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Health Locus of Control and Cardiovascular Risk Factors in Veterans with Type 2 Diabetes

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Abstract

PURPOSE—Perceptions of control impact outcomes in veterans with chronic disease. The purpose of this study was to examine the association between control orientation and clinical and quality of life (QOL) outcomes in male veterans with type 2 diabetes (T2DM).

METHODS—Cross-sectional study of 283 male veterans from a primary care clinic in the southeastern US. Health locus of control (LOC) was the main predictor and assessed using the Multidimensional Health Locus of Control Scale. Clinical outcomes were glycosylated hemoglobin A1c (HbA1c), systolic (SBP) and diastolic (DBP) blood pressure, and low-density lipoprotein cholesterol (LDL-C). Physical (PCS) and mental (MCS) health component scores for QOL were assessed using the Veterans RAND 12-Item Health Survey. Unadjusted and adjusted multivariate analyses were performed to assess associations between LOC and outcomes.

RESULTS—Unadjusted analyses showed internal LOC associated with HbA1c (β=0.036; 95% CI 0.001,0.071), external LOC:powerful others inversely associated with LDL-C (β=−0.794; 95% CI −1.483,−0.104), and external LOC:chance inversely associated with MCS QOL (β=−0.418;

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95% CI −0.859,−0.173). These associated remained significant when adjusting for relevant covariates. Adjusted analyses also demonstrated a significant relationship between external LOC:chance and PCS QOL (β=0.308; 95% CI 0.002,0.614).

CONCLUSIONS—In this sample of male veterans with T2DM, internal LOC was significantly associated with glycemic control, and external was significantly associated with QOL and LDL-C, when adjusting for relevant covariates. Assessments of control orientation should be performed to understand the perceptions of patients, thus better equipping physicians with information to maximize care opportunities for veterans with T2DM.

Keywords

health locus of control; diabetes; diabetes outcomes; cardiovascular disease risk factors; quality of life; veterans

INTRODUCTION

Diabetes mellitus is a prevalent chronic disease affecting 29 million people (9.3% of the population) [1]. In 2011, diabetes accounted for more than 230,000 deaths annually in the United States [2]. Although it dropped from the sixth to the seventh leading cause of death, it remains the leading cause of kidney failure, nontraumatic lower-limb amputations, and incident blindness within the American adult population [2]. Cardiovascular disease is the primary cause of death and disability in people with diabetes [3] with a death rate two to four times higher compared to those without the diagnosis [2–5]. Certain population subgroups, such as racial/ethnic minorities, rural residents, and military veterans—especially those residing in rural areas, face an even greater risk of poor diabetes outcomes given the higher prevalence of diabetes and its complications [1,6–7]. Additionally, evidence supports the notion that individuals with chronic diseases such as diabetes and CVD have lower quality of life (QOL), potentially contributing to inadequate care management and poor clinical and psychological outcomes [8–10].

As a single diagnosis, multiple factors are necessary to adequately manage and successfully control and slow the progression towards the complications of diabetes. Such factors include increasing diabetes knowledge, improving self-management skills, and making informed lifestyle choices congruent with good glycemic control. These processes become even more intricate when CVD develops as a comorbid condition, or a disease that occurs concurrently with another disease—in this scenario, diabetes. The added burden of blood pressure and cholesterol control becomes paramount to avoid further health problems and reduce risk of death. According to Tuerk et al., approximately 98% of the effort for diabetes management, specifically, the majority of the variation observed in glycosylated hemoglobin A1c (HbA1c) control, is that of the individual patient [11]. The perception of control an individual has over his/her disease suggests that life is manageable by his/her own actionable behaviors [12]. Thus, perceived control may be central to how patients with type 2 diabetes (T2DM) manage the condition.

Related to this, health locus of control (LOC) is a psychological construct where an individual's belief about control over his/her health is either externally or internally oriented

[13]. In general, an internal LOC is associated with positive health outcomes [14–17]; however, in a state of poor glycemic control, an internal LOC can be associated with negative outcomes. The extent of control over diabetes is also likely affected by the presence of other (comorbid) disease conditions that require attention during daily self-management such as additional dietary changes or more medications. This situation is often routinely faced by people dealing with diabetes as they need to be cognizant of ways to control blood pressure and cholesterol in an effort to reduce their already high risk of adverse CVD outcomes. The multiple behavioral changes that accompany gaining control of diabetes diminish QOL, although it is expected that improving an individual's control of diabetes will dampen this effect [18,19]. However, the evidence base is weak for understanding the relationship of LOC with multiple diabetes-related and QOL outcomes. This study fills this gap in the literature by assessing the association between control orientation and CVD risk factors and QOL among veterans with T2DM who reside in the southeastern region of the US, an area considered even higher risk for adverse CVD outcomes given a greater prevalence of diabetes, stroke, and heart disease [20–21].

MATERIALS AND METHODS

Research Design and Sample Characteristics

The main study was a prospective cohort in which participants completed baseline assessments, were followed for 12 months and repeated the assessments at the end of the 12 month follow up. The study was conducted between 2004 and 2007. The current analyses was based on the baseline assessment and the aim was to evaluate LOC and its effect on diabetes-related cardiovascular risk factors and QOL outcomes. Male veterans were recruited from a Veterans Affairs (VA) Medical Center (VAMC) in the southeastern United States. Eligibility criteria included being 18 years of age or older, having a diagnosis of T2DM, having no cognitive impairments, and being English speaking. Invitations were sent through the mail to eligible patients. Those interested in participating replied by using a return postcard or calling designated research personnel. Those willing to participate were provided a description of the study prior to consent. All demographics data were based on self-report. Diagnosis of T2DM, as well as health utilization and diabetes-specific health outcomes, were obtained from electronic medical records. The study was approved by the Institutional Review Board (IRB) and VA Research & Development (VA R&D) Committee.

Demographic Characteristics

Age was grouped into four categories using the quartiles as cut-off points: <58 years, 59–67 years, 68–74 years, and ≥75 years. Race/ethnicity was based on self-report and included non-Hispanic Whites (NHWs), non-Hispanic Blacks (NHBs), and Hispanics/Other. Marital status was dichotomized as married or not married. Educational level was categorized as <high school (HS) graduate, HS graduate, or college graduate. Employment status was dichotomized as employed, retired, disabled, or other. Three income categories were defined as: 1) <$20,000, 2) $20,000–$34,999, 3) ≥$35,000. Health insurance was divided into two groups: VA only or dual insurance coverage.

Clinical Variables

Diabetes duration was based on self-report and treated as a continuous variable. Comorbidity was assessed by the Charlson Comorbidity Index [22] and treated as a continuous variable. Depression was measured by the Center for Epidemiological Studies Depression (CES-D) Scale) [23] and treated as a continuous variable.

Diabetes Knowledge and Self-Care

Diabetes knowledge was assessed by the Diabetes Knowledge Test (DKT) [24–25] and diabetes self-management (including understanding, diabetes adherence, and control problems) was measured by a scale developed by Michigan Diabetes Research Training Center [24–25]. These variables were treated as continuous.

Locus of control

The MHLC General Form B was used to assess participants' perceptions of control over important health related issues. General Forms A and B were first described by Wallston, Wallston, & DeVellis [13] and have been used since the mid-to-late 1970's. Form B includes18 questions and each question is assigned an agreement score that ranges from 1 (strongly disagree) to 6 (strongly agree). The 18 questions can be grouped in three distinct categories: internality, powerful others externality, and chance externality. Individuals with an internal LOC believe their state of health is strongly affected by their own intrinsic ability to manage their diabetes condition. By contrast, those with an external LOC believe their health is controlled externally either by powerful others or by chance. The Cronbach alpha [27] of the MHLC scale ranges between 0.62–0.76, suggesting good reliability.

Quality of Life

The Veterans RAND 12 Item Health Survey (VR-12) [28–30], formerly known as the Veterans SF-12, was used to assess health related quality of life by computing physical (PCS) and mental (MCS) component summary scores. Derived from the Veterans RAND 36 Item Health Survey (VR-36) [28–30] the VR-12 includes twelve items from the VR-36 sampling each of eight domains of health (physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health) [26] and 2 change items (*"Compared to one year ago, how would you rate your* ***physical health*** *in general now?", and "Compared to one year ago, how would you rate your* ***mental health*** *in general now?"*). [6,26].

CVD Risk Factors

Four different clinical measures related to diabetes outcomes and considered CVD risk factors were assessed including HbA1c, systolic and diastolic blood pressures (SBP and DBP, respectively), and low-density lipoprotein cholesterol (LDL-C). Multiple measurements were available for each participant and for each clinical outcome over the 12-month period. The average measure for each participant was computed for each outcome and used as a continuous variable. Physical and mental health components of QOL were measured using the Veteran Short-Form (SF-12) survey [26], with physical component summary (PCS) and mental component summary (MCS) scores also considered continuous variables.

Statistical Analyses

We performed four sets of analyses. First, the overall demographics characteristics of the sample were assessed. Second, correlation analyses were conducted to determine the association between LOC, clinical outcomes (HbA1c, SBP, DBP, LDL-C) and QOL outcomes. Third, unadjusted analyses were performed to assess associations between the three LOC subscales and CVD risk factors and QOL. For the unadjusted regression model, the three LOC subscales were examined in relation to each of the CVD risk factors and QOL outcomes. Fourth, adjusted analyses were performed in four incremental steps: first we adjusted for demographics, second for demographics and social economic status (SES), third for demographics, SES, and clinical covariates, and forth for demographics, SES, clinical and diabetes self-care variables. The variables included in the adjusted analyses have been shown to be related to the QOL and clinical outcomes in individuals with diabetes [31–33]. The data analyses for this manuscript were performed using SAS software version 9.3. The significance level was set at alpha 0.05.

RESULTS

The original sample was 302, but we had an analysis sample of 283 participants after excluding women (<1% of sample), Hispanic/Other self-reported race/ethnicity (<3% of sample and undetermined work status (<3% of sample).

Table 1 shows the sample demographics for this study population. Of this sample of male veterans with T2DM, equal percentages of participants were represented in each age category and by race/ethnicity. Thirty-six percent graduated from high school, and 42% were college educated. The majority of the sample (71%) had an annual household income level <$35,000. Sixty-five percent of the sample was married and only 27% were employed. Approximately 29% of the sample reported being disabled, and 45% were retired. Seventy-two percent of the sample was covered by dual insurance. The average number of comorbid conditions was 1.94, and the average length of having diabetes was 11 years.

Table 2 shows unadjusted mean scores for multiple diabetes-related and QOL outcomes. The study participants were generally well-controlled in terms of the clinical outcomes of HbA1c, SBP, DBP, and LDL-C. The unadjusted mean QOL scores were 34.24 ±9.96 and 47.72±11.56 for PCS and MCS, respectively.

Table 3 shows unadjusted linear regression models between the three LOC subscales and multiple outcomes. Both internal and external LOC subscales were significantly associated with clinical and QOL outcomes. Specifically, internal LOC was significantly associated with HbA1c such that as internal LOC increased by one unit, glycemic control worsened by 0.036. External LOC due to chance was significantly inversely associated with mental health QOL ($\beta=-0.418$; 95% CI −0.859,−0.173), and external LOC due to powerful others was significantly inversely associated with LDL-C ($\beta=-0.794$; 95% CI −1.483,−0.104), but not significantly associated with any other clinical measures. There were no significant associations between (internal or external) LOC and blood pressure or physical health QOL outcomes.

Table 4 shows adjusted linear regression analyses between health LOC and the clinical and QOL outcomes. After adjusting for demographic characteristics (age, race/ethnicity, gender) in Model 1, external LOC: chance was significantly associated with MCS QOL ($\beta=-0.566$; 95% CI −0.901,−0.231) as was external LOC: powerful others with LDL-C ($\beta=-0.823$; 95% CI −1.490,−0.155). In Model 2, external LOC: chance remained significantly associated with MCS QOL as did external LOC: powerful others with LDL-C, after adjusting for demographic variables plus socioeconomic variables (income, employment, education, insurance). After adjusting for sociodemographic characteristics and clinical variables (diabetes duration, comorbidity burden, and depression) in Model 3, external LOC: chance was significantly associated with PCS QOL ($\beta=0.308$; 95% CI 0.002, 0.614) and external LOC: powerful others with LDL-C ($\beta=-0.810$; 95% CI −1.543,−0.077). In the final fully adjusted Model 4 (sociodemographic characteristics plus clinical and self-care variables), only internal LOC was significantly associated with glycemic control ($\beta=0.045$; 95% CI 0.004, 0.086). None of the LOC subscales were significantly associated with blood pressure.

DISCUSSION

In this study sample of adults with type 2 diabetes in the southeastern United States, both internal and external LOC subscales were significantly associated with both clinical and QOL outcomes. In unadjusted analyses, internal LOC was significantly associated with HbA1c; external LOC by reason of powerful others was inversely associated with LDL-cholesterol, and similarly, LOC attributable to chance was inversely associated with mental health QOL. These significant associations held steadfast even after adjusting for sociodemographic characteristics. External LOC as a result of powerful others also held when additional adjustments for clinical variables were performed. In the final model, however, when controlling for all covariates (sociodemographic, clinical and self-care), only internal LOC was significantly associated with HbA1c. These findings suggest that LOC is associated with both clinical (except blood pressure) and QOL health outcomes; however, only internal LOC is significantly associated with glycemic control after adjusting for covariates. Knowing that internal perception of control is related to diabetes outcomes, clinicians have a basis for targeting specific behaviors and treatment plans to improve blood sugar control. Additionally, the perception that external factors such as chance and powerful others are main drivers of improved clinical outcomes among adults with T2DM can act as inhibitors to self-care management rather than promoters influencing healthier behaviors. This information may also serve as a source for care management as providers incorporate patient centered care into treatment protocols.

The findings of this study suggest a relationship between LOC and health-related outcomes. Previously published research has shown internal and external-powerful others LOC to be associated with improved diabetes-related or CVD outcomes [15–17]. In this sample, external LOC was significantly associated with better physical health QOL and LDL-C; however, internal LOC was significantly associated with poorer glycemic control and external LOC due to chance was related to declining mental health QOL when adjusting for relevant covariates. A recent observational study of the effect of health LOC on CVD risk reduction among underserved, inner-city and rural populations found that those with an internal LOC or powerful others LOC tended to be associated with lower CVD risk [17]. Another population-based cohort study of more than 5,000 participants revealed a 25% lower relative risk of myocardial infarction among those with an increase of 1 standard deviation in internal LOC [16]. Similarly, in a cross-sectional study to identify facilitators and barriers to self-management in thirty-eight urban African American adults with T2DM, Chlebowy et al found external factors, such as family members, peers, and healthcare professionals were seen primarily as facilitators to care compared to internal factors, as they provided assistance and reinforcement, and served as sources of information [35]. This suggests that internal motivations and the external influence of powerful others, like healthcare professionals and supportive family members and friends, can drive improvements in control of CVD risk factors. Gutierrez et al. [36] examined LOC and medication adherence in veterans with diabetes and serious mental illness finding that only external LOC-chance was significantly associated with poorer medication adherence ($p=0.048$). Collectively, these findings would support the notion that professional and social supports can impact initial improvements in diabetes-related outcomes but, over time, help construct the internal motivations needed to sustain long-term control of diabetes outcomes. However, if left to chance, adverse outcomes such as early onset of diabetes complications are likely.

In studies where LOC was measured in the context of group care interventions among patients with type 2 diabetes, internal LOC was higher ($p<0.001$), external-chance LOC was lower ($p<0.001$), and external-powerful others LOC was not significantly different compared to those who were followed in traditional one-to-one care [15]. These observations have also been supported in a nonrandomized study with a small outpatient clinic sample [37]. In contrast to those significant findings, a meta-analysis of the relationship of internal and external LOC with glycemic control among people with diabetes found little to no correlation [38]. Given the variation of need among individuals with diabetes, which likely depends on their history of control, comorbidities and complications, health LOC may be a moving target. Consequently, one should expect that LOC needs to be routinely assessed as individuals progress through the changes and challenges of managing diabetes in order to deliver patient-centered care.

There are study limitations that must be mentioned. First, this was a cross-sectional studies, thus, is limited in being able to draw causal associations. Second, there are potential confounders that were not controlled for, including, medication adherence, self-management routines, and social support. Third, the generalizability of the study findings may be limited given the study population. These findings result from a sample comprised of male veterans and may not be generalizable to women veterans or the general civilian population. Additionally, this sample population was recruited from the southeastern United States and may not represent those living in other parts of the country.

CONCLUSIONS

The findings of this study indicate that, in conjunction with diabetes education, the impact of LOC can be a powerful influence on multiple diabetes and QOL outcomes. Perceptions of internal control should be examined in an effort to improve adherence to diabetes management. Assessments of the control orientation in patients with T2DM should be broadly and routinely performed as it provides specific understanding of how to effect improvements in self-management behaviors. This allows healthcare professionals to receive early prompts about engaging strong social supports and increasing internal motivations among those who are struggling with achieving good glycemic control.

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Table 1

Sample Characteristics for Male Veterans with Type 2 Diabetes

Variables	All (N=283)
Age	
<=58 years old	25.0
59–67 years old	25.4
68–74 years old	25.7
75+ years old	23.9
Race/Ethnicity	
Non-Hispanic White	50.4
Non-Hispanic Black	49.6
Educational Level	
<High School	21.8
High School Graduate	36.1
College	42.1
Annual Household Income Level	
<$20,000	40.5
$20,000 – $34,999	30.7
$35,000+	28.8
Marital Status	
Not married	34.7
Married	65.3
Employment Status	
Employed	26.7
Retired	44.7
Disabled	28.6
Insurance Coverage	
VA only	28.2
Dual Insurance	71.8
Comorbid Conditions	1.94 ± 1.95
Diabetes duration, years	11.07±9.86
Depression score	32.69±10.52
Diabetes Knowledge	11.35±4.17
Diabetes Understanding	3.16±0.70
Diabetes Diet Adherence	1.82±1.27

Variables	All (N=283)
Diabetes Control problems	1.74±0.65
Locus of Control - Chance	17.40±5.90
Locus of Control - Internal	25.93±5.66
Locus of Control - Others	23.71±5.65

All numbers represent percentages or mean ± standard deviation

Table 2

Unadjusted Mean Scores for Outcomes of Male Veterans with Type 2 Diabetes

Variables of Interest	**Mean ± SD**
Clinical Outcomes[#]	
Glycosylated Hemoglobin A1c (%)	6.96 ± 1.32
Blood Pressure (mmHg)	
Systolic	134.07 ± 15.10
Diastolic	73.18 ± 9.26
Low-density lipoprotein cholesterol (mg/dL)	93.90 ± 26.46
Quality of Life Outcomes	
PCS	34.24 ± 9.96
MCS	47.72 ± 11.56

Data are mean ± standard deviation (SD) values.

[#]The clinical outcomes were available at multiple time points; the average of all measurements available for each individual was used for the analysis

Table 3

Unadjusted Regression Model for Health Locus of Control and Outcomes

	HbA1c	SBP	DBP	LDL-C	PCS	MCS
	β coefficient (95% CI)	**β coefficient (95% CI)**	**β coefficient (95% CI)**	**β coefficient (95% CI)**	**β coefficient (95% CI)**	**β coefficient (95% CI)**
LOC_1: Internal	**0.036* (0.001, 0.071)**	−0.112 (−0.527, 0.303)	0.181 (−0.071, 0.433)	−0.138 (−0.858, 0.582)	0.368 (−0.004, 0.740)	0.070 (−0.364, 0.504)
LOC_2: Chance	0.002 (−0.028, 0.033)	0.101 (−0.255, 0.457)	0.042 (−0.174, 0.258)	−0.071 (−0.544, 0.686)	0.072 (−0.223, 0.366)	**−0.418* (−0.859, − 0.173)**
LOC_3: Others	−0.012 (−0.046, 0.022)	−0.042 (−0.440, 0.356)	−0.096 (−0.338, 0.146)	**−0.794* (−1.483, − 0.104)**	0.084 (−0.264, 0.431)	0.115 (−0.471, 0.338)

* Significant at alpha level 0.05.

LOC=Locus of Control; HbA1c=Glycosylated Hemoglobin A1c; SBP=Systolic Blood Pressure; DBP=Diastolic Blood Pressure; LDL-C=Low-Density Lipoprotein Cholesterol; PCS=Physical Component Summary Score of Quality of Life; MCS=Mental Component Summary Score of Quality of Life

Table 4

Adjusted Regression Models for Health Locus of Control and Outcomes

	HbA1c	SBP	DBP	LDL-C	PCS	MCS
	β coefficient (95% CI)	**β coefficient (95% CI)**	**β coefficient (95% CI)**	**β coefficient (95% CI)**	**β coefficient (95% CI)**	**β coefficient (95% CI)**
LOC_1:Internal						
Model 1	0.031 (−0.004, 0.065)	−0.108 (−0.520, 0.304)	0.117 (−0.121, 0.354)	−0.195 (−0.885, 0.496)	0.356 (−0.013, 0.725)	0.141 (−0.289, 0.570)
Model 2	0.034 (−0.000, 0.068)	−0.159 (−0.574, 0.255)	0.074 (−0.158, 0.307)	−0.012 (−0.702, 0.679)	0.116 (−0.224, 0.456)	0.081 (−0.364, 0.526)
Model 3	0.037 (−0.002, 0.077)	−0.178 (−0.671, 0.252)	0.218 (−0.036, 0.471)	−0.021 (−0.845, 0.803)	0.145 (−0.255, 0.545)	−0.138 (−0.244, 0.520)
Model 4	**0.045* (0.004, 0.086)**	−0.216 (−0.741, 0.308)	0.189 (−0.074, 0.453)	0.104 (−0.750, 0.957)	0.255 (−0.147, 0.656)	0.078 (−0.294, 0.450)
LOC_2:Chance						
Model 1	−0.004 (−0.026, 0.033)	0.009 (−0.347, 0.365)	0.005 (−0.200, 0.211)	−0.061 (−0.652, 0.530)	0.084 (−0.204, 0.371)	**−0.566* (−0.901, − 0.231)**
Model 2	−0.000 (−0.030, 0.029)	0.085 (−0.274, 0.444)	0.064 (−0.138, 0.265)	−0.169 (−0.757, 0.419)	0.182 (−0.079, 0.444)	**−0.600* (−0.942, − 0.259)**
Model 3	−0.019 (−0.053, 0.015)	−0.003 (−0.435, 0.428)	−0.044 (−0.266, 0.177)	−0.494 (−1.200, 0.213)	**0.308* (0.002, 0.614)**	−0.092 (−0.385, 0.201)
Model 4	−0.026 (−0.060, 0.009)	0.018 (−0.421, 0.457)	−0.035 (−0.255, 0.186)	−0.552 (−1.258, 0.154)	0.202 (−0.106, 0.511)	−0.051 (−0.337, 0.235)
LOC_3: Others						
Model 1	−0.000 (−0.033, 0.034)	−0.082 (−0.481, 0.316)	−0.025 (−0.255, 0.204)	**−0.823* (−1.490, − 0.155)**	0.034 (−0.309, 0.377)	−0.174 (−0.574, 0.225)
Model 2	−0.006 (−0.039, 0.028)	−0.118 (−0.519, 0.283)	−0.074 (−0.298, 0.151)	**−0.972* (−1.637, − 0.306)**	0.045 (−0.268, 0.357)	−0.112 (−0.520, 0.297)
Model 3	−0.011 (−0.047, 0.024)	0.042 (−0.400, 0.483)	−0.020 (−0.246, 0.207)	**−0.810* (−1.543, − 0.077)**	0.130 (−0.207, 0.467)	−0.019 (−0.342, 0.303)
Model 4	−0.009 (−0.047, 0.028)	0.178 (−0.291, 0.647)	0.017 (−0.219, 0.252)	−0.500 (−1.266, 0.267)	0.168 (−0.190, 0.525)	−0.082 (−0.414, 0.250)

Model 1 is adjusted for demographic variables (age, race, and gender)

Model 2 is adjusted for model 1 plus social economic status variables (income, work status, education and insurance)

Model 3 is adjusted for model 2 and clinical variables (diabetes duration, comorbidities, and depression)

Model 4 is adjusted for model 3 and self-care variables (diabetes knowledge, diabetes understanding, diabetes diet adherence and diabetes control problems)

* Significant at alpha level 0.05.

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