Brief Report: Characterizing the Burden of Cardiometabolic Disease among Public Housing Residents Served by an Urban Hospital System

Earle C. Chambers, PhD, MPH[1,3];
Colin D. Rehm, PhD, MPH[2,3]

Objective: Housing status is a primary social determinant of health that is not typically not collected in clinical settings. Residential address data collected during clinical visits can identify patients at high-risk for cardiometabolic disease (CMD) residing in public housing.

Design: This study examined CMD and related risk factors among patients living in public housing and a comparison group not living in public housing.

Setting: All patients (n=173,568) were receiving primary care in a large hospital system in the Bronx, New York between January 1, 2016 and December 31, 2017.

Results: Patients in public housing were more likely to be women, to be Black or Hispanic, and to be on Medicaid compared with patients not living in public housing. Women in public housing were more likely than men to have had a higher prevalence of CMD and related risk factors.

Conclusion: The burden of CMD among public housing residents shows sex disparities where women have a higher prevalence of CMD and related risk factors than men. *Ethn Dis*. 2019;29(3):463-468; doi:10.18865/ed.29.3.463

Keywords: Cardiometabolic Disease; Public Housing; Electronic Health Record (EHR); Smoking; Obesity

[1] Department of Family & Social Medicine, Albert Einstein College of Medicine, Bronx, NY
[2] Office of Community & Population Health, Montefiore Health System, Bronx, NY
[3] Department of Epidemiology & Population Health, Albert Einstein College of Medicine, Bronx, NY

Introduction

Public housing (PH) residents are a vulnerable population who often live in high poverty and high crime areas with limited access to health-promoting resources.[1,2] Researchers have documented the higher prevalence of adverse health outcomes and hospitalizations among public housing residents compared with the general population[3-6] but few have examined risk factors for cardiometabolic (CMD) disease, such as smoking, hypertension, and prediabetes.[7,8] Furthermore, the reports that have examined the risk of CMD among public housing residents have typically relied on self-reported data with small samples and heterogeneous comparison groups.[4,6,9]

Housing is a primary social determinant of health and questions about housing are included on many screening tools for use in clinical settings to identify and address the social needs of patients.[10-12] However, it is not always feasible within the clinical workflow to systematically screen a patient's housing status. Fortunately, residential address is systematically collected during clinical visits and can be used to categorize patients by type of housing. The purpose of this study was to: 1) determine whether patients living in public housing had a higher prevalence of CMD compared with non-PH residents; and 2) examine whether sex disparities were present. This information will guide future efforts to use hous-

The purpose of this study was to: 1) determine whether patients living in public housing had a higher prevalence of cardiometabolic disease compared with non-public housing residents; and 2) examine whether sex disparities were present.

Address correspondence to Earle Chambers, PhD, MPH; Albert Einstein College of Medicine-Montefiore Medical Center; 1300 Morris Park Avenue; Harold and Muriel Block Building, Room 409; Bronx, NY 10461; 718.430.3057; earle.chambers@einstein.yu.edu

ing status as a screening measure to identify patients at high risk for CMD and eligible for available services.

Methods

This study used routinely collected data on residential address taken during outpatient visits overlaid with locations of New York City (NYC) PH to identify primary care patients who reside in PH. We examined the burden of CMD and related risk factors among these PH residents compared with patients not living in PH adjusting for individual-level socioeconomic status (SES) and area demographics. This study was conducted in a large urban health care system in the Bronx, NY servicing predominantly lower-income Black and Hispanic patients. The study was approved by the Institutional Review Board of the Albert Einstein College of Medicine /Montefiore Medical Center.

Study Population

All adults (aged ≥18 years) with a primary care (ie, internal medicine, family medicine, pediatrics and non-specialty OB/GYN) outpatient visit between January 1, 2016 and December 31, 2017 were identified in the electronic health record (EHR). Study participants were patients having a primary care visit during the study timeframe; however, we used outcome data from any visit type, including specialty care and inpatient/emergency department visits. The analyses were limited to individuals in primary care to reduce concerns about patients seen for specialty care visits, for example, who may have undiagnosed CMD. The initial sample consisted of 213,184 patients. Women who were pregnant (n=10,328) and patients who died during the study timeframe (n=1,156) were excluded from the analysis. Data were extracted using Looking Glass™ Clinical Analytics (Streamline Health, Atlanta, Georgia) an application supporting creation of patient cohorts and extraction of clinical data from the EHR.[13]

The data were geocoded in ArcGIS using the New York State Street and Address Composite geocoding services tool. Ninety-six percent (95.6%)

Table 1. Prevalance or mean values for sociodemographic variables by housing status

	% or mean (SD)			
	Public housing	**Non-public housing**	**P**	**Bronx County population[a]**
Age, mean (SD)	49.2 (19.0)	49.2 (18.5)	.85	44.7 (15.6)
Sex, %				
Female	63.3	69.2	<.001	54.2
Male	36.7	30.8		45.8
Race/ethnicity, %				
Hispanic/Latino	54.3	49.4	<.001	54.1
Non-Hispanic Black	43.0	39.2		30.0
Non-Hispanic White	1.0	7.0		10.3
Non-Hispanic Asian/Pacific Islander	.1	.5		5.5
American Indian/Alaskan Native	.1	.3		
Non-Hispanic mixed race	1.7	3.7		
Missing	15.2	21.3		
Insurance status, %				
Medicaid	43.8	34.5	<.001	30.6
Commercial	25.0	38.3		46.7
Medicare	28.9	23.1		12.1
Missing/no insurance	2.2	4.1		10.6
Primary care visits in 2-year period, %				
1	21.2	17.8	<.001	-
2	16.3	15.0		-
3-4	23.4	21.3		-
5-9	28.2	30.1		-
≥10	10.8	15.8		-

a. All Bronx data were derived from the 2016 American Community Survey Public Use Microdata.

of patients were succesfully matched to geocode.[13] Of these patients, 173,568 resided in Bronx County, NY and were used in the analysis.

Identifying Patients in Public Housing

After geocoding, tax lots that were PH locations were flagged in the NYC PLUTO database.[14] The "select by location" tool was used to identify the nearest tax lot to each patient and patients whose nearest tax lot was a PH building or whose geocoded location fell within a PH tax lot were flagged as PH residents. Those not falling within a PH tax lot were determined to be non-PH residents. A total of 15,719 individuals were identified as PH residents (9.7% of the analytic sample). For comparison, in 2017, 9.9% of Bronx County and 6.2% of the NYC population lived in public housing.[15]

Outcome Definitions

All CMD outcomes and risk factors were determined based on information recorded in the EHR for the 2-year study timeframe. The outcomes were obesity, smoking, prediabetes, diabetes, hypertension, high cholesterol, ischemic heart disease, heart failure, and stroke. The case definitions are in the footnotes of Figures 1, 2 and 3.

Covariates

The individual-level covariates used in this study were age, sex, race/ethnicity, insurance type, and number of primary care visits. All individual-level variables were obtained in the EHR. The area-level variables of interest were % below the poverty level; % non-Hispanic Black; and % Hispanic. All area-level variables were measured at the census block-groups from the 2012-2016 American Community Survey 5-year estimates.[16]

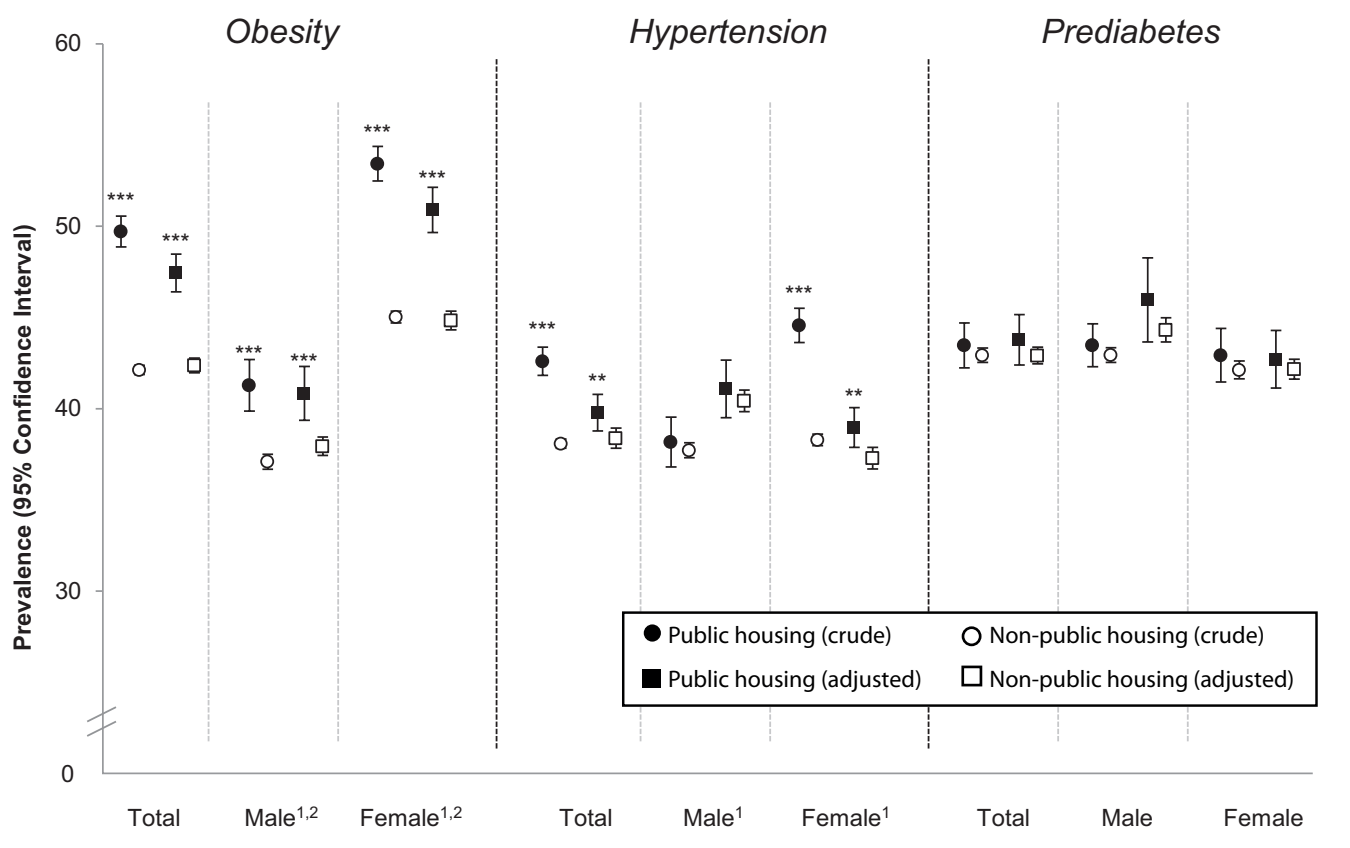

Figure 1. CMD outcomes and risk factors: obesity, hypertension, prediabetes

Case Definitions: Obesity, body mass index ≥ 30 kg/m²; hypertension, ICD-10 diagnosis (I10); Prediabetes, hemoglobin A1C 5.7-6.4% and no prior evidence of diabetes (using diabetes definition found in Figure 2 definitions).

*.01<P<.05; **.001<P<.01; ***P<.001; All comparisons are between public housing vs non-public housing patients; [1] p-interaction only shown when P<.05 for crude analysis; and [2] for adjusted analysis. All analyses adjusted for age, race/ethnicity, insurance status, the number of primary care visits, area-level percent below the poverty level, % non-Hispanic Black, and % Hispanic. All area-level measures at the census block-group level from the 2012-2016 American Community Survey 5-year estimates.

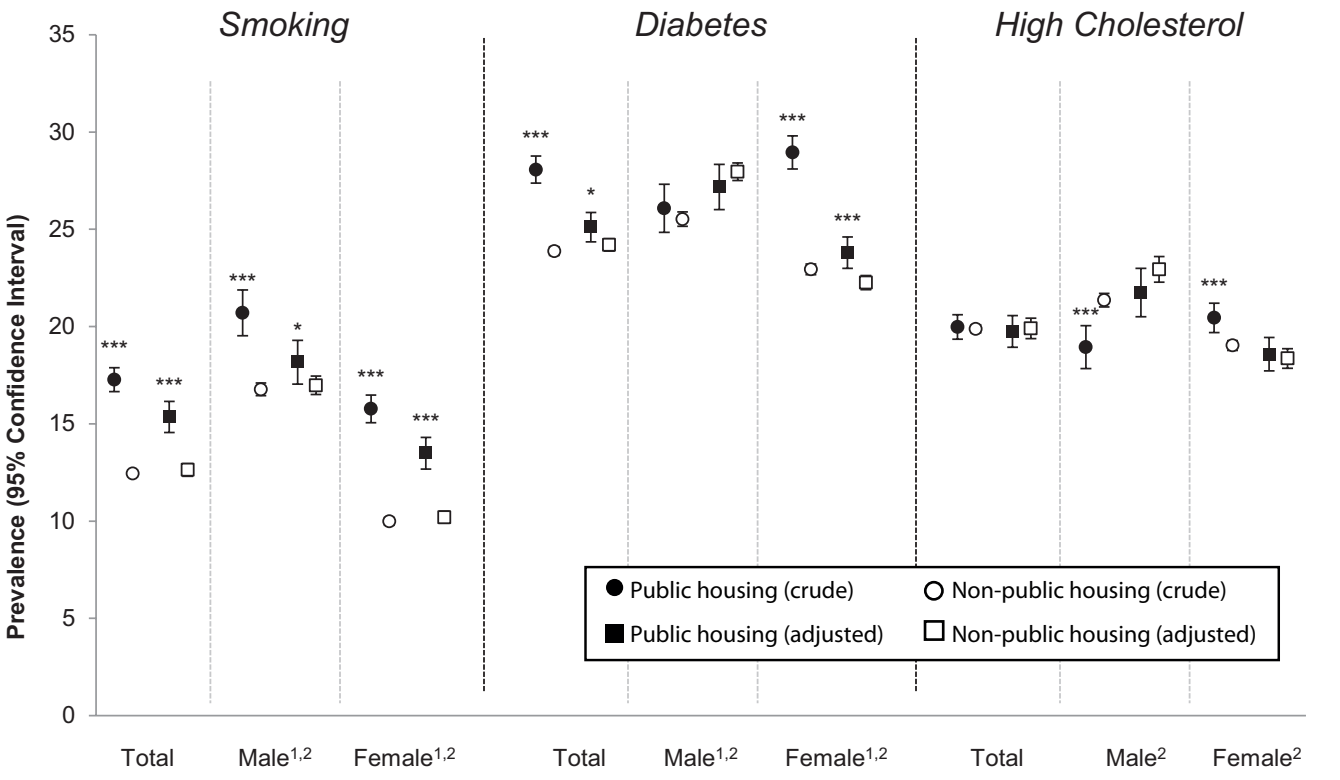

Figure 2. CMD outcomes and risk factors: smoking, diabetes, high cholesterol

Case Definitions: Current smoking, positive response to screening question regarding current cigarette use; Diabetes, ICD-10 diagnosis (E10.X, E11.X, E13.X) or inclusion of diabetes on patient problem list (excluding gestational diabetes) or use of anti-diabetic agents excluding metformin or hemoglobin A1C≥7.0%; High cholesterol, ICD-10 diagnosis (E78.5).

*.01<P<.05; **.001<P<.01; ***P<.001; All comparisons are between public housing vs non-public housing patients; [1] p-interaction only shown when P<.05 for crude analysis; and [2] for adjusted analysis. All analyses adjusted for age, race/ethnicity, insurance status, the number of primary care visits, area-level percent below the poverty level, % non-Hispanic Black, and % Hispanic. All area-level measures at the census block-group level from the 2012-2016 American Community Survey 5-year estimates.

Analysis

Logistic regression models were used to estimate the adjusted odds ratio of each CMD risk factor and outcome with adjustment for covariates. Predictive margins were then estimated after fitting each logistic regression model to present the data as adjusted prevalences for each outcome. Interaction terms with sex were tested. Data are presented for the overall association and were also stratified by sex. Patients with missing data on BMI (2.4%) or smoking status (5.7%) were removed from analyses of these respective outcomes. Those missing data on BMI and smoking were on average younger, had fewer primary care encounters and were more likely to be male. An alpha-level of .05 was used for all statistical tests and statistical analyses used Stata 13.1 (College Station, TX 2016). GIS analyses used ArcGIS 10.3 (Environmental Systems Research Institute, Redlands, CA 2015).

Results

Approximately 10% of patients from the EHR database lived in PH. PH patients were more likely to be women, to be Black or Hispanic, and to be on Medicaid compared with non-PH patients (Table 1). Forty four percent of PH patients and 35% of non-PH patients were on Medicaid (P<.001). PH patients tended to live in census blocks with a larger percentage of households living below poverty and in areas with a larger precentage of Black and Hispanic residents as compared with non-PH patients (data not shown). Women in PH had a higher prevalance of obesity, diabetes, hypertension (Figures 1 and 2), ischemic

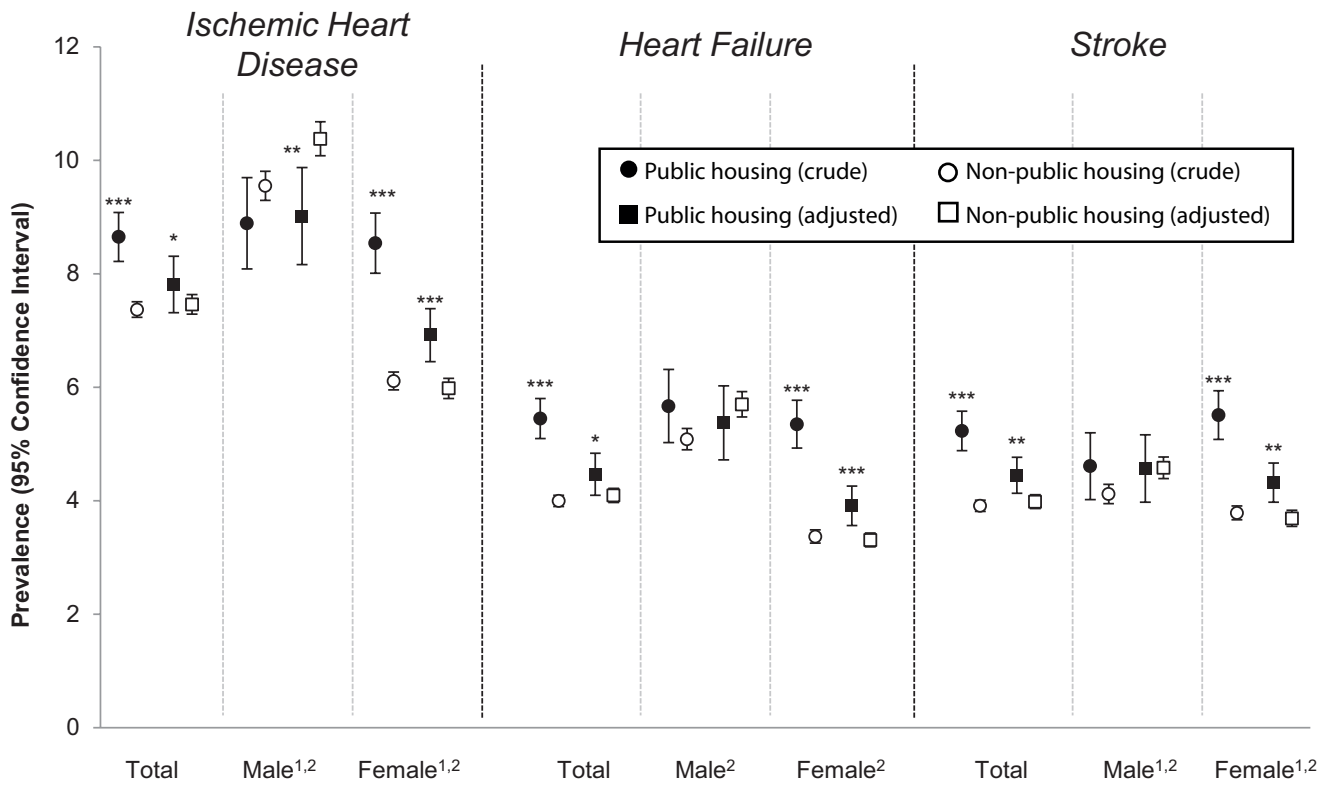

Figure 3. CMD outcomes and risk factors: ischemic heart disease, heart failure, stroke

Case Definitions: Ischemic heart disease, ICD-10 diagnosis (I20.X, I21.X, 122.X, 123.X, 124.X, I25.X); Heart failure, ICD-10 diagnosis (I50.X); Stroke, ICD-10 diagnosis (I60.X)

*.01<P<.05; **.001<P<.01; *** P<.001; All comparisons are between public housing vs non-public housing patients; [1] p-interaction only shown when P<.05 for crude analysis; and [2] for adjusted analysis. All analyses adjusted for age, race/ethnicity, insurance status, the number of primary care visits, area-level percent below the poverty level, % non-Hispanic Black, and % Hispanic. All area-level measures at the census block-group level from the 2012-2016 American Community Survey 5-year estimates.

heart disease, heart failure, stroke (Figure 3), and smoking (Figure 2) than non-PH women. Men residing in PH had a higher prevalence of obesity but lower prevalence of ischemic heart disease than non-PH residents (Figure 3).

Discussion

Overall, PH patients had a higher prevalance of obesity and smoking compared with non-PH patients. Sex stratified analysis showed that women in PH have a higher burden of CMD risk factors than their non-PH counterparts. Men, on the other hand, show an opposite trend where PH patients have a lower prevalence of many CMD outcomes than non-PH men although only ischemic heart disease was statistically significant. Strengths of this study include the large sample size and focus on a demographically homogenous geographic area. Using a demographically homogeneous geographic area may reduce concerns about confounding when comparing PH and non-PH patients. All patients using a PH address at outpatient visit were included in this study; thus, we were likely to capture all patients living in PH regardless of whether they are on the lease or not, a limitation of studies that only sample lease holders. This study also shows that the burden of risk varied by sex for certain risk factors. This can be important for targeting patients for interventions within hospital systems.

Limitations of this study include only using data that are routinely collected in the EHR. Using routinely collected health and demographic indicators may not capture all rel-

evant CMD risk factors for patients. Another limitation of these data may include some measurement error for clinically measured body mass index and smoking status since there was not a standard protocol used for all measurements, as would be the standard for research quality data.

Conclusions

Under the Affordable Care Act, many hospitals with tax-exempt status must identify community health needs and devise strategies to address these needs. These needs can pose barriers to overall wellness and can be social and behavioral in nature. Intervention strategies to address community health needs require multipronged approaches. Residential address, when combined with housing-related data sources, can provide information about the housing and neighborhoods of patients with no additional burden of data collection on clinical staff. The results of this study provide important information for health care providers as they develop strategies to screen for social needs among patients and target patients at high risk for CMD. Public housing patients, particularly women, are a high-risk group that should be targeted more aggressively by comprehensive interventions.

Overall, public housing patients had a higher prevalance of obesity and smoking compared with non-public housing patients.

Acknowledgments

This study was supported by the National Heart, Lung, and Blood Institute (NHLBI) grant K01HL125466 and 1R03HL140265.

Conflict of Interest

No conflicts of interest to report.

Author Contributions

Research concept and design: Chambers, Rehm; Acquisition of data: Rehm; Data analysis and interpretation: Chambers, Rehm; Manuscript draft: Chambers, Rehm; Statistical expertise: Rehm; Acquisition of funding: Chambers; Administrative: Chambers, Rehm; Supervision: Chambers, Rehm

References

1. Talen E, Koschinsky J. The neighborhood quality of subsidized housing. *J Am Plann Assoc*. 2014;80(1):67-82. https://doi.org/10.1080/01944363.2014.935232
2. Talen E, Koschinsky J. Is subsidized housing in sustainable neighborhoods? Evidence from Chicago. *Hous Policy Debate*. 2011;21(1):1-28. https://doi.org/10.1080/10511482.2010.533618
3. Yim B, Howland RE, Culp GM, Zhilkova A, Barbot O, Tsao TY. Disparities in preventable hospitalizations among public housing developments. *Am J Prev Med*. 2019;56(2):187-195. https://doi.org/10.1016/j.amepre.2018.08.019 PMID:30553691
4. Howell E, Harris LE, Popkin SJ. The health status of HOPE VI public housing residents. *J Health Care Poor Underserved*. 2005;16(2):273-285. https://doi.org/10.1353/hpu.2005.0036 PMID:15937391
5. Helms VE, King BA, Ashley PJ. Cigarette smoking and adverse health outcomes among adults receiving federal housing assistance. *Prev Med*. 2017;99:171-177. https://doi.org/10.1016/j.ypmed.2017.02.001 PMID:28192095
6. Digenis-Bury EC, Brooks DR, Chen L, Ostrem M, Horsburgh CR. Use of a population-based survey to describe the health of Boston public housing residents. *Am J Public Health*. 2008;98(1):85-91. https://doi.org/10.2105/AJPH.2006.094912 PMID:18048798
7. Ludwig J, Sanbonmatsu L, Gennetian L, et al. Neighborhoods, obesity, and diabetes—a randomized social experiment. *N Engl J Med*. 2011;365(16):1509-1519. https://doi.org/10.1056/NEJMsa1103216 PMID:22010917
8. Chambers EC, Rosenbaum E. Cardiovascular health outcomes of Latinos in the Affordable Housing as an Obesity Mediating Environment (AHOME) Study: a study of rental assistance use. *J Urban Health*. 2014;91(3):489-498. https://doi.org/10.1007/s11524-013-9840-9 PMID:24190105
9. Parton HB, Greene R, Flatley AM, et al. Health of older adults in New York City public housing: part 1, findings from the New York City Housing Authority Senior Survey. *Care Manag J*. 2012;13(3):134-147. https://doi.org/10.1891/1521-0987.13.3.134 PMID:23072177
10. Billioux A, Verlander K, Anthony S, Alley D. *Standardized Screening for Health-Related Social Needs in Clinical Settings. The Accountable Health Communities Screening Tool (Discussion Paper).*Washington DC: National Academy of Medicine; 2017. Last accessed June 6, 2019 from https://nam.edu/wp-content/uploads/2017/05/Standardized-Screening-for-Health-Related-Social-Needs-in-Clinical-Settings.pdf
11. Centers for Medicare & Medicaid Services (CMS) Center for Medicare and Medicaid Innovation (CMMI). *The Accountable Health Communities Health-Related Social Needs Screening Tool.* 2018. Last accessed June 6, 2019 from https://innovation.cms.gov/Files/worksheets/ahcm-screeningtool.pdf.
12. National Association of Community Health Centers, *PRAPARE: Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences*. 2018. Last accessed June 6, 2019 from http://www.nachc.org/research-and-data/prapare/.
13. Bellin E, Fletcher DD, Geberer N, Islam S, Srivastava N. Democratizing information creation from health care data for quality improvement, research, and education-the Montefiore Medical Center Experience. *Acad Med*. 2010;85(8):1362-1368. https://doi.org/10.1097/ACM.0b013e3181df0f3b PMID:20453810
14. MapPLUTO Database, 18v1.1. New York City Department of City Planning. BYTES of the BIG APPLE –Archive. Last accessed June 6, 2019 from https://www1.nyc.gov/site/planning/data-maps/open-data/bytes-archive.page?sorts[year]=0.
15. New York City Housing and Vacancy Survey, United States Census Bureau. Last accessed Jun 6, 2019 from https://www.census.gov/programs-surveys/nychvs.html.
16. American Community Survey (ACS). 2016. Last accessed June 6, 2019 from https://www.census.gov/programs-surveys/acs/news/data-releases/2016/release.html.