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Using Local Data to Monitor Obesity Rates in Wisconsin Counties, 1994-2003

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ABSTRACT

Introduction: Although county-level obesity estimates are necessary for planning and evaluating community-based interventions, the quality of these data has never been examined.

Objectives: To evaluate the reliability of the county-level obesity prevalence estimates from Wisconsin's 72 counties and to highlight the variation of obesity among Wisconsin counties.

Methods: Obesity prevalence data for each county in Wisconsin were obtained from the Wisconsin Behavioral Risk Factor Surveys (BRFS) from 1994 to 2003. During this 10-year period, 26,635 residents were interviewed by telephone, with sample sizes ranging from 6586 in Milwaukee County to 15 in Menominee County. The number of counties with reportable and reliable estimates, using criteria of sample sizes ≥50 and ≥300, respectively, was determined.

Results: The 10-year obesity prevalence was reportable for 68 of Wisconsin's 72 counties, ranging from 9.7% in Bayfield County to 29% in Langlade County. By pooling data from the BRFS for 5-, 3-, and 1-year periods, estimates are reportable for 43, 24, and 4 counties, respectively. A sample size of at least 300 provides a more reliable estimate, but is available for only 5 counties for a 5-year period.

Conclusions: By pooling 10 years of survey data, obesity rates can be estimated for most of Wisconsin's 72 counties, demonstrating marked variation in rates across the state. This surveillance system provides valuable data for larger counties for planning and program evaluation. Supplemental surveys can be conducted to provide more reliable and timely estimates.

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INTRODUCTION

The health and economic costs of obesity are now widely acknowledged. In addition to moderately increased risk of mortality,[1] obesity is associated with significant morbidity, including cardiovascular disease, type 2 diabetes, arthritis, and cancer.[2] This epidemic accounts for approximately 7% of medical expenditures in the United States,[3] and is responsible for significant indirect costs in the form of lost productivity due to illness or death.[2]

Given the increasing prevalence of obesity nationally, these costs are likely to increase in the future. From 1993 to 2003, obesity (BMI ≥30 kg/m^2) had increased 58%, totalling 23% of adults in the United States, while another 37% of adults were overweight (BMI 25.0-29.9 kg/m^2).[4] Previous research has shown that Wisconsin was one of the first states to show evidence of an obesity epidemic. In 1990, one study published in the *Wisconsin Medical Journal* reported that Wisconsin had the highest prevalence of adult obesity in the nation,[5] while a 1993 article named Wisconsin among the first states to show a significant increase in obesity prevalence.[6] In 2003, the prevalence of obesity among adults in Wisconsin was 21%, a 19% increase over the previous decade.[4]

The increasing trends in obesity in Wisconsin led overweight and obesity (and lack of physical activity) to become 1 of the 11 Health Priorities in *Healthiest Wisconsin 2010*.[7] The adult goal for obesity is a reduction to 15% by 2010,[8] which would require a significant decrease from the 2003 prevalence. To make continued progress towards this goal, evidence-based strategies, such as those described in the "Guide to Community Preventive Services," will need to be developed in communities statewide.[9]

While this topic may not initially seem relevant to

clinicians, health care professionals increasingly are becoming involved in community partnerships aimed at improving the health of the public. It is the role of these partnerships to aid communities in needs assessment, and planning and implementation of prevention and intervention strategies.

As communities begin to address the obesity epidemic, local data will be needed to aid in program planning and evaluation. Local data on obesity have been traditionally reported by the Behavioral Risk Factor Surveillance System (BRFSS), a national telephone survey conducted annually by state health departments regarding risk behaviors and health practices. In 2003 Aurora Healthcare, a non-profit health care provider in Wisconsin, conducted the Community Health Survey in 13 of Wisconsin's 72 counties. The survey gathered data on adult lifestyle, habits, risk factors, and disease prevalence. However, none of the literature focusing on obesity in Wisconsin has used these data to focus on county-level estimates.[5,10-13]

The BRFSS has been widely used to monitor the trends and prevalence of many risk behaviors, at both the national and state level. Sample sizes have grown over the years, and the data now are able to be used at the county and, in some cases, the city level.[14] However, annual sample sizes can be quite small, especially for sparsely populated counties. This article evaluates the reliability of the county-level obesity prevalence estimates and highlights the variation of obesity among Wisconsin counties.

METHODS

The obesity prevalence data for Wisconsin counties were obtained from the Wisconsin Behavioral Risk Factor Survey from 1994 to 2003, part of the national BRFSS coordinated by the Centers for Disease Control and Prevention (CDC). The BRFSS is a state-based random-digit-dialing telephone survey of non-institutionalized adults aged 18 and older. The sampling and survey methodology for the BRFSS have been described elsewhere.[15,16]

Annual BRFSS "final weight" data from 1994 to 2003 were combined to calculate the prevalence of obesity, and the sample sizes used were actual, not weighted.[15] Microsoft Excel (2002) was used to calculate summary statistics and approximate 95% confidence intervals for the 10-year combined data. While a statistical package such as SUDAAN is typically used to adjust the confidence intervals for the complex survey design of the BRFSS, including the post-stratification weights, the data weighting is limited for county data.[17] Therefore the confidence intervals reported may underestimate the variance, and so should be treated as estimates. EpiInfo was used to overlay the obesity prevalence for each county on a map of Wisconsin.

The data presented are crude rates. Age-adjusted rates were calculated, but adjustment had little effect on the rates. In addition, we wanted the numbers reported here to be consistent with those published by the Wisconsin Department of Health and Family Services, which are also not age-adjusted. While obesity rates tend to be higher in women,[18] gender differences are not reported here due to the small sample sizes.

We also determined the number of counties with reportable and reliable obesity estimates. Estimates were considered reportable, by BRFSS standards, if the sample size was ≥50.[14] Estimates were considered minimally reliable if the sample size was ≥300, which will generally provide a 95% confidence limit that is 10% of the prevalence estimate. Using these criteria, we determined the number of counties with sufficient sample sizes to produce reportable and reliable annual estimates, and 3- and 5-year moving averages.

RESULTS

The prevalence of obesity in Wisconsin has steadily increased from 18% in 1994 to 21% in 2003, similar to that of the nation (Figure 1). While the data indicate that the trend has leveled off in recent years, Wisconsin is still well above the *Healthiest Wisconsin 2010* goal of 15% for the prevalence of obesity in adults, and it appears unlikely that the goal will be met.[8]

The 10-year obesity prevalence among Wisconsin counties ranged from 9.7% in Bayfield County to 29% in Langlade County (Table 1). The mean and median were both approximately 22%, and the standard deviation (SD) was 4.7%. These prevalence estimates are similar to the numbers recently reported in the 2004 Wisconsin County Health Rankings (median 22%, SD 5.1%, range 10%-37.2%), which combined BRFSS data from 1997 to 2003.[19] They are also well correlated with the obesity data from those counties surveyed in the 2003 Aurora Community Health Survey (Pearson correlation coefficient 0.64, data not shown). In observing the distribution of obesity across the state (Figure 2), there are few distinct patterns, other than small clusters in the northeast and center regions of the state.

The number of counties with sufficient sample size to produce reportable and reliable obesity prevalence estimates is shown in Figure 3. Four counties have reportable estimates with annual data, whereas 24 require pooling data from 3 years, and over half require 5 years

Table 1. 10-Year Obesity Prevalence in Wisconsin, By County, 1994-2003

County	Sample Size	Obesity Prevalence (%)	95% Confidence Interval*	County	Sample Size	Obesity Prevalence (%)	95% Confidence Interval*
Menominee†	15	40	(15, 65)	Vernon	148	22	(16, 29)
Pepin†	33	31	(15, 46)	Walworth	318	22	(17, 26)
Langlade	91	29	(20, 38)	Waupaca	244	22	(17, 28)
Monroe	189	29	(22, 35)	Iowa	97	21	(13, 29)
Taylor	114	29	(20, 37)	Kenosha	423	21	(17, 24)
Buffalo	80	28	(18, 38)	Manitowoc	414	21	(17, 24)
Juneau	97	28	(19, 37)	Racine	890	21	(19, 24)
Oconto	175	28	(22, 35)	Eau Claire	399	20	(16, 24)
Price	97	28	(19, 36)	Polk	196	20	(15, 26)
Washburn	82	28	(18, 38)	Sawyer	75	20	(11, 29)
Grant	239	27	(21, 32)	Calumet	194	19	(14, 25)
Adams	116	26	(18, 33)	Dunn	182	19	(13, 25)
Green Lake	103	26	(18, 35)	Lincoln	138	19	(12, 25)
Jackson	83	26	(17, 36)	Milwaukee	6586	19	(18, 20)
Jefferson	297	26	(21, 32)	Ozaukee	279	19	(15, 24)
Marinette	196	25	(19, 32)	Sauk	260	19	(14, 24)
Clark	170	24	(17, 30)	Winnebago	684	19	(16, 22)
Door	144	24	(17, 31)	Barron	232	18	(13, 23)
Douglas	199	24	(19, 30)	Brown	1211	18	(16, 20)
Rusk	84	24	(15, 33)	Florence†	22	18	(2, 34)
Shawano	206	24	(18, 30)	Forest	61	18	(8, 28)
Vilas	123	24	(16, 31)	Lafayette	71	18	(9, 27)
Chippewa	305	23	(18, 27)	Oneida	177	18	(13, 24)
Columbia	243	23	(18, 28)	Outagamie	710	18	(15, 21)
Dodge	381	23	(19, 28)	Richland	84	18	(10, 27)
Fond du Lac	430	23	(19, 26)	Washington	390	18	(14, 21)
Portage	305	23	(18, 27)	Kewaunee	99	17	(10, 24)
St. Croix	277	23	(18, 28)	La Crosse	515	17	(14, 20)
Waushara	151	23	(16, 30)	Waukesha	1216	17	(15, 20)
Wood	431	23	(19, 27)	Burnett	84	16	(8, 24)
Ashland	81	22	(13, 31)	Dane	2090	16	(14, 17)
Crawford	90	22	(14, 31)	Green	185	16	(11, 22)
Marathon	639	22	(19, 25)	Marquette	66	16	(8, 25)
Rock	670	22	(19, 25)	Iron†	46	14	(4, 25)
Sheboygan	516	22	(18, 25)	Pierce	157	11	(6, 15)
Trempeleau	133	22	(15, 29)	Bayfield	107	10	(4, 15)

* 95% confidence intervals are approximate since they do no account for the complex survey design

† Rate unreliable since sample size <50

of pooled data. The number of counties with reliable estimates is much smaller: 1, 4, and 5 counties have reliable estimates with annual data, and after pooling data from 3 and 5 years, respectively. Using this criterion, not even half of the counties have reliable estimates with 10 years of pooled data.

DISCUSSION

Local obesity data exist for every county in Wisconsin. However, estimates based on sample sizes under 50 are so unreliable that the CDC does not recommend reporting them. Estimates based on surveys with between 50 and 300 respondents should be interpreted with caution, and those based on samples sizes over 300 can be considered reasonably reliable.

Since the early 1980s the demand for local data has increased,[20] especially with the advent of state and national health goals. Local data are needed to assess the burden of disease or risk factors, set objectives, guide local prevention and intervention activities, and monitor progress toward goals. A recent article evaluated the extent to which local data are available to measure progress toward the National Health Objectives. Not surprisingly, the author concluded that counties are able to monitor only 33% of their objectives based on existing data sets.[21] Fortunately, height and weight data

are available in the BRFSS, and can be analyzed at the county level. However, the inherent limitations of the BRFSS, the small sample sizes, and the use of self-reported weight and height call into question the accuracy of the data.

In general, the BRFSS has been reported to be both valid and reliable.[20] However, there is potential for major sources of error within the BRFSS: non-coverage, sampling, non-response, and measurement errors. The primary concern with non-sampling error, which cannot be adjusted for in the analysis, is the exclusion of institutionalized persons, as well as those who do not have a telephone. The BRFSS users' guide indicates that the percent of institutionalized persons is quite small relative to the adult population of the entire state, and therefore is unlikely to affect the resulting estimates.[22] Until recently, telephone non-coverage was determined to be a non-issue due to the fact that only 5% of US residents did not have a telephone (although this varies for some subpopulations).[23] However, with the increase in cellular phones, caller-ID, and call blocking, non-coverage will likely become an important consideration in the future.

Sampling error is minimized by following strict surveillance procedures. Non-response bias is inversely proportional to response rates, such that surveys with high response rates are less likely to be biased. Wisconsin's response rate has varied from 50% to 70% since 1996, which falls in line with the median response rates for all states and territories included in the survey.[24] Note that this is not an indicator of the actual amount of bias, but rather the potential for bias. Measurement errors, specifically those regarding self-report, will be discussed below.

While the BRFSS is a readily available source of county-level data, only about 4000 people in Wisconsin are sampled each year. This may lead to small sample sizes for sparsely populated counties. The BRFSS does not report data for sample sizes less than 50 to account for the complicated sample design.[14] This threshold is similar to that used for other national surveys.[25] Using the BRFSS standard, 68 of 72 counties provided reportable rates when 10 years of data were pooled (estimates were unreportable for Menominee, Florence, Pepin, and Iron counties). However, a sample size of 50 is too small to provide a reliable estimate. Large standard errors created by small samples may create spurious variability in the prevalence estimates, and may explain large differences between neighboring counties. Therefore, a reliability criterion of a minimum sample size of 300 was considered, which would ensure a narrower confidence interval such that meaningful comparisons could be made between counties and within a county over time. In reality, reliability falls on a continuum, and there is no number above which estimates can be considered definitively reliable, and below which are considered definitively unreliable. Therefore the criteria for reportability and reliability presented here simply provide interpretation guidelines for users of local obesity data.

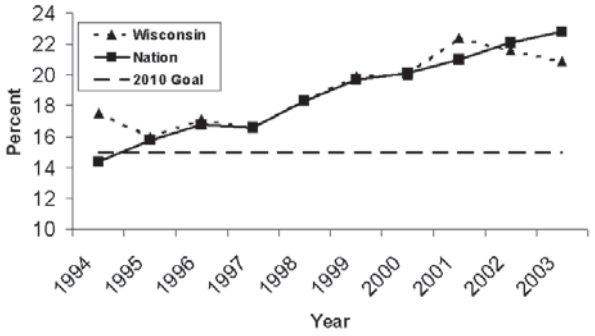

Figure 1. Adult obesity trend, 1994-2003.

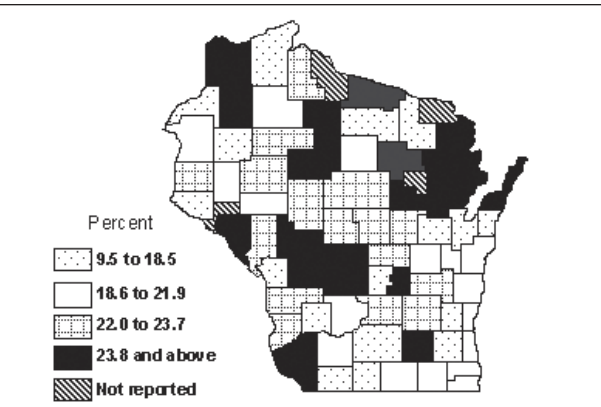

Figure 2. Distribution of 10-year adult obesity prevalence among Wisconsin counties, 1994-2003.

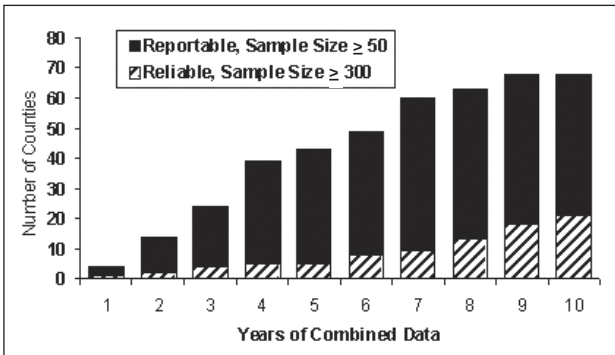

Figure 3. Comparison of the number of Wisconsin counties with reportable and reliable obesity prevalence estimates, 1994-2003.

For this analysis, 10 years of data were combined as a means to increase the precision of the prevalence estimate. While this is common practice for overcoming the issue of small sample sizes, it limits the ability to monitor trends over time, as needed to assess the efficacy of prevention or intervention efforts. Other methods of dealing with small sample sizes include small area estimation techniques such as regression analysis, spatial data smoothing, and the synthetic method. While multivariate regression analysis was deemed to yield the best estimates, it requires extensive area-specific demographic information that may not be readily available.[26] Spatial smoothing techniques "borrow" data from surrounding areas to stabilize the estimates in smaller areas. However, counties along Lakes Michigan and Superior are surrounded by fewer counties than those in the center of the state or along state borders, which could influence the prevalence estimates. In addition, this method increases the bias for the small area, and therefore individual county results cannot be interpreted, only clusters of counties with similar values.[23] The synthetic method, which applies large group (e.g. state) characteristics to smaller areas (e.g. county), may also lead to inaccurate estimates. A similar method to these was used in the 2003 Wisconsin County Health Rankings but was discontinued in 2004 due to feedback from policy makers indicating a preference for individual data, despite being based on small numbers. Therefore, while combining data may prevent monitoring temporal trends, the results can still be useful for determining relative differences, such as county-to-county variation.

The use of self-reported height and weight data, especially among those in the higher weight categories, has been well-documented in the literature. The results of both national as well as international studies have been the same: both women and men with higher weights are more likely to under-report their weight, women moreso than men.[27,28] Increasing age is a predictor of over-reported height, but, on average, overweight people tend to over-report height slightly more than those who are mid- or underweight. The combination of under-reported weight and over-reported height leads to an underestimation of BMI, and therefore obesity prevalence, especially among those who weigh more. The magnitude of the under-reporting of weight varies with age, weight, and cultural norms.[27] When relative weight categories such as BMI are used to distinguish overweight and obese, significant misclassification can occur. In general, weight may be better used as a continuous variable. However, there is a very high correlation between self-reported and measured weight: 0.97 for men and 0.98 for women. While this does not mean that self-reported weights are accurate, it does mean they are at least consistently under-reported.[29] This allows for comparison of data over time, as long as it is collected in the same manner each year. For our purposes, BMI based on self-reported height and weight provides the relative differences for each county, and while the absolute numbers may not be accurate, they likely represent the minimum obesity prevalence for each county.

CONCLUSION

Local obesity data can be used by clinicians as well as state and local county health officials to guide community-based prevention and intervention efforts. The reliability of these data vary, therefore the sample size used to calculate the estimate and the survey methodology should be considered when interpreting the data. Estimates based on sample sizes ≤50 should not be reported. For those counties with a reliable sample size (either with annual data or pooled over several years), the absolute prevalence estimates should still be interpreted with caution. These estimates likely represent an underestimation due to self-reported height and weight, but may also reflect an overestimation in counties with smaller samples sizes. In addition, variations in the prevalence of obesity should be interpreted in the context of differences in community characteristics, such as social, behavioral, cultural, environmental, physiological, and genetic factors.[30] While bias due to BRFSS methodology or differential self-report is important, it should be consistent across counties, and therefore the relative differences are still useful. Once reliable estimates are available, these data are important for surveillance, local discussions on risk behavior, resource allocation, prevention and intervention planning, and policy decision-making.

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