

Ethnic Differences in Mortality, End-Stage Complications, and Quality of Care Among Diabetic Patients

A review

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OBJECTIVE — To determine the influence of ethnic differences in diabetes care on inequalities in mortality and prevalence of end-stage complications among diabetic patients. The following questions were examined: 1) Are there ethnic differences among diabetic patients in mortality and end-stage complications and 2) are there ethnic differences among diabetic patients in quality of care?

RESEARCH DESIGN AND METHODS — A review of the literature on ethnic differences in the prevalence of complications and mortality among diabetic patients and in the quality of diabetes care was performed by systematically searching articles on Medline published from 1987 through October 2004.

RESULTS — A total of 51 studies were included, mainly conducted in the U.S. and the U.K. In general, after adjusting for confounders, diabetic patients from ethnic minorities had higher mortality rates and higher risk of diabetes complications. After additional adjustment for risk factors such as smoking, socioeconomic status, income, years of education, and BMI, in most instances ethnic differences disappear. Nevertheless, blacks and Hispanics in the U.S. and Asians in the U.K. have an increased risk of end-stage renal disease, and blacks and Hispanics in the U.S. have an increased risk of retinopathy. Intermediate outcomes of care were worse in blacks, and they were inclined to be worse in Hispanics. Likewise, ethnic differences in quality of care in the U.S. exist: process of care was worse in blacks.

CONCLUSIONS — Given the fact that there are ethnic differences in diabetes care and that ethnic differences in some diabetes complications persist after adjustment for risk factors other than diabetes care, it seems the case that ethnic differences in diabetes care contribute to the more adverse disease outcomes of diabetic patients from some ethnic minority groups. Although no generalizations can be made for all ethnic groups in all regions for all kinds of complications, the results do implicate the importance of quality of care in striving for equal health outcomes among ethnic minorities.

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Abbreviations: ESRD, end-stage renal disease; LEA, lower-extremity amputation.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Diabetes is one of the most common chronic diseases in Europe and the U.S. (1–3). Diabetes is divided into etiologic subclasses, of which type 1 and type 2 are the most prevalent (4). The prevalence of type 1 and, in particular, type 2 diabetes is rising in all European countries (2). Type 2 diabetes is the major contributor to the epidemic rise in diabetes because this type accounts for >90% of diabetes. In the U.S., the overall prevalence of diabetes increased from 4.9% in 1990 to 6.5% in 1998 (5). There is a parallel rise in the prevalence of complications related to diabetes.

The prevalence of diabetes varies, among other factors, by ethnicity. Several studies (3,6,7) on ethnic differences in diabetes have reported higher prevalence and incidence rates among ethnic minorities. Furthermore, end-stage complications of diabetes have been reported to be more common among ethnic minorities (8–10), who also experience higher mortality (11,12). However, research on ethnic differences in mortality and complications among diabetic patients is fragmented; a systematic overview is missing.

Explanatory research of ethnic differences in general health has mainly focused on factors that are related to the ethnic minorities directly, such as genetic, socioeconomic, and sociocultural factors (13). Another possible determinant of ethnic health differences is health care itself, more specifically the accessibility and the quality of health care (13). Although health care alone cannot be expected to eliminate ethnic inequalities in health outcomes, it can potentially play an important role, especially for chronic diseases for which prolonged and regular treatment is required. Only a few studies (14,15) have examined the role of quality of care as a contributor to ethnic differences in health. For depression, another chronic disease requiring prolonged and regular treatment, it has been found that

Table 1—Summary table

Cover terminology	Ethnic minority groups	Number of studies	Outcomes			
			Mortality	Complications	Intermediate outcomes	Process of care
Black	African American, black, non-Hispanic black, African Caribbean	39	6	18	9	15
Hispanic	Mexican American, Latino, Hispanic, Hispanic American	19	1	10	4	6
Asian	Asian, Indo Asian, South Asian	9	1	7	—	1
Other	Native American, Algerian, other ethnicity	5	1	3	—	2

Summary of categories of ethnic minority groups and the number of studies in which the specific outcomes have been studied for each of the ethnic categories. The majority group consisted of Caucasians or non-Hispanic whites.

improving quality of care substantially reduced ethnic disparities (16).

Adequate treatment is important for the management of diabetes and the prevention of diabetes complications (17). Although plausible, it is unknown whether ethnic differences in quality of care contribute to the explanation of ethnic differences in mortality and end-stage complications among diabetic patients. Therefore, a review of the literature was performed in which the following research questions were addressed: 1) Are there ethnic differences among diabetic patients in mortality and end-stage complications and 2) are there ethnic differences among diabetic patients in quality of care?

RESEARCH DESIGN AND METHODS

We searched the Medline database for articles published between January 1987 and October 2004. We used the keywords “ethnic” and “diabetes” in combination with at least one of the following: “quality of care,” “mortality,” “complications,” “cardiovascular disease,” “nephropathy,” “retinopathy,” “lower extremity,” “end-stage renal disease,” “care,” “outcome,” or “HbA_{1c}.”

The following inclusion criteria were used. Studies in which ethnic minority groups were compared with a white/Caucasian majority group were included, and studies with international comparisons (comparing ethnic groups of different countries) were excluded. Only studies restricted to diabetic populations were included. Our interest was in ethnic differences in the development of diabetes complications and the risk of mortality among diabetic patients and the effects of their quality of care. In studies of ethnic differences in diabetes complications per-

formed among the general population, part of the ethnic differences is due to ethnic differences in the incidence of diabetes, which is beyond the scope of our report. Studies on patients with both type 1 and/or type 2 diabetes were included. Studies that discussed ethnic differences in a quantitative manner, e.g., by giving relative risks, were included. Only mortality studies in which all-cause mortality rates were reported were included. We restricted quality of care to the actual care given (process). Studies about quality of care in which access to care is investigated were not covered.

The search produced 407 articles. Screening titles and abstracts narrowed this down to 85 articles. In a careful examination of these 85 manuscripts, 43 studies did not meet the inclusion criteria, and this left us with 42 eligible articles for our review. Then, we examined the bibliographies of these articles, adding nine articles to our list. Finally, a total of 51 studies were included. Appendix 1 of the online appendix (available at <http://care.diabetesjournals.org>) provides an overview of the eligible studies for this review indicating the ethnic groups and outcomes involved.

Variables

Most studies included patients with both type 1 and type 2 diabetes or did not explicitly state the type of diabetes of the patients included in their study. Since the majority of studies did not make a distinction between patients with type 1 or type 2 diabetes in the presentation of their outcomes, we were unable to make this distinction in our review.

There is no universally accepted definition of quality of care. For this review, we focused on an important dimension of

care: actually delivered care. We adapted an operational definition: whether the care that individuals received was effective. Effectiveness is composed of the structure, process, and outcome of care (19). Structure of health care, referring to the organizational factors, is the first aspect. On the whole, the structure is mainly an indirect and contingent influence on care, especially when ethnic differences in quality of care are studied within hospitals and not between hospitals. Although structural aspects can have a direct impact on outcomes, we do not think that they are the main reason of ethnic differences, and we decided to leave them out of consideration (19). Process of care is the actual delivery and receipt of care, with technical interventions and interpersonal interactions between users and members of a health care system as key processes. Process measures were ordered in five categories in order to assess the quality of care: Test HbA_{1c} (A1C; test performing and treatment in case of poor control), test blood pressure (test performing and treatment in case of poor control), eye examination, renal function and lipid examination, and others (physician visits, dietary consultations) (20). Outcomes are consequences of care. Mortality and complications (lower-extremity amputations, retinopathy, renal dysfunction, cardiovascular disease, and neuropathy) are considered as long-term outcomes, while outcome measures like A1C and blood pressure, for instance, are considered intermediate outcomes of care. We included all ethnic groups, but in practice, the diversity is restricted to a few main groups. The different ethnic groups were categorized into four categories (Table 1) for ease of analysis.

Table 2—Ethnic differences in mortality (reference whites) reported by included studies (parts of studies)

Region	No adjustment	Adjusting for confounders	Adjusting for additional risk factors
U.S.			
Black		— — — —	=
Hispanic		— =	— = = =
U.K.			
Black		+ +	=
Asian		=	
Other		— =	

Outcomes are coded as —, worse situation and higher mortality; =, no difference in mortality; and +, better situation and lower mortality. Studies addressing several outcome variables and/or ethnic groups or studies making stepwise adjustment for confounders and risk factors could contribute more than one sign to the table.

Analysis

We analyzed the data successively for mortality, complications of diabetes, intermediate outcomes of care, and quality of care. In the different studies included in this review, there was a large variation in the (number of) variables for which adjustments were made. To determine whether any ethnic differences existed between diabetic patients and mortality and end-stage complications (research question 1), we started to assess studies in which only adjustments were made for confounders. Only three factors were considered as confounders: age, sex, and duration of diabetes. Other factors (such as socioeconomic status, smoking, and health insurance) that can act as intermediaries in the causal chain between ethnic background and diabetes outcomes were considered as risk factors. Studies in which adjustment is made for such risk factors could, indirectly, shed some light on the question of whether quality of care has the potential to decrease ethnic differences in mortality and end-stage complications among diabetic patients. If ethnic differences disappear after controlling for other risk factors, there is no need to focus further on ethnic differences in quality of care as a possible explanation. On the other hand, if there has been extensive control for other risk factors and ethnic differences in diabetes complications and mortality still persist, there is room for quality of care to play a role in the explanation of the remainder of the ethnic differences in diabetes outcomes. Therefore, the outcomes of the studies of this review are described in two steps. First, the outcomes of studies after adjustment for con-

founders are assessed in order to determine whether there are ethnic differences among diabetic patients in mortality, end-stage complications, and intermediate outcomes of care. Second, the outcomes of studies are assessed after adjustment for risk factors of adverse diabetes complications other than the quality of care (e.g., educational level, obesity status, smoking, income). Throughout the article, adjustment for these risk factors is referred to as a “more comprehensive adjustment” besides the “basic adjustment” for confounders. In studies where more comprehensive adjustment for risk factors was made, we evaluated whether ethnic differences that could be attributed to ethnic differences in health care remained.

RESULTS

Ethnic differences in mortality and diabetes complications

Mortality. In Table 2, the outcomes of studies on ethnic differences in mortality are shown. In Tables 2–5, a single study addressing several ethnic groups (and/or several outcome variables) could contribute more than one sign. That also applies for studies with stepwise adjustment for confounders and risk factors. Since there were only a few studies that investigated more than one minority group or outcome variable or that made stepwise adjustments, nearly each sign represents one study. A more detailed overview of mortality and morbidity data are given in appendix 2 of the online appendix.

Five U.S. studies (12,21–24) reported higher mortality rates among ethnic minorities, after adjustment for confound-

ers. In one study (22), the ethnic differences in black versus white disappeared after adjustment for additional risk factors like income and cigarette smoking. In another study, the ethnic differences persisted for U.S.-born Mexican Americans after adjusting for risk factors like smoking status and blood pressure. However, after additional adjustment for more risk factors like disease severity, the differences disappeared (24).

Two U.K. studies (11,25) reported, on the contrary, lower mortality rates among blacks after adjusting for age, sex, and BMI, which was no longer statistically significant after adjustment for additional risk factors (25). One U.K. study (26), which was adjusted for sex, age, and duration of diabetes, reported no differences in mortality rates between Asians and whites. A New Zealand study (27) showed higher mortality rates for Maori people but no differences for inhabitants of the Pacific Islands.

After adjusting for confounders, higher mortality rates were found among blacks in the U.S. but lower rates among blacks in the U.K. After adjusting for other risk factors, besides age and sex, no ethnic differences in mortality were found in most studies.

Complications

Lower-extremity amputations. In four U.S. studies (8,10,28,29) in which no adjustments, apart from age and/or sex, were made, higher risks of lower-extremity amputation (LEA) were reported among ethnic minorities (Table 3). In other studies, in which more comprehensive adjustments were made, risks for ethnic groups were different compared with studies only adjusting for confounders. For blacks, increased risks were seen in two studies (30,31), whereas in four other studies (28,32–34) no differences were reported. In two studies among Asians (30,33), in which comprehensive adjustments were used, a decreased risk of LEA was reported. For Hispanics, results were more contradictory. One study (8), only adjusted for age, showed a lower risk. In other studies on Hispanics, after adjusting for additional factors, equal risk was reported in two studies (32,33) and increased risk in two studies (29,30). Native Americans have a higher risk of LEA; one study (30) reported an increased risk after adjusting for several risk factors besides age and sex.

Table 3—Ethnic differences in diabetes complications (reference whites) reported by included studies (parts of studies)

Complication	No adjustment	Adjusting for confounders	Adjusting for additional risk factors
LEA			
U.S.			
Black	--	-- =	-- = = = =
Hispanic	-	- + =	- =
Asian			+ +
Other			- =
U.K.			
Black	+		=
Asian		+	
Retinopathy			
U.S.			
Black		-	- + = = =
Hispanic		-	- - - +
U.K.			
Black		=	
Asian			+
Other			
Other		=	
Nephropathy and ESRD			
U.S.			
Black		- - =	- - =
Hispanic		- =	- =
Asian			-
U.K.			
Black		=	
Asian	-		-
Other			
Asian		-	
Other		=	
Cardiovascular complications			
U.S.			
Black		= =	+ = =
Hispanic		= =	+ + +
Asian			+ + +
U.K.			
Black		+	
Asian			+ =
Neuropathy			
U.S.			
Black		=	=
Hispanic		=	=
Other			
Other		-	

Outcomes are coded as -, worse situation and increased/higher risk; =, the same situation and no different risk; and +, better situation and decreased/lower risk. Studies addressing several outcome variables and/or ethnic groups or studies making stepwise adjustment for confounders and risk factors could contribute more than one sign to the table.

In two U.K. studies (35,36), one without adjustment and another adjusting for only age and sex, lower risks for LEA were reported among blacks and Asians. The lower risk for blacks dis-

appeared after adjusting for risk factors such as smoking and neuropathy (35). After adjustment for confounders (age and sex), most ethnic minorities in the U.S. have increased risks of LEA, which are

absent after a more comprehensive adjustment for risk factors.

Retinopathy

After adjusting for confounders, blacks as well as Hispanics had a higher risk of retinopathy in the U.S. (32). In studies with more comprehensive adjustments, the risk of retinopathy for blacks in the U.S. was conflicting: three studies reported equal risks of retinopathy (9,37,38), one reported a lower risk (39), and one demonstrated a higher risk for developing progressive retinopathy (40). In other studies, in which only adjustments for risk factors were performed, risk for Hispanics (Mexican Americans) was higher than for whites in two studies (9,41), whereas one study (42) noted a smaller risk.

In the U.K., blacks had an equal risk of retinopathy after adjustment for age (25), and Asians had a lower risk after adjustment for risk factors like smoking or treatment (43). In France, Algerian immigrants had equal risk of retinopathy compared with French people after matching for sex and duration of diabetes (44). Generally, ethnic minorities in the U.S. seem to have a higher risk of retinopathy. After adjusting for risk factors, results are inconsistent for blacks. Only the higher risk for Hispanics persists.

Cardiovascular disease

Cardiovascular complications included coronary heart disease, myocardial infarction, stroke, and congestive heart failure. After adjustment for confounders, one U.S. study (32) reported equal risks of cardiovascular diseases for blacks and Hispanics. After adjustments for risk factors in another study (33), Asians and Hispanics had a lower risk, while an equal risk for blacks remained.

Two U.K. studies (25,43) reported a lower risk of cardiovascular disease in blacks and Asians, although Asians had an equal risk for heart vascular diseases (angina and myocardial infarction). Overall, a lower risk of cardiovascular disease was reported for ethnic minorities.

Renal complications (nephropathy and end-stage renal disease)

In the U.S., the risk of end-stage renal disease (ESRD) is reported to be higher among Hispanics and blacks than among whites (45,46), after adjusting for confounders. One study reported equal risk

Table 4—Ethnic differences in intermediate outcomes of care (reference whites) measured by separate indicators and reported by included studies (parts of studies), all U.S. studies

Intermediate outcome	No adjustment	Adjusting for confounders	Adjusting for additional risk factors
A1C			
Black	= =	-	- - - - -
Hispanic	-		- - = =
Other			
Black	- - - = = = = = = +		- - = = =
Hispanic	- = = +		- = = =

Outcomes are coded as -, worse outcome regarding one indicator; =, equal outcome regarding one indicator; and +, better outcome regarding one indicator. Studies addressing several outcome variables and/or ethnic groups or studies making stepwise adjustment for confounders and risk factors could contribute more than one sign to the table.

(32). In studies with adjustments for risk factors, equal risks for blacks are noted in one study (38), while two studies (33,47) noted an increased risk for blacks. Asians were reported to have a higher risk of ESRD, and for Hispanics conflicting results were reported. One study (42) reported an equal risk, and an increased risk was mentioned in another study (33).

Two U.K. studies (43,48) reported higher rates of ESRD among Asians, and one study (25) found no differences between blacks and whites in proteinuria. Asians had an increased risk in a Dutch study (49), and a French study (44) reported no ethnic differences among Algerians who were living in France. In conclusion, ethnic minorities showed a higher risk of ESRD than whites, especially blacks and Asians. After adjusting for risk factors, the higher risk remains.

Neuropathy

No ethnic differences were reported in risk of neuropathy in the U.S. for blacks or Hispanics (32,38,42). On the other hand, a French study (44) has reported a higher risk of neuropathy among Algerians in France.

Ethnic differences in intermediate outcomes of care

In 13 studies (14,15,50–56), all performed in the U.S., intermediate outcomes of diabetes care are discussed (Table 4). In nine studies (14,50–55,57,58), worse levels of outcomes (e.g., higher A1C, higher risk of hypertension) are reported among ethnic minorities (i.e., Hispanics, African Americans, blacks). Most studies among blacks

(14,50–55,57,58) reported worse outcomes, whereas two studies (59,60) report only worse outcomes among black women but no differences for men. An interventional study (56) showed no difference in the outcomes neither before nor after the intervention took place. The majority of studies (15,50,51,53–55,57–60) about blacks adjusted for several factors. Only two studies (14,52) did not adjust at all, with similar results compared with the adjusted studies. For Hispanics, one (unadjusted) study (14) reported worse glycemic control and a higher risk for clinical proteinuria. Two other studies, after adjusting extensively, reported different outcomes in glycemic control. One study (60) demonstrated no ethnic differences in glycemic control, while another study (50) showed worse control among Hispanics. Overall, intermediate outcomes of care were worse in blacks, and outcomes among Hispanics were inclined to be worse.

Ethnic differences in quality of care

Results of ethnic differences in quality of care (process of care) are shown in Table 5. In this table, a lot of studies investigated more than one process measure. That implies that in this table, in contrast with the previous tables, one study contributed, on average, more than one sign. Overall, 15 studies concerning ethnic differences in quality of care were included, all of which were performed in the U.S. As previously mentioned, we restricted ourselves to process of care. Indicators were mainly the frequency of several preventive tests for treatment of diabetes. Two studies only took the frequency of eye

care tests into account, whereas other studies assessed several tests simultaneously. In five studies (15,32,50,55,61), higher quality for ethnic minorities for at least one indicator was reported, but eight studies (14,38,51–53,62–64) reported an overall lower quality for ethnic minorities in process of care. The only intervention study (56) included in this review showed lower quality for ethnic minorities before the intervention was implemented, and after the intervention, differences disappear. Blacks especially scored lower on one or more indicators (14,38,51–53,62–64). One study (54) reported equal quality of care (process of care) for blacks, and three studies (15, 32,55) noted predominantly a higher quality of care for blacks. For Hispanics, two studies (32,54) reported equal quality of process of care, two studies (14,64) reported lower quality, and one study (50) higher quality. One study (61) involved non-English-speaking Asians (56% of the Asians compared with 7% of whites were non-English speaking). Non-English-speaking diabetic patients were receiving higher quality of process of care. Overall, process of care was worse for blacks and Hispanics.

Relationship between quality of care and diabetic morbidity and mortality

Studies in which both quality and outcomes of care (intermediate outcomes, morbidity, and/or mortality) are measured and where associations between both factors have been analyzed would provide a direct opportunity to determine the influence of ethnic differences in diabetes care on inequalities in diabetes outcomes. Many studies (14,15,50–55) have investigated quality of care and intermediate outcomes of care. Unfortunately, with the exception of four studies (14, 53,55,56), most research has treated the measurements separately and not analyzed the associations. The first study (53) examined several factors that may explain why black patients, compared with whites, have worse intermediate outcomes (glycemic control). Process of care is considered as a determinant, and three indicators were investigated: control of cholesterol, control of blood pressure, and reporting of a flu shot in the past year. One indicator, receiving a flu shot, was associated with glycemic control. Not receiving flu shots is related to worse glyce-

Table 5—Ethnic differences in process of care (reference whites) measured by separate indicators and reported by included studies (parts of studies), all U.S. studies

Process of care	No adjustment	Adjusting for confounders	Adjusting for additional risk factors
Test A1C			
Black	-- =		----- = = = =
Hispanic			=====
Asian			+
Other			
Blood pressure			
Black	=====		=
Hispanic	----- =		=
Asian			
Other			
Eye exam			
Black	----- =		----- = =
Hispanic	=		+
Asian			=
Other			
Lipids and renal function			
Black	----- = = = =		----- = = = = +
Hispanic	----- =		=====
Asian			=====
Other			
Other			
Black	-- ++ = = =	+	----- = = = = = = +
Hispanic		=	----- = = = =
Asian			++
Other		=	

Outcomes are coded as –, worse quality regarding one indicator; =, equal quality regarding one indicator; and +, better quality regarding one indicator. Studies addressing several outcome variables and/or ethnic groups or studies making stepwise adjustment for confounders and risk factors could contribute more than one sign to the table.

mic control. This supports the notion that a higher quality of care is associated with better glycemic control. However, in this study, no ethnic differences in glycemic control were found. In the second study (55), process of care (frequencies of tests: e.g., A1C) of African Americans and Caucasians were compared. The finding that African Americans were in poorer metabolic control than Caucasians led to the analysis of the relationship of glycemic control to determine test frequency per group. There were no ethnic differences in the frequency of testing for A1C. African Americans were more likely to have a cholesterol or creatinine test. Those in poorer control tended to have a low number of tests. The third study reported no association between outcomes of care and process of care (one indicator: the number of physician visits per year), with a

few exceptions. Hypertensive blacks with six or more visits in the previous year were more likely to have a blood pressure <140/90 mmHg compared with those with less than six visits (14). So, these studies do not suggest ethnic differences in outcomes caused by ethnic differences in process of care. The fourth study is an intervention study in which an intervention to improve health care was implemented, focusing on ethnic populations. The intervention had three foci. Partly, it consisted of improvements of quality of care. Two years after the implementation, ethnic differences in the process of care had disappeared (56). Two studies (32, 38) investigated the quality of care and subsequent morbidity and/or mortality. In these studies, no analyses were conducted to assess the relationship between quality of care and/or morbidity.

CONCLUSIONS— After adjusting for confounders, the literature shows that diabetic patients from ethnic minorities have higher mortality rates and a higher risk of diabetes complications. After additional adjustment for risk factors like smoking, socioeconomic status, income, years of education, and BMI, in most instances, ethnic differences disappear. Nevertheless, among U.S. blacks and Hispanics and among U.K. Asians, an increased risk of ESRD is seen, and blacks and Hispanics in the U.S. have an increased risk of retinopathy. Intermediate outcomes of care are worse in blacks, and outcomes among Hispanics were also inclined to be worse. Likewise, ethnic differences in the quality of care in the U.S. exist: process of care is worse among blacks.

Several limitations of this review need to be mentioned before the findings are discussed. A common problem in a review is the comparability of the studies included. In our review, comparability may be limited by a lack of a clear definition of ethnic groups and the outcome measures (especially measures of the quality of care), a clear description of type of diabetic patient included in the study, and heterogeneity in the age range and the source population of the patients.

First, the lack of a clear definition of ethnicity makes it difficult to compare ethnic groups in a reliable way. Mexican Americans and Hispanics belong partly to the same ethnic group, but studies included probably one of the two without giving a more precise definition. Creating subgroups of black and white Hispanics, without specifying the definition, makes it more complex to separate whites, blacks, and Hispanics from each other.

A clear definition of outcome measures, especially for quality of care, was missing in most studies. Only a few studies discussed the criteria for quality in an explicit way. The lack of definitions of quality or operational definitions makes it difficult to compare studies regarding quality of care. To investigate the importance of quality of care for ethnic differences in diabetes outcomes, it is important that future research describes how quality of care is defined and operationalized. Besides, in most studies, quality of care was not investigated. For these studies, we infer the possible meaning of quality of care by assessing the explanation of ethnic differences by factors other

than quality of care. However, most studies did correct for confounders and/or other factors, but only a few studies corrected for confounders in the beginning and subsequently extended the adjustment with risk factors. The last methodology would have produced results concerning the influence of quality of care on ethnic differences in outcomes. In the absence of these types of studies, we had to infer the explanations from different factors between different studies. In addition, the inclusion of different types of diabetes further complicated the preparation of this review. About half of the studies gave a description of the type of diabetes included. Studies included type 1 and/or type 2 diabetes. Almost none of the studies, which included both types of diabetes, investigated in the analyses the role of the different types of diabetes on the outcomes. Two studies (45,47) reported different relative risks of ESRD for insulin-dependent diabetes (type 1 diabetes) and non-insulin-dependent diabetes (type 2 diabetes) separately. The relative risks for blacks versus whites in the two studies for type 1 diabetes was 0.90 and 1.03, respectively, and for type 2 diabetes, the risk was significantly increased to 4.80 and 4.31. Based on only two studies, we cannot determine ethnic differences in outcomes regarding the type of diabetes. Finally, the comparability of studies is complex because some studies used national data while others used data from one hospital. We did not give a higher weight to the results of a national study with large populations (55) in comparison with results based on a smaller population in one setting (49). The methodological issues with regard to the comparability of the studies only allow us to draw tentative conclusions.

We noticed differences between the results of studies conducted in the U.S. and studies conducted in the U.K. In many U.S. studies, ethnic minorities were found to have increased risks for mortality and diabetes complications, whereas in many U.K. studies, ethnic minorities were reported to have lower or equal risks in comparison with the white majority. Ethnic minority groups in the U.S. and U.K. are partly different. Asians in the U.S. mainly originate from countries as China and Japan, while Asians in the U.K. mostly originate from India and Pakistan. Blacks in the U.S. and blacks in the U.K. have, although both originating from Af-

rica, different migration histories. However, with regard to this last group, it was remarkable that blacks in the U.S. have an increased risk of mortality and diabetes complications, whereas in the U.K., blacks had lower risks. These differences cannot be attributed to genetic differences. Although cultural differences between blacks living in the U.S. and U.K. could be an explanation, health care differences between these countries could also be a probable explanation. Access to care in the U.K., with its National Health Service, is more equal than in the U.S. (65). It is also possible that differences in the quality of care exist between these countries, with the quality of care in the U.K. being more equal among ethnic groups than in the U.S. Unfortunately, the studies on ethnic differences in quality of care all originated from the U.S., and, consequently, we are not able to study this assumption further.

Further, we did not take ethnic-specific guidelines into account and assumed that optimally, the process of care should be the same for all ethnic groups. This is debatable because the process of care is based on guidelines with overall less attention for specific clinical circumstances. Specific clinical circumstances usually refer to the age and sex of the patient. In ethnic minority groups, particular diseases can be more prevalent or more severe, and this may also determine the patient's clinical circumstances. Ignorance of ethnic differences between patients could lead to inferior quality of care for ethnic minorities (66).

We found no studies in which the role of quality of care in the explanation of ethnic differences in mortality and diabetes complications was empirically tested. However, recently a study (56) showed that by improving (in a broad approach with three different main foci) the quality of care, ethnic differences in process of care disappeared. Further, there are several indirect indications that the quality of care might be of importance. In studies in which extensive adjustment was made for other risk factors except the quality of care, e.g., by adjusting for patient and socioeconomic characteristics, for several outcome measures ethnic differences in the outcomes remained present. Differences in risk of retinopathy and ESRD mainly persisted for blacks and Hispanics after adjustment. Because adjustments were made for a wide range of variables,

except for quality of care, it is plausible to state that quality of care might play a role. Additionally, although there were no studies in which adjustment was made for quality of care, there were several studies in which adjustment was made for intermediate outcomes of care. While studies adjusted for confounders demonstrate the presence of ethnic differences, subsequent adjustment for intermediate outcomes of medical care, like hypertension, A1C levels, cholesterol levels, and proteinuria, result in no ethnic differences in long-term diabetes outcomes (22,25,28,35). To elaborate on this, outcomes of medical care have a direct influence on morbidity and mortality; therefore, it can be concluded that the quality of this care plays an important role.

We did not investigate the reasons for ethnic differences in the quality of care, but recently, a U.S. study explored the reasons why black patients received lower-quality health care than white patients. Black patients and white patients are to a large extent treated by different physicians. The physicians treating black patients may be less well trained clinically and may have less access to important clinical resources than physicians treating white patients. To a certain extent, these differences may have led to disparities in the outcomes (67). Other reasons could be racism (68), physicians' perceptions of patients (69), preferences of the patients (70,71), or the patient-caregiver relationship (72).

We conclude that, especially for blacks and Hispanics in the U.S., differences in outcomes can decrease by improving the quality of care. For the U.K., only Asians have a higher risk of ESRD, and the influence of quality of care on this result is less convincing than in the U.S. There is no general pattern in risks of complications or mortality for ethnic minorities as a whole. The diversity in risks of the several diabetes complications in ethnic groups, combined with the different results for the U.S. and the U.K., does not allow us to generalize the results to other regions or other ethnic groups. However, the results indicate that quality of care is an important factor among ethnic minority groups.

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