Diabetes and Public Housing

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Abstract

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"Here is my abstract"

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1 Background and Significance

1.1 Public Housing

Housing is widely awknowledged as an important social determinant of health (Thomson, Thomas, Sellstrom, & Petticrew, 2013). Health outcomes driven by housing are mediated by housing quality, safety, stability and affordability (Taylor, 2018). There are well established links between housing quality and morbidity from mental disorders, injuries infectious diseases, and chronic diseases (Krieger & Higgins, 2002). There is a growing body of evidence associating substandard housing with poor health outcomes, however, the relationship between public housing and health is minimaly explored. Public housing provides decent and safe subsidized rental housing for eligible populations including low-income families, the elderly, and persons with disabilities (Housing & Development, 2020). Relevant studies have shown that public housing residents have worse health outcomes than other city residents (Digenis-Bury, Brooks, Chen, Ostrem, & Horsburgh, 2008 & Manjarrez, Popkin, & Guernsey (2007)).

Even less understood is the relationship between public housing and chronic health conditions like diabetes.

1.2 Diabetes

Diabetes is a chronic disease that is characterized by an inability of the body to maintain a healthy blood glucose level, this can cause a variety of symptoms that affect multiple systems in the body and can lead to potentially life-threatening complications. The key regulator hormone of glucose is insulin and it is produced in the pancreas. The absence or malfunction of insulin leads to elevated blood glucose levels called hyperglycemia. When insulin hormone is missing or ineffective the disease is called Diabetes Mellitus and this condition has multiple types.

1.2.1 Diabetes Variants

The most common diabetes variants include type I diabetes mellitus, type II diabetes mellitus, and gestational diabetes. Type I diabetes is usually caused by genetic factors triggering an autoimmune reaction that results in the destruction of insulin producing cells in the pancreas. Also known as Juvenile Diabetes, the type I classification is typically diagnosed relatively early in life during childhood or early adulthood. Whereas, Type II diabetes develops when the body can still produce insulin however the amount is insuffient or when the body becomes resistant to the effects of insulin. Type II diabetes is largely attributed to lifestyle factors. Gestational diabetes is the least common type and occurs during pregnancy. The prevalance of type II diabetes are much higher than type I. In the US, type II and type I diabetes account for approximately 91% and 6% of all diagnosesd diabetes cases (Bullard et al., 2018).

Diabetes is a serious chronic condition without a medical cure. The treatment for diabetes involves disease prevention and management. Medical treatment of diabetes primarily consists of exogenous insulin replacement or use of medications that stimulate the pancreas to produce endogenous insulin. Without adequate blood control, diabetes can lead to increased risk of other conditions including vision loss, heart disease, stroke, kidney failure, nerve damage, amputation and even premature death.

1.3 Problem Definition

Disease management for type II diabetics focuses on lifestyle modification such as diet control and increased physical activity. The goal is to promote weight loss and reduce excess fat that subsequently reduces insulin resistance and enhances disease control. However, other determinants of health have been recognized to impact the effectiveness of diabetes management, namely healthcare access, cultural and social support, economic stability and built environments (Clark, 2014). Housing instability and food insecurity in particular have been shown to reduce diabetes management self-efficacy in low income adults (Vijayaraghavan, Jacobs, Seligman, & Fernandez, 2011).

Again, while there are numerous published literature on the association between substandard housing and chronic conditions like diabetes, few studies examine the relationship between public housing and diabetes. For this reason, the current study aimed to explore this public health issue within a local context in King County, WA.

In the effort to decrease the gap of knowledge between the junction of public housing and health, Public Health Seattle and King County (PHSKC) formed a unique partnership with King County Housing Authority (KCHA), Seattle Housing Authority (SHA) enabling data to be shared across sectors with the intention of informing and measuring future interventions that would improve the health of the county residents. This research aims to use the provided data to contribute to the literature on the association between public housing and diabetes among medicaid and medicare patients.

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Methods

2.1 Study Setting and Study Design

The current study investigates whether public housing is asociated with risk of diabetes status among King County, WA residents who were enrolled in Medicare and Medicaid. This study uses a descriptive cross-sectional design. The cross-sectional design is appropriate because it allows for an estimate of a dichotomous disease outcome at a particular point in time (Greenland & Morgenstern, 1988).

The analysis of this study was conducted on a dataset compiled from the King County *Data Across Sectors for Housing and Health (DASHH)* partnership. The findings from the original initial study have previously been reported (Public Health - Seattle & King County, 2018).

2.2 Data Sources

In an effort to reduce fragmented data siloes across different sectors, the DASHH partnership was formed in 2016 between Public Health - Seattle and King County , and two public housing authories, King County Housing Authority and Seattle Housing Authority. The primary objectives for DASHH were to join health and housing administrative data together to inform and measure future interventions, relating to policy, outreach, and program evaluation that would improve the health of King County residents, as well as to disseminate actionable data with key health and housing stakeholders.

The housing data provided by both KCHA and SHA originated from the US Department of Housing and Urban Development (HUD). This data source contained elements that included demographic information and period of enrollment for families and individuals. Claims and enrollment for Medicaid and Medicare data were from Washington Health Care Authority (HCA) which was provided to PHSKC. Enrollment data contained information on who was recieving Medicaid and Medicare benefits. Claims data provided elements such as diagnosis codes that were used to identify acute events and chronic conditions. All these data sources were linked together by a unique identifier ID.

2.3 Study Population

The study population were participants that were enrolled in either Medicare or Medicaid programs. Further eligibility for study participation included King County, Washington residency and at least 11 months of Medicare or Medicaid coverage in 2017. The minimum coverage restriction provides a more accurate representation of participants with full medicaid and medicare insurance benefits. The overall number of participants derived from the DASHH dataset totaled 585,372.

2.3.1 Exposure Variable

The exposure variable for this study was public housing assistance status. This was extracted from the HUD-50058 form which was provided by the PHAs. The HUD-50058 form provides information on families that participate in public housing or Section 8 rental subsidy programs (Housing & Development, 2020). Housing assitance is separated into 3 main types:

- Housing Choice Vouchers - vouchers provided to recipients to rent units on the private housing market
- Public housing properties and units - subisidized housing managed by PHAs
- Project-based vouchers - subsidized housing units not managed by PHAs

Responses on the HUD-50058 form were combined into a composite public housing binary variable. Study partipants that were not enrolled in any of the listed housing assistance programs were coded as 0 for PHA status. Whereas, those responses that contained any of the 3 types of housing housing assistance was given a 1 for PHA status.

2.3.2 Outcome Variable

The outcome variable for this study was diabetes status.This was defined using the Centers for Medicare and Medicaid Services (CMS) Chonic Conditions Warehouse (CCW) algorithm (Centers for Medicare and Medicaid Services, 2020). According to the CCW, a participant meets the criteria if they have at least 1 inpatient, skilled nursing facility, home health agency visit or 2 hospital outpatient or carrier claims with diabetes diagnoses codes as outlined by the chronic conditions reference list within the last 2 years(Centers for Medicare and Medicaid Services, 2020). This definition does not specify diabetes variant but instead accounts for any type diabetes diagnoses. The diabetes status outcome variable was dichotomous, given a 0 or 1. Those that did not meet the CCW alogrithm were coded a 0 and those that met the criteria were coded as 1 for diabetes status.

2.3.3 Potenetial Confounders

Potential confounders were identified based on literature review. This study considers age, race and ethnicity and gender as potential confounding variables. Each of these variables were selected due to the increased baseline risk for partipants to be either in public housing or have diabetes. It is known that diabetes is an age-related disease, with a higher risk for older populations (Selvin & Parrinello, 2013). Age was presented as a discrete variable for the partipants age in 2017. Similarly, according to CDC data, racial minority groups may be differentially at risk for both type 1 and type 2 diabetes compared to their white counterparts (Divers et al., 2020 & CDC (2020)). Race and ethnicity variable was defined categorically and included: American Indians/Alaska Natives, Asian, Asian Pacific Islander, Black/African American, Latino, Multiple, Native Hawaiian and Pacific Islander, Other, Unknown, and

White. Gender was selected because both psychosocial and biological factors are responsible for sex and gender diabetes risk differences (Kautzky-Willer, Harreiter, & Pacini, 2016). Gender was grouped categorically and included: Female, Male, and Multiple.

2.4 Analyses

As is common in epidemiological and health services research, demographic characteristics were presented to describe the population distribition (Hayes-Larson, Kezios, Mooney, & Lovasi, 2019). Descriptive analyses were first used to list the percentages for each of the demographic categorical variables. (See table 1). The demographics table is arranged by PHA status, this included: KCHA, SHA, combined PHA and non-PHA. Although the discrete variable for age was used in the statistical analyses, age was reported categorically in the descriptive analyses for a simpler layout. Mean and median age were also shown for each category.

For the statistical analyses, logistic regression models were fitted to assess the risk of diabetes status in relation to public housing assistance status. This analysis is appropriate for this study because logistic reregression analyses allows for measuring the association of an effect towards a binomial response variable by combining multiple variables to avoid confounding (Sperandei, 2014).

Two models were used to determine the odds ratios (OR) and coresponding 95% confidence intervals for the association between public housing assistance and diabetes status. The models used were the unadjusted model, without any other variables included in the analysis and the adjusted model including age, race and ethnicity and gender variables. In addition, models were fit to determine the odds ratio of diabetes status for each of the public housing authority. Similarly, the unadjusted model and the adjusted model that included age, race and ethinicity and gender variables were used to determine the association for the second analysis. Findings were statistical significant if the estimates did not cross the the confidence intervals and p-values were below <0.05 cutoff. Analyses were conducted using R version 3.6.0.

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Results

3.1 Descriptive Statistics

Among the study participants, the proportion of people that were in the PHA category was 10.4% and of that, 5.9% were with KCHA and 4.6% with SHA (See Table 1). The majority of the study participants, 89.5% did not have any public housing assitance in 2017. Descriptive analysis revealed that PHA population had a greater proportion of people meeting the definition of diabetes at 12.7% compared to the non-PHA group with 9.6%. Overall, 9.9% were considered to meet the definiton of diabetes and the rest, 90.1% were not considered to have diabetes.

Additionally, the population age distribution were different bewtween PHA status, the non-PHA category had an older population with a median of age of 62 and a mean age of 50 compared to the PHA population with a median and mean age of 34 and 35.7 respectively. The PHA group were more racial and ethnically diverse than the non-PHA group. However, the gender distribution between the two groups were similar.

3.2 Public Housing and Diabetes

For the primary analysis, the assocation between diabetes status and public housing assistance, the crude model showed that the odds ratio of having diabetes was 1.34 fold greater for those with public housing assistance (table 2). In the adjusted model, PHA residents were 94% more likely to meet the definition of diabetes compared to those that were non-PHA residents. (Table 3)

Table 3.1: Association between PHA Status and Diabetes

Housing Status	Model 1	Model 2
Non-PHA	Referent	Referent
PHA	1.34 (CI: 1.31-1.38)	1.94 (CI: 1.88-1.99)

3.3 Public Housing Authorities and Diabetes

In the second analysis, the association between diabetes status and the specific public housing authorities, the crude model showed that the odds of meeting the definiton of diabetes were 1.28 times greater among KCHA residents and 1.42 times greater among SHA residents. The adjusted model revealed that among KCHA residents the odds of meeting the definition of diabetes were 2.16 times higher and 1.70 for SHA residents compared to non-PHA residents. (table 4)

Table 3.2: Association between the Public Housing Authorities and Diabetes

Status	Model 1	Model 2
Non-PHA	Referent	Referent
KCHA	1.28 (CI: 1.24-1.33)	2.16 (CI: 2.09-2.25)
SHA	1.42 (CI: 1.38-1.48)	1.70 (CI: 1.64-1.77)

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Discussion

4.1 Discussion

Findings from this study indicate that public housing assistance was associated with diabetes status. Even after adjusting for potential confounders (age, gender, race and ethinicity) the effect of public housing on diabetes status was increased. Furthermore, findings also suggest that when divided into PHA agency in the crude model, KCHA residents where were less likely to meet the definition of diabetes than SHA residents but still more likely than the non-PHA group. After adjust for potential confounders, the effect of association between PHA agency on diabetes saw a greater increase for KCHA residents than SHA residents.

The increased risk of diabetes observed in our study in relation to public housing had similar results to another study that compared public housing residents in Boston, MA to other city residents for health outcomes including diabetes that revealed worse health outcomes for public housing residents (Digenis-Bury et al., 2008). A potential explanation of these findings may be attributed to the fact that public housing resisdents were more likely to be racial and ethnic minorities and the prevalance of diabetes is often greater for racial and ethinic populations(Chow, Foster, Gonzalez, & McIver, 2012).

These findings suggest that public housing may be an avenue in which diabetes management may be of higher priority.

4.2 Limitations

There are serveral limitations to note. First, there was the huge reduction in the eligible population. People who met the definition of diabetes in this population for this study was significantly reduced from approximately 43,000 to 13,600 after applying the inclusion criteria, a 69% decrease. Other potentially significant data could be gleamed from those missing in the diabetes group among this population.

Another limitation is that this study does not provide the prevalence of diabetes due to the inherent characteristic of claims data. The population captured in the study were only those that sought health care services for diabetes related outcomes. People who may have had diabetes but were asymptomatic or those who had been previously diagnosed with diabetes but did not seek care within the time frame of meeting the definition of diabetes were not captured in the study.

Despite the limitations, this study contributes to our understanding of poverty and diabetes self-management the findings are generalizable to low-income, racially and ethnically diverse populations with diabetes who obtain health care in safety-net health settings

A
Appendix

Table A.1: Population Demographics

Characteristics	KCHA	SHA	Combined PHA	Non-PHA
	N=34,514 (5.9%)	N=27,044 (4.6%)	N=60,919 (10.4%)	N=523,814 (89.5%)
Age				
<5	6.6%	6.1%	6.4%	5.5%
5-9	12.0%	10.2%	11.2%	7.0%
10-17	19.5%	14.9%	17.5%	9.8%
18-29	12.5%	9.9%	11.3%	8.3%
30-49	21.0%	19.3%	20.3%	11.2%
50-64	15.3%	19.9%	17.4%	9.4%
65-74	6.8%	11.5%	8.9%	28.0%
75+	6.1%	7.9%	7.0%	20.6%
Median	39.1 years	29.0 years	34.0 years	62.0 years
Mean	33.3 years	38.7 years	35.7 years	50.0 years
Race and Ethnicity				
American Indian or Alaska Native	0.8%	1.4%	1.0%	0.8%
Asian	5.5%	11.7%	8.3%	6.9%
Asian Pacific Islander	0.1%	0.2%	0.2%	3.5%
Black/African American	36.9%	44.9%	40.2%	7.9%
Latino	3.8%	2.8%	3.4%	6.5%
Multiple	15.5%	10.2%	13.2%	8.0%
Native Hawaiian or Pacific Islander	2.3%	1.9%	2.1%	2.4%
Other	0.0%	0.0%	0.0%	0.8%
White	30.1%	22.3%	26.8%	56.1%
Unknown	5.0%	4.5%	4.8%	6.9%
Gender				
Female	58.6%	53.5%	56.3%	52.4%
Male	40.6%	45.7%	42.9%	47.2%
Multiple	0.8%	0.8%	0.8%	0.4%

Note:
Percentages may not add up to 100 because of missing data

Table A.2: Crude PHA Regression Model

Term	Odds Ratio	SE	P-Value	95% CI Low	95% CI High
(Intercept)	0.11	0.00	0	0.11	0.11
pha	1.35	0.01	<0.05	1.31	1.38

Table A.3: Adjusted PHA Regression Model

Term	Odds Ratio	SE	P-Value	95% CI Low	95% CI High
(Intercept)	0.02	0.05	<0.05	0.01	0.02
pha	1.94	0.01	<0.05	1.88	1.99
Age	1.04	0.00	<0.05	1.04	1.04
Male	1.17	0.01	<0.05	1.15	1.19
Multiple	1.33	0.08	<0.05	1.13	1.56
Asian	1.02	0.05	0.71	0.93	1.12
Asian PI	0.37	0.05	<0.05	0.33	0.41
Black	0.82	0.05	<0.05	0.75	0.90
Latino	0.64	0.05	<0.05	0.58	0.71
Multiple	0.81	0.05	<0.05	0.74	0.89
NH/PI	1.54	0.05	<0.05	1.39	1.71
Other	0.42	0.06	<0.05	0.37	0.47
Unknown	0.61	0.05	<0.05	0.56	0.68
White	0.36	0.05	<0.05	0.33	0.40

Table A.4: Crude PHA Agency Regression Model

Term	Odds Ratio	SE	P-Value	95% CI Low	95% CI High
(Intercept)	0.11	0.00	<0.05	0.11	0.11
KCHA	1.29	0.02	<0.05	1.25	1.33
SHA	1.43	0.02	<0.05	1.38	1.48

Table A.5: Adjusted PHA Agency Regression Model

Term	Odds Ratio	SE	P-Value	95% CI Low	95% CI High
(Intercept)	0.02	0.05	<0.05	0.01	0.02
KCHA	2.17	0.02	<0.05	2.09	2.25
SHA	1.71	0.02	<0.05	1.64	1.78
Age	1.04	0.00	<0.05	1.04	1.04
Male	1.17	0.01	<0.05	1.15	1.19
Multiple	1.34	0.08	<0.05	1.14	1.57
Asian	1.02	0.05	0.72	0.93	1.12
Asian PI	0.37	0.05	<0.05	0.33	0.40
Black	0.82	0.05	<0.05	0.75	0.90
Latino	0.64	0.05	<0.05	0.58	0.71
Multiple	0.80	0.05	<0.05	0.73	0.88
NH/PI	1.53	0.05	<0.05	1.38	1.70
Other	0.41	0.06	<0.05	0.37	0.47
Unknown	0.61	0.05	<0.05	0.55	0.67
White	0.36	0.05	<0.05	0.33	0.39

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