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Consumer credit, chronic disease and risk behaviours

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ABSTRACT

Background Credit scores have been identified as a marker of disease burden. This study investigated credit scores' association with chronic diseases and health behaviours that are associated with chronic diseases.

Methods This cross-sectional analysis included data on 2083 residents of Philadelphia, Pennsylvania, USA in 2015. Nine-digit ZIP code level FICO credit scores were appended to individual self-reported chronic diseases (obesity, diabetes, hypertension) and related health behaviours (smoking, exercise, and salt intake and medication adherence among those with hypertension). Models adjusted for individual-level and area-level demographics and retail pharmacy accessibility.

Results Median ZIP code credit score was 665 (SD=58). In adjusted models, each 50-point increase in ZIP code credit score was significantly associated with: 8% lower chronic disease risk; 6% lower overweight/obesity risk, 19% lower diabetes risk; 9% lower hypertension risk and 14% lower smoking risk. Other health behaviours were not significantly associated. Compared with high prime credit, subprime credit score was significantly associated with a 15%–70% increased risk of chronic disease, following a dose–response pattern with a prime rating.

Conclusion Lower area level credit scores may be associated with greater chronic disease prevalence but not necessarily with related health behaviours. Area-level consumer credit may make a novel contribution to identifying chronic disease patterns.

BACKGROUND

A growing body of research has associated area-level and individual-level consumer credit with a number of health outcomes,[1–7] with most focusing on general health and acute conditions. No previous studies have explored the association between area-level consumer credit, chronic diseases and behaviours associated with those diseases.

Consumer credit scores are quantitative measures of a person's financial history and cumulative financial decisions, based on the use and timely payment of loans, credit cards and debts.[1 2] Credit scores trend higher with increasing income[2 8] and older age, but there are gaps in knowledge about credit scores among those with low educational attainment.[9] Scores may be lower among racial/ethnic minorities and lower among those in economically distressed communities, who are most likely to be targets of lower value and subprime credit products that are either not included or are penalised in scoring models.[10 11] While these trends are seen in credit scores for individuals, individual scores are related to area-level scores, which we define as the aggregate mean of individual's scores who reside in a geographic unit.

Area-level scores represent averages of individual scores, such that a community with many low individual scores would have lower area-level scores or a community with many high individual scores would have higher area-level scores. One study showed that residents of areas recovering from a local economic downturn[11] were assigned lower credit ratings, than those in economically stronger areas who had the same credit history. In this way, the local credit economy forms a foundation for individual credit scores, which may then reflect back onto an area's overall future creditworthiness. These area-level scores characterise the local credit economy and are used by retail businesses to determine which products, services and interest rates will be advertised to individuals in certain areas.[10] This may influence, for example, the location of retail pharmacies in that area.[12] Previous work supports that retail pharmacies, particularly chains, are less likely to be located in socioeconomically challenged areas[13] or medically underserved areas.[14] Thus, both economic and demographic factors may be important to consider in investigations of credit scores and health, especially given that age and socioeconomic gradient also influence health outcomes.[15–18]

An area-level credit score may be a measure of area-level socioeconomic position (SEP).[5] SEP is an aggregate latent construct that includes both resource-based (income, wealth, education) and prestige-based (education, social connections, and status) measures that represent one's social position and access to material goods.[19] Credit scores reflect both of these properties and may have advantages over commonly used SEP measures, such as income and education. For example, while area-level household averages of income and education are commonly collected SEP measures, the nature of employment and assistance makes income challenging to capture among people who do not earn a regular salary, is often misreported or unreported and even when reported may not truly capture one's actual economic circumstances and resources.[20–22] According to the Federal Reserve, 20% of households reported outspending what they had earned in the past 12 months (May 2015 data[8]) indicating that income may not fully capture a household's economic situation. Thus, education is more likely to be accurate and easy to assess in self-reports, but the economic and social returns of educational attainment vary by societal culture and age cohort.[22] In comparison, consumer credit ratings and credit scores represent a single measure that can

be readily obtained, that captures both resource-based and prestige-based SEP dimensions, and can capture both what economic opportunities are extended to members of a community and the economic assets present in a community; however, few studies have linked consumer credit to health conditions.[1–7 23–31]

In the USA, obesity, hypertension and diabetes are among the top 10 chronic medical conditions for which patients receive treatments that incur high ongoing out-of-pocket costs,[17] which may have direct implications for consumer credit. Smoking and lack of physical activity may elevate risk for these diseases.[18] This study assessed area-level consumer credit scores and risk behaviours associated with the chronic diseases of obesity, diabetes and hypertension, adjusting for individual-level and area-level socioeconomic and demographic factors.

METHODS

This cross-sectional study used de-identified data from a 2015 random digit dialling survey of Philadelphia, Pennsylvania residents ≥18 years old (Public Health Management Corporation Community Health Data Base, 2015 Southeastern Pennsylvania Household Health Survey). The response rates of 9.6% for landlines and 12.6% for cell phones fall within the range of other respected population-based health surveys (eg, California Health Interview Survey and Pew Internet and American Life Project). Individual-level survey responses were matched to US Census-derived 9-digit ZIP code demographic data calculated by Easy Analytic Software (Easy Analytic Software I. ZIP4 EASI Demographic Files. 2015). Retail pharmacy counts were based on data from the National Council for Prescription Drug Programs (NCPDP), which includes all active retail pharmacies as of February 2015. The study was deemed exempt from Institutional Review Board review.

Outcomes

The primary outcomes were self-reported: overweight or obese (BMI >25); prior diagnosis of diabetes, or hypertension; and among those with hypertension, currently watching or reducing sodium intake, and compliance with prescribed hypertension medication (adheres all of the time vs less than all of the time), current smoker and exercising ≥90 min per week.

Exposure

The exposure was Equifax average household FICO credit scores in 2015 in Philadelphia County, aggregated to 9-digit ZIP codes (n=2002) and merged to respondents based on their reported address of residence in 2015. FICO scores were calculated for a 9-digit zip code area when there were data from at least seven households. The smallest area unit available was the 9-digit ZIP code, which we used as a proxy for the local credit economy. FICO scores range from 300 to 850 where higher values represent better credit.

Covariates

Individual-level covariates included: self-reported age, race, ethnicity, annual household income, education, below 200% poverty and health insurance status. Area-level covariates were chosen as corollaries of individual-level covariates to account for the compositional contributions of neighbourhood demographics to credit scores and health. Area-level covariates included: median age, % non-Hispanic (NH) Black, % Hispanic/Latinx ethnicity, % with annual household income >$100 000 and number of retail pharmacies in Philadelphia County. Nine-digit ZIP code level variables were calculated by EASI Analytic Software. Comparable area-level poverty and health insurance prevalence estimates were not available.

Analysis

Frequencies and means were calculated for each covariate. The income variable was missing for 22% of respondents and was imputed using a logit model based on individual and area-level demographics. Spearman correlations between all variables were assessed to account for the non-normal distributions across 9-digit ZIP codes. Generalised estimating equation (GEE) models were used to obtain robust standard errors to account for potential clustering across ZIP codes. In the first set of analyses, continuous credit scores were divided into 50-point categories, such that the reported effect sizes are interpreted in terms of 50 point increments. The second set of analyses used the Federal Reserve designations of subprime (≤659; worst credit), near prime (660–719) and higher than prime (≥720, best credit).[32] All models adjusted for area-level and individual-level income, education, age, race, ethnicity; individual-level insurance status and poverty; and area-level retail pharmacy counts. We also ran models with and without credit scores to check for attenuation of the relationship between race or racial composition and health outcomes. Outcomes were estimated on the relative risk

Table 1 Descriptive characteristics of Philadelphia 9-digit ZIP codes (n=2002) and individual survey respondents (n=2083)

	N(%) or mean(SD)
Area-level (9-digit ZIP) socioeconomic and demographic characteristics	
Median credit score	665 (58)
Subprime* (≤660)	998 (47.9)
Near prime* (660–719)	579 (27.8)
High prime* (≥720)	506 (24.3)
Median age	37(7)
% Annual household income >$100 000	20.5 (13.5)
% Graduate degree	10.3 (12.6)
% Black	43.9 (37.1)
% Hispanic/Latinx ethnicity	10.2 (14.3)
Number of retail pharmacies	11 (5)
Individual-level socioeconomic and demographic characteristics	
Age	54 (15)
Below 200% poverty	822 (39.5%)
Income >$100 000	400 (19.6%)
Graduate degree	286 (13.7%)
Black (non-Hispanic/Latinx)	829 (39.8%)
Hispanic/Latinx ethnicity	148 (7.1%)
Insured	1981 (95.1%)
Behavioural risk factors and chronic disease outcomes	
Overweight/obese (BMI >25)	1481 (71.1%)
Diabetes	347 (16.7%)
Hypertension	885 (42.5%)
Watching salt intake (n=879)	713 (80.6%)
Not adherent to hypertension medications (n=780)	113 (12.7%)
Smoking	387 (18.6%)
Exercise ≥90 min per week	994 (47.7%)

*Designations from the Federal Reserve Bank of New York.[32]
BMI, body mass index.

Table 2 Spearman correlations between credit scores and regression model covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Area-level characteristics														
(1) Credit Scores	1.00													
(2) Median Age	0.38	1.00												
(3) % Income >$100 000	0.66	0.41	1.00											
(4) % Grad Degree	0.56	0.31	0.62	1.00										
(5) % NH Black	−0.67	−0.09	−0.47	−0.33	1.00									
(6) % Hispanic/Latinx	0.03	−0.51	−0.11	−0.13	−0.38	1.00								
(7) Pharmacy count	−0.02	−0.23	−0.18	−0.17	−0.24	0.42	1.00							
Individual-level characteristics														
(8) Age	0.01	0.09	−0.01	0.05	0.05	−0.10	−0.04	1.00						
(9)>200% Poverty	−0.38	−0.21	−0.34	−0.24	0.22	0.08	0.09	0.15	1.00					
(10) Income >$100 000	0.36	0.19	0.32	0.26	−0.23	−0.06	−0.06	−0.20	−0.41	1.00				
(11) Grad degree	0.20	0.05	0.17	0.24	−0.06	−0.06	−0.08	−0.03	−0.26	0.29	1.00			
(12) NH Black	−0.50	−0.02	−0.30	−0.22	0.69	−0.34	−0.22	0.03	0.20	−0.21	−0.08	1.00		
(13) Hispanic/Latinx	0.14	0.21	0.18	0.16	0.01	−0.26	−0.12	0.03	−0.14	0.08	0.03	0.18	1.00	
(14) Insured	0.08	0.07	0.07	0.07	−0.06	−0.03	−0.02	0.09	−0.13	0.10	0.07	−0.01	0.04	1.00

scale. Statistical significance was assessed at $p<0.05$. Analyses were conducted using Stata V.14.

RESULTS

We analysed data among 2083 respondents. The median are-level credit score was 665 (SD=58), with a range of 531–804, which was comparable to the median national credit score of 675 in 2015.[33] Prevalence of behavioural risk factors and chronic disease outcomes were comparable to or higher than USA-based averages in 2015 for the population above 18 years.[34] Prevalence of overweight/obese was 71%, diabetes was 17%, hypertension was 43%, smoking was 19% and regular exercise was 48%. Of those with hypertension, 81% were watching salt intake and 13% were not taking hypertension medications as prescribed. The full set of descriptive statistics appear in table 1.

Table 2 includes Spearman correlations between consumer credit and each covariate in the regression model. Higher area-level credit scores were positively moderately correlated with median age (r=0.38), percent with income >$100 000 (r=0.66), and percent with a graduate degree (r=0.56), and were negatively correlated with percent Black (r=−0.67). Count of pharmacies (r=0.01) and percent Hispanic/Latinx (r=0.03) were not correlated. Correlations between area-level credit scores and individual-level variables of age (r=0.01), Black race (r=−0.50),

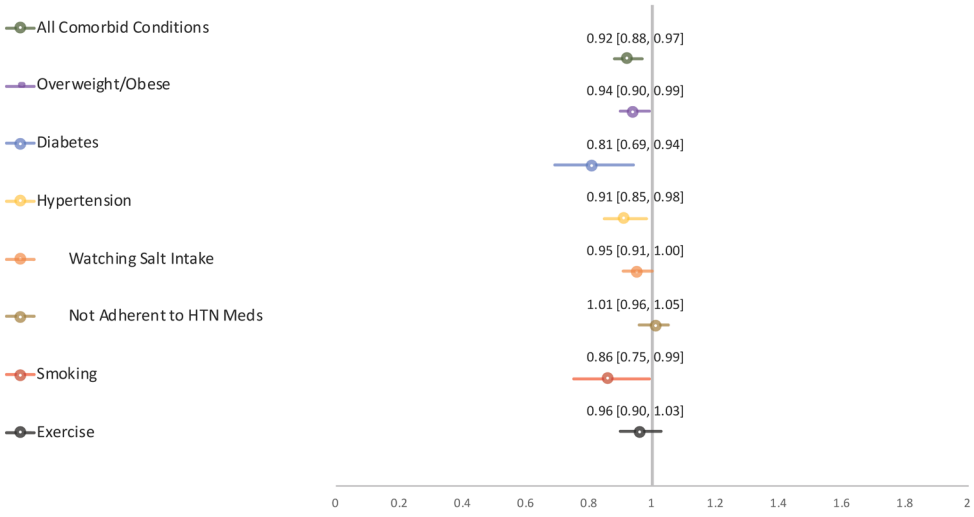

Figure 1 Adjusted PR for chronic disease outcomes and behaviours per 50-point FICO score increment.*All models adjusted for area-level and individual-level income, education, age, race, ethnicity, individual-level insurance status and area-level pharmacy counts. PR, prevalence ratio; HTN, hypertension.

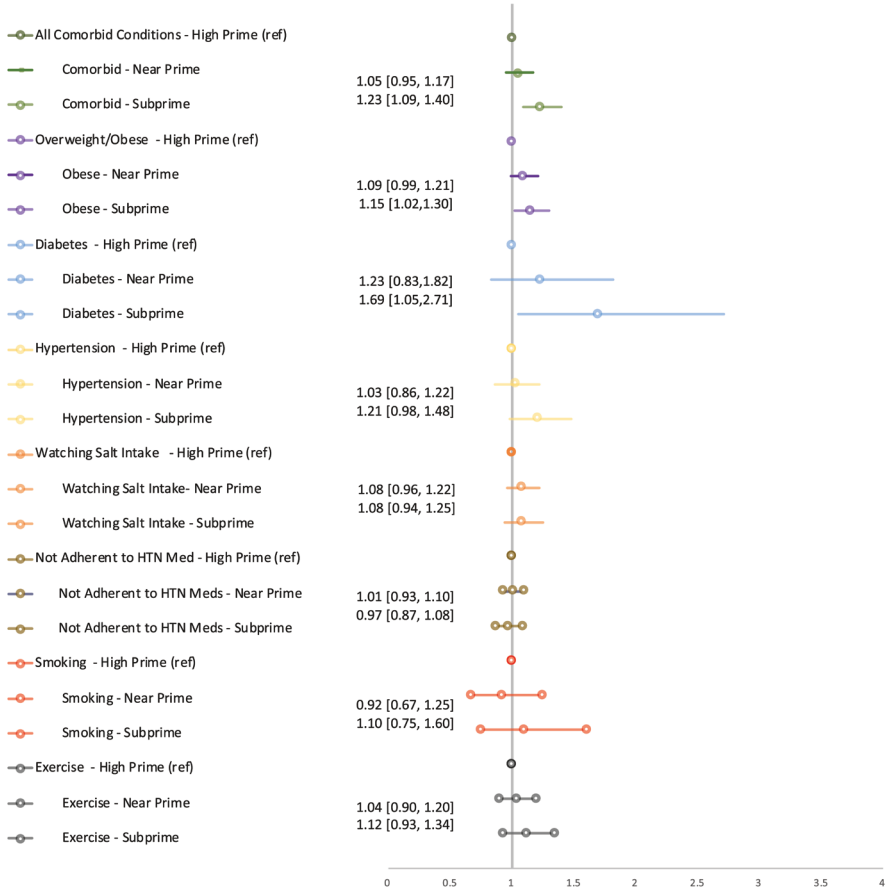

Figure 2 Adjusted PR for chronic disease outcomes and risk behaviours per increasing credit tier, compared to high prime (best credit). *All models adjusted for area-level and individual-level income, education, age, race, ethnicity, individual-level insurance status, area-level pharmacy counts and credit tier designations from the Federal Reserve Bank of New York.[32] PR, prevalence ratio; HTN, hypertension.

ethnicity (r=0.14) and health insurance (r=0.08) were null to moderate. Consumer credit scores were negatively correlated with an individual being in poverty (r=−0.38) and positively correlated with having an income >$100 000 (r=0.36).

Each 50-point increase in ZIP code credit score was associated with 8% lower risk of any chronic disease (PR=0.92; 95% CI 0.88 to 0.97); 6% lower risk of being overweight/obese (PR=0.94; 95% CI 0.90 to 0.99); 19% lower risk of diabetes (PR=0.81; 95% CI 0.69 to 0.94); 9% lower risk of having hypertension (PR=0.91; 95% CI 0.85 to 0.98) and 14% lower risk of smoking (PR=0.86; 95% CI: 0.75 to 0.99) (figure 1). Exercise, management of hypertension and pharmacy counts were not associated with credit scores. Compared with those in high prime credit areas, the total number of chronic disease, overweight/obesity, diabetes and hypertension were higher with each worsening credit tier, suggesting a dose–response relationship. Subprime credit was associated with a 15%–70% increased risk across the chronic diseases measured (figure 2). Full model results appear in the online supplementary appendix 1. There was no evidence of attenuation of race or racial composition when credit scores were included in any of the models.

CONCLUSION

This is the first study to examine area-level consumer credit as an exposure for chronic diseases and the health behaviours that shape those diseases. Findings suggest that area-level consumer credit may be incrementally associated with the presence of chronic diseases and some behavioural risk factors associated with disease, but not disease management behaviours. This may support the hypothesis that chronic disease is an economic shock that has sustained impact on economic well-being, which can have influences that expand beyond the individual. Alternately, our findings could indicate that areas with a higher prevalence of chronic disease may comprise many people who are facing greater economic challenges which may be reflected in area-level credit scores.

There are several plausible explanations for how area-level credit may be related to individual health outcomes[12]:

(1) *Area-level credit scores could depict the context in which health and disease arise*. Area-level consumer credit ratings may represent the aggregate effects of individual-level pathways (compositional factor) or an ecological feature of the social environment (contextual factor). Credit scores may reflect personal characteristics, such as an individual's ability to manage complex

processes, like navigating payment schedules, or preferences for risky behaviours. For example, studies have shown that credit scores are higher among those with greater speed and capacity for processing and responding to information,[2] while another showed that individuals with higher bankruptcy risk were more likely to experience car crashes,[35] and another estimated that people who were more able to delay gratification had FICO scores that were approximately 30 points higher than those least willing to delay gratification.[36] While these are individual-level findings that cannot be imputed to area-level mechanisms, it is possible that area-level credit scores represent the compositional effects of people with certain characteristics clustering in certain areas. The present study's findings of no association between credit and chronic disease management behaviours suggest that area-level consumer credit may not reflect that areas with poorer credit comprise people with a certain set of behavioural characteristics, as some have theorised for individual's credit scores.[2 3 36] Instead, as other recent work suggests,[5] area-level consumer credit may better approximate a measure of area-level SEP.

There may be stronger evidence to support our hypothesis that area-level credit scores represent socioeconomic contextual characteristics of an environment, as has been previously suggested.[5] Additionally, area-level consumer credit ratings may alter the retail landscape through business loans and interest rates, and influence the placement of resources to manage the disease, such as retail pharmacies. However, the current study found no association between credit scores and presence of retail pharmacies, suggesting that area-level credit scores may not influence the placement of retailers that may be related to management of chronic disease behaviours. Future study should consider whether or not area-level credit scores are associated with the placement of other health-related resources.

(2) *Area-level consumer credit may also reflect areas where disease prevalence is high, especially when costs to manage or treat those chronic diseases may lead to populations who experience higher medical costs.* For example, one ecological study in the USA found small but significant increases in city-wide influenza severity with a higher area-level credit card and mortgage default rates.[4] The authors attributed this to the increased likelihood of consumer credit borrowing in areas with higher disease rates. Other recent work suggests that each SD increase in area-level credit score was associated with 26% greater odds of better individual self-rated health.[5] The present study's findings of higher risk of common chronic diseases further support this pathway.

While this study suggests that area-level credit scores may be promising to consider in health studies, the inclusion of area-level consumer credit to understand health may pose challenges to health equity. Credit score models may be less accurate predictors of loan default for racial/ethnic minority individuals[37] and communities,[10] thus we adjusted for individual and area-level race and ethnicity in our models. Despite that the use of race and public assistance is prohibited by the Consumer Credit Protection Act, there is some evidence that low-value and subprime credit products are marketed to racial-ethnic minority communities,[10] and that living in an area recovering from economic downturn can adversely affect credit.[11] In Philadelphia, for example, the median credit score in predominantly White areas is 132 points higher than predominantly non-White areas.[33] These communities are more likely to include micro-lenders, community-based and faith-based organisations, and credit unions, which would not contribute to credit scoring.[10] Although we found no evidence of attenuation of the relationship between race, racial composition and health outcomes when credit was included in regression models, results may mask heterogeneity in the relationship between credit and health for specific subgroups. This should be explored in future studies.

This cross-sectional study could not assess temporality and no information was available on length of credit history or the length of time with a chronic disease. It is possible that the same factors that give rise to credit may also be giving rise to health outcomes—unmeasured factors that are related to health might also be related to credit scores. In short, we cannot assume that one's credit score is exogenous to one's health outcomes and must consider that when interpreting results of studies linking credit and health.[12] Measurement error is also a factor, given that 20% of Philadelphia residents have no record of a credit score with the Federal Reserve in 2015.[32] Across the USA, approximately 20% of the population have no credit, either due to no records on account (11%; 'credit invisible') or insufficiently short or outdated histories (8%)[38 39]; however, the need for or usage of credit of itself may be associated with health. The measure cannot reflect behaviours or outcomes among those who do not yet have a credit score. Credit scores are not perfect predictors of future default behaviour and may be influenced by the credit products available in a particular area.[10] Results may not be generalisable to other areas.

This study contributes to the growing body of literature suggesting a relationship between consumer credit and health or disease and suggests a relationship between area-level credit and individual health. While the study highlights the need to understand causal mechanisms linking credit and disease, this analysis forms a foundation to explore mechanisms by which consumer credit might be related to chronic disease, opens a new path for considering which area-level factors might best be used to identify chronic disease patterns.

What is already known on this subject

- Consumer credit is increasingly linked to health outcomes, yet few studies have linked consumer credit scores and non-communicable or chronic disease.
- No studies have assessed the behavioural mechanisms by which consumer credit is linked to chronic disease.

What this study adds

- This study identifies area-level consumer credit as a potential exposure for chronic disease outcomes, but less so for behaviours associated with increased chronic disease risk.
- In doing so, it offers researchers a novel exposure to consider to better understand chronic disease patterns.

Correction notice This article has been corrected since it first published online. An error in the Abstract has been corrected.

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