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Diabetes and Cardiovascular Disease Risk in Cambodian Refugees

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Abstract

Background—To determine rates of diabetes, hypertension, and hyperlipidemia in Cambodian refugees, and to assess the proportion whose conditions are satisfactorily managed in comparison to the general population.

Methods—Self-report and laboratory/physical health assessment data obtained from a household probability sample of U.S.-residing Cambodian refugees (N = 331) in 2010-2011 were compared to a probability sample of the adult U.S. population (N = 6360) from the 2009-2010 National Health and Nutrition Examination Survey.

Results—Prevalence of diabetes, hypertension and hyperlipidemia in Cambodian refugees greatly exceeded rates found in the age- and gender-adjusted U.S. population. Cambodian refugees with diagnosed hypertension or hyperlipidemia were less likely than their counterparts in the general U.S. population to have blood pressure and total cholesterol within recommended levels.

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Conclusions—Increased attention should be paid to prevention and management of diabetes and cardiovascular disease risk factors in the Cambodian refugee community. Research is needed to determine whether this pattern extends to other refugee groups.

Keywords

Epidemiology; Refugees; Diabetes; Cardiovascular Risk

INTRODUCTION

Approximately 3 million refugees have resettled in the United States since 1975.[1] Although the psychiatric problems of refugees are well-documented,[2-5] relatively little attention has been devoted to the physical health of refugees. In addition, most studies of refugee physical health have focused on acute infectious diseases in the immediate post-resettlement period[6,7] rather than on long-term physical health issues. Of investigations examining long-term refugee physical health, the majority are limited either by focusing on self-rated health and disability,[8,9] or on convenience samples seeking medical treatment.[10]

Despite the relative absence of research on refugee physical health, research and theory suggest that refugees may be at heightened risk for health conditions such as diabetes and cardiovascular disease. For example, starvation, a common occurrence in refugees, has been linked to increased risk of subsequent cardiovascular disease.[11,12] Similarly, exposure to stressful and/or traumatic life events has been implicated in the development of diabetes and cardiovascular disease.[13-16] Insofar as scant research has examined the possibility that refugees are at elevated risk for chronic health problems such as diabetes and cardiovascular disease, research is needed to determine whether refugees are, in fact, at greater risk so as to alert treatment providers and the public health community so that appropriate steps can be taken.

The purpose of this study is to determine the prevalence of diabetes and other cardiovascular disease risk factors (i.e., hypertension and hyperlipidemia) in Cambodian refugees residing in Long Beach, CA which is home to the largest such community in the United States.[17] Additionally, we sought to characterize the percentage of Cambodian refugees with diabetes, hypertension, and hyperlipidemia whose conditions are successfully managed. The Cambodian refugee community in the United States is well-suited to an evaluation of possible refugee risk for diabetes and cardiovascular disease. This group constitutes one of the largest U.S. refugee communities. Moreover, nearly three decades have passed since resettlement, allowing time for chronic physical conditions to have manifested in this aging population.

METHODS

Overview

Data were drawn from the Cambodian Health Study (CHS) and the National Health and Nutrition Examination Survey (NHANES). The CHS is a two-panel study designed to represent the Cambodian refugee community residing in Long Beach, CA. Individuals were

eligible for participation in the CHS if they had lived in Cambodia during the Khmer Rouge regime (April 1975 to January 1979), were born before 1970, and had immigrated as refugees. The CHS is a household probability sample in which eventual participants were initially approached at their homes and, for both panels, took part in in-person interviews conducted in respondent residences.

Overall, 86% of persons who screened as eligible participated in the initial CHS interview addressing psychosocial and psychological topics conducted between October 2003 and February 2005. For the current purposes, CHS data for this study were drawn from a follow-up assessment that included a laboratory component which took place between January 2011 and March 2012. Seventy-two percent of original CHS participants were re-assessed (N = 331). CHS participants averaged 59 years of age (*SD* = 10.02); 62.8% were currently married or living as married; and 62.9% were female. This gender distribution is attributable to disproportionate male loss of life during the Khmer Rouge era and associated civil wars.[9]

All instruments were translated following recommended procedures.[18] Interviews were conducted in Khmer by trained bilingual lay interviewers. All CHS participants provided written informed consent, and the study was monitored by the RAND Human Subjects Protection Committee.

Prior to weighting, follow-up participants were slightly younger and in better mental health than the full sample. To address differential attrition, inverse probability retention weights[19] were developed to balance the follow up participants with the baseline sample on the full range of variables. Additional details regarding the method and sampling design for recruiting the initial cohort can be found elsewhere.[2]

Comparison data were drawn from the NHANES. The NHANES is a cross-sectional survey fielded continuously by the National Center for Health Statistics (NCHS)/Centers for Disease Control and Prevention, designed to obtain a representative sample of non-institutionalized adults residing in the United States. We used data from the NHANES 2009-2010 to match most closely the timeframe of the CHS field period. Analyses are restricted to respondents who completed the NHANES interview and laboratory examination (N = 6360), response rate = 73%. NHANES participants provided written informed consent, and the NHANES study was approved by the NCHS Research Ethics Review Board.

Interview-Reported Health Measures

Participants in both studies were asked whether they had ever been told by a physician that they had high cholesterol, high blood pressure, or diabetes. Persons who reported having been told that they had a given medical condition were asked whether they were currently taking medication for the condition. Those who reported having received a diagnosis and who reported currently taking medication were defined as meeting criteria for the condition.

Laboratory-Based Health Measures

Venous blood draws and laboratory assays for determination of total cholesterol and glycosylated hemoglobin (HbA1c) values were performed in the NHANES following

standardized protocols.[20,21] For the CHS, Dried Blood Spot (DBS) samples were obtained via finger stick by licensed phlebotomists. DBS samples were collected and shipped in batches for analysis to the Department of Laboratory Medicine of the University of Washington. HbA1c was analyzed using high-performance liquid chromatography via the Bio-Rad Variant II NU Hemoglobin Testing System (Hercules, CA). DBS analysis for HbA1c has been validated against venous blood assays in several studies with venous blood scores predicting DBS scores with a high degree of accuracy.[22] A widely-used conversion formula was applied to equate DBS values to venous blood equivalent values.[23] For the CHS study, total cholesterol was measured using fluorometric assay.[24] DBS analysis for total cholesterol has been validated against venous blood assays with venous blood scores predicting DBS scores moderately well.[22] A conversion formula was used to equate DBS total cholesterol values with venous blood values.[25] Hyperlipidemia was defined by total cholesterol level ≥ 240 mg/dL.[26] HbA1c values ≥ 6.5% (48 mmol/mol) were classified as meeting screening criteria for diabetes.[27,28]

For the NHANES, blood pressure (BP) was measured by trained examiners using mercury sphygmomanometry.[29] For the CHS, blood pressure was assessed using an automated oscillometric monitor, i.e., the Ancillare BPM-100 (Horsham, PA). The device has been shown to be an accurate and reliable method of BP measurement.[30] For both the NHANES and the CHS, three consecutive blood pressure readings were obtained after first allowing participants to rest quietly in a seated position for 5 minutes. A composite blood pressure score was created from the average of the two readings after excluding the first reading. In instances in which only two readings were taken, the second BP was used. The first BP was used only if one reading was obtained. Hypertension was classified as a mean systolic BP of at least 140 mm Hg or a mean diastolic BP of at least 90 mm Hg.[31]

For each condition, the proportion of participants meeting criteria was reported as determined by (a) self-report data, (b) laboratory or physical examination results, or (c) either index.

Statistical Analysis

All analyses of NHANES data employed weights designed to allow inference to the general adult U.S. population. Similarly, analyses of CHS data employed weights to account for the sampling strategy design effects as well as for attrition over time.

As shown in Table I, Cambodian refugees were substantially older and more likely to be female than the general U.S. population. To permit direct comparison of Cambodian refugees to the general population, an NHANES analytic sample was created that was balanced with the Cambodian sample on age and gender. Specifically, post-stratification weights were applied to the NHANES data so that the NHANES and CHS samples had the same age and gender distributions. The age and gender distributions of the CHS as well as the age and gender distributions of the NHANES data, before and after applying post-stratification weights, are shown in Table I. As shown, after post-stratification, all NHANES participants younger than 35 years of age were eliminated from the analytic sample. Similarly, the age and gender distribution for NHANES participants greater than 40 years of age was slightly adjusted.

We reported the percentage of persons in the Cambodian refugee and age- and gender-adjusted general population with each health condition as determined by self-report, laboratory/physical examination or either self-report or laboratory/examination. Finally, given that health differences across populations may reflect differences in the receipt of treatment, we computed the percentage of individuals who reported currently taking medication to manage each of the three conditions as well as the proportion with successfully managed conditions. For the latter purpose, the following criteria were used: HbA1c values < 7.0% (53 mmol/mol)[27]; systolic and diastolic BP values < 140 mm Hg and 90 mm Hg, respectively)[31], and total cholesterol values < 200 mg/dL.[26]

RESULTS

Mean scores for Cambodian refugees were significantly higher than scores for the adjusted general population on continuous risk index measures in each instance. Systolic blood pressure: $M = 137.5$ ($SD = 23.5$) vs. $M = 124.9$ ($SD = 10.2$), $p < .0001$; diastolic blood pressure: $M = 82.2$ ($SD = 10.2$) vs. $M = 70.2$ ($SD = 6.2$), $p < .0001$; HbA1c: $M = 6.4$ ($SD = 1.2$) vs. $M = 5.8$ ($SD = 0.5$), $p < .001$; and total cholesterol: $M = 225.7$ ($SD = 46.8$) vs. $M = 203.8$ ($SD = 23.2$), $p < .0001$.

Similarly, using the previously mentioned clinically meaningful cutpoints, Cambodian refugees had substantially higher rates of hypertension, hyperlipidemia, and diabetes relative to the U.S. population even after age- and gender adjustment. As shown in Table II, Cambodian refugees had more than twice the rate of diabetes relative to the U.S. population whether assessed by laboratory test, 27.6% vs. 12.4%, $p < .0001$, self-report, 27.0% vs. 12.5%, $p < .0001$, or by either criterion, 37.8% vs. 16.0%, $p < .0001$ Similarly, as shown in Table II, hypertension prevalence in Cambodian refugees greatly exceeded rates in the age- and gender-adjusted general U.S. population, whether determined by physical examination, 47.9% vs. 20.0%, $p < .0001$, self-report, 52.1% vs. 38.4%, $p < .0001$, or by either criterion, 63.6% vs. 47.4%, $p < .0001$. In addition, Cambodian refugee hyperlipidemia prevalence also exceeded the rates in the age- and gender-adjusted general population whether assessed by laboratory data, 38.0% vs. 18.3%, $p < .0001$, self-report, 55.4% vs. 27.0% $p < .0001$, or by either criterion, 73.6% vs. 42.2%, $p < .0001$.

A mixed pattern emerged with regard to management of diabetes and cardiovascular disease risk factors. As shown in Table III, in persons with physician-diagnosed diabetes, no significant difference was observed in the proportions of Cambodian refugees and individuals in the general population with HbA1c levels below 7.0%. However, Cambodian refugees with diagnosed hypertension were less likely than their counterparts in the age- and gender-adjusted general population to have their blood pressure within recommended levels, 31.7% vs. 70.8%, $p < .0001$. Similarly, refugees with physician-diagnosed hyperlipidemia were less likely than their counterparts in the adjusted general population to have total cholesterol levels below 200 mg/dL, 33.4% vs. 47.0%, $p < .01$.

Rates of current medication use in individuals with diagnosed conditions differed across health conditions in the two populations. As shown in Table III, no significant differences were observed in rates of taking medication for physician-diagnosed diabetes or

hypertension. In contrast, Cambodian refugees were more likely than their counterparts in the age- and gender-adjusted general population to be taking medication for hyperlipidemia, 78.0% vs. 61.5%, $p < .001$.

DISCUSSION

This study reveals evidence of substantial health disparities in the Cambodian refugee community. Specifically, Cambodian refugees were much more likely than persons in the general population to suffer from probable diabetes, hypertension and hyperlipidemia, even after taking into account population differences with respect to gender and age. Important differences were also observed with respect to the health status of individuals with physician-diagnosed conditions. In particular, Cambodian refugees with previously-diagnosed hypertension were much less likely to have blood pressure levels within recommended limits. Similarly, Cambodian refugees with diagnosed hyperlipidemia were less likely to have total cholesterol levels within recommended limits, although no differences were observed for diabetes management.

Inasmuch as hypertension, hyperlipidemia and diabetes are major risk factors for stroke and cardiovascular disease which, in turn, are leading causes of premature death and disability in the United States[32], the high rates of diabetes and cardiovascular disease risk factors found in the Cambodian refugee community should be of particular concern. Consistent with our findings, California death records show that ethnic Cambodians of whom virtually all are refugees, suffer from stroke deaths at twice the state-wide average.[33]

Although Asian Americans are traditionally viewed as being at low risk for cardiovascular disease[34], these data highlight the inadequacy of viewing Asian Americans as homogeneous with respect to cardiovascular disease risk. Cambodian refugees appear to be at high risk for cardiovascular disease. Yet, because of their small numbers relative to other Asian American subgroups, little research on cardiovascular disease risk has been conducted in this group, and further study of factors that underlie elevated risk is needed.

Overall, these results are consistent with other research on Cambodian refugees showing high rates of self-reported hypertension and diabetes in refugees residing in the second largest such community in the United States, i.e., the Lowell, MA area.[8] Thus, our findings do not appear confined solely to Cambodian refugees residing in Long Beach, CA. Similarly, in an earlier study, we reported that this Cambodian refugee cohort had far lower levels of self-reported physical health than did non-refugee Asian immigrants with similar demographic characteristics residing in CA.[9] Hence, the current study of laboratory-assessed risk factors converges with similar research that focused on self-appraised physical health status to indicate that this Cambodian refugee community differs not only from the general United States population but also from non-refugee immigrants of Asian origin residing in California.

Our findings are also in general agreement with research documenting that other refugee groups in the United States often have significant risk factors for chronic health problems or manifest chronic illness.[35,36] For example, a recent study of Hmong refugees newly arrived

in MN from a refugee camp reported marked evidence of coronary disease risk factors in refugees greater than 20 years of age.[36] The latter study provides evidence that cardiovascular disease risk factor development can predate refugee arrival in the United States.

In interpreting these findings, certain limitations should be considered. First, this research was designed to determine whether a health disparity exists. The study is not suited to determining what it is about being a refugee that may increase risk for chronic disease. As noted earlier, life history factors including trauma exposure and starvation have been linked to increased cardiovascular risk. Moreover, numerous additional factors including socioeconomic status[37] and acculturation to a Western lifestyle[38] have been linked to cardiovascular disease risk. Thus, although any of a number of factors may contribute to Cambodian refugee elevated cardiovascular risk including repeated trauma exposure, acculturation to a Western lifestyle, or the high levels of poverty, low English fluency, low educational attainment and high unemployment documented in our previous work[2] and elsewhere[39], this study is not well-suited to providing insights into the causal pathways underlying the observed findings. Further research designed for this purpose is required.

Other limitations are worthy of note. The size of our Cambodian refugee sample was relatively small, limiting our ability to make comparisons between Cambodian refugees and the general population with respect to treatment status. In addition, the CHS relied on analysis of dried blood spots to assess total cholesterol and HbA1c whereas the NHANES used venous blood specimens. Although a growing body of research shows evidence of good concordance between methods[22] and the dried blood spot testing is becoming widely-used in large scale, population-based survey research[40], analysis of venous blood remains the “gold standard.” Concerns regarding reliance on dried blood spot testing in the CHS may be somewhat mitigated given that self-reports and the physical assessments for conditions not involving dried blood spot testing (i.e., hypertension) resulted in a similar pattern of findings.

Another caveat concerns the use of HbA1c rather than fasting blood glucose for diabetes determination. Some Southeast Asian subpopulations are more likely than other groups to have a hemoglobin variant that can compromise the validity of HbA1c assay results.[41] HbA1c testing systems vary considerably in the extent to which they are affected by the presence of this variant and our results might, to some degree, be biased. However, available research indicates that the specific testing procedure used in this study may actually underestimate diabetes prevalence in Cambodian refugees.[42] Thus, our HbA1c data might provide a conservative estimate of the prevalence of diabetes in this community. Nonetheless, research is required to replicate these findings using other HbA1c testing methods or other tests altogether, e.g., fasting blood glucose.

Finally, although this sample was representative of the largest single Cambodian refugee community in the United States and results appear broadly consistent with findings from other large Cambodian refugee communities in the United States, results may not generalize to other refugee groups residing in the United States. Refugee groups differ by country of origin, length of time in the United States, socioeconomic status in the United States as well

as in their countries of origin, and their life experiences both here and abroad. Thus, it would not be surprising if different refugee communities had different standing on cardiovascular risk factors. In fact, one recent study found both that refugee risk factors varied by country of origin and that some refugee groups had low levels of cardiovascular risk.[43] The relatively low prevalence of certain risk factors in the latter study is not necessarily surprising, however, given that participants were in their mid-30s on average and risk factors may have had less time to become manifest. In comparison, the refugees in the current study were approximately two decades older. Nonetheless, research is needed to determine the degree to which other refugee groups also have high rates of diabetes and cardiovascular disease risk and to understand the specific influences that may give rise to elevated risk in at least some refugee groups.

In conclusion, significant attention has been devoted to documenting the mental health needs of Cambodian and other refugee groups. Yet, the current study shows that Cambodian refugees are at substantially elevated risk of poor long-term physical health with consequences such as premature death, compromised quality of life, lost productivity, and increased health care costs. The heightened risk for diabetes and cardiovascular disease appears underappreciated relative to the well-documented mental health problems of this community, perhaps because the former conditions may not manifest themselves fully until decades after resettlement. Soundly designed epidemiological research is needed, especially with more recently arrived refugee groups, e.g., Burmese, Iraqi, Somali—and ideally using a longitudinal component—to determine the degree to which this pattern extends to other groups in the United States. Efforts should also be undertaken to determine how best to prevent and manage diabetes, hyperlipidemia and hypertension in Cambodian refugees.

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Table I

Characteristics of the NHANES and CHS Samples

	NHANES: U.S. Adult Population		NHANES: Adjusted to Refugees[a]		CHS	
	Percent	**SE**	**Percent**	**SE**	**Percent**	**SE**
Age						
18-24	12.0%	0.5	0.0	--	0.0	--
25-34	17.9%	0.6	0.0	--	0.0	--
35-44	18.8%	0.6	8.0%	0.5	7.7%	1.9%
45-54	18.9%	0.7	27.9%	1.1	28.1%	2.9%
55-64	15.2%	0.6	34.2%	1.2	34.8%	3.5%
65-74	9.9%	0.4	23.0%	0.9	22.7%	3.2%
75+	7.2%	0.3	7.0%	0.4	6.5%	1.7%
Gender						
Male	48.3%	0.8	36.1%	1.1	37.2%	3.6%
Female	51.7%	0.8	63.9%	1.1	62.8%	3.6%

Note:

NHANES = National Health and Nutrition Examination Survey

CHS = Cambodian Health Study

SE = Standard Error

[a]Post-stratification weights were used to adjust the NHANES to the CHS data with respect to gender and age distributions.

Table II

Prevalence of Health Conditions for the Adjusted NHANES and CHS Samples

	NHANES: Adjusted to Refugees[a]		CHS		
	Percent	**SE**	**Percent**	**SE**	***p*-value**
Diabetes					
HbA1c ≥ 6.5% (48 mmol/mol)	12.4%	0.7	27.6%	3.2	<0.0001
MD Diagnosis & Medication[b]	12.5%	0.7	27.0%	3.5	<0.0001
Either Criterion[c]	16.0%	0.8	37.8%	3.7	<0.0001
Hypertension					
BP ≥ 140 systolic or ≥ 90 diastolic	20.0%	0.9	47.9%	3.6	<0.0001
MD Diagnosis & Medication[b]	38.4%	1.1	52.1%	3.6	<0.0001
Either Criterion[c]	47.4%	1.2	63.6%	3.4	<0.0001
Hyperlipidemia					
Total Chol ≥ 240 mg/dL	18.3%	1.0	38.0%	3.4	<0.0001
MD Diagnosis & Medication[b]	27.0%	1.0	55.4%	3.5	<0.0001
Either Criterion[c]	42.2%	1.2	73.6%	3.2	<0.0001

Note:

NHANES = National Health and Nutrition Examination Survey

CHS = Cambodian Health Study

HbA1c = Glycosolated hemoglobin

SE = Standard Error

[a] Post-stratification weights were used to adjust the NHANES to the CHS data with respect to gender and age distributions.

[b] Participants had received a given diagnosis and were currently taking medication for the condition.

[c] Participants met either self-report or physical measurement-based criteria for a given health condition.

Table III

Treatment Status of Participants Who Report a Physician Diagnosis

	NHANES: Adjusted to Refugees[a]		Cambodian Refugees		
	%	SE	%	SE	*p*-value
Diabetes					
Taking medication[b]	90.7% N=572	1.5	82.6% N=75	5.0	0.06
HbA1c < 7.0%[c] (53 mmol/mol)	53.6% N=312	3.0	62.8% N=46	7.0	0.25
Hypertension					
Taking medication[b]	86.3% N=1531	1.2	89.0% N=164	2.9	0.44
BP < 140 systolic AND < 90 diastolic[c]	70.8% N=1160	1.5	31.7% N=63	4.3	<0.0001
Hyperlipidemia					
Taking medication[b]	61.5% N=1004	1.8	78.0% N=174	3.3	<0.001
Total Chol < 200 mg/dL[c]	47.0% N=733	1.8	33.4% N=70	4.1	<0.01

Note:

HbA1c = Glycosolated hemoglobin

[a] NHANES data are adjusted to the refugee sample on age and gender using post-stratification weights.

[b] Participants reported currently taking medication for the condition.

[c] Values used to reflect control of diabetes, hypertension, or hyperlipidemia.