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Disease Knowledge, Perceived Risk and Health Behavior Engagement among Adolescents and Adults with Congenital Heart Disease

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Abstract

Objective—Survivors of congenital heart disease (CHD) are at risk for life-threatening complications as they age. This study aimed to examine the association of knowledge of future health risks, perceived risk, and health behaviors among adolescents and adults with CHD.

Methods—CHD survivors (N=199, ages 15–39; 23% simple, 44% moderate, 33% complex lesions) completed measures of risk knowledge accuracy and perceived risk for developing complications, and reported physical activity and saturated fat intake.

Results—CHD survivors reported poor risk knowledge and consuming high-fat diets. Adolescents reported more physical activity than young adults. Greater risk knowledge was associated with lower fat intake, and participants who exercised more expected fewer future complications, and this difference remained statistically significant when accounting for education and age.

Conclusions—CHD survivors, regardless of age, have poor risk knowledge and diets. Survivors may benefit from emphasis on future health risks and health behaviors from both pediatric and adult providers.

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Keywords

congenital heart disease; disease knowledge; perceived risk; diet; physical activity

Introduction

Medical advancements have extended life expectancy for individuals with congenital heart disease (CHD) and over 1,000,000 adults with CHD currently reside in the U.S.[1, 2] Cardiac lesions that comprise CHD vary in severity and are typically categorized as "simple," "moderate" or "complex." Some individuals need no surgical intervention (more commonly simple lesion types), while others requires series of surgeries over the lifespan, medication and close monitoring. With the transition from adolescence to adulthood, individuals with CHD must assume responsibility for their healthcare, but many may lack knowledge about their condition which would help them accomplish this goal. Adults, as well as adolescents, often have difficulty recalling the name of their diagnosis,[3–5] and do not understand important general medical management issues, such as endocarditis prevention, the negative effects of smoking and alcohol, and contraception choices.[3–8] Despite these documented gaps, the relationship between disease knowledge and health behaviors has not been investigated among survivors of CHD.

Individuals with CHD are at heightened risk for multiple health concerns, including endocarditis, pregnancy complications, as well as life threatening cardiac-related complications such as aortic aneurysms, stroke, coronary artery disease, hypertension, and congestive heart failure. Some of these complications are even more pronounced for those with certain lesion types and surgical histories.[9, 10] For example, all CHD patients are at greater risk for developing coronary artery disease and hypertension as compared to individuals without CHD. However, those with bicuspid aortic valves or coarctation of the aorta have the greatest risk for developing these complications.[9] Several of these cardiac-related complications are amenable to lifestyle changes, including coronary artery disease and hypertension. Therefore, engaging in positive health behaviors (e.g., eating a diet low in saturated fat, being physically active) may help prevent or slow the development of these complications.[11]

The Health Belief Model contains multiple factors that have been used to help explain health behavior engagement,[12] such as undergoing screening for cancer detection. One component of this model includes believing in personal susceptibility (risk) to a particular negative health outcome if a certain behavior is not performed. Personal susceptibility beliefs may or may not be accurate, with some individuals underestimating and others overestimating their risk. Therefore risk can be delineated into accuracy of understanding potential complications and their symptoms (risk knowledge) and believing one is personally susceptible to complications (perceived risk). The association between risk knowledge and perceived risk has been inconclusive in the literature.[13–16] Recent evidence suggests that risk perception may differ by age such that young adults engage in more risky behaviors and perceive less risk than adolescents.[13] Other studies have found similar levels of perceived risk among adolescents as adults,[15, 16] but differences in health risk perceptions among adolescents and young adults with CHD have not been substantiated. Adolescents with CHD, including those with complex lesion types, are unlikely to have experienced as many disease complications as adult CHD survivors and may differ in both risk knowledge and perceived risk. Thus, identifying levels of risk knowledge and perceived risk among both adolescents and adults with CHD may inform understanding health behavior engagement in this population.

The level of health behavior engagement among individuals with CHD remains understudied, despite evidence suggesting CHD survivors are at greater risk for developing cardiac-related complications that are amenable to lifestyle changes. One study assessed fat intake among older children and adolescents with CHD in Belgium and Germany, and results indicated that 40% of participants consumed whole milk daily and 50% ate French fries once per week.[17] Conflicting findings have been noted in the literature among adolescents and adults with CHD for physical activity.[18–21] Given the obesity epidemic in the United States among both children and adults,[22] CHD survivors living in the country may be at particular risk for poor health behavior engagement, and based on the Health Belief Model, perceptions of risk may contribute to the level of engagement.

The aims of the current study were to (1) compare the levels of personal (recall of diagnosis and treatment history, and risk knowledge) and general CHD disease knowledge among adolescents, emerging adults, and young adults with CHD of various lesion severities, (2) determine the level of engagement in positive health-behaviors (i.e., consuming a low-fat diet and being physically activity) and whether levels differ between age groups, and (3) explore the relationship between aspects of disease knowledge, perceived risk, and health behaviors among age groups. We hypothesized that the overall levels of personal and general disease knowledge would be low across all age groups. Younger individuals were hypothesized to have poorer risk knowledge than older CHD survivors. Perceived risk and level of engagement in positive health behaviors were not predicted to differ across age groups. Lastly, higher levels of risk knowledge and perceived risk were hypothesized to be associated with greater engagement in positive health behaviors than recall knowledge across all age groups.

Methods

Study Design

This was a cross-sectional study conducted in both adult and pediatric outpatient cardiology clinics at a pediatric hospital in the Midwestern United States. Eligible patients were identified through schedules for future clinics, mailed a letter by their attending cardiologist notifying them of the study, and then contacted over the phone for recruitment or approached in clinic if they could not be reached by phone. Participants were asked to complete online self-report measures of disease knowledge, saturated fat intake and physical activity at home, on their own with help from others, prior to attending a cardiology outpatient clinic appointment. Participants who were unable to complete the measures before their clinic appointment were encouraged to complete the surveys during their appointment using a tablet computer. Medical chart reviews provided information to score the disease knowledge measure. Participants were compensated for their time. The study protocol was approved by the hospital Internal Review Board.

Sample

Eligible patients (1) had a structural heart defect and (2) were between the ages of 15 and 39 years old. Both emerging adults (18–25 years old) and young adults (26–39 years old) were included because developmental research suggests these are unique developmental periods, each having particular challenges and opportunities for personal growth.[23] Patients were excluded if they were diagnosed with a genetic syndrome that had cardiac involvement (e.g., Down, Marfan, etc.), as well as had cognitive impairments or were not proficient in English since this would impede their ability to complete the measures. Of those approached for recruitment, 14 declined, resulting in a recruitment rate of 93%.

Measures

Disease Knowledge—A 24-item measure, the CHD Assessment of Information Measure (CHD-AIM), was developed for this study to expand upon available CHD disease knowledge measures that do not assess understanding of future complications. The Leuven Knowledge Questionnaire[6] served as a foundation for the content of the CHD-AIM, and the newly created items were written with input from a panel of adult CHD specialists, including cardiologists, nurse practitioners, and nurses. Preliminary items were reviewed by 12 individuals with CHD of various ages (15–38 years) and cardiac lesion severities who provided feedback about item difficulty and reasons for choosing particular responses. Items were then edited to improve clarity.

Three aspects of disease knowledge were measured by the AIM. *Recall* knowledge was comprised of three free-response items that asked participants to recall personal information about their condition, including the name of their CHD diagnosis, current medications, and cardiac surgical history. Items were scored 0, 1, or 2 depending on the level of accuracy when compared to participants' medical chart. For example, a response of "heart problem" to the item asking for diagnosis would be scored 0, "hole in my heart" would receive a 1, and "ventricular septal defect" or "hole between my ventricles" would be scored 2. The final score was then converted to percent correct across all three items with the total number of points ranging from 0 to 6 (e.g., 3/6 = 50%). *Risk* knowledge assessed the accuracy of participants' ability to identify cardiac-related conditions for which they are at risk due to their cardiac lesion, including arrhythmia, heart failure, stroke, aortic aneurysm, coronary artery disease, and hypertension. While not an exhaustive list, these conditions were chosen because they require early identification. Accuracy was determined based on the participant's diagnosis. For example, individuals diagnosed with tetralogy of Fallot are more commonly at risk for arrhythmia and heart failure. Participants received a 0 if they identified ≤ 25% of the conditions for which they are risk, 1 if they identified 26%–74%, and 2 if they identified ≥75%. Because arrhythmia, heart failure, stroke, and aortic aneurysm present with warning signs, participants at risk for these complication received an additional question about identifying symptoms of those conditions (e.g., "Which *best* describes the signs/symptoms of stroke?"), which was scored either as 0, "incorrect," or 1, "correct." Scores were expressed as a percentage of correct items out of 6, which is the maximum amount of points possible. *General* knowledge consisted of 11 multiple choice items pertaining to a range of CHD self-care, including whether individuals with CHD are "fixed" after having cardiac surgery, heart-healthy diet (i.e., low sodium and saturated fat), exercise recommendations, the duration of follow-up care, endocarditis, and whether CHD survivors are at an increased risk of having offspring with CHD. Men were given two additional items about the presence of erectile dysfunction and sexual performance difficulty, while women received two additional items about pregnancy. Items were scored as either 0, "incorrect," or 1, "correct." Similar to Recall knowledge, the percent correct was calculated across the items with a range in total score of 0 to 11 (e.g., 5/11 = 45%).

Perceived Risk—Perceived risk was assessed by totaling the number of cardiac conditions for which participants believed they were at risk due to their CHD, regardless of accuracy (see list of conditions under risk knowledge). Scores could range from 0 to 6.

Health Behaviors—Saturated fat intake and physical activity were measured by two self-report measures. The Northwest Lipid Research Clinic Fat Intake Scale (FIS)[24] is a 12-item questionnaire that asks how much meat, cheese, and other sources of saturated fats have been consumed within the past month. The FIS moderately correlates with food diaries and has shown utility as a screener for fat intake.[24] Scores may range from 12 to 45 with higher scores indicating greater saturated fat intake. For the current study, internal consistency was good ($\alpha = .75$). If <20% of the items were missing, prorating was employed to impute estimates of missing values. The Godin Leisure-Time Exercise Questionnaire (GLT)[25] is a two-item measure that provides an estimate of physical activity for the past week based on the intensity and frequency of activities lasting 15 minutes or longer. The GLT has been used in previous studies of health behaviors among individuals with acquired heart disease.[26] Higher scores suggest greater intensity and frequency of physical activity. Internal consistency was optimal ($\alpha = .79$).

Medical Chart Information—Age, diagnosis, surgical history, and current medication list were recorded. CHD lesion severity was classified as "simple," "moderate," or "complex" according to the American College of Cardiology and the American Heart Association.[27]

Statistical Analyses

First, age group differences in disease knowledge (recall, general, and risk knowledge), perceived risk, saturated fat intake (FIS) and physical activity (GLT) were examined using one-way analysis of variance (ANOVA). Pearson correlations were employed to determine the relationship between disease knowledge subscales, perceived risk, saturated fat intake, and physical activity. Finally, hierarchical regressions were utilized to examine the unique contribution of disease knowledge and perceived risk for those health behaviors with which they were correlated. Age and/or level of education were included as covariates for the regression models that included predictors or outcomes with which they were significantly correlated.

Results

Participants included adolescent (15–18 years old; $n = 56$), emerging adult (19–25 years old; $n = 65$), and young adult (26–39 years old; $n = 78$) survivors of CHD with a variety of lesion severities (simple = 46, moderate = 88, complex = 65). Approximately half of sample was male (49%) and a majority of the participants were Caucasian (86.5%). Table 1 lists characteristics of the sample by age.

Average scores for percent correct on each domain of CHD knowledge, and differences between age groups, are reported in Table 1. Only 17% of participants correctly recalled all components of their diagnosis (full recall: 56.5%; partial recall: 11%; no recall: 26%), current medications (full recall: 54%; partial recall: 3.5%; no recall: 30.5%), and surgical history (full recall: 41.5%; partial recall: 14%; no recall: 38.5%). Mean recall scores did not vary by age group. Young adults obtained higher mean scores for risk ($F[2,184] = 29.39$, $p < .001$) and general knowledge ($F[2,196] = 7.37$, $p = .001$) than adolescents or emerging adults. Only a small proportion of participants (9%) correctly identified all of the conditions for which they are at risk in the future. The average number of conditions for which patients perceived themselves to be at risk was 1.7 (SD = 1.56), and young adults perceived themselves to be at risk for more future conditions than did adolescents or emerging adults ($F[2,196] = 8.79$, $p < .001$).

Scores for saturated fat consumption using the FIS ranged from 13 to 43 with a mean of 30.36, indicating higher levels of saturated fat consumption. Responses on the GLT for physical activity ranged from 0 to 78 with a mean of 28.05, suggesting that on average, participants engaged in approximately 15 minutes of either strenuous activity 3 days per week, moderate activity 5 days per week, or both strenuous and moderate activity several days per week. Age groups significantly differed in physical activity such that adolescents reported being more physically active than young adults ($F[2,165] = 5.24$, $p = .006$), but no differences were found among age groups for diet (see Table 1).

Associations between disease knowledge, health behaviors, and age can be seen in Table 2. In support of study hypotheses, greater general knowledge and risk knowledge were associated with less saturated fat intake. However, in contrast to study predictions, greater risk knowledge and perceived risk were associated with less physical activity. General knowledge was not correlated with physical activity.

Hierarchical regressions were conducted to determine whether disease knowledge and perceived risk remained significantly associated with physical activity and saturated fat intake after accounting for level of education and age (see Table 3). Risk knowledge was no longer significantly associated with physical activity with these covariates. However, the negative relationship between physical activity and perceived risk remained significant when age was entered into the model. Saturated fat intake remained negatively associated with general and risk knowledge after accounting for level of education and age.

Discussion

This is one of the first studies to examine risk knowledge and perceived risk among individuals with CHD, as well as how different aspects of disease knowledge are associated with health behaviors across a developmentally important range of ages. Understanding processes that may inhibit health-behavior engagement among those transitioning from adolescence to adulthood is critical for optimizing their care. These findings also have implications for where to direct efforts in developing educational interventions.

Participants reported consuming comparable amounts of saturated fat as adults who had elevated LDL scores.[25] These findings are of particular concern because many individuals with CHD have complications, such as arterial hypertension, as well as aortic and coronary artery dysfunction, which contribute to coronary artery disease risk. The atherosclerotic process begins early in childhood,[28] therefore it is as important for adolescents with CHD to maintain a diet low in saturated fats as adults.

Participants in the current study reported optimal levels of physical activity, which is in accordance with several previous studies.[18,19] However, the only study to date that has used accelerometer data as an objective measure of physical activity, found that adult survivors of CHD engaged in less physical activity than what is recommended by United Kindgdom guidelines.[21] Future research on this population should include objective measures, in addition to self-report, to optimally characterize the level of engagement in physical activity.

Adolescents and emerging adults had the lowest scores on risk knowledge out of the three domains of disease knowledge. Although young adults performed significantly better on this dimension than both adolescents and emerging adults, their average accuracy was below 70%. This finding suggests that CHD survivors may gain a better understanding of their future risks over time, but it is important to consider that many health behaviors, such as diet and physical activity, are established in adolescence and may even decline over the transition to adulthood.[29–32] The negative relationship between risk knowledge and saturated fat intake identified in the current study suggests that having less accurate knowledge about future health risks may undermine engagement in positive health behaviors, such as consuming a heart-healthy diet. Longitudinal research is needed that will track both changes in knowledge and perceived risk, as well as development of health behaviors over time.

The ability to recall personal disease knowledge, as well as general knowledge about one’s condition have been examined among both adolescents and adults with CHD in separate studies using the Leuven Knowledge Questionnaire for Congenital Heart Disease.[4, 6] Recall of personal medical information and general cardiac knowledge have not been directly compared among adolescents and young adults. Although both age groups demonstrate difficulty recalling the name of their diagnosis, adults may be more proficient at recalling medications and general disease knowledge.[4, 6] Results from the current study indicate that adolescents and adults do not differ in their ability to recall information about their diagnosis and treatment history, but adults may possess more general knowledge about cardiac care. Therefore, general knowledge, as well as risk knowledge, may be appropriate targets for educational intervention, especially given that both aspects of disease knowledge were associated with consuming a diet higher in saturated fat. The current study did not find associations between recall knowledge and health behaviors, indicating that while it is important for patients to communicate their diagnosis and treatment history with other healthcare providers, this aspect of disease knowledge may not affect health behaviors.

In contrast to study hypotheses, perceived risk for future cardiac co-morbidities were greater for young adults than adolescents or emerging adults with CHD. This finding is also in contrast to previous studies that showed no difference among healthy adolescents and adults.[15, 16] However, perceived risk may differ across age groups within a chronic disease population, as evidenced by the improvement in risk knowledge among the young adults in comparison to adolescent and emerging adult participants. As patients age, they may learn more about the possibility of future complications, which could result in increased perceived risk. This same mechanism may not apply among a sample of healthy individuals. Also in contrast to study hypotheses, results showed a negative association between perceived risk and physical activity. One interpretation of this finding is that individuals who engaged in more physical activity perceived themselves to be at less risk for future complications. Similar findings were reported in a study of perceived coronary risk among healthy Hispanic and African American adults for both physical activity and diet.[33] However, individuals who perceive themselves to be at risk for more future conditions may avoid physical activity because they are more sensitive to somatic sensations, including their heartbeat.[34]

The current study had several limitations. First, the study was cross-sectional, therefore investigators cannot make causal inferences about the relationship between disease knowledge, perceived risk and health behaviors. Despite this limitation, the current study provides valuable insight into what factors should be further explored in the context of a longitudinal design so that causal relationships may be identified. In addition, posthoc power analyses indicated that the current study was sufficiently powered to detect small to moderate effect sizes (.20) for two-tailed correlations with $\alpha = .05$ and $1\text{-}\beta = .80$ using the lowest available sample size ($n = 168$). Therefore, it is unlikely that significant relationships between variables were undetected due to Type 2 error. Second, the measure of perceived risk in the current study was a total of the number of cardiac-related conditions for which individuals believed themselves to be at risk in the future due to their CHD. Other measures of perceived risk used in the literature include 0–10 ratings, which may provide more detailed estimates of risk estimation for each condition. Third, the measures of health behaviors in the current study were self-report and may be less valid than objective indicators of saturated fat intake and physical activity, such as blood lipid levels and accelerometer data. Lastly, several of the conditions for which survivors of CHD are at risk are less/not amenable to exercise and diet intervention (e.g., arrhythmia, aortic aneurysm).

Future research could not only address the limitations raised for the current study, but also expand upon the current findings. Using a longitudinal design, changes in disease knowledge and health behaviors could be tracked over time spanning multiple important developmental stages to identify the direction of the relationship between disease knowledge and health behaviors. In addition, objective measures of health behaviors should be employed given the potential bias introduced by self-report assessments that rely on recall.

Given that not all complications arising from CHD are amenable to health behavior changes, other types of self-management behaviors should also be considered in future studies, such as medication adherence and follow-up attendance.

In summary, the current study offers perspective on the relationship between aspects of disease knowledge and health behaviors among an important age span of CHD survivors who are beginning the process of assuming more healthcare autonomy. Theoretical frameworks, such as the Health Belief Model, outline a complex interplay of factors that result in health behavior engagement, including understanding personal susceptibility to future complications. While awareness of future health risks may contribute to health behavior engagement, it is not sufficient to solely drive behavior change in all circumstances.[35–37] Results from the current study suggest that risk knowledge may play a role in explaining health behavior engagement. Therefore, members of both the pediatric and adult medical care teams caring for individuals with CHD should consider emphasizing age-appropriate disease knowledge, as well as reinforce participation in good health behaviors. In particular, patients should be aware of the complications for which they are at risk in the future and ways to potentially mitigate these complications through proper health behaviors and other forms of self-management.

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Abbreviation List

CHD	congenital heart disease
CHD-AIM	congenital heart disease assessment of information measure
FIS	Northwest Lipid Fat Intake Scale
GLT	Godin Leisure-Time Exercise Questionnaire

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Table 1

Clinical and demographic characteristics

	Mean (SD)			
	Total Sample N = 200	**Adolescents n = 56**	**Emerging Adults n = 66**	**Young Adults n = 78**
Age (years)	24.55 (6.79)	16.78 (1.15)	22.53 (2.03)	31.83 (3.70)
Gender (% male)	49%	51.8%	57.6%	39.7%
Race (% Caucasian)	86.5%	83.9%	81.8%	92.3%
Education (% completed or current)				
High School	68.4%	92.9%	62.1%	52.6%
Post-High School/Trade School	6.6%	5.4%	7.6%	6.4%
College	18.9%	1.8%	22.7%	26.9%
Graduate/Professional	6.1%	--	3%	12.8%
Lesion Severity				
Simple	23%	26.8%	28.8%	15.4%
Isolated BAV	8%	7.1%	15%	3.8%
ASD	5%	5.3%	3%	7.7%
VSD	5%	7.1%	9%	1.3%
Mild PS	2%	5.3%	0%	1.3%
Other	3%	2%	1.8%	1.3%
Moderate	44.5%	51.8%	39.4%	43.6%
TOF	13%	14.2%	12.1%	14.1%
COA	11%	21.4%	6%	9%
Moderate/Severe PS	4%	3.5%	1.5%	7.7%
AVSD/AV Canal	2.5%	2%	3%	2.5%
Ebstein's Anomaly	1%	2%	1.5%	1.3%
APVR	1%	2%	1.5%	1.3%
Other	12%	6.7%	13.8%	7.7%
Complex	32.5%	21.4%	31.8%	41%
TGA	12.5%	7.1%	10.6%	16.7%
Single Ventricle	9%	9.1%	9%	9%
DORV	5%	0%	4.5%	9%
Other	7%	5.2%	7.7%	6.3%
Open-Heart Surgeries				
Septal defect closure	16%	3.6%	18.2%	23.1%
Valve repair	11.5%	3.6%	12.1%	16.7%
Valve replacement	19%	10.7%	27.8%	17.9%
Shunt placement	16%	10.7%	12.1%	23.1%
Arterial switch	2%	0%	4.5%	1.3%
COA repair	10.5%	17.9%	6.1%	9%
Fontan procedure	10%	8.9%	9.1%	11.5%
Glenn procedure	3.5%	3.6%	7.6%	0%

	Mean (SD)			
	Total Sample N = 200	**Adolescents n = 56**	**Emerging Adults n = 66**	**Young Adults n = 78**
Mustard/Senning procedure	7%	3.6%	4.5%	11.5%
Rastelli procedure	1.5%	0%	1.5%	2.6%
TOF repair	19.5%	19.6%	16.7%	21.8%
Other	16.5%	17.9%	12.1%	7.7%
No surgery	20%	32.1%	24.2%	19.2%
Disease Knowledge (CHD AIM)				
Recall (% accuracy)	.61 (.28)	.55 (.34)	.64 (.26)	.62 (.26)
General (% accuracy)	.77 (.17)	.72 (.18)[a]	.76 (.16)[a]	.82 (.15)[b]
Risk (% accuracy)	.51 (.28)	.37 (.26)[a]	.42 (.27)[a]	.68 (.22)[b]
Perceived Risk (CHD AIM)	1.70 (1.56)	1.23 (1.49)[a]	1.45 (1.38)[a]	2.24 (1.60)[b]
Saturated Fat Intake (FIS)	30.36 (5.34)	31.41 (5.15)	30.31 (20.76)	29.63 (5.07)
Physical Activity (GLT)	28.50 (22.95)	36.16 (23.13)[a]	30.14 (20.76)	22.39 (23.18)[b]

Note. Means that are significantly different from other means have different superscripts (i.e., a, b, c). A mean without a superscript is not significantly different from any other mean for that variable.

ASD = atrial septal defect; APVR = anomalous pulmonary venous return; AV = atrioventricular; AVSD = atrioventricular septal defect; BAV = bicuspid aortic valve; CHD AIM = Congenital Heart Disease Assessment of Information Measure; COA = coarctation of the aorta; DOV = double-outlet ventricle; FIS = Northwest Lipid Research Clinic Fat Intake Scale; GLT = Godin Leisure-Time Questionnaire; PS = pulmonary stenosis; SD = standard deviation; TGA = transposition of the great arteries; TOF = Tetralogy of Fallot.

* $p < .05$

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Table 2

Pearson correlations between disease knowledge, perceived risk, health behaviors, age, and level of education

	Recall Knowledge	General Knowledge	Risk Knowledge	Perceived Risk	Physical Activity	Saturated Fat Intake	Age
General Knowledge	.11	--					
Risk Knowledge	.15*	.49**	--				
Perceived Risk	.05	.21**	.59**	--			
Physical Activity	.03	−.11	.22**	−.24**	--		
Saturated Fat Intake	−.11	−.30**	−.27**	−.12	−.01	--	
Age	.11	.28**	.48**	.31**	−.29**	−.12	--
Education	.15*	.26**	.17*	.05	.08	−.14	.34*

* $p \le .05$;

** $p \le .01$

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Table 3

Hierarchical linear regressions examining the unique contribution of domains of disease knowledge and perceived risk on health behaviors while accounting for level of education and age

	β	SE	R^2	ΔR^2	ΔF
Physical Activity					
Level of Education	.16*	1.89			
Age	−.31**	.31			
Risk Knowledge	−.09	7.01	.12	.01	1.23
Age	−.25**	.27			
Perceived Risk	−.16*	1.14	.11	.02	4.35*
Saturated Fat Intake					
Level of Education	−.05	.40			
Age	−.01	.06			
General Knowledge	−.30**	2.29	.11	.08	17.26**
Level of Education	−.04	.42			
Age	.06	.07			
Risk Knowledge	−.30**	1.56	.08	.07	12.84**

β = standardized regression coefficient; SE = standard error; ΔR^2 = change in R^2; ΔF = change in F

* $p \leq .05$;

** $p \leq .01$