Effect on Oral Health Estimates of Response Disparities: Results from the Survey of Oral Health Status, Maryland School Children 2005-2006

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Abstract

In a survey of Maryland children between 2005 and 2006, 55% of those who returned a questionnaire (collecting demo-social characteristics and self-reported oral health) participated in a screening exam (collecting objective oral health). This paper examines the differences in socio-economic and oral health status among screening examination respondents and non-respondents and the effect of non-response on estimates of oral health. Two-sided z-tests, t-tests, and chi-square tests were used for appropriate data and a significance level of 0.05 is applied for all comparisons. Population estimates of demo-social characteristics among screening examination respondents were not significantly different from non-respondents. Although an overall low response rate may potentially bias our population estimates, if the sample is representative of the target population then weight adjustment, stratification, and imputation at the analysis stage can limit this bias.

Key Words: survey response, oral health

1. Introduction

The Survey of the Oral Health Status of Maryland School Children 2005-2006 is a dental evaluation of the State's public school children in kindergarten and 3rd grade. A detailed description of the study objectives and research questions can be found in Manski et al's report (Manski et al., 2007). The survey had two components: The questionnaire collected students' social-demo characteristics and self-reported outcomes (dental caries and related experience in the past 12 months). The screening examination collected objective outcomes such as dental caries, sealants and restorations detected by a dentist examiner. In total 2322 students returned the questionnaires, out of which only 1280 (55%) students returned the consent form and received the screening exam (Manski et al., 2007). Thus, the questionnaire data were available for both respondents and non-respondents of the screening examination. Such information enabled us to carry out a study of the effect of non-response on estimators obtained from respondents' data (Tolonen et al.,2005). This paper compares characteristics of respondents to non respondents to the screening exam and how these differences affect overall population and sub-population estimates of outcomes.

2. Materials and Methods

2.1 The Survey of the Oral Health Status of Maryland School Children 2005-2006

The general methodology of the Survey of the Oral Health Status of Maryland School Children 2005-2006 has been described elsewhere (Manski, et al. 2007). The recruitment of the survey involved four operational steps: (1) sampling of school utilizing a probability sample design; (2) agreement of selected schools to participate; (3) the administration of a questionnaire to all Kindergarten and 3rd grade students from participating schools; (4) a screening oral examination of students who returned the questionnaire and a consent form. Fifty schools with approximate 8,000 students in kindergarten and 3rd grade were selected from the entire 2005-2006 Maryland public elementary school list using a complex, multi-stage probability sample design. Fifteen schools in three sampled counties declined to participate. Students in kindergarten and 3rd grade from the 35 participating schools who returned the questionnaire and consent form were given an oral screening examination. Figure 1 shows the operational steps and the stages at which non-response occurred.

2.1.1 Sampling

The first projected sample of 50 schools was selected using a stratified proportion to population (PPS) sample design. The sampling frame was all public elementary schools of Maryland in 2004 provided by Maryland department of Education. Schools were stratified into urban versus rural municipality. It was pre-determined that 20 schools would be selected from a rural area and 30 schools would be selected from an urban municipality. Within each municipality, schools were selected using the PPS sampling method. This resulted in a sample of 50 schools with approximate 8000 Kindergarten and 3rd grade students that were in 17 out of 24 Maryland counties plus Baltimore City.

2.1.2 Agreement from the county superintendents and the selected schools

The State, County and school district superintendents, and the school principals of the 50 schools were contacted, in order, to obtain permission to conduct this survey. Only 35 schools with approximate 4500 Kindergarten and 3rd grade students in 15 counties agreed to participate in this study.

2.1.3 Questionnaire dissemination and data collection

Each student participant received a survey package which included a questionnaire, a consent form and a research information brochure. The questionnaire was designed to establish each students' social-demo characteristics and self-reported outcomes (dental caries and related experience in the past 12 months). In addition, the questionnaire included municipality (rural vs. urban) and region (Central Washington D.C., Central Baltimore, Western, Eastern Shore, and Southern Maryland) where the student lives, grade (kindergarten vs. 3rd grade), gender (boy vs. girl), race (non-Hispanic whites, non-Hispanic blacks, non-Hispanic others, or Hispanics), student's eligibility of free or reduced meal (yes vs. no), student's caregiver's education level (college graduates or higher vs. less than college graduates), student's dental insurance coverage type (Medicaid, private, or no dental coverage), visit to a dental care place in the past 12 months (yes vs. no), and availability when a dental care was needed in the past 12 months (yes vs. no) . The self-reported oral health outcomes included dental caries experience in the past 12 month, if the dental caries was treated or not, and if it caused toothache or not.

2.1.4 Consent/assent and screening examination

As a result, 2322 students returned the questionnaire, among whom, 1280 students returned the consent form with the questionnaire. They were participants of the oral

screening examination. The screening examination collected objective outcomes such as dental caries, sealants and restorations detected by a dentist examiner.

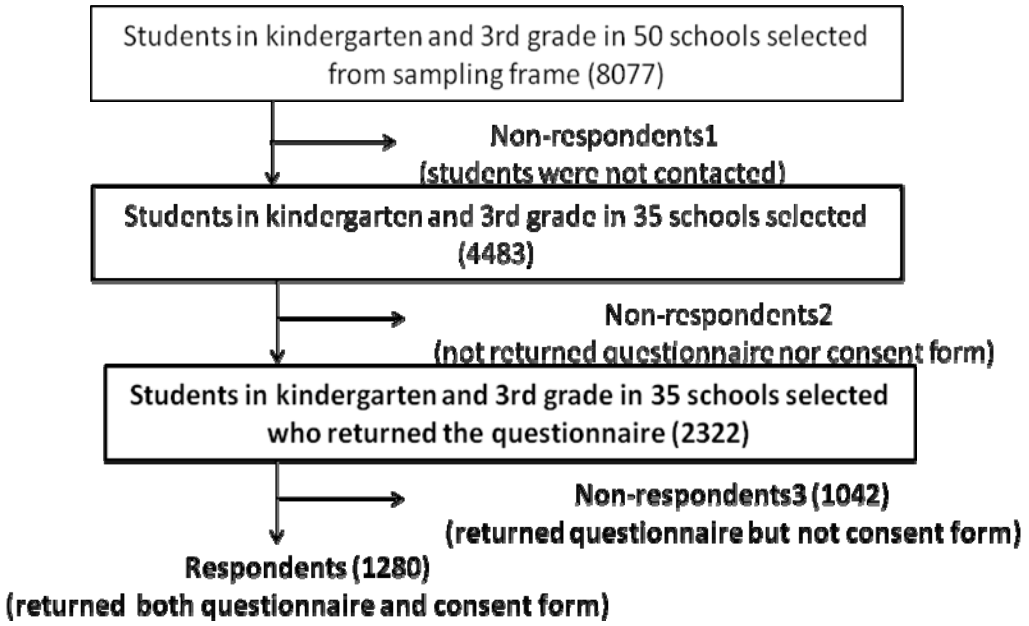

Figure 1: Operational steps and non-response-stages of the Survey of the Oral Health Status of Maryland School Children 2005-2006

2.2 Statistical Analysis

Our analyses focused on the differences between respondents and non-respondents. Respondents were defined as students who completed both the questionnaire and the screening examination (Figure 1, respondents). Non-respondents were defined as students who completed the questionnaire only (Figure 1, Non-respondents3).

The impact of response on the generalizability of the data was examined by comparing respondents to those who completed the questionnaire (Figure 1, respondents + non-respondents3). Ideally, in these analyses, the appropriate comparison is of respondents to projected sample (Figure 1, respondents + non-respondents 1+ non-respondents 2+ non-respondents3). Since we have no information collected on non-respondents1 and non-respondents2, we assumed that non-respondents3 is a random sample of the projected sample.

Both prevalence estimates without weight adjustment (i.e., sample estimates, or un-weighted estimates) and those with weighted for unequal sampling probability and non-response were calculated. The weights for the questionnaire sample were calculated as the inverse of product of selected probability and response rate to questionnaire. The weights for the examined sample were calculated as the inverse of product of selected probability and response rate to examination. The weights for the non-examined sample were calculated as the inverse of product of selected probability and response rate to the questionnaire minus the response rate to the examination.

We first compared sample distributions of region, grade level, gender, race, eligibility for

free or reduced meals at school, caregiver's education level, dental insurance coverage, dental care service availability, and dentist visit in past 12 months between the two groups using chi-square test. We then compared weighted estimates of distributions of region, grade level, gender, and race by questionnaire sample and by examined sample, respectively, to their population distributions using z-test. At last, we evaluated the effects of those demo-social differences on weighted estimates of oral health status by questionnaire sample and by the examined sample using t-test. All analyses conducted using SAS software. Two-sided test at significance level of 0.05 is applied for all comparisons.

3. Results

3.1 Non-response analysis

Table 1 presents and compares the distribution of sample characteristics and self-reported caries of respondents to non-respondents. It shows that children who lived in Eastern Shore region of Maryland, were 3rd graders, non-Hispanic black, eligible for free/reduced meals, whose caregivers' education was lower, who had Medicaid, had no dental visit in the past 12 months, had no dental care access when needed, and reported caries in the past 12 months were more likely to participate in the screening exam (chi-square tests p-value <0.01). In addition, Table 1 also presents point missing numbers of sample characteristics and self-reported caries for questionnaire-returned, examined, and non-examined, respectively. All sample characteristics and self-reported caries except region have missing points to a different degree from 3 of grade and 162 of gender. Non-examined sample has significantly more missing points in gender and less missing points in race/ethnicity than examined sample (chi-square tests p-value <0.05).

3.3 Non-response adjustment

Table 2 presents results of comparisons of weighted estimates of distributions of region, grade level, gender, and race by questionnaire sample, by examined sample, and by non-examined sample, respectively, to their population distributions. It shows that weighted estimates by each of the samples are essentially the same as their population distributions from where they were sampled (*p*-values of goodness-of-fit chi-square tests between actual distribution and estimated distribution by Q-returned, examined, and non-examined samples, respectively ranged from 0.22 to 0.99, which were not showed in table 2).

Table 3 presents comparisons of weighted estimates of distributions of those characteristics that had no actual population distributions available by examined sample to those by non-examined sample. It shows that after weight adjustments for both unequal selection probability and non-response, disparities between examined and non-examined samples were nominal.

Table 4 presents results of weighted self-reported caries overall and across characteristics by questionnaire sample, by examined sample, and by non-examined sample. It shows that weighted estimate of overall prevalence of self-reported caries by examined sample (32.14%) was essentially same as that by non-examined sample (33.30%) (p-value of t-test is 0.73). It also shows that prevalence of self-reported caries at each level across

characteristics with no significant difference by examined sample from by non-examined sample (p-values of t-tests ranged from 0.09 to 0.98). However, there is an exception; the weighted prevalence of self-reported caries in Eastern Shore by examined sample (40.77%) was significantly higher than that by non-examined sample (27.45%) (p-value of t-test is 0.02).

4. Discussions

This study investigated response rate disparity and potential survey estimates bias of the Survey of the Oral Health Status of Maryland School Children 2005-2006. It identified sample response disparities by demo-social characteristics that had been reported to have an impact on outcomes. These findings are consistent with previous studies reporting that non-respondents differ from respondents in relation to socio-economic status and health profile (Korkeila et al., 2001, Savitz 2003). This information is useful to plan the upcoming 2010-2011 state survey in order to increase response rate, which is the best way to limit non-response bias (Tolonen, Dobson, & Kulathinal, 2005). Also a higher response rate will result in more accurate variance estimates.

This survey had an overall response rate as low as 25%. Low response rates potentially biases population estimates obtained from respondents' data in terms of both accuracy and precision of population estimators (Tolonen, Dobson, & Kulathinal, 2005), demanding a non-response analysis (OMB). This study demonstrated that weight adjustment plays an important role in survey data with a low response rate and with non-response bias. In this study, after weight adjustment for both unequal selection probability and non-response, estimators of region, grade, sex, and race/ethnicity obtained from samples are as similar as target population distributions; estimators of free/reduced meal, caregivers' education, dental insurance coverage, dental visit in the past 12 months, and dental care availability obtained from respondents sample are as similar as those from non-respondents sample; estimators of outcomes, overall self-reported caries and self-reported caries across each characteristics obtained from the respondent sample are as similar as from the non-respondent sample.

Although this study only investigated unit non-response analysis, significant item non-response was found in this survey data. Respondents of screening exam were found to have significant lower chance of missing cases' sex than non-respondents in this study (Table 1). Imputation is a common approach to compensate for the bias caused by item non-response and should be used in the future study (Groves, Fowler, Couper, Lepkowski, Singer, & Tourangeau, 2004).

In summary, any health surveys should follow the Standards and Guidelines for Statistical Surveys published by the Office of Management and Budget of the White House (OMB). That is, make sure that the best strategies are implemented at the design stage to obtain the best response rate possible. However, if a low response is obtained, the analyst should evaluate the potential bias thoroughly, and use strategies such as weight adjustment to limit the bias within a reasonable range.

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Table 1. Sample characteristics and self-reported caries for questionnaire-returned, examined, and non-examined students of K+3rd grade: Maryland, 2005-2006

Characteristic	Q-returned N (%)	Examined N (%)	Non-Examined N (%)	Chi-square p-value
Overall	2,322	1,280	1,042	--
Region				
Known	2,322(100.0)	1,280(100.0)	1,042(100.0)	<0.0001
I – Western	482(20.8)	257(20.1)	225(21.6)	
II – Central DC	433(18.6)	221(17.3)	212(20.3)	
III – Southern	329(14.2)	160(12.5)	169(16.2)	
IV – Central Baltimore	549(23.6)	297(23.2)	252(24.2)	
V – Eastern Shore	529(22.8)	345(26.9)	184(17.7)	
Grade level				
Known	2,319(100.0)	1,277(100.0)	1,042(100.0)	<0.01
Kindergarten	1,087(46.9)	566(44.3)	521(50.0)	
3rd-grade	1,232(53.1)	711(55.7)	521(50.0)	
Unknown	3	3	0	
Gender*				
Known	2,160(100.0)	1,222(100.0)	938(100.0)	0.11
Boys	1,047(48.5)	574(47.0)	473(50.4)	
Girls	1,113(51.5)	648(53.0)	465(49.6)	
Unknown	162	58	104	
Race/ethnicity				
Known	2,259(100.0)	1,239(100.0)	1,020(100.0)	<0.0001
Non-Hispanic white	1,481(65.5)	730(58.9)	751(73.6)	
Non-Hispanic black	463(20.5)	332(26.8)	131(12.8)	
Non-Hispanic other	169(7.5)	94(7.6)	75(7.4)	
Hispanic	146(6.5)	83(6.7)	63(6.2)	
Unknown	63	41	22	
Free/reduced meal				
Known	2,283(100.0)	1,255(100.0)	1,028(100.0)	<0.0001
Eligible	720(31.5)	513(40.9)	207(20.1)	
Ineligible	1,563(68.5)	742(59.1)	821(79.9)	
Unknown	39	25	14	
Caregiver's education				
Known	2,288(100.0)	1,257(100.0)	1,029(100.0)	<0.0001
College graduate	1,103(48.2)	522(41.5)	581(56.5)	
Less than college graduate	1,185(51.8)	735(58.5)	448(43.5)	
Unknown	34	23	13	
Insurance coverage				
Known	2,302(100.0)	1,264(100.0)	1,036(100.0)	<0.0001
Medicaid	659(28.6)	448(35.4)	209(20.2)	
Private	1,384(60.1)	675(53.4)	709(68.4)	
No	259(11.3)	141(11.2)	118(11.4)	
Unknown	20	16	6	
Dentist visit in past 12 months				
Known	2,292(100.0)	1,260(100.0)	1,032(100.0)	<0.0001
Yes	1,930(83.1)	992(77.5)	938(90.0)	
No	362(15.6)	268(20.9)	94(9.0)	
Unknown	30	20	10	
Dental care service availability				
Known	2,284(100.0)	1,257(100.0)	1,027(100.0)	<0.0001
Yes	2,097(84.2)	1,127(89.7)	970(94.4)	
No	187(15.8)	130(10.3)	57(5.6)	
Unknown	38	23	15	
Reported past-12-mon caries				
Known	2,270(100.0)	1,243(100.0)	1,025(100.0)	0.0001
Yes	722(31.8)	437(35.2)	284(27.7)	
No	1,548(68.2)	806(64.8)	741(72.3)	
Unknown	52	37	17	

SOURCE: Survey of the Oral Health Status of Maryland School Children, 2005-2006.
*Significant lower percentage of missed sex of respondents (5%) than non-respondents (10%) were found (p-value < 0.01).

Table 2. Actual[1] distribution of selected characteristic vs. weighted[2] estimates by questionnaire-returned, examined, non-examined sample of K+3rd grade: Maryland, 2005-2006[3]

Characteristic	Actual[1] %	Q-returned %	Examined %	Non-Examined %
Overall	100	100	100	100
Region				
I – Western	9	10	10	10
II – Central DC	37	38	38	38
III – Southern	7	5	5	5
IV – Central Baltimore	40	37	37	36
V – Eastern Shore	7	10	10	11
Grade level				
Kindergarten	47	48	44	53
3rd-grade	53	52	56	47
Gender				
Boys	51	49	49	48
Girls	49	51	51	52
Race/ethnicity				
Non-Hispanic white	49	44	43	46
Non-Hispanic black	37	38	39	34
Non-Hispanic other	6	8	8	9
Hispanic	8	10	10	11

[1]SOURCE: Maryland Public School Enrolment by Race/Ethnicity, Gender and Number of Schools September 30, 2003; MSDE.
[2] Weights for questionnaire-returned, examined, and non-examined samples were all adjusted for non-response at corresponding levels. That is, weight for questionnaire-returned sample was adjusted for non-response to questionnaire; weight for examined sample was adjusted for both non-response to questionnaire and to screening exam.
[3]SOURCE: Survey of the Oral Health Status of Maryland School Children, 2005-2006.

Table 3. Weighted[¥] characteristics and self-reported caries for questionnaire-returned, examined, and non-examined students of K+3rd grade: Maryland, 2005-2006

Characteristic	Q-returned (%)	Examined (%)	Non-Examined (%)	t-test p-value
Overall	112,661(100.0)	112,661(100.0)	112,661(100.0)	--
Free/reduced meal				
Eligible	48,444(43.0)	49,008(43.5)	47,543(42.2)	0.90
Ineligible	61,738(54.8)	60,274(53.5)	63,879(56.7)	0.75
Caregiver's education				
College graduate	44,050(39.1)	43,037(38.2)	45,402(40.3)	0.80
Less than college graduate	66,132(58.7)	67,146(59.6)	64,667(57.4)	0.78
Insurance coverage				
Medicaid	40,671(36.1)	41,797(37.1)	37,741(33.5)	0.61
Private	57,232(50.8)	54,303(48.2)	62,414(55.4)	0.31
No	13,181(11.7)	14,421(12.8)	11,491(10.2)	0.34
Dentist visit in past 12 months				
Yes	87,425(77.6)	84,721(75.2)	94,297(83.7)	0.07
No	23,208(20.6)	25,461(22.6)	17,237(15.3)	0.10
Dental care service availability				
Yes	98,128(87.1)	95,987(85.2)	102,184(90.7)	0.18
No	11,604(10.3)	13,069(11.6)	8,562(7.6)	0.26

SOURCE: Survey of the Oral Health Status of Maryland School Children, 2005-2006.
[¥] Weights for questionnaire-returned, examined, and non-examined samples were all adjusted for non-response at corresponding levels. That is, weight for questionnaire-returned sample was adjusted for non-response to questionnaire; weight for examined sample was adjusted for both non-response to questionnaire and to screening exam.

Table 4. Weighted[¥] prevalence of self –reported dental caries by characteristics for questionnaire-returned, examined, and non-examined students of K+3rd grade: Maryland, 2005-2006

Characteristic	Prevalence % (SE)			t-test p-value
	Q-returned (N=2322)	Examined (N=1280)	Non-Examined (N=1042)	
Overall	32.10(1.66)	32.14(1.74)	33.30(3.01)	0.73
Region				
I – Western	31.84(2.99)	32.49(4.43)	28.90(3.05)	0.50
II – Central DC	30.15(3.22)	30.52(3.84)	29.05(3.19)	0.77
III – Southern	32.29(4.55)	38.30(6.32)	28.55(4.45)	0.21
IV – Central Baltimore	33.10(2.90)	30.47(2.18)	41.44(7.22)	0.15
V – Eastern Shore	35.79(4.23)	40.77(4.95)	27.45(2.97)	0.02*
Grade level				
Kindergarten	28.32(2.18)	28.69(2.34)	29.09(3.24)	0.92
3rd-grade	35.50(2.16)	34.93(2.75)	38.08(4.56)	0.55
Gender				
Boys	32.85(2.65)	30.76(2.71)	36.64(4.37)	0.25
Girls	30.37(1.95)	33.05(2.41)	28.06(4.01)	0.29
Race/ethnicity				
Non-Hispanic white	26.59(1.64)	27.38(1.96)	26.29(2.90)	0.76
Non-Hispanic black	35.65(2.26)	33.15(3.16)	41.82(3.95)	0.09
Non-Hispanic other	35.22(4.32)	39.94(5.62)	30.86(7.86)	0.35
Hispanic	42.21(4.57)	46.18(6.20)	37.95(6.44)	0.36
Free/reduced meal				
Eligible	39.60(2.15)	40.59(2.63)	38.92(5.08)	0.77
Ineligible	27.05(1.65)	26.82(1.92)	29.16(2.94)	0.51
Caregiver's education				
College graduate	24.08(1.72)	24.07(2.08)	23.75(2.28)	0.94
Less than college graduate	37.47(1.46)	37.60(1.76)	39.59(4.31)	0.67
Insurance coverage				
Medicaid	41.07(2.79)	41.16(3.03)	40.25(5.81)	0.89
Private	27.05(2.12)	26.19(2.49)	30.40(3.44)	0.32
No	29.17(3.34)	32.94(4.54)	26.18(5.82)	0.36
Dentist visit in past 12 months				
Yes	34.60(2.25)	34.55(2.14)	35.11(3.00)	0.88
No	23.88(3.47)	25.05(3.82)	25.56(7.64)	0.98
Dental care service availability				
Yes	33.08(1.98)	25.70(4.41)	21.47(9.56)	0.68
No	24.04(3.06)	33.32(2.02)	33.81(3.08)	0.89

SOURCE: Survey of the Oral Health Status of Maryland School Children, 2005-2006.

[¥] Weights for questionnaire-returned, examined, and non-examined samples were all adjusted for non-response at corresponding levels. That is, weight for questionnaire-returned sample was adjusted for non-response to questionnaire; weight for examined sample was adjusted for both non-response to questionnaire and to screening exam.