on income can be difficult to collect with high refusal rates and low reliability.

Further, these individual and household level measures do not incorporate a spatial dimension and give no indication of where groups with poor health or high needs for services live. They are then, of little use in terms of the targeting of services or disease prevention and health promotion programmes to neighbourhoods or communities with the highest needs.

Finally, in measuring the characteristics of individuals or households they ignore the broader social environments in which people live. Since the social environment is considered to be a significant determinant of health, measures which incorporate a socio-environmental dimension would be a useful tool in addressing health inequalities.

Given these limitations, a number of investigators have sought alternatives in the form of area-based measures (10). These classify population sub-groups based on the socio-economic characteristics of the neighbourhood or area in which they live. There is evidence to suggest that these measures are better predictors of health status than occupation, income or education and that they add explanatory power to models of health inequalities (12). A major advantage of these measures is that the

only information required to classify an individual is his/her address or postal code, data which are easy to collect and universally collected. Since most health records contain this information but do not usually have information on occupation, education or income, the use of health records or routinely collected health information in studies of health inequalities is facilitated.

Three types of area-based measures have been used in studies of health inequalities. All employ small area statistics derived from the census. These types are 1) proxy measures, 2) measures of material deprivation, and 3) pragmatic social classifications (12).

Proxy measures have been used when socioeconomic information such as household income is not available for individuals so area-level data such as the mean household income of the census tract or enumeration area in which the individual lives is used as a substitute. Cherkin et al (13) have demonstrated that mean household income for a census block provides an acceptable estimate of the household income. **Measures of material deprivation** were specifically designed to study health inequalities and rank groups according to the material circumstances of the area in which they live using census-based indicators such as percentage of persons unemployed, percentage of households overcrowded and percentage of households with no car. **Pragmatic social classifications** were created for marketing purposes and allow socially homogenous, geographically referenced segments of the population to be identified and targeted. In general, these classifications are descriptive and do not arrange groups into a hierarchy. The ACORN system (**A** Classification of

Residential Neighbourhoods), which has been used in a number of general health and dental surveys in the U.K. (14-15), is a good example of this type of classification.

Measures of material deprivation and the pragmatic social classifications have been shown to be as good as or better than socioeconomic status at differentiating groups based on their health experience and use of health services (16-18). For example, in a study designed to assess ACORN, Morgan and Chinn (17) found that it differentiated as well as social class on several measures of child health and the variation identified was largely independent of social class. In addition, it proved to be valuable in identifying small areas with particularly high rates of morbidity.

As alternative indicators of social inequality, area-based measures have the following potential uses: 1) monitoring health inequalities within a population; 2) explaining health inequalities; 3) facilitating the use of data from health records in studies of health inequalities; and, 4) as a planning tool for identifying areas with poor health and high needs for resources.

This report describes the results of a study to evaluate two pragmatic social classifications developed in Canada for marketing and marketing research purposes as alternative indicators of social inequality and predictors of health status. These are the LIFESTYLES system developed by COMPUSEARCH Social and Market Research Ltd (19) and the MOSAIQUE system developed by the Canadian Market Analysis Centre (20).

AIMS AND OBJECTIVES

The study aimed to evaluate these two systems by:

1. comparing the strength of the association between measures of oral health, general health and access to dental services and LIFESTYLE and MOSAIQUE groups, and to compare this with the grouping of subjects by income;

2. determining whether or not there is a consistent and meaningful ranking of the two classifications on these measures of health and health service use; and

3. assessing whether the associations between these classifications and selected health outcome measures is independent of income group and measuring the relative strength of the independent effects.

METHODS

Data sources

Data on health and health related behaviours were obtained from a telephone interview survey of persons aged 50 years and over living independently in four communities in Ontario, Canada. This formed the initial phase of the Ontario Study of the Oral Health of Older Adults. The study, its methods and results have been described in a number of previous papers (21-23). Three of the study communities (City of Toronto, City of North York, Simcoe County) were located in Central Eastern Ontario and one (Sudbury and District) in North Eastern Ontario. The survey was based on random digit dialling and was used to identify households containing one or more persons aged 50 years and over. One person was selected at random from all eligible households identified and asked to complete a 22-item telephone administered questionnaire. This was used to collect data on self-reported oral health status, general health status, dental visiting patterns and sociodemographic characteristics

including household income. At the completion of the interview, all respondents were asked to participate in a personal interview and clinical examination phase. All those agreeing gave their full name and address including their postal code. Consequently, these subjects were available for classification by the LIFESTYLE and MOSAIQUE systems.

Area-based measures

LIFESTYLES and MOSAIQUE are geo-demographic targeting systems, a blending of geography and demography, which identify geographically referenced population segments living in various neighbourhood types.

Both systems were developed from a cluster analysis of census variables using the enumeration area as the basic unit of analysis. The enumeration area is the smallest area for which census data are released consisting of, on average, 250 households. The census variables selected reflect the population and family structure, household type, economic status and ethnic composition of each enumeration area. Data from the Print Measurement Bureau and consumer purchasing data were also included so that the classifications go beyond socioeconomic status to encompass broader aspects of lifestyle and the social environment in which people live. Since these systems are commercial products produced within a competitive market, exact details of how they were produced are not available.

The LIFESTYLES system consists of 70 homogenous types of neighbourhoods which differ in their demographic and socioeconomic characteristics. These 70 types

can be collapsed into 13 major groups; 10 classify urban areas and the remaining 3 rural and small urban areas. A list of the groups comprising the system is attached as an Appendix. Although the classifications were developed at the level of the enumeration area, for technical reasons they are applied at the level of the forward sorting area (FSA), identified by the first three digits of the code. Since these encompass rather large population segments the ability of the system to differentiate population sub-groups on the basis of health and health-related behaviours may be compromised. As Morgan (5) has indicated, the larger the population segments identified by an area classification, the more likely it is that these segments are socially heterogenous and the weaker the predictive power of the measure.

The MOSAIQUE system consists of 46 segments which fall into three broad settlement patterns varying in terms of their types of household structure and levels of urbanization. These are further organized into 17 target groups which share certain attributes in common and are identified by the same alphabetic character. In general, the settlement patterns are arranged into an income hierarchy as are the target groups comprising these patterns and the individual groups comprising the targets. A list of these groups is also included in the Appendix. In this system, the classification codes are applied at the level of the enumeration area. In order to classify an individual, the address and postal code are used to identify the enumeration area in which the address falls and a computerized data-base (PCENSUS) supplied by Tetrad Computer Applications Ltd used to locate the appropriate MOSAIQUE segment code.

Household income

Data on household income were obtained as part of the telephone interview survey. Eight household income groups were used in the analysis and ranged from less than $10,000 per annum to $80,000 or more per annum.

Health and service use variables

Nine variables derived from the telephone-interview survey were used in the analysis. These were: 1) dental status (dentate/edentulous); 2) one or more dental or oral pain symptoms in the previous 4 weeks (based on a four-item index); 3) a problem chewing one or more foods differing in their texture and consistency (also based on a four-item index); 4) self-rating of oral health (excellent or good; fair or poor); 5) self-perceived need for dental treatment (yes/no); 6) one or more dental visits in the previous year (yes/no); 7) dental insurance coverage (yes/no); 8) one or more chronic medical conditions (based on a check list of seven common conditions), and 9) one or more limitations in activities of daily living (based on a check list of seven).

Creation of the database

A file containing the identification number and postal code of all telephone interview subjects from whom an address was obtained was sent to COMPUSEARCH who attached the appropriate LIFESTYLE group code to each subject. The allocation of the MOSAIQUE codes was undertaken manually. The enumeration identification code for each address was located using Statistics Canada street directories and

enumeration area maps. The relevant MOSAIQUE code was then identified using the computer program PCensus. Prior to analysis, the LIFESTYLE and MOSAIQUE codes were attached to the telephone interview data file using file merging techniques in SPSSPC.

Data analysis

The analysis of the data broadly followed the strategy adopted by Morgan and Chinn (17) in their evaluation of the ACORN system. The nine outcome variables were analyzed by LIFESTYLE group, MOSAIQUE group and household income to determine how much variation was identified by each classification. The extent of this variation was tested using the Chi-square statistic and Cramer's V. Cramer's V allows the strength of association between variables in two or more cross-tabulations to be compared. Odds ratios comparing the groups with the best and worst health experience for each measure were also calculated and compared.

In addition, the consistency of the rankings of these nine variables on LIFESTYLE, MOSAIQUE and household income groups was examined. In order to determine whether or not the area classification had effects independent of household income, stratified and logistic regression analyses were undertaken using **dental status**, **visiting a dentist in the previous year** and **one or more limitations in activities of daily living** as dependent variables. In response to a question raised by Morgan and Chinn (17) in their evaluation of the ACORN system, logistic regression analysis was also used to determine whether or not variations in these

three variables by LIFESTYLE and MOSAIQUE group were also independent of regional variations. In a previous paper we have reported considerable differences on both measures between the community in North East Ontario and the communities in Central East Ontario (21). Subjects from the North East had higher rates of edentulism and lower rates of use of dental services than subjects from the Central East region.

RESULTS

Number of subjects

The full address and postal code was obtained for 1875 subjects who completed the telephone interview. All but 1.5% were allocated to one of the LIFESTYLE neighbourhood types. The 29 subjects who could not be classified lived in remote areas and their postal code identified a post-office box from which they collected their mail rather than their home address. MOSAIQUE codes were allocated to all but 7.7% of subjects for whom enumeration area codes could not be identified. Again, those who could not be classified lived in remote and sparsely populated areas. In contrast, 25.1% of subjects were unwilling or unable to reveal the income of the household in which they lived. Complete data were available for 1404 subjects who were included in the analysis.

Since the number of subjects falling into some of the LIFESTYLE groups was small, subjects living in areas designated as young singles and young couples were combined into one group, as were subjects in the three rural and small urban groups.

The resulting 10 groups used in the analysis are listed in Table 1, with the mean income of Canadian households falling into each group. Table 1 also shows that the study subjects were distributed fairly evenly across the ten LIFESTYLE groups used in the analysis.

The 46 MOSAIQUE segments were also collapsed into nine major groups by combining adjacent target groups. These consisted of four suburban/urban home owner groups, three big city multi-unit housing groups and two rural and small town groups. Three groups were not used because they contained no subjects. Table 2 lists the nine groups, the number of segments comprising the groups and the number of subjects in each.

Variations in oral health status

Tables 3 to 5 present the distributions of the nine dependent variables by LIFESTYLE group, MOSAIQUE group and household income.

The range of values identified by the three classifications was considerable on all five oral health status variables. For example, the percentage of subjects who were edentulous varied from 3.6% to 34.4% when classified by LIFESTYLE group; from 6.5% to 57.0% when classified by MOSAIQUE group and from 4.2% to 49.0% when analyzed by household income.

Since ten LIFESTYLE groups and nine MOSAIQUE groups were used in the analysis, it was expected that these classifications would identify a greater range of values on the oral health variables than household income. This tended not to be the

case; income identified 5 of the 10 extreme values, although differences between the three classifications were often small in percentage terms. It identified the group with the worst oral health experience on four of five oral health status indicators and the group with the most favourable experience for one of the five indicators. The MOSAIQUE classification identified the group with the worst experience for the remaining four. Overall, however, the distributions were broadly comparable with subjects living in the poorest households contributing to the greater variation identified by household income.

Variations in access to dental care

A similar pattern was observed for the two variables documenting access to dental care. Analysis by household income identified two out of the four extreme values. It identified the group with the lowest and the highest rate of dental insurance coverage. Only 28.9% of those in the lowest income group had dental insurance coverage compared with 75.2% of the highest. When the data were analyzed by LIFESTYLE group, the lowest rate observed was 35.3% and the highest 60.9%. The figures for the MOSAIQUE classification were 43.2% and 59.0%, respectively. The LIFESTYLE classification identified the group with the most favourable dental visiting rate while the MOSAIQUE classification identified the group with the least favourable.

Variations in general health status

The analysis by household income revealed more variation in the two variables representing general health status than did the other two classifications. It identified all four of the extreme values, revealing the groups with the most and least favourable health experience in terms of chronic illness and disability.

Taken together the results indicate that household income revealed 11 of 18 extreme values. In addition, it identified the broadest range of values for eight of the nine variables examined (Table 6). However, in many cases the percentage differences between the classifications were small to moderate only.

Examination of p-values derived from Chi-square analysis showed that there were significant income differences with respect to all nine outcome variables. Differences between LIFESTYLE groups were significant for seven and differences between MOSAIQUE groups significant for six. Moreover, odds ratios and Cramer's V showed that the association between all dependent variables and household income was stronger than that between these variables and LIFESTYLE and MOSAIQUE groups.

These analyses were repeated using only the 1087 subjects who were dentate. The aim here was to remove the potentially confounding effects of dental status on the associations between the dependent variables and the remaining independent variables. The results were virtually identical to those obtained from the analyses using all subjects. Household income more often identified the extreme values and

showed stronger associations with the dependent variables than LIFESTYLE or MOSAIQUE group although the differences were not marked.

Consistency of rankings

The rankings of household income categories and LIFESTYLE and MOSAIQUE groups across the nine dependent variables are shown in Table 7 along with the maximum difference in rankings for each category and group. A rank of one indicates which group had the most favourable health experience, i.e. the lowest prevalence of edentulism, the lowest prevalence of oral pain, etc., the highest rate of insurance coverage and the highest rate of use of dental care. This table allows the consistency of rankings across these outcome variables to be examined. There was a high degree of consistency in the rankings by household income particularly at the upper and lower end of the scale. This consistency is reflected in the fact that the maximum difference in ranks was one for three out of the eight income categories and two for four others. The maximum difference in ranks observed for any category was four.

Although there was less consistency in the rankings by LIFESTYLE group, as evidenced by the larger maximum difference in ranks for each group, a general pattern can be observed. That is, groups ranked between one and five on one variable tended to occupy a similar position on the others and this was also the case with respect to groups ranked six to ten. The same pattern was also evident with respect to the ranks for the nine MOSAIQUE groups. These was less consistency in ranks than for income groups but a general tendency for groups to be ranked consistently

in the upper or lower end of the distribution.

The relative performance of the three classifications in terms of consistency is revealed by a comparison of the means of the maximum differences in ranks. For LIFESTYLE it was 4.1, for MOSAIQUE it was 5.4 and for household income it was 1.9.

Independence of effects

In order to determine whether or not the associations between the outcome variables and the two pragmatic social classifications were independent of household income, stratified and logistic regression analyses were undertaken.

Table 8 shows the percent edentulous, the percent with at least one dental visit in the previous year and the percent with one or more limitations in activities of daily living by LIFESTYLE group controlling for income. In order to ensure sufficient numbers of subjects in each cell, the affluent, upscale and middle class LIFESTYLE groups were combined and household income was reduced to a dichotomy: less than $20,000 per annum and $20,000 or more per annum. Significant differences emerged in the percent of low-income subjects who were edentulous and the percentage with one or more dental visits in the previous year across LIFESTYLE groups. These analyses suggest that low income subjects living in high status areas are in better health and have better access to dental services than those living in lower status areas. A broadly similar pattern was observed for the percentage with limitations in ADL although the differences were not as consistent. The lowest rate of disability

among lower income subjects, for example, was found for those living in low income areas.

These findings were confirmed by the logistic regression analyses (Table 9). Here, subjects living in affluent, upscale and middle class neighbourhoods were compared with all others. Age was used as a control variable in the regression model for edentulism and limitations in ADL, while age and dental status were included in the model for dental visits. The LIFESTYLE classification had significant independent effects after controlling for income and other variables for two of the three outcome measures: edentulism and access to dental care. However, the associated odds ratios suggest that income exerts a stronger effect than the LIFESTYLE classification on both of these variables. The LIFESTYLE classification did not have a significant independent effect with respect to the proportion with disabilities, although household income and age did.

Logistic regression analysis (not shown) also revealed that the area-based measure had significant effects on edentulism and dental visiting when controlling for region and household income. In these analyses subjects living in the North Eastern community were compared with those living in the three Central Eastern communities. As before, age was entered into the model for edentulism and age and dental status into the model for dental visiting. In both models, the odds ratios suggested that household income (OR=2.9 and 1.9 respectively; $p<.0001$ and $p<.0001$)) and region (OR=2.2 and 1.6 respectively; $p<.0001$ and $p<.001$) had stronger effects than the classification by LIFESTYLE group (OR=0.63 and 0.67 respectively; $p<.01$

and $p<.01$). When region was added to the model for limitations in ADL, only household income emerged as a significant predictor.

Tables 10 and 11 show the results of a similar set of analyses using the MOSAIQUE classification. For the stratified analysis, MOSAIQUE groups AB and CD were combined. For the regression analyses, groups AB, CD and E1 were combined and compared with all others.

The results of the stratified analysis again suggest that low income subjects living in higher status areas were less likely to be edentulous than those living in lower status areas (Table 10). Although significant differences in dental visiting rates were also observed, the pattern was not clear-cut, with some low income subjects in lower status areas having higher visiting rates than their counterparts in higher status areas. However, the data do confirm that the socioeconomic status of the neighbourhood has some effect on use of dental services even when controlling for income. In contrast, no differences were observed in the prevalence of disability across MOSAIQUE groups after controlling for income.

Table 11 shows that the dichotomous MOSAIQUE classification had significant effects on edentulism after controlling for income and age and on dental visiting after controlling for income, age and dental status. In both cases the odds ratios associated with household income were marginally stronger than those associated with MOSAIQUE group. However, the MOSAIQUE classification did not emerge as a significant predictor of the probability of having one or more limitations in ADL.

The analyses for edentulism and dental visiting were repeated, including region

in the predictor variables (not shown). In both analyses the MOSAIQUE classification remained significant (OR=0.46 and 0.64 respectively; $p<0.0001$ and $p<.01$) although the effect was not as strong as for household income (OR= 2.52 and 1.89 respectively; $p<.0001$ and $p<.0001$) or region (OR=2.94 and 1.90 respectively; $p<.0001$ and $p<.01$). In the model for limitations in ADL, MOSAIQUE group was not significant but income, region and age were.

DISCUSSION

The analyses reported above suggest that household income is a better predictor of inequalities in oral health status, access to dental care and general health status than the LIFESTYLES and MOSAIQUE area classifications. It more frequently identified the extreme values of nine outcome variables and showed a more consistent and stronger associations with these variables than either LIFESTYLES or MOSAIQUE. In addition, it showed a more consistent ranking on these measures of health and access to care. Nevertheless, differences between household income and the two area classifications were not substantial and the area-based systems performed almost well as household income in differentiating population segments on the basis of oral health, access to dental care and general health.

In terms of the performance of the two area-based classifications, there was little to distinguish between them. While the MOSAIQUE classification identified more extreme values, the LIFESTYLES system was more consistent in terms of the ranking of the nine outcome variables. The LIFESTYLES system has the advantage

that the group codes can be attached by computer, as opposed to the laborious manual process required by MOSAIQUE. However, MOSAIQUE has the advantage that codes classify enumeration areas, while the LIFESTYLE codes are attached at the level of the FSA.

The analyses also illustrate some of the advantages of area-based measures. First, 98.5% of subjects were allocated to a LIFESTYLE group and 92.7% to a MOSAIQUE group while only 74.9% could be classified by household income. Consequently, analyses using household income as an indicator of social inequality may be faced with problems of statistical power due to loss of subjects and bias due to item non-response. These problems are avoided in studies using area-based measures since virtually the entire population can be classified if an address or postal code is obtained. Such data are also less likely to be subject to social desirability bias than data on occupation, income or education and are probably more reliable.

Second, area-based measures can identify differences in health status between population sub-groups with broadly similar material standards of living. For example, census data show that the mean household incomes of areas in the LIFESTYLE categories working class, ethnic and rural are very similar, yet the prevalence of edentulism among subjects living in those areas was 29.4%, 22.1% and 34.4%, respectively.

Third, the analysis confirms previous work which demonstrates that the area in which people live has an influence on health and health related behaviour which is independent of their personal circumstances. Subjects from low income households

who live in high status areas have better oral health and make more frequent use of dental services than their counterparts living in lower status areas. This may reflect the better provision of services in high status areas or may be explained in other ways. Whatever the explanation for this observation, it seems to be the case that area-based measures add explanatory power to models of inequalities in oral health.

Finally, the study also confirms that area-based measures such as the LIFESTYLES and MOSAIQUE systems may be valuable as a planning tool in identifying and directing resources to areas with the greatest dental health care needs. Further work in this area is warranted to determine the relative merits of conventional indicators of inequalities in oral health such as household income and the alternatives offered by area-based measures.

Although appealing, area-based measures have a number of disadvantages. One potential limitation is that census data are produced only periodically and classification systems such as LIFESTYLES and MOSAIQUE may become out-of-date. Areas may change quite dramatically over this time span. Redevelopment, gentrification and changes in the economy leading to high levels of unemployment can change the character of a small area. Since they reference small population sub-groups, numerically small changes in population may render the area classification invalid. This is less of a problem in countries such as Canada where a census is undertaken every five years than it is in the U.K. where the census is undertaken at ten year intervals. This problem needs to be taken into account when assessing the merits of an area classification.

Another limitation is that information regarding the construction of the measures and information regarding the allocation of codes to individual addresses is incomplete since the companies who developed the measures are unwilling to release it. Consequently, the specific variables and analytic techniques used in identifying population segments is not known. While this may not be important in a commercial context, it can be important in terms of health research. If these classifications are good predictors of the health needs of population segments it is useful to know why. Measures of material deprivation, constructed directly from census variables, do not suffer from this problem.

Although this study has demonstrated that area classifications have some potential, this study has been a limited one. First, we examined a narrow range of health variables and focused predominantly on oral health. Since the classifications did not appear to be as good at predicting two (rather weak) measures of general health, further exploration using a wider variety of health outcomes is needed. Further, because the number of subjects completing the telephone interview survey was small, the area classifications had to be collapsed into major groups. Since this renders the groups heterogenous in terms of their sociodemographic and behavioural characteristics, it inevitably leads to a loss of sensitivity. Consequently, the ability of these classifications to discriminate groups on the basis of health has yet to be fully tested. The Ontario Health Survey, because of its size and the fact that its sampling design was based on enumeration areas, offer an ideal opportunity for further work in this regard.

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TABLE 1

LIFESTYLE GROUPS USED IN THE ANALYSIS

Lifestyle Group	Mean Household Income ($)*	Number of Subjects
Affluent (4)	148,212	120
Upscale (4)	77,624	181
Empty-nesters (5)	56,302	213
Middle class (7)	56,797	249
Young singles/ couples (8)	35,417	211
Ethnic (4)	40,549	150
Low income (5)	29,694	150
Working class (6)	41,926	297
Old and retired (5)	31,230	172
Rural (22)	41,463	103

Numbers in parentheses represent the number of neighbourhood types in each LIFESTYLE group.

*Mean income of Canadian households falling into each group.

TABLE 2

MOSAIQUE GROUPS USED IN THE ANALYSIS

AB (3)	179
CD (6)	101
E1 (2)*	312
E2 (4)*	162
G (10)	534
H (2)	138
IJKL (6)	99
M (4)	99
NO (6)	101

*E1 was made up of groups E10 and E11 while E2 comprised groups E12 to E15.

Figures in parentheses represent the number of MOSAIQUE segments in each group.

The groups are arranged broadly in terms of an income hierarchy.

TABLE 3

DISTRIBUTION OF DEPENDENT VARIABLES BY LIFESTYLE GROUP (%)

LIFESTYLE GROUP	Edent	Chew	Pain	Rate	Need	Visit	Insure	ADL	Chronic
Affluent	3.6	10.8	20.5	10.8	16.9	91.6	56.6	8.4	51.8
Upscale	12.0	18.0	27.8	20.5	25.8	77.9	60.9	12.0	52.6
Empty-nesters	18.0	17.5	29.5	20.5	24.0	71.3	51.4	15.2	59.4
Middle class	18.9	17.9	29.5	25.3	28.4	65.4	53.4	20.0	63.7
Young singles/ couples	20.8	16.8	26.4	26.8	25.0	64.8	53.7	19.2	55.2
Ethnic	22.1	24.7	37.7	31.5	34.0	62.3	50.3	26.0	66.9
Low income	28.9	23.7	30.3	32.0	30.7	50.7	59.2	14.5	63.2
Working class	29.4	27.0	31.3	26.4	26.5	54.6	49.4	23.3	63.2
Old and retired	32.2	34.7	37.3	34.5	29.3	51.3	35.3	32.2	76.3
Rural	34.4	28.0	29.6	32.0	30.7	51.6	59.2	17.6	64.0
p	***	**	NS	*	NS	***	*	***	*
OR	14.0	4.4	-	4.3	-	10.6	2.8	5.1	3.0
CV	.195	.148	.091	.132	.080	.229	.138	.155	.132

Variable names - **Edent**: Edentulous; **Chew**: reporting a chewing problem; **Pain**: having oral pain in previous 4 weeks; **Rate**: rating oral health only fair or poor; **Need**: perceiving need for dental care; **Visit**: reporting one or more dental visits in previous year; **Insure**: having some form of dental insurance coverage; **ADL**: limitation in one or more activities of daily living; **Chronic**: one or more chronic medical conditions.

P - *** $p<0.0001$; ** $p<0.001$; * $p<0.01$: p values obtained from chi-square analysis
OR - Odds ratios comparing groups with worst and most favourable outcomes
CV - Cramer's V

TABLE 4

DISTRIBUTION OF DEPENDENT VARIABLES BY MOSAIQUE GROUP (%)

Group	Edent	Chew	Pain	Rate	Need	Visit	Insure	ADL	Chronic
AB	6.5	14.6	26.8	15.6	19.5	85.4	56.1	11.4	52.8
CD	15.3	12.9	36.5	25.3	24.7	68.2	59.0	16.5	65.9
E1	11.9	22.0	30.0	22.3	26.7	77.0	52.0	13.7	56.4
E2	22.7	16.8	31.9	22.6	28.6	57.1	58.0	19.3	63.9
G	24.6	23.4	33.0	27.1	29.4	59.5	48.6	20.4	61.8
H	17.8	18.8	20.8	26.7	29.0	75.2	52.5	19.8	62.4
IJKL	57.0	44.3	36.7	42.3	36.4	30.3	45.5	35.4	82.3
M	26.3	23.7	34.2	25.7	22.7	57.9	44.6	31.6	69.7
NO	36.5	25.9	24.7	26.8	15.7	50.0	43.2	20.0	57.6
p	***	***	NS	*	NS	***	NS	**	*
OR	19.03	5.35	-	3.98	-	13.44	-	4.27	4.14
CV	.280	.163	.093	.126	.107	.277	.092	.154	.137

Variable names - **Edent**: Edentulous; **Chew**: reporting a chewing problem; **Pain**: having oral pain in previous 4 weeks; **Rate**: rating oral health only fair or poor; **Need**: perceiving need for dental care; **Visit**: reporting one or more dental visits in previous year; **Insure**: having some form of dental insurance coverage; **ADL**: limitation in one or more activities of daily living; **Chronic**: one or more chronic medical conditions.

P - *** p<0.0001; ** p<0.001; * p<0.0l: p values obtained from chi-square analysis
OR - Odds ratios comparing groups with worst and most favourable outcomes
CV - Cramer's V

TABLE 5

DISTRIBUTION OF DEPENDENT VARIABLES BY HOUSEHOLD INCOME (%)

Household Income	Edent	Chew	Pain	Rate	Need	Visit	Insure	ADL	Chronic
$80,000 or more	4.2	7.6	20.2	10.2	13.4	90.7	73.7	5.1	51.7
$60-79,999	5.5	9.9	19.8	13.0	19.0	79.0	75.2	7.9	42.6
$50-59,999	12.2	11.3	29.6	17.7	25.7	78.3	69.3	6.3	50.0
$40-49,999	10.0	10.8	27.5	20.2	26.7	74.2	65.5	10.0	56.7
$30-39,999	17.6	19.5	23.3	24.7	23.6	69.8	62.4	12.6	54.1
$20-29,999	19.4	21.8	27.8	27.0	28.7	62.3	48.4	17.9	61.0
$10-19,999	31.0	29.2	38.9	30.7	29.7	57.1	32.9	28.5	68.8
Less than $10,000	49.0	40.5	37.5	37.8	35.4	35.2	28.9	38.5	83.6
p	***	***	***	***	***	***	***	***	***
OR	20.6	8.0	2.3	5.4	3.5	17.5	7.4	11.7	6.9
CV	.328	.250	.153	.190	.130	.319	.346	.284	.239

Variable names - **Edent**: Edentulous; **Chew**: reporting a chewing problem; **Pain**: having oral pain in previous 4 weeks; **Rate**: rating oral health only fair or poor; **Need**: perceiving need for dental care; **Visit**: reporting one or more dental visits in previous year; **Insure**: having some form of dental insurance coverage; **ADL**: limitation in one or more activities of daily living; **Chronic**: one or more chronic medical conditions.

P - *** p<0.0001; ** p<0.001; * p<0.0l: p values obtained from chi-square analysis
OR - Odds ratios comparing groups with worst and most favourable outcomes
CV - Cramer's V

TABLE 6

PERCENT DIFFERENCE BETWEEN MINIMUM AND MAXIMUM VALUES:
OUTCOME VARIABLES BY LIFESTYLE, MOSAIQUE AND HOUSEHOLD INCOME

	LIFESTYLE	MOSAIQUE	Household Income
% edentulous	30.8	50.5	44.8
% with chewing limitation	23.5	31.4	32.9
% with pain	17.2	9.9	18.7
% rating oral health as poor	23.7	26.7	27.6
% perceiving treatment need	17.1	16.9	22.0
% with dental insurance	25.6	15.8	42.3
% with limitation in ADL	23.8	24.0	33.4

TABLE 7

RANKING OF LIFESTYLE GROUPS, MOSAIQUE GROUPS AND HOUSEHOLD INCOME CATEGORIES ON THE DEPENDENT VARIABLES

LIFESTYLE GROUP	Edent	Chew	Pain	Rate	Need	Visit	Insure	ADL	Chronic	Max. Diff.
Affluent	1	1	1	1	1	1	3	1	1	2
Upscale	2	3	5	4	2	2	1	2	2	4
Empty-nesters	3	4	3	2	2	3	6	4	4	4
Middle class	4	4	4	7	4	4	5	7	7	3
Young singles/ couples	5	2	2	3	7	5	4	6	3	5
Ethnic	6	9	7	10	8	6	7	9	9	4
Low income	7	6	6	9	9	10	2	3	5	8
Working class	8	7	8	5	6	7	9	8	5	4
Old and retired	9	8	10	8	10	9	10	10	10	2
Rural	10	5	9	6	5	8	8	5	8	5
MOSAIQUE GROUP										
AB	1	2	3	1	2	1	3	1	1	2
CD	3	1	8	4	4	4	1	3	7	6
E1	2	5	4	2	5	2	5	2	2	3
E2	5	3	5	3	6	7	2	4	6	5
G	6	6	6	8	7	5	6	7	4	4
H	4	4	1	6	8	3	4	5	5	7
IJKL	9	9	7	9	9	9	7	9	9	2
M	7	7	9	5	3	6	8	8	8	6
NO	8	8	2	7	1	8	9	6	3	8

TABLE 7 (cont'd)

RANKING OF LIFESTYLE GROUPS, MOSAIQUE GROUPS AND HOUSEHOLD INCOME CATEGORIES ON THE DEPENDENT VARIABLES

HOUSEHOLD INCOME	Edent	Chew	Pain	Rate	Need	Visit	Insure	ADL	Chronic	Max. Diff.
$80,000 or more	1	2	1	1	1	1	2	1	3	2
$60-79,999	2	1	2	2	2	2	1	3	1	2
$50-59,999	4	6	4	4	3	3	3	2	2	4
$40-49,999	3	4	3	5	4	4	4	4	5	2
$30-39,999	5	3	5	3	5	5	5	5	4	2
$20-29,999	6	5	6	6	6	6	6	6	6	1
$10-19,000	7	8	7	7	7	7	7	7	7	1
Less than $10,000	8	7	8	8	8	8	8	8	8	1

MAX DIFF: Maximum difference in ranks per group or category.

TABLE 8

PERCENT EDENTULOUS, PERCENT REPORTING ONE OR MORE DENTAL VISITS IN THE PREVIOUS YEAR AND PERCENT WITH LIMITATION IN ADL BY LIFESTYLE GROUP AND HOUSEHOLD INCOME

	% edentulous		% with dental visit		% with limitation in ADL	
	<$20,000	$20,000 or more	<$20,000	$20,000 or more	<$20,000	$20,000 or more
Affluent, upscale and middle class	26.6	9.6	59.1	79.4	28.7	10.9
Empty-nesters	35.0	11.5	55.0	77.6	25.0	11.5
Young singles/ couples	30.0	16.5	52.5	70.6	40.0	9.4
Ethnic	30.8	13.2	56.4	68.4	38.5	13.2
Low income	39.5	15.2	42.9	60.6	16.3	12.1
Working class	41.7	16.5	40.5	69.6	33.3	12.7
Old and retired	49.3	9.8	34.3	74.0	47.8	11.8
Rural	46.8	22.2	47.5	55.6	24.2	11.1
p	<0.05	NS	<0.05	<0.01	<.01	NS

TABLE 9

RESULTS OF THE LOGISTIC REGRESSION ANALYSES

Dependent variable: Dental Status
(Edentulous=1; Dentate=0)

Independent variable:	B	se	p	OR*	95% CI
LIFESTYLE GROUP (Affluent, upscale and middle class=1; Other=0)	-.5047	.1702	.003	0.60	0.43-0.84
Household Income (less than $20,000=1; $20,000 or more=0)	1.1214	.1466	.0000	3.06	2.30-4.10
Age (in years)	.0290	.0078	.0002	1.03	1.01-1.05
Constant	-3.5134	.4895	.0000		

Dependent variable: Dental visit in last year
(No=1; Yes=0)

Independent variable:	B	se	p	OR*	95% CI
LIFESTYLE GROUP (Affluent, upscale and middle class=1; Other=0)	-.4108	.1522	.007	0.66	0.49-0.89
Household Income (Less than $20,000=1; $20,000 or more=0)	.6496	.1452	.0000	1.91	1.44-2.54
Dental Status (Edentulous=1; Dentate=0)	2.5174	.1699	.0000	12.40	6.29-17.29
Age (in years)	-.0119	.0080	.1385	0.99	0.97-1.00
Constant	-.5716	.4856	.2392		

TABLE 9 (cont'd)

RESULTS OF THE LOGISTIC REGRESSION ANALYSES

Dependent variable: Limitation in activities of daily living
(Yes=1; No=0)

Independent variable:	B	se	p	OR*	95% CI
LIFESTYLE GROUP (Affluent, upscale and middle class=1; Other=0)	-.1074	.1689	NS	-	-
Household Income (less than $20,000=1; $20,000 or more=0)	1.0982	.1538	.0000	2.99	2.22-4.05
Age (in years)	.0341	.0080	.0000	1.03	1.02-1.05
Constant	-4.0965	.5103	.0000		

*Odds ratio; 95% CI - 95% confidence interval around the odds ratio.

TABLE 10

PERCENT EDENTULOUS, PERCENT WITH ONE OR MORE DENTAL VISITS AND PERCENT WITH LIMITATIONS IN ADL BY MOSAIQUE GROUP AND INCOME

	% edentulous		% with dental visit		% with limitation in ADL	
	<$20,000	$20,000 or more	<$20,000	$20,000 or more	<$20,000	$20,000 or more
ABCD	20.1	8.0	54.8	82.9	30.3	10.3
E1	20.8	9.2	58.5	82.7	30.2	8.6
E2	35.4	14.1	43.8	66.2	35.4	8.5
G	39.1	11.7	47.4	70.4	31.3	10.7
H	25.8	14.3	64.5	80.0	35.5	12.9
IJKL	54.4	-	30.3	-	36.8	-
M	36.1	17.5	61.1	55.0	38.9	25.0
NO	48.6	28.0	44.1	54.0	31.4	12.0
	p<.01	p<.0001	p<.01	p<.0001	NS	NS

- Too few numbers in cell for stable estimate.

TABLE 11

RESULTS OF LOGISTIC REGRESSION ANALYSES

Dependent variable: Dental status
(Edentulous=1; Dentate=0)

Independent variable:	B	se	p	OR*	95% CI
MOSAIQUE GROUP (ABCDE1=1; Other=0)	-.8618	.1805	<.0001	0.42	0.29-0.60
Household income (Less than $20,000=1; $20,000 or more=0)	.9902	.1527	<.0001	2.69	1.99-3.63
Age (in years)	.0335	.0080	<.0001	1.03	1.01-1.05
Constant	-3.6230	.5032	<.0001	-	-

Dependent variable: Dental visit in last year
(No=1; Yes=0)

Independent variable:	B	se	p	OR*	95% CI
MOSAIQUE GROUP (ABCDE1=1; Other=0)	-.4999	.1557	<.01	0.61	0.45-0.82
Household income (Less than $20,000=1; $20,000 or more=0)	.6615	.1525	<.0001	1.94	1.44-2.61
Dental status (Edentulous=1; Dentate=0)	2.5863	.1791	<.0001	13.28	9.35-18.86
Age (in years)	-.0133	.0083	NS	-	-
Constant	-.4612	.5019	NS	-	-

TABLE 11 (cont'd)

RESULTS OF LOGISTIC REGRESSION ANALYSES

Dependent variable: Limitation in ADL
(Yes=1; No=0)

Independent variable:	B	se	p	OR*	95% CI
MOSAIQUE GROUP (ABCDE1=1; Other=0)	-.2498	.1741	NS	-	-
Household income (Less than $20,000=1; $20,000 or more=0)	1.1104	.1610	<.0001	3.03	2.21-4.16
Age (in years)	.0358	.0082	<.0001	1.04	1.02-1.05
Constant	-4.1515	.5227	<.0001	-	-

APPENDIX

MOSAIQUE SETTLEMENT PATTERNS AND SEGMENTS

AREA I SUBURBAN/URBAN HOMEOWNER FAMILIES

A01 Old money and establishment wealth
A02 Affluence and achievement
B03 Upscale with immigrant roots

C04 Young professional families in transition
C05 Established mainstream w/Mediterranean roots
C06 Exurban English traditionalist
C07 English empty-nesters
C08 Struggling young English families
D09 French middle-class

E10 Gold years affluence
E11 Maturing English and immigrant families

E12 Maturing French w/limited resources
E13 English and immigrant mix w/limited income
E14 Struggling English single parents
E15 Maturing and empty-nest English homeowners

AREA II BIG CITY MULTI-UNIT HOUSING

G17 Maturing, affluent singles and couples
G18 Golden age, condo-owning singles and couples
G19 Maturing singles and couples w/moderate incomes
G20 Urban immigrant melting pot
G21 English and immigrant singles w/limited means
G22 Struggling young families and lone parents
G23 Singles and couples w/moderate incomes
G24 Maturing and retired blue collar
G25 Pensioners on fixed incomes
G26 Low skill English and Asian singles

H27 Young professional cliff dwellers
H28 Retired professional cliff dwellers

I30 Aging blue collar French
J31 French & Italian big city tenants
J32 Economically depressed French and Asian tenants
K33 Aging pensioners in high-rise urban core
L34 Child-rearing French, just getting by

AREA III RURAL AND SMALL TOWN

M35 Maturing English w/moderate incomes
M36 Child-rearing English, just getting by
M37 Older and retired English w/limited means
M38 English pensioners

N39 Maturing blue-collar English
N40 Aging labourers in big & small cities
N42 Aging labourers in remote rural areas
O43 Struggling French village labourers
O44 Struggling Atlantic French & English mix families

LIFESTYLES GROUPS

URBAN CENTRES

AFFLUENT

A1 Wealthiest, very well-educated, large families in very expensive houses, middle-aged

A2 Wealthy, well-educated families in expensive houses, middle-aged or older

A3 Older, wealthy, well-educated couples and widow(er)s in newer apartments and condominiums; white collar and managerial

A4 Younger, very high income, well-educated, larger families with young teenagers in high-value homes

UPSCALE

U1 High income, older families with teenagers in higher value houses in stable neighbourhoods

U2 High income, very well-educated, small and older white collar households in old, expensive, mixed housing types, some rental

U3 Younger, above average income, professional families with young children in new or renovated houses; both spouses work

U4 Above average income, middle-aged to older families with older children in modest, newer, owned houses

MIDDLE CLASS

M1 Middle-aged to older, upper middle class families with teenagers; residing in houses in stable neighbourhoods

M2 Younger, upper middle class families with many young children in new housing

M3 Older, upper middle class families, some with teenagers, in older houses in very stable neighbourhoods; some ethnic

M4 Young, middle class, educated, white collar families, some with younger children, in new dwellings

M5 Young, middle class families with many younger children in new townhouses and other dwellings; some ethnic

M6 Wide age range, middle class couples and smaller families in newer apartments and condominiums; some ethnic

M7 Younger, middle class traditional families with many young children in detached houses; largely French

WORKING (BLUE COLLAR CLASS)

W1 Middle-aged to older, strongly blue collar, working class families with children in modest, older, owned homes

W2 Young, mixed occupation working class families with many young children in new multiple dwellings; mainly renters

W3 Various age groups, blue collar, working class families with children in new multiple dwellings; some ethnic

W4 Young, well-educated singles and couples (with some children) and older retired people in older, mainly rented multiple dwellings

W5 Younger, mainly blue collar, traditional working class families with young children in new multiple dwellings

W6 Mostly older (and some young) working class families with moderate income in row housing; largely French

LOW INCOME

L1 Young mobile blue collar, low income families with young children in high rise buildings; some ethnic

L2 Young, low income, blue collar families with some children, in rented multiple dwellings

L3 Young and older, lower income households with some children in older, rented multiple dwellings; many ethnic

L4 Older, with some young singles, in lower income areas, few children in old, low rent, multiple dwellings; mainly French

L5 Very poor, single mothers with young children in subsidized high-rise buildings

YOUNG SINGLES

S1 Below average income, educated, mobile, white collar singles in high-rises, some ethnic

S2 Low income, white collar, very young singles, some elderly, in older, rented multiple dwellings; some ethnic

S3 Younger, professional, very well-educated singles and couples in high-rise apartments

S4 Young, white collar, very well-educated singles and couples in older, rented multiple dwellings

S5 Very young, lower income singles, couples and students in rented multiple dwellings; some blue collar

YOUNG COUPLES

C1 Younger, mobile, working class couples and some singles, in high-rise buildings

C2 Young, low income couples in rented low-rise and townhouse multiple dwellings; some French

C3 Very young, mobile, lower income working couples and singles in new high-rises; some students

EMPTY-NESTERS

N1 Upper middle class empty nester couples in new high-rises and condominiums; some older retired singles

N2 Upper middle class, well-educated empty nesters and widow(er)s in apartments

N3 Upper middle class, white collar empty nesters in older, owned houses in stable neighbourhoods

N4 Middle class empty nester couples and some families with older children, in mixed housing types

N5 Working class empty nester couples with some older singles and families with children in lower priced houses

OLD AND RETIRED

O1 Very old, very low income, widow(er)s in subsidized apartments

O2 Working class, retired ethnic couples, some widow(er)s, in high-rise apartments

O3 Older, retired, working class widow(er)s plus some educated couples in apartments

O4 Low income, low education, retired widow(er)s with some couples in rented dwellings

O5 Low income, retired widow(er)s with some couples and young, white collar singles, in rented high rises

ETHNIC

E1 Heavily ethnic, working class families with many children in older multiple dwellings in stable neighbourhoods

E2 Higher status, above average income, middle aged, blue collar, large ethnic families in owned houses

E3 Old, very low income and education, ethnic, many widow(er)s in older rental houses and apartments

E4 Younger, low income ethnic families with younger children in low rent apartments

THE SMALL URBAN AND RURAL CLUSTERS

UPSCALE

X1 High income, young and middle-aged professional families with children in expensive houses

X2 Above average income, younger and some middle-aged professional families with some children in houses

X3 Young, above average income, mobile families with many younger children in newer houses, many at-home mothers

X4 Young, above average income, white collar, traditional young families with young children in rented multiple dwellings, predominantly with the Canadian military

X5 Above average income, families with older children in high value older housing; mixed occupations, some farmers

X6 White collar, older couples and single retirees in owned and rented dwellings

X7 Young, working class singles and couples with children, in newer rental apartments and multiple dwellings

X8 Lower income, mixed occupations, smaller families and retirees in apartments, condominiums and multiple dwellings; some French

WORKING CLASS AND LOW INCOME

Y1 Below average income households in older dwellings, wide age spread, average education, some children; some French

Y2 Low income, younger, primarily blue collar families with children in newer dwellings; strongly French

Y3 Lower income, older widow(er)s, some white collar couples and young singles in older rented multiple dwellings

Y4 Lower income, blue and white collar empty nesters and widow(er)s in both owned and rented dwellings

Y5 Older, lower income, blue collar, large families with some older children in lower value, owned houses; strongly French

Y6 Older, lower income, low education, small, blue collar families in older dwellings; both spouses work

Y7 Low income, low education, younger and middle-aged blue collar families with many children, in houses

Y8 Low income, low education, older widow(er)s and middle-aged couples in mixed housing types; strongly ethnic

Y9 Low income and education, strongly ethnic and native, large and extended families in lower value houses

FARMING

Z1 High income, larger farming families in above average value owned houses; some blue collar

Z2 Average income, medium sized, middle-aged farming families in owned houses; wife usually working on farm

Z3 Low income, older, ethnic farming families in owned houses

Z4 Low income, middle-aged large farming families in owned houses

Z5 Lower income, farming and blue collar families, in older owned houses, many age groups; some French