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Factors Associated with Medical and Dental Compliance for Adults with Diabetes Mellitus

Mahua Saha
University of Nebraska Medical Center

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Abstract

Background: Over the few decades, diabetes has become one of the most common chronic conditions in the U.S and worldwide. With the increasing number of incidences of diabetes and the cost associated with the treatment, adherence to treatment regimens is one key factor, which immensely affects the success of the diabetes treatment. The American Diabetes Association recommends annual preventive care for diabetes in terms of self-care practices such as daily blood glucose check and daily foot check. An eye examination with pupil dilation and a dental checkup are also recommended as part of annual care for diabetic patients. Considering the effect and the importance of various factors on the emergence of this chronic disease, the purpose of this study was to investigate the demographic and socioeconomic factors impacting the treatment compliance in patients with diabetes.

Objective: To identify the factors associated with the medical and dental compliance among patients with diabetes.

Methods: The analysis was conducted using the Behavioral Risk Factor Surveillance System (BRFSS) data. Both Univariate and Multivariable logistic regressions were used to assess the relationship between the factors (independent) and medical compliance or dental compliance (dependent) among diabetes patients with account for survey design using the SURVEYLOGISTIC procedure in SAS.

Results: The Odds of following medical compliance for diabetic care were higher for female (OR=1.21; 95%CI=1.02-1.43), older patients with age of 65 or older, non-White patients (non-Hispanic Black: OR=1.26; 95%CI=1.02-1.54; Hispanic: OR=1.33; 95%CI=1.02-1.74; Other Non-Hispanic: OR=1.15; 95%CI= 0.76-1.73), married, and with college degree and health coverage plan. Additionally, patients, who had alcoholic beverages within last 30 days (OR=0.67;

95%CI=0.54-0.82) and with good general health status (OR=0.84; 95%CI=0.70-0.99), had lower odds to follow medical compliance.

For annual dentist visit, females had higher odds of dental compliance (OR=1.23; 95%CI=1.12-1.35) as compared to male. Older people (65+) were less compliant as compared to younger patients. Patients with BMI less than 30 had higher odds to visit dentist during past 12 months. All race groups had lower odds to visit dentist annually as compared to white people. Patients with income less than $50000, current (OR=0.60; 95%CI=0.53-0.68) and former smokers (OR=0.81; 95%CI=0.74-0.90) had lower odds to visit dentist. Diabetes patients with college degree, with good health status (OR=1.35; 95%CI=1.23-1.48) and with health coverage plan (OR=1.64; 95%CI=1.31-2.06) had higher odds to follow dental compliance of diabetes.

Conclusion: There are significant disparities in following medical compliance and dental compliance among diabetes patients with different demographic and social-economic variables. A success in reducing or eliminating these disparities will help to improve health outcome relevant to diabetes management. Providers of diabetes care can play a key role in diminishing these disparities through understanding and addressing patient factors such as health literacy and focusing on improved patient communication and cultural competence.

Literature Review

The number of people with diabetes worldwide has increased from 108 million in 1980 to 422 million in 2014 [1]. In 2012, an estimated 1.5 million deaths were directly caused by diabetes and another 2.2 million deaths were attributable to high blood glucose [1]. About 28 percent of the Americans with diabetes are undiagnosed, and another 86 million American adults have blood glucose levels that greatly increase their risk of developing type-2 diabetes in the next several years [2]. The total estimated cost incurred towards diagnosed diabetes in 2012 was $245 billion, which included $176 billion in direct medical costs and $69 billion in reduced productivity [3]. Diabetic retinopathy (DR), the most common microvascular complication of diabetes, is predicted to be the principal reason of blindness among working population [4, 5]. Studies have shown that the diabetic retinopathy is the major reason of blindness in adults, especially between 20-74 years of age in the United States of America [6]. Around 25% of type 1 diabetic patients are impacted by DR [7], whereas the type 2 diabetes attributes to a higher percentage of vision loss amongst the patients [8].

A diabetic patient is usually recommended to go through a dilated eye exam test by a healthcare professional on a yearly basis. Studies have shown that the testing is underused by many low-income and ethnic minority patients with diabetes. Data from the National Health and Nutriion Examination Survey and the National Health Interview Survey indicates that people without a high school diploma or people at lower income levels have significantly higher rates of DR [9]. In addition, low screening rates for DR in racial/ethnic minority patients is mainly attributed to lack of understanding of the fact that diabetes can lead to complications such as DR [10]. These findings

indicate a greater need for increased DR screening and patient education among the low-income minority patients [11].

In 2012, the estimated incremental burden of diabetic foot ulceration in all Medicare and non-Medicare patients in the United States was $9.1–13 billion [12]. These costs do not include the suffering of patients and families, loss of income, loss of mobility, and predicted increased mortality. It is estimated that 24.4% of the total health care expenditure among diabetic population is related to foot complications [13] and the total cost of treating diabetic foot complications is approaching $11 billion in the USA [14]. The risk of ulceration and amputation among diabetic patients increases by two to four folds with the progression of age and duration of diabetes, regardless of the type of diabetes [15]. Many longitudinal epidemiological studies have shown that 25% of diabetic patients are at risk of foot ulcer during their lifetime [16]. Foot ulceration is a preventable condition, where simple interventions can reduce amputations by up to 70% through programs that could reduce its risk factors [17]. A diabetic patient is usually recommended to have an annual comprehensive foot examination by a healthcare professional on an annual basis. They also recommend inspecting foot on daily basis to check for foot injury. Based on the National Institute for Health and Clinical Excellence strategies, early effective management of DFU can reduce the severity of complications and can improve overall quality of life.

One of the important oral signs of diabetes is gingivitis and periodontitis. Patients with undiagnosed or poorly controlled diabetes mellitus type 1 or type 2 are at higher risk for periodontal diseases [18]. Many studies had demonstrated an association between diabetes and an increased susceptibility to oral infections including periodontal disease [19]. Periodontitis progresses more rapidly in poorly controlled diabetics. Periodontal diseases should be managed more actively in people with diabetes for an immediate or long-term gain. It is recommended to

have a dental checkup annually for a diabetic patient. Several studies show that the prevalence and severity of periodontal disease vary with demographical factors such as age, sex and educational level [20]. The burden of periodontal diseases is disproportionately higher particularly among certain minority and economically disadvantaged groups.

Studies have shown that females are more prone to be adherent to prescribed drugs for diabetes. Studies also indicated the other factors associated with non-adherence as not understanding the drug regimen well enough, affording only some or none of prescribed drugs and longer time since last since the last visit to a health worker [21].

Studies have shown that people with diabetes do not adhere to recommended care guidelines until complications develop [22]. To improve diabetic outcomes, interventions should focus on the adherence to the recommended diabetic care.

Study Design and Methods

Data Sources and study sample:

The analysis was based on the cross-sectional data from 2016 BRFSS survey for 18 years or older US resident with diabetes. Persons with diabetes were identified by a yes response to the question, "Have you ever been told by a doctor that you have diabetes?".

Exclusion Criteria:

Patients with gestational diabetes or pre-diabetes or borderline diabetes were classified as not having diabetes. Respondents who were not sure, or who refused to answer this question, were excluded from analysis (<0.1% of all respondents). Respondents with missing covariates were too few to be meaningfully analyzed in a separate 'missing' category and were excluded.

Objective:

The Goal of this project was to identify and quantify the factors associated with medical and dental compliance among patients with diabetes.

Outcome variable:

The outcome variables are defined as follows:

- Medical compliance:
    - Compliant: Patients with diabetes, who had checked their blood sugar and feet on average once a day, had an eye check up with dilation by a health professional in last 12 months.
    - Non-compliant: Patients with diabetes, who did not follow one or more of the following criteria for medical compliance.
        - Checked their blood sugar on average once a day
        - Checked their feet on average once a day
        - Had an eye check up with dilation by a health professional in last 12 months.
- Dental compliance:
    - Compliant: Patients with diabetes visited a dentist in last 12 months.
    - Non-Compliant: Patients with diabetes who did not visit a dentist in last 12 months.

Persons who reported that they had diabetes were asked questions from the diabetes module on preventive-care practices, including:

- Q1: About how often do you check your blood for glucose or sugar?
- Q2: When was the last time you had an eye exam in which the pupils were dilated?
- Q3: About how often do you check your feet for any sores or irritations?
- Q4: Adults who have visited a dentist, dental hygienist or dental clinic within the past year

The four variables: Bld_Sugar", " Eye_Exam", "Feet_Check" , and Dent_Visit were defined by using the responses from Q1-Q4. The table below describes the variables in details [23]:

Table 1: American Diabetes Association Guideline-Recommended Preventive Care for Diabetic Patients

Preventive Care	BRFSS Question	Coding
Daily Self-Monitoring of Blood Glucose	About how often do you check your blood for glucose or sugar?	≥7 / week = met the guideline; < 7 or 888 did not meet; 777, 999 or missing = excluded
Daily Self-Exam of Feet	About how often do you check your feet for any sores or irritations?	≥7 / week = met the guideline; < 7 or 888 did not meet; 555, 777, 999 or missing = excluded
Annual Eye Exam	When was the last time you had an eye exam in which the pupils were dilated?	1, 2 = met the guideline; 3, 4, or 8 = did not meet; 7, 9, missing = excluded
Annual Dentist Visit	Adults who have visited a dentist, dental hygienist or dental clinic within the past year	1= met the guideline; 0=did not meet; 9=excluded

Independent Variables:

Self-reported information on gender, age, race/ethnicity, marital status, smoking status, alcohol intake, education, income level, general health, mental health, health care coverage and occupation were selected for as the covariates to validate whether they were association with the compliance for diabetic care as reported in previous literatures [24, 25].

The study population was divided into four age groups: 18-44, 45-54, 55-65 and older than 65. The four race categories were non-Hispanic white, non-Hispanic black, Hispanic and others. Marital Status had four levels: Married, Divorced/Separated/Never Married, Widowed, and Unmarried Couple.

Socioeconomic status indicators included educational attainment, employment and income adequacy. Education had four different levels including less than high school, high school graduate, some college/ Technical degree and College graduate. Employment was categorized in three groups as employed, homemaker or student or retired, not employed or unable to work. Four different income group was defined as less than $15K, $15K-<$35K, $35K-<$50K and $50K+. Smoking status was classified as three levels including current smoker (i.e. currently smokes every-day or someday), former smoker, and non-smoker.

The alcohol status were defined based on affirmative responses for the question: During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage such as beer, wine, a malt beverage or liquor?". The participants were classified as alcohol users if answering yes, and non-alcohol user otherwise. Survey participant's general health status had two levels. General health status responses like Excellent, Very Good and Good were grouped together as good general health status whereas the fair and poor health status was grouped together as poor health status. The responses from the survey question; "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?" was used to define a binary variable regarding the ownership of health plan (Yes/No).

Methods:

There were several types of missing data. A domain variable, "Missing" was created to categorize the study population as missing and non-missing. Any missing value for independent and outcome variable were included to identify the Missing subpopulation (Missing=1). The reports focused on the analyses results from the non-missing domain.

In statistical analysis, descriptive statistics were first calculated to describe the frequency distribution of the study participants using Surveyfreq procedure of SAS. Univariate analyses were performed with weighted data to identify univariate association of the independent variables with adherence to medical and dental compliance. Odds ratios, 95% confidence intervals and p-values were obtained. Then two types of multivariate logistic regressions were fitted to estimate the odds ratios with 95% confidence intervals for the main effects of each variable, controlling for the effects of all other variables. In the first type of multivariate logistic regression, a full model including all considered independent variables was fitted. In the second type of multivariate logistic regression, the final models including all selected variables via backward variable selection with p values of 0.1 for removal was used. The significance of the main effect was tested with the Wald Chi-square test separately. Adjusted odds ratio and 95% confidence interval (adjusted for all the variables in the final model) and the corresponding p-values were obtained. All logistic regression was conducted using PROC SURVEYLOGISTIC of SAS (SAS Institute, Inc, Cary, NC), to calculate standard errors after accounting for the complex survey design of the BRFSS. Specifically, we adjusted the sample design using the stratification variable (_STSTR), primary sample unit (_PSU) and final weight (_LLCPWT) available in the BRFSS data files.

Analysis and Results

Table 2 and Table 3 represent the data overview of the medical and dental compliance analytical sample without considering the sample design. After excluding no diabetic, Gestational diabetes and pre-diabetes or borderline diabetes, currently pregnant and missing data for diabetes, there were 66,000 patients with diabetes who participated in the BRFSS 2016 survey dataset. For Medical and Dental compliance, any patient not had valid answers to define values regarding medical compliance or dental compliance was categorized as missing and was excluded. Among

66,000 patients with diabetes, 56,784 patients had missing responses for medical compliance and 1,047 patients had missing responses for dental compliance. Finally, after excluding patients with missing covariates there were 6,899 patients in the medical analytical samples and 48,702 patients in the dental compliance analytical samples.

Table 2: Data (Raw) Overview of Medical Compliance

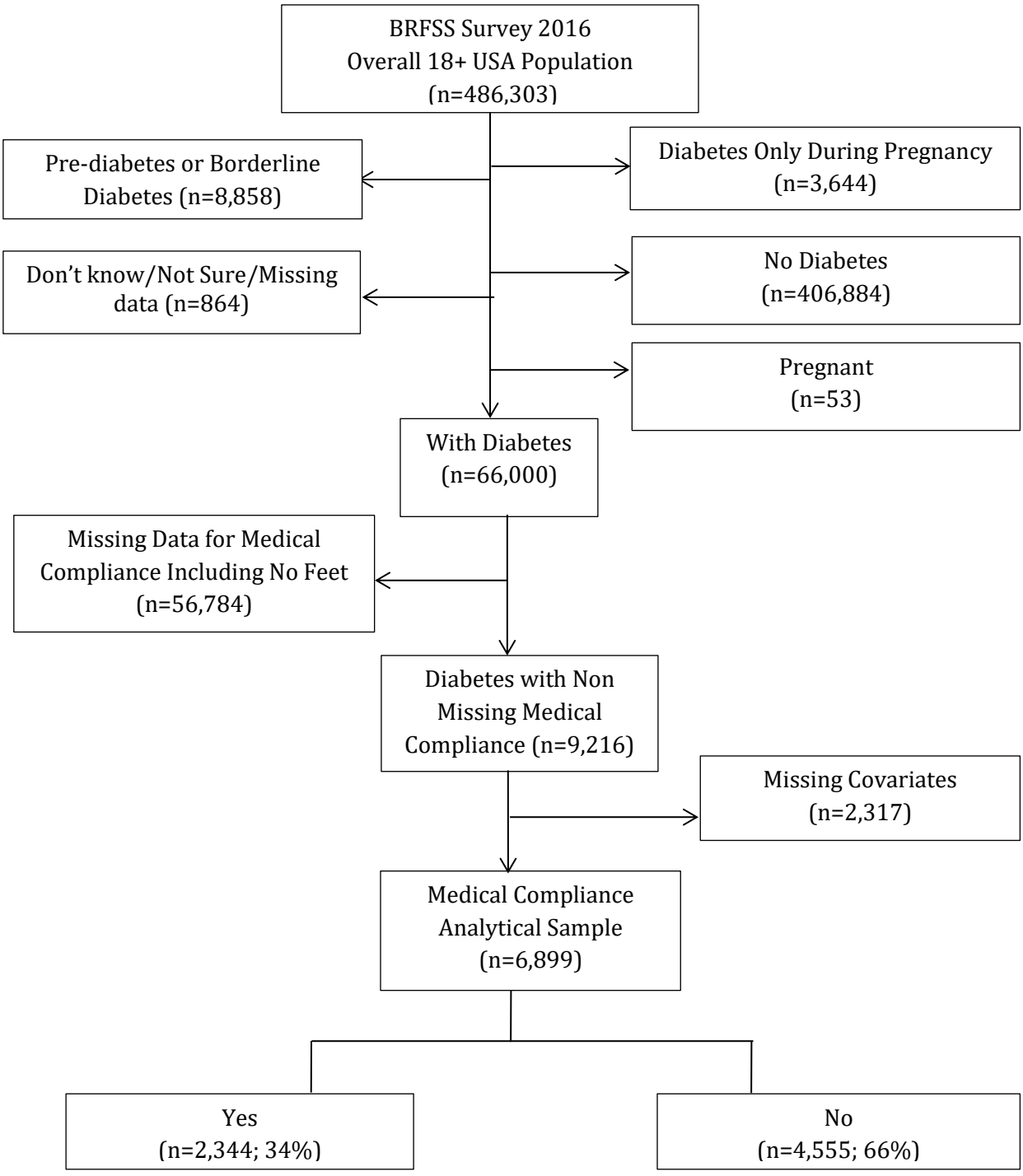

Table 3: Data (Raw) Overview of Dental Compliance

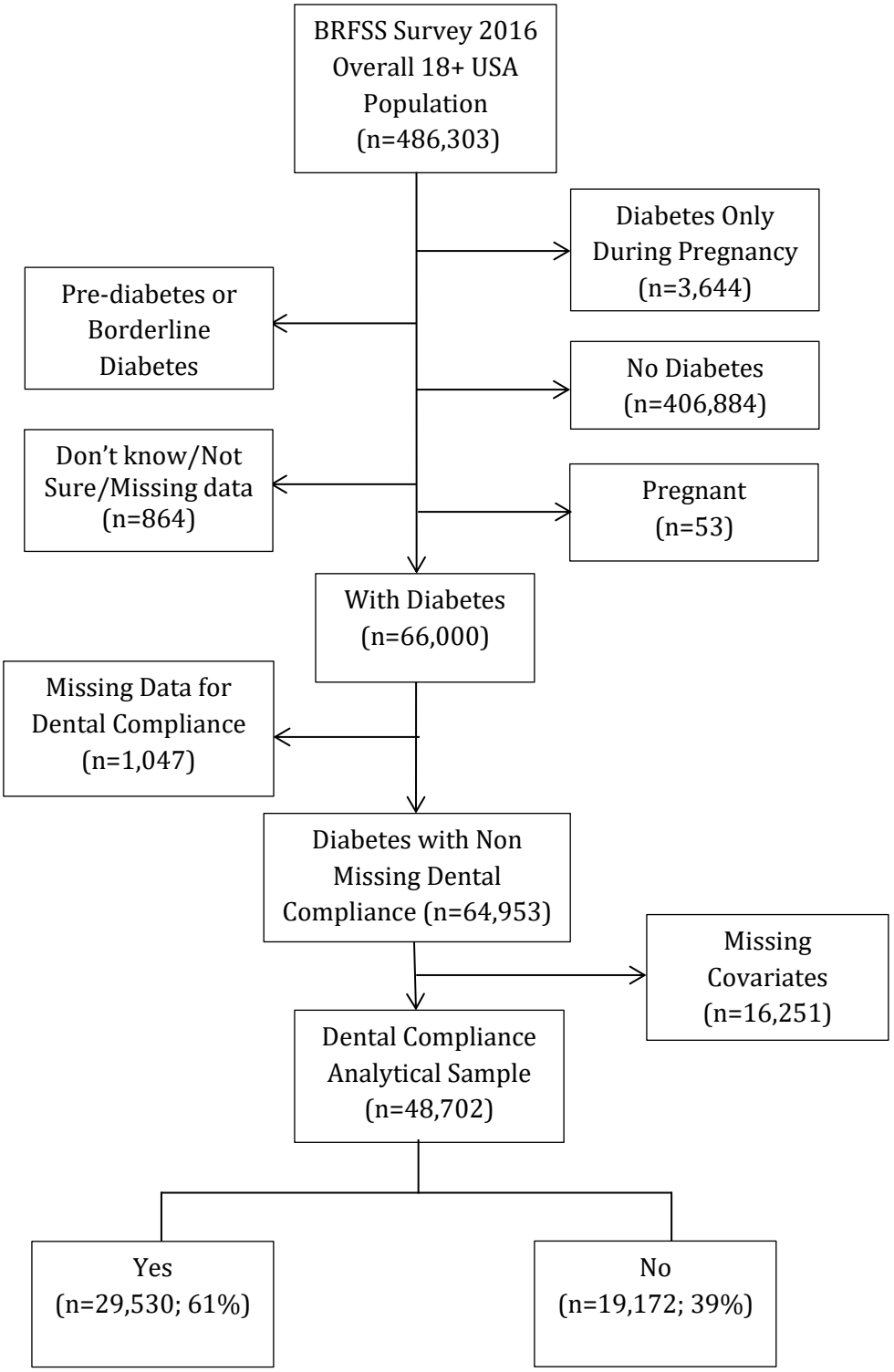

Table 4 and Table 5 represent the frequency distribution of independent variables by medical and dental compliance. The sample frequency (n) was based on sample data without accounting for the sampling design whereas the population estimate (N and %) were based on the complex study design.

There were 2,594,541 patients included in the analysis for the medical compliance. The overall adherence to recommended medical compliance for diabetic care was 31% (N=798,003). About half of them were female (N=407,977). The majority of the patients who were medically compliant with the diabetic care were 65 years of age or older (46.3%, N=369,674), married (54.7%, N=436,726), obese (55.6%, N=443,844) and never smoked (52.4%, N=418,405). Only 28.3% of them were employed, and around 20% of them had income less than $15,000. Among patients who were not medically compliant with the diabetic care, 54.7% of them were male (N=982,324), 39.8% of them were 65 years of age or older (N=715,438), 50% were married (N=912,658), 35% of them were employed (N=628,512) and 49% were never smoked (N=879,480).

There were 20,143,757 patients were included in the analysis for the dental compliance. The overall prevalence of compliance of dental compliance was 61% (N=11,994,246). The majority of the patients who were compliant with the dental care recommended for patients with diabetes were male (53.8%, N= 5,543,693), 65 years of age or older (42%, N=5,037,148), married (59.1%, N=7,089,916), obese (52.4%, N=6,287,711), and never smoked (53.7%, N=6,439,768). Only 39.1% of them were employed. The patients who were non-compliant with the dental care recommended for patients with diabetes, 53% of them were male (N=4,316,960), 42.6% of them were 65 years of age or older (N=3,469,234), 46.6% were married (N=3,793,560), and 43.4% were never smoked (N=3,534,063), while 27.4% of them were employed (N=2,230,922).

Table 4: Frequency distribution of independent variables by medical compliance

Independent Variables		Medical Compliance (n= 6,899; N=2,594,541)					
		Yes (n= 2,344; N=798,003)			No (n=4,555; N=1,796,538)		
		Sample Frequency	Population Estimate		Sample Frequency	Population Estimate	
		n	N	%	n	N	%
Sex	Male	939	390,026	48.9	2,165	982,324	54.7
	Female	1,405	407,977	51.1	2,390	814,214	45.3
Age	18-44	131	65,527	8.2	329	239,993	13.4
	45-54	301	150,338	18.9	625	339,731	18.9
	55-64	611	212,464	26.6	1,288	501,375	27.9
	65+	1,301	369,674	46.3	2,313	715,438	39.8
BMI	Underweight/Normal Weight	354	122,359	15.3	636	243,141	13.5
	Overweight	735	231,800	29.1	1,457	551,293	30.7
	Obese	1,255	443,844	55.6	2,462	1,002,104	55.8
Race/Ethnicity	White Only, Non-Hispanic	1,182	423,850	53.1	2,602	1,052,344	58.6
	Black Only, Non-Hispanic	600	196,989	24.7	997	416,028	23.1
	Other Race Only, Non-Hispanic/Multiracial	147	33,003	4.1	334	70,218	3.9
	Hispanic	415	144,160	18.1	622	257,948	14.4
Marital Status	Married	1,111	436,726	54.7	2,215	912,658	50.8
	Divorced/Separated/Never Married	722	228,107	28.6	1,432	591,789	32.9
	Widowed	478	120,153	15.1	805	232,831	13.0
	Member of Unmarried Couple	33	13,017	1.6	103	59,260	3.3
Education	< High School	340	174,666	21.9	659	386,413	21.5
	High School Grad	756	242,462	30.4	1,488	558,775	31.1
	Some College/Technical	609	206,919	25.9	1,217	539,240	30.0
	College Grad	639	173,956	21.8	1,191	312,110	17.4
Employment	Employed	571	225,759	28.3	1,375	628,512	35.0
	Homemaker/Student/Retired	1,252	373,355	46.8	2,182	722,029	40.2
	Not employed/ Unable to Work	521	198,889	24.9	998	445,996	24.8
Income Level	<$15000	509	166,218	20.8	918	350,991	19.5
	$15000-$34999	919	291,249	36.5	1,649	626,610	34.9
	$35000-$49999	306	103,210	12.9	582	214,443	11.9
	$50000+	610	237,327	29.8	1,406	604,493	33.7
Smoking Status	Current	261	103,735	13.0	705	323,557	18.0
	Former	807	275,863	34.6	1,546	593,501	33.0
	Never Smoked	1,276	418,405	52.4	2,304	879,480	49.0
Alcohol Intake	Yes	596	224,439	28.1	1,594	687,177	38.3
	No	1,748	573,564	71.9	2,961	1,109,361	61.7
General Health	Good or Better Health	1,176	390,936	49.0	2,531	961,942	53.5
	Fair/Poor	1,168	407,068	51.0	2,024	834,595	46.5
Health Plan	Yes	2,283	778,657	97.6	4,293	1,666,051	92.7
	No	61	19,347	2.4	262	130,486	7.3

Population estimate (N and %) were based on the study design. p values were calculated using the population estimate and based on the Wald Chi-Square test.

BMI: Body Mass Index; Underweight/Normal Weight: BMI<25, Overweight: 25=<BMI <30, Obese: BMI>=30

Smoking Status: Current: Smokes every day or some days, Former smoker: Smoked Before and Never Smoked.

Alcohol Intake: Yes: Had alcoholic beverage during past 30 days, No: No alcoholic beverage during past 30 days.

General Health: Self - reported health status

Health Plan: Yes: Have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service.

Table 5: Frequency distribution of independent variables by dental compliance

Independent Variables		Dental Compliance (n= 48,702;N=20,143,757)					
		Yes (n=29,530;N=11,994,246)			No (n= 19,172;N=8,149,511)		
		Sample Frequency	Population Estimation		Sample Frequency	Population Estimation	
		n	N	%	n	N	%
Sex	Male	14,569	6,450,553	53.8	9,035	4,316,960	53.0
	Female	14,961	5,543,693	46.2	10,137	3,832,551	47.0
Age	18-44	1,897	1,445,789	12.0	1,235	1,023,744	12.6
	45-54	3,746	2,121,614	17.7	2,607	1,422,139	17.4
	55-64	7,896	3,389,697	28.3	5,074	2,234,395	27.4
	65+	15,991	5,037,148	42.0	10,256	3,469,234	42.6
BMI	Underweight/Normal Weight	4,207	1,784,443	14.9	2,659	1,148,288	14.1
	Overweight	9,818	3,922,093	32.7	5,549	2,371,759	29.1
	Obese	15,505	6,287,711	52.4	10,964	4,629,465	56.8
Race/Ethnicity	White Only, Non-Hispanic	22,228	7,497,349	62.5	13,534	4,865,187	59.7
	Black Only, Non-Hispanic	3,093	1,756,915	14.7	2,590	1,314,989	16.1
	Other Race Only, Non-Hispanic/Multiracial	2,053	1,010,328	8.4	1,455	525,740	6.5
	Hispanic	2,156	1,729,656	14.4	1,593	1,443,595	17.7
Marital Status	Married	16,352	7,089,916	59.1	7,906	3,793,560	46.6
	Divorced/Separated/Never Married	7,855	3,184,557	26.6	6,656	2,835,313	34.8
	Widowed	4,877	1,439,035	12.0	4,249	1,298,232	15.9
	Member of Unmarried Couple	446	280,738	2.3	361	222,405	2.7
Education	< High School	1,964	1,692,067	14.1	3,314	2,388,360	29.3
	High School Grad	8,288	3,429,029	28.6	7,486	2,693,672	33.0
	Some College/Technical	8,681	3,903,319	32.5	5,350	2,205,682	27.1
	College Grad	10,597	2,969,832	24.8	3,022	861,796	10.6
Employment	Employed	9,850	4,691,989	39.1	4,384	2,230,922	27.4
	Homemaker/Student/Retired	15,437	5,188,168	43.3	9,419	3,390,123	41.6
	Not employed/ Unable to Work	4,243	2,114,090	17.6	5,369	2,528,466	31.0
Income Level	<$15000	3,049	1,388,788	11.6	4,693	2,017,343	24.8
	$15000-$34999	8,794	3,528,665	29.4	8,732	3,582,707	44.0
	$35000-$49999	4,819	1,738,618	14.5	2,443	1,030,897	12.6
	$50000+	12,868	5,338,176	44.5	3,304	1,518,563	18.6
Smoking Status	Current	2,957	1,379,973	11.5	3,793	1,629,878	20.0
	Former	10,874	4,174,505	34.8	7,291	2,985,569	36.6
	Never Smoked	15,699	6,439,768	53.7	8,088	3,534,063	43.4
Alcohol Intake	Yes	11,650	4,891,635	40.8	5,124	2,439,596	29.9
	No	17,880	7,102,612	59.2	14,048	5,709,915	70.1
General Health	Good or Better Health	19,190	7,503,534	62.6	9,026	3,675,876	45.1
	Fair/Poor	10,340	4,490,713	37.4	10,146	4,473,635	54.9
Health Plan	Yes	28,668	11,412,909	95.2	17,942	7,312,405	89.7
	No	862	581,337	4.8	1,230	837,106	10.3

Population estimate (N and %) were based on the study design. p values were calculated using the population estimate and based on the Wald Chi-Square test.

BMI: Body Mass Index; Underweight/Normal Weight: BMI<25, Overweight: 25=<BMI <30, Obese: BMI>=30

Smoking Status: Current: Smokes every day or some days, Former smoker: Smoked Before and Never Smoked.

Alcohol Intake: Yes: Had alcoholic beverage during past 30 days, No: No alcoholic beverage during past 30 days.

General Health: Self - reported health status

Health Plan: Yes: Have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service.

Table 6 shows the odds ratios for assessing the association of each covariate with medical compliance. Three different analyses including univariate analyses, multivariate analyses using full model (all covariates), and multivariate analysis using covariates identified by the backward variable selection were conducted. For all three analyses, the same sample size was used to maintain the consistency. Specifically, if any of the independent variables were missing, the data were included in the Missing domain and the analytical results based on the data from non-missing domain were reported. .

Univariate logistic regression results showed that the females had higher odds of being adherent to medical compliance (OR=1.26; 95%CI=1.07-1.49, p value=0.006) for diabetic care as compared to male. Diabetic patients of 64 years and younger were less compliant as compared to 65+ patients with diabetes. Widows had higher odds of being compliant (OR=1.08; 95%CI=0.87-1.34, p value=0.492) while member of unmarried couple (OR=0.46; 95%CI=0.24-0.88, p value=0.019) and divorced or separated or never married (OR=0.81; 95%CI=0.66-0.981, p value=0.027) had lower odds of being medically compliant as compared to married. Patients who were not college graduates had lower odds of adherence to medical compliance. Patients who were homemakers or students or retired had higher odds (OR=1.44; 95%CI=1.19-1.74, p value<0.001) of adherence to medical compliance as compared to those who were employed. Diabetic patients who drank alcohol within past 30 days had lower odds (OR=0.63; 95%CI=0.52-0.77, p value<0.001) of medical compliance as compared to those who did not have alcohol. Patients with health care coverage (OR=3.15; 95%CI=2.10-4.74, p value<0.001) had higher odds of being medically compliant for diabetes care.

The final model adjusting for all variables that were identified by the backward variable selection and complex study design was fitted, and the results show the relevant adjusted odds ratio (AOR)

with 95% confidence interval. Among patients with diabetes, females had higher odds of being medically compliant (AOR=1.21; 95%CI=1.02-1.43, p value=0.031) as compared to male diabetic patients. Patients with age 64 years old or younger had lower odds for medical compliance as compared to 65+ years of age. Odds were higher for the Non-Hispanic Black (AOR=1.26; 95%CI=1.02-1.54, p value=0.030). Likewise, Hispanic (AOR=1.33; 95%CI=1.02-1.74, p value=0.034) and Other Non-Hispanic (AOR=1.15; 95%CI= 0.76-1.73, p value=0.519) had higher odds as compared to White. Unmarried couples (AOR=0.49; 95%CI=0.26-0.93, p value=0.029), divorced (AOR=0.78; 95%CI=0.64-0.96, p value=0.021) and widows (AOR=0.88; 95%CI=0.70-1.11, p value=0.290) had lower odds to follow medical compliance as compared to married patients. For diabetes patients who were high school graduate (AOR=0.72; 95%CI=0.58-0.90, p value=0.004) or had some college/Technical degree (AOR=0.65; 95%CI=0.52-0.81, p value<0.001), had lower odds to follow medical compliance as compared to college grads. Patients, who had alcoholic beverages within last 30 days (AOR=0.67; 95% CI=0.54 to 0.82, p value <0.001) and with good general health status (AOR=0.84; 95% CI=0.70 to 0.99, p value=0.047), had lower odds to follow medical compliance. As expected, patients with a health coverage plan had higher odds (AOR=2.62; 95%CI=1.75-3.93, p value <0.001) of following medical compliance of diabetes as compared to who didn't have health coverage plan.

Table 6: Crude and Adjusted Odds Ratios' for medical compliance, by Independent Variables

Independent Variables		Univariate		Full Model* (Multi-variable)		Final Model* (Multi-variable)	
		Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Sex	Female	1.26(1.07,1.49)	0.006	1.19(1.00,1.42)	0.047	1.21(1.02,1.43)	0.031
	Male (ref)						
Age	18-44	0.53(0.39,0.71)	<0.001	0.72(0.51,1.01)	0.117	0.64(0.47,0.86)	0.026
	45-54	0.86(0.67,1.10)		1.10(0.82,1.47)		0.98(0.76,1.27)	
	55-64	0.82(0.67,1.00)		0.94(0.75,1.17)		0.88(0.71,1.08)	
	65+ (ref)						
BMI	Underweight/Normal Weight	1.15(0.93,1.43)	0.453	1.14(0.88,1.46)	0.418		
	Overweight	1.02(0.87,1.20)		0.95(0.79,1.16)			
	Obese (ref)						
Race/ Ethnicity	Black Only, Non-Hispanic	1.18(0.97,1.43)	0.053	1.24(1.00,1.53)	0.196	1.26(1.02,1.54)	0.068
	Hispanic	1.39(1.08,1.79)		1.25(0.92,1.69)		1.33(1.02,1.74)	
	Other Race Only/Multiracial, Non-Hispanic	1.17(0.75,1.82)		1.12(0.75,1.69)		1.15(0.76,1.73)	
	White Only, Non-Hispanic (ref)						
Marital Status	Divorced/Separated/Never Married	0.81(0.66,0.98)	0.007	0.76(0.61,0.94)	0.021	0.78(0.64,0.96)	0.033
	Member of Unmarried Couple	0.46(0.24,0.88)		0.49(0.25,0.94)		0.49(0.26,0.93)	
	Widowed	1.08(0.87,1.34)		0.85(0.67,1.08)		0.88(0.70,1.11)	
	Married (ref)						
Education	Less than High School	0.81(0.62,1.06)	0.008	0.65(0.47,0.88)	0.001	0.68(0.51,0.91)	0.001
	High School Grad	0.78(0.63,0.96)		0.69(0.55,0.88)		0.72(0.58,0.90)	
	Some College/Technical	0.69(0.56,0.85)		0.63(0.51,0.79)		0.65(0.52,0.81)	
	College Grad(ref)						
Employment	Homemaker/Student/Retired	1.44(1.19,1.74)	0.001	1.16(0.92,1.47)	0.397		
	Not employed/ Unable to Work	1.24(0.97,1.59)		1.17(0.88,1.55)			
	Employed (ref)						
Income Level	<$15,000	1.21(0.96,1.52)	0.283	1.15(0.89,1.47)	0.611		
	$15000-$34999	1.18(0.97,1.45)		1.19(0.88,1.61)			
	$35000-$49999	1.23(0.90,1.66)		1.15(0.82,1.61)			
	$50,000+ (ref)						
Smoking Status***	Current	0.67(0.52,0.88)	0.012	0.83(0.63,1.10)	0.337		
	Former	0.98(0.82,1.17)		1.03(0.86,1.24)			
	Never Smoked (ref)						
Alcohol Intake	Yes	0.63(0.52,0.77)	<.001	0.70(0.57,0.85)	0.001	0.67(0.54,0.82)	<0.001
	No (ref)						
General Health	Good or Better Health	0.83(0.71,0.98)	0.030	0.87(0.73,1.04)	0.127	0.84(0.70,0.99)	0.047
	Fair/Poor (ref)						
Health Plan	Yes	3.15(2.10,4.74)	<.001	2.68(1.79,4.02)	<0.001	2.62(1.75,3.93)	<0.001
	No (ref)						

*****Sample size for Univariate, Full and Final Model: n=6899; N=2,594,541**.**Full and Final models were adjusted for all the variables in the model; p values were calculated using the population estimate and based on the Wald Chi-Square test.
If any of the independent variables were missing were included in the Missing domain and was not the part of the analysis.
BMI: Body Mass Index; Underweight/Normal Weight: BMI<25, Overweight: 25=<BMI <30, Obese: BMI>=30
Smoking Status: Current: Smokes every day or some days, Former smoker: Smoked Before and Never Smoked.
Alcohol Intake: Yes: Had alcoholic beverage during past 30 days, No: No alcoholic beverage during past 30 days.
General Health: Self - reported health status
Health Plan: Yes: Have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service.

Table 7: Crude and Adjusted Odds Ratios' for dental compliance, by Independent Variables

Independent Variables		Univariate		Full/Final Model * (Multi-variable)	
		Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Sex	Female	0.97(0.89,1.05)	0.431	1.23(1.12,1.35)	<.001
	Male (ref)				
Age	18-44	0.98(0.85,1.12)	0.75	1.10(0.91,1.33)	0.042
	45-54	1.03(0.92,1.15)		1.15(0.99,1.33)	
	55-64	1.05(0.95,1.15)		1.19(1.05,1.34)	
	65+ (ref)				
BMI	Underweight/Normal Weight	1.14(1.01,1.29)	<.001	1.19(1.04,1.35)	<.001
	Overweight	1.22(1.11,1.33)		1.19(1.08,1.32)	
	Obese (ref)				
Race/Ethnicity	Black Only, Non-Hispanic	0.87(0.77,0.97)	<.001	0.84(0.7,1.008)	0.002
	Hispanic	0.78(0.68,0.89)		0.91(0.71,1.19)	
	Other Race Only/Multiracial, Non-Hispanic	1.25(1.03,1.52)		0.76(0.66,0.89)	
	White Only, Non-Hispanic (ref)				
Marital Status	Divorced/Separated/Never Married	0.60(0.55,0.66)	<.001	1.10(0.97,1.25)	0.094
	Member of Unmarried Couple	0.68(0.51,0.90)		1.31(1.13,1.53)	
	Widowed	0.59(0.53,0.67)		1.20(0.96,1.50)	
	Married (ref)				
Education	Less than High School	0.21(0.18,0.24)	<.001	0.45(0.38,0.52)	<.001
	High School Grad	0.37(0.33,0.41)		0.63(0.56,0.71)	
	Some College/Technical	0.51(0.46,0.58)		0.74(0.64,0.83)	
	College Grad(ref)				
Employment	Homemaker/Student/Retired	0.73(0.66,0.80)	<.001	1.06(0.93,1.20)	<.001
	Not employed/ Unable to Work	0.34(0.35,0.45)		0.88(0.77,1.01)	
	Employed (ref)				
Income Level	<$15,000	0.20 (0.17,0.22)	<.001	0.34(0.28,0.40)	<.001
	$15000-$34999	0.28(0.25,0.31)		0.40(0.36,0.46)	
	$35000-$49999	0.48(0.42,0.54)		0.58(0.50,0.66)	
	$50,000+ (ref)				
Smoking Status	Current	0.47(0.41,0.52)	<.001	0.60(0.53,0.68)	<.001
	Former	0.77(0.70,0.84)		0.81(0.74,0.90)	
	Never Smoked (ref)				
Alcohol Intake	Yes	1.61(1.48,1.76)	<.001	1.19(1.08,1.31)	<.001
	No (ref)				
General Health	Good or Better Health	2.03(1.87,2.21)	<.001	1.35(1.23,1.48)	<.001
	Fair/Poor (ref)				
Health Plan	Yes	2.25(1.82,2.77)	<.001	1.64(1.31,2.06)	<.001
	No (ref)				

*****Sample size for Univariate, Full and Final Model: n=48,702; N=20,143,757**.**Full and Final models were adjusted for all the variables in the model; p values were calculated using the population estimate and based on the Wald Chi-Square test.
If any of the independent variables were missing were included in the Missing domain and was not the part of the analysis.
BMI: Body Mass Index; Underweight/Normal Weight: BMI<25, Overweight: 25=<BMI <30, Obese: BMI>=30
Smoking Status: Current: Smokes every day or some days, Former smoker: Smoked Before and Never Smoked.
Alcohol Intake: Yes: Had alcoholic beverage during past 30 days, No: No alcoholic beverage during past 30 days.
General Health: Self - reported health status
Health Plan: Yes: Have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service.

Table 7 shows the odds ratios for the association of each covariate with dental compliance, with the univariate results showing the univariate association while full model and final model showing the independent association after adjusting for all considered covariates, or the covariates identified by the backward variable selection.

Univariate Logistic regression for dental compliance results show that the widows (OR=0.59; 95%CI=0.53-0.67, p value<0.001), member of unmarried couple (OR=0.68; 95%CI=0.51-0.90, p value=0.001) and divorced or separated or never married (OR=0.60; 95%CI=0.55-0.66, p value<0.001) had higher odds to follow the dental compliance as compared to married. Patients who were not college graduate had lower odds of adherence to dental compliance. Patients who were homemaker or student or retired had lower odds (OR=0.73; 95%CI=0.66-0.80, p value<0.001) of adherence to dental compliance as compared to who were employed. Diabetic patients with alcohol intake within past 30 days (OR=1.61; 95%CI=1.48-1.76, p value<0.001), good general health status (OR=2.03; 95%CI=1.87-2.21, p value<0.001) and with health care coverage (OR=2.25; 95%CI=1.82-2.77, p value<0.001) also had higher odds of dental compliance for diabetes care.

The final model based on backward variable selection on dental compliance identified all the considered independent variables in the model as important confounders; hence the final model was the same as the full model. The final model results summarized in Table 7 show the adjusted odds ratio with 95% confidence interval. For annual dentist visit, females had higher odds of dental compliance (AOR=1.23; 95%CI=1.12-1.35, p value<0.001) as compared to male. Older people (65+) were less compliant as compared to younger patients. Patients with BMI less than 30 had higher odds to visit dentist during past 12 months. All race groups had lower odds to visit dentist annually as compared to white people. For diabetes patients with education less than high school

(AOR=0.45; 95%CI=0.38-0.52, p value<0.001), high school (AOR=0.63; 95%CI=0.56-0.71, p value<0.001) and some college /Technical (AOR=0.74; 95%CI=0.64-0.83, p value<0.001) had lower odds to follow dental compliance of diabetes as college grads. Patients with income less than $50000 had lower odds to visit dentist. The likelihood of visiting dentist in last 12 months increased with income level as well as the education level. Current (AOR=0.60; 95%CI=0.53-0.68, p value<0.001) and former smokers (AOR=0.81; 95%CI=0.74-0.90, p value<0.001) had lower odds of following dental compliance as compared to never smoked. As expected, patients with good health (AOR=1.35; 95%CI=1.23- 1.48, p value<0.001) and with health coverage plan (AOR=1.64; 95%CI=1.31-2.06, p value<0.001) had higher odds to follow dental compliance of diabetes.

Conclusion

In this study we observed that the Odds of following medical compliance for diabetic care were higher for female, older people with 65+ years of age, patients with fair or poor health and patients who did not have alcohol in last 30 days. On the other hand, odds of following dental compliance for diabetic care were higher for female, younger patients with less than 65 years of age, patients with BMI less than 30, patients who were not married, patients with good general health and who had alcohol in last 30 days. Lower education level also had lower odds of following recommended medical care for diabetes. Furthermore in this study, patients with health plan was associated with adherence to medical or dental compliance implying that costs of treatment may have been an inhibitory factor for following the regime. We observed that the White, non-Hispanic patients are less likely to follow medical compliance while more likely to visit dentist during past 12 months as compared to the other race group.

To reduce or eliminate these disparities proper intervention is needed to improve health outcome. To achieve sustainable change that reduces disparities, new and improved health care policies and systems are needed that can identify high-risk people, allow adaptation of evidence-based strategies by modifying existing service-delivery policies and procedures or initiate new ones to support provision of high-quality clinical care, enhanced clinician-patient communication, and empowering self-management education.

Achieving such change within and across health care facilities and communities requires participation by key stakeholders in the problem. Providers of diabetes care can play a key role in diminishing these disparities through understanding and addressing patient factors such as health literacy and focusing on improved patient communication and cultural competence. Physicians' knowledge of their patients' limited health literacy can aid providers in tailoring their delivery of health information and potentially affect both diabetes management and outcomes [26].

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Service Learning

The service learning was performed at Live Well Omaha, under the supervision of Sarah Sjolie, the Chief Executive Officer of Live Well Omaha.

Live Well Omaha leads a group of organizations that are committed towards building a culture of health in the Greater Omaha area. The organization connects partners and health data together from different sectors to activate policy, system and environmental change for a long-term reduction in health inequities and improvement in population health. Live Well Omaha collaborates with more than 50 public, private and non-profit organizations in the Omaha metro. They conduct various educational forums, advocacy group discussions and partner meetings to prepare, design, and promote their various projects and policies that advance health equity. Some of the common work areas include leading a healthy weight coalition called Live Well Omaha Kids, improving opportunities for physical activity and active transportation (bike, walk, bus, and carpool), teaching bike safety, increasing access to nutritious and affordable food, and making streets accessible to all users. The organization partners with the Douglas County Health Department to survey local residents regarding health-related risk behaviors and chronic health conditions and social factors to build the case for health.

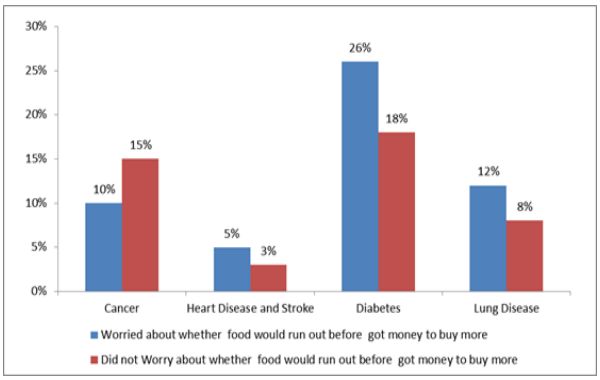
I had a great experience while working at Live Well Omaha. It was great to learn how they were working towards the public health knowledge dissemination to practice and policy with their available resources.

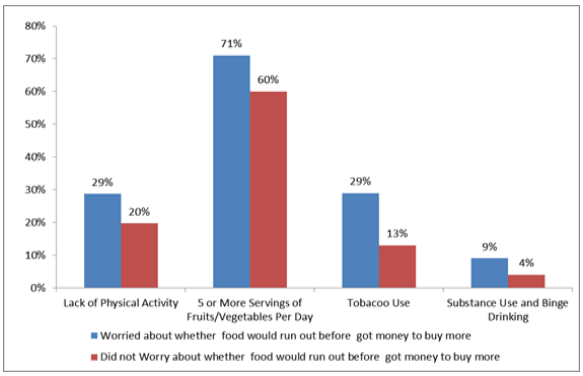
Part of the service learning project, I attended different meetings and interacted with members of the organization to understand how they operate, the work they do towards community. I have also participated in Data Question Review meeting for Community Health Needs Assessment (CHNA) on behalf of Live Well Omaha. Reviewed the 2015 CHNA survey questioner and analyzed the

data at the zip code level for Douglas County. Prepared report on how food insecurity is linked to the health behavior questions. There were 2600 responders to the survey and 382 (14.7%) participants were worried about running out of food before they can buy more .

The participants with food insecurities had higher frequency of physical inactivity, not having 5 or more serving of fruit or vegetables per day, tobacco use, or substance and binge drinking use.

The participants with food insecurities have higher frequency of heart disease, lung disease, diabetes, but lower frequency of cancer.





Through service learning activities, I have learned better data management skills while working on the community survey data. Also gained a better knowledge of community based public health issues and how they can be linked to research findings by applying appropriate statistical methods based on specific study design.

The greatest challenge of my Service Learning/Capstone Experience was to define a scope for a timeboxed project that can produce meaningful deliverables. Some of the other challenges were related to my personal time management with my other job commitments. ll the members of the service learning site were helpful and flexible enough to overcome this challenge.

My views towards public health practice have enhanced to a great extent through my SL/CE. Service learning gave me the opportunity to study the community we are part of very carefully. I now truly understand the need to partner with the various tenants of the health care community and create an overall positive impact.