The Impact of the COVID-19 Pandemic on Ethnic Minority Groups With Diabetes

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Major ethnic disparities in diabetes care, especially for intermediate outcomes and diabetes complications, were evident prior to the coronavirus disease 2019 (COVID-19) pandemic. Diabetes is a risk factor for severe COVID-19, and the combination of these ethnic disparities in diabetes care and outcomes may have contributed to the inequity in COVID-19 outcomes for people with diabetes. Overall, ethnic minority populations have suffered disproportionate rates of COVID-19 hospitalization and mortality. Results from the limited number of studies of COVID-19 in ethnic minority populations with diabetes are mixed, but there is some suggestion that rates of hospitalization and mortality are higher than those of White populations. Reasons for the higher incidence and severity of COVID-19–related outcomes in minority ethnic groups are complex and have been shown to be due to differences in comorbid conditions (e.g., diabetes), exposure risk (e.g., overcrowded living conditions or essential worker jobs), and access to treatment (e.g., health insurance status and access to tertiary care medical centers), which all relate to long-standing structural inequities that vary by ethnicity. While guidelines and approaches for diabetes self-management and outpatient and inpatient care during the pandemic have been published, few have recommended addressing wider structural issues. As we now plan for the recovery and improved surveillance and risk factor management, it is imperative that primary and specialist care services urgently address the disproportionate impact the pandemic has had on ethnic minority groups. This should include a focus on the larger structural barriers in society that put ethnic minorities with diabetes at potentially greater risk for poor COVID-19 outcomes.

A significant body of evidence indicates that many of the most vulnerable in our society have faced the greatest burden of both direct and indirect consequences of the coronavirus disease 2019 (COVID-19) pandemic, including the elderly, people living in deprived areas, people with learning difficulties, the homeless, and migrants. In particular, ethnic minority populations in many European countries and North America are at greater risk of infection and severe outcomes due to COVID-19 (1–3), although recent data on later waves and variants suggest some of these disparities have reduced for some minority groups (4).

There is now strong evidence that having a long-term condition, such as diabetes, increases risk of severe COVID-19 outcomes. Due to the greater prevalence of comorbidities in some ethnic minority populations (5), this may be one factor explaining outcome disparities between ethnic groups (Fig. 1). However, despite the large volume of literature and many reviews focusing on the association between ethnicity and COVID-19, there is, to our knowledge, far less attention paid to

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PERSPECTIVES IN CARE

POOR CONTROL MEASURES
- Language barriers
- Increased vaccine hesitancy
- Poor access to public health messaging
- Poor uptake of or access to screening
- Structural discrimination

INCREASED EXPOSURE TO VIRUS
- Key worker roles
- Overcrowded and multigenerational housing
- Increased contact with others
- Dense housing
- Residing in deprived area
- Structural discrimination

INCREASED RISK OF COVID-19 IN ETHNIC MINORITY POPULATIONS

DISADVANTAGED SOCIAL ENVIRONMENT
- Poor working conditions
- Poverty
- Barriers to health care access
- Mistrust toward medical community
- Structural racism

INCREASED VULNERABILITY TO DISEASE
- Increased stress
- Increased comorbidities, including type 2 diabetes and obesity
- Worse comorbidity risk factor control
- Poor air quality
- Structural discrimination
- Biological differences

Figure 1—Potential reasons for COVID-19 disparities among ethnic minority populations.

examining differences in COVID-19 outcomes by ethnic groups in patients with diabetes.

Therefore, this Perspective summarizes the literature on prepandemic ethnic disparities in diabetes care as well as the wider context of disrupted diabetes care during the pandemic. It also provides an overview of the limited literature on ethnic disparities in COVID-19 in people with diabetes. Finally, this article concludes with a summary of potential explanatory mechanisms for ethnic disparities in COVID-19, interventions implemented to improve diabetes outcomes during the pandemic, structural determinants that require addressing, and recommendations for future research.

PREPANDEMIC DISPARITIES IN DIABETES CARE

Prior to the COVID-19 pandemic, numerous studies had reported major ethnic and socioeconomic disparities in diabetes care, particularly for intermediate outcomes and diabetes complications. For patients with type 1 diabetes, inequalities in access to technology and insulin pumps also exist. The combination of these ethnic disparities in diabetes care and outcomes has been a significant contributor to the predictable and undesirable inequity in COVID-19 outcomes for people with diabetes.

Internationally, ethnic and socioeconomic disparities in intermediate diabetes outcomes have been repeatedly demonstrated. For example, a 2013 U.S. study found that the Hispanic population was less likely to receive five diabetes quality-of-care recommendations, including twice-yearly HbA_{1c} tests and yearly foot exam, dilated eye exam, cholesterol test, and flu vaccination (6). Black patients were also less likely to receive HbA_{1c} tests, eye exams, and flu vaccination, and Asian patients were less likely to receive HbA_{1c} tests and annual foot and eye examinations. These differences were eliminated after adjusting for insurance status and education.

Similarly, in a nationally representative study of 164 English primary care practices, Black patients and people from the lowest socioeconomic status (SES) groups had higher HbA_{1c} than White patients and people from the highest SES groups (7). In a systematic review of 24 studies, Black patients were ~30% less likely to have HbA_{1c} and blood pressure control but were ~20–50% more likely to receive eye or foot examinations than White patients (8). A high school degree or higher was associated with a greater likelihood of HbA_{1c} control and eye examination. Other social determinants of health (i.e., income, access to care, and food insecurity) were also related,

albeit more weakly, to these intermediate outcomes.

The results of disparities in diabetes quality of care and intermediate outcomes have translated into well-characterized ethnic and socioeconomic disparities in eye, kidney, and cardiovascular disease. Black, Latino, and Asian patients all have higher rates of diabetic eye disease than non-Hispanic White patients (8). Additionally, Black, Latino, Asian, Filipino, and mixed-ethnicity patients all have been found to have higher rates of end-stage renal disease than non-Hispanic White patients within the Kaiser Permanente Northern California integrated health care delivery system (9). Furthermore, in a 2020 study of people with type 2 diabetes, South Asian patients had a higher cardiovascular disease risk than people of White ethnicity (10).

Studies in China, Sweden, and the U.S. have identified an association between low SES and increased diabetes complication rates. For example, in a Chinese cohort of over 25,000 patients with type 2 diabetes, the least educated population groups had the highest risk for cardiovascular disease, cerebrovascular disease, and retinopathy, and the lowest household income population had the highest rate of retinopathy and neuropathy (11). In a study of over 24,000 Swedish patients with type 1 diabetes, similarly, the risk of death was three times

higher among patients in the two lower income quintiles compared with the highest income quintile, and the risk for cardiovascular disease and stroke was twofold (12). Higher education was also associated with a lower risk of stroke. In the U.S., risk of death was ~1.5 times greater among those with the lowest education level and without measures of financial wealth, such as home ownership (13). Importantly, accounting for U.S. socioeconomic differences by ethnicity narrows the excess mortality attributed to diabetes for White and Hispanic populations but not for non-Hispanic Black populations (14).

IMPACT OF THE PANDEMIC ON DIABETES CARE FOR ETHNIC MINORITIES

Data from England suggest there was between a 74% and 88% reduction in care processes during the pandemic compared with prepandemic levels (15). Other work has also suggested reduced consultation rates and hospital admissions, 30% reduction in diabetes diagnoses, and 70% reduction in HbA_{1c} testing during the pandemic (16). Older patients from deprived areas experienced the largest reductions in health checks, but high-quality data on the differences by ethnic groups are lacking.

The few studies that have examined the impact of the pandemic on diabetes care have suggested that there have been no ethnic disparities in diabetes care. For example, in the U.K., a study of 618,161 people with type 2 diabetes from 1,744 general practices identified similar lower rates of performing health checks and prescribing diabetes medications by ethnicity (15). Interestingly, a study of a large academic U.S. health system reported a higher rate of eye exams among Black, Asian, and Hispanic patients with diabetes compared with White patients and no difference in HbA_{1c} and nephropathy testing (17). Of note, a major shift to telemedicine occurred during the pandemic, and one study of 1,292 patients did not identify ethnic disparities in telemedicine use for subspecialty diabetes care but did report lower rates of telemedicine use among people with a non-English primary language and older adults (18).

ETHNIC DISPARITIES IN COVID-19 OUTCOMES IN PEOPLE WITH DIABETES

Diabetes is a risk factor for severe COVID-19, including intensive care unit (ICU) admission and death (19). However, despite multiple publications reporting the association of ethnicity with COVID-19 outcomes in ethnic minority populations, very few studies have examined differences in COVID-19 outcomes by both ethnicity and diabetes (Table 1). The largest is a National Population Database study, which included 264,390 people with type 1 diabetes and 2,874,720 people with type 2 diabetes in England (20). Overall, in individuals with type 1 diabetes, South Asian, Black, mixed, and other ethnic groups had significantly higher mortality risk from COVID-19 versus White populations (20). For people with type 2 diabetes, risk of in-hospital mortality was greater for Asian, Black, and mixed ethnic groups but not for the other ethnic groups (20). The other ethnic groups included Vietnamese, Japanese, Filipino, Malaysian, and other ethnicities.

Another U.K. study of over 19,000 COVID-19 high-dependency-unit and ICU admissions found that of 3,524 patients with diabetes, 58.5% were White, 21.9% were Asian, 11.6% were Black, and 8% were mixed or other ethnicity. There was no evidence of a difference in COVID-19 mortality associated with type 2 diabetes in subgroups defined by ethnicity (21). Other U.K. data include a small, single-center study of 39 patients with end-stage renal disease secondary to diabetic kidney disease, which reported a higher prevalence of patients of African-Caribbean ethnicity hospitalized with COVID-19 (60%) versus White or other ethnic groups (22).

In a multisite, cross-sectional, observational study of 113 people in the U.S. with type 1 diabetes (n = 58 hospitalized), people of ethnic minority background (Black, Hispanic, and other) with confirmed COVID-19 were, on average, 3.63 times more likely to be hospitalized than non-Hispanic White patients (23). The same research group also subsequently reported a cohort of 180 patients with type 1 diabetes and laboratory-confirmed COVID-19, and they found that Black patients were significantly more likely to present with diabetic ketoacidosis

(DKA) than non-Hispanic White patients (24). Additionally, in a multisite prospective study of 137 service locations and 313 patients with type 1 and type 2 diabetes, compared with the White group, the Black group was significantly associated with hospitalization and worsening illness severity within 114 days of a positive COVID-19 test (25). However, a retrospective study of 6,104 people with type 2 diabetes from an ethnically diverse southern U.S. sample found 239 (39%) tested positive for COVID-19, but there were no significant differences in mortality between Black and White patients (26).

In a retrospective study from the University of Michigan, among those with diabetes, in the whole cohort Black patients were significantly more likely to be tested for COVID-19 and have positive test results than White patients; however, hospitalization, ICU admission, and mortality were not different for White and Black COVID-19 patients with type 2 diabetes (5). Another multisite study of 4,413 COVID-19 patients with type 2 diabetes admitted to New York hospitals reported that most patients were non-White (67.3%), with 27.1% Black, 17.2% Hispanic, and 24.9% multiethnic or other ethnicity (27). There was no significant association between ethnicity and mortality (27). Similarly, a nationwide retrospective cohort study in the U.K. (n = 19,256) reported no difference in mortality associated with type 2 diabetes in subgroups defined by ethnicity (21).

Overall, results from the few studies of COVID-19 in ethnic minority populations with diabetes are mixed, but there is some suggestion that the rates of hospitalization and mortality are higher than those of White populations. Although a number of larger population-level studies have been performed, these were all conducted in the U.K. or U.S., and there is a need for evidence from other countries, particularly lower- and middle-income countries. In addition, further work is needed to examine disparities for more granular ethnic groups (e.g., breaking down South Asian into Indian, Pakistani, etc.), although efforts may be hampered by poor ethnicity coding in routine health care data in many countries.

Table 1—Summary of studies on COVID-19–related outcomes by ethnic group in patients with diabetes

Reference	Country	Design	Population	Results
Corcillo et al. (22)	U.K.	Not stated	Type 1 and 2 diabetes	High prevalence of patients of Afro-Caribbean ethnicity hospitalized with COVID-19; 73% and 54% prevalence in renal transplant and hemodialysis groups, respectively. The mortality rate of the cohort was 36%.
Holman et al. (20)	U.K.	Population cohort	Type 1 and 2 diabetes	In individuals with type 1 diabetes, South Asian (HR 1.57, 95% CI 1.16–2.12), Black (HR 1.77, 95% CI 1.25–2.49), mixed (HR 1.77, 95% CI 1.25–2.49), and other ethnic groups (HR 1.89, 95% CI 1.03–2.37) had significantly higher mortality risk from COVID-19 than White populations. For people with type 2 diabetes, risk of in-hospital mortality was greater for Asian (HR 1.08, 95% CI 1.01–1.15), Black (HR 1.63, 95% CI 1.51–1.77), and mixed ethnic groups (HR 1.30 95% CI 1.10–1.55) but not for the other ethnic groups (HR 1.01, 95% CI 0.86–1.18).
Dennis et al. (21)	U.K.	Retrospective cohort	Type 2 diabetes	No difference in mortality associated with type 2 diabetes in subgroups defined by ethnicity.
Crouse et al. (26)	U.S.	Retrospective data registry	Type 2 diabetes	In COVID-19–positive patients ($n = 604$), diabetes was associated with increased mortality (OR 3.62, 95% CI 2.11–6.2), adjusting for age, sex, ethnicity, obesity, and hypertension. Ethnicity was not an independent predictor of mortality.
Ebekozien et al. (24)	U.S.	Observational	Type 1 diabetes	Non-Hispanic Black (11.7 [IQR 4.7]) and Hispanic (9.7 [IQR 3.1]) patients had higher median HbA_{1c} than White patients (8.3 [IQR 2.4]). More non-Hispanic Black (55%) and Hispanic (33%) patients presented with DKA than White patients (13%). Adjusting for confounders, non-Hispanic Black patients continued to have greater odds of presenting with DKA than non-Hispanic White patients (OR 3.7, 95% CI 1.4–10.61).
Gold et al. (63)	U.S.	Prospective	Type 1 and 2 diabetes	Among 305 patients, 121 (39.7%) had diabetes, of whom 103 (41.7%) were of Black ethnicity and 56 (32.0%) were of other ethnicities. Clinical outcomes (discharged alive, still hospitalized, needed invasive mechanical ventilation, and death) were similar between Black and non-Black individuals.
Gregory et al. (25)	U.K.	Prospective cohort	Type 1 and 2 diabetes	Compared with patients without diabetes, patients with type 1 diabetes had adjusted ORs for hospitalization risk of 3.90 (95% CI 1.75–8.69) and worsening illness severity of 3.35 (95% CI 1.53–7.33). For patients with type 2 diabetes, adjusted ORs were 3.36 (95% CI 2.49–4.55) for hospitalization, 3.42 (95% CI 2.55–4.58) for worsening illness severity, and 3.21 (95% CI 1.54–6.70) for death. Adjusted risk of worsening illness severity for Black versus White ethnic groups was 1.88 (95% CI 1.47–2.41).
Gu et al. (5)	U.S.	Retrospective cohort	Type 2 diabetes	In the COVID-19–positive cohort ($n = 1,139$), Black patients were more likely to be hospitalized (OR 1.72, 95% CI 1.15–2.58). No difference was found in ICU admission by ethnicity after adjusting for covariates. Type 2 diabetes was associated with hospitalization in White (OR 2.59, 95% CI 1.49–4.48) but not Black (OR 1.17, 95% CI 0.66–2.06) patients.

Table 1—Continued

Reference	Country	Design	Population	Results
Kabarriti et al. (47)	U.S.	Retrospective	Type 1 and 2 diabetes	Of 5,902 patients who tested positive for COVID-19, 509 (8.6%) were non-Hispanic White, 1,935 (32.8%) were non-Hispanic Black, 1,905 (32.3%) were Hispanic, 171 (2.9%) were Asian, and 1,382 (23.4%) were other/unknown/decline to answer. Overall, 74 (14.5%) non-Hispanic White, 162 (8.4%) non-Hispanic Black, 175 (9.2%) Hispanic, 36 (21.1%) Asian, and 388 (28.1%) unknown/other ethnic group patients had diabetes. Overall, in adjusted analysis, Hispanic or non-Hispanic Black patients had significantly improved survival versus non-Hispanic White patients.
Myers et al. (27)	U.S.		Type 2 diabetes	Of 4,413 patients examined by multivariate analysis, male sex, older age, and admission hyperglycemia associated with increased mortality and intubation but not ethnicity, insurance type, or HbA$_{1c}$ level.
O'Malley et al. (23)	U.S.	Multisite observational	Type 1 diabetes	Of 58 hospitalized COVID-19 patients, 26 were admitted to ICU and 5 male patients died. Hospitalization was more likely for increasing age, minority ethnicity (OR 3.63, 95% CI 1.42–9.70), and cardiovascular disease.
Price-Haywood et al. (64)	U.S.	Retrospective	Diabetes (does not state which type)	Of 3,481 COVID-19 patients, 2,451 (70.4%) were non-Hispanic Black and 1,030 (29.6%) were non-Hispanic White. Overall, 454 (18.5%) Black and 112 (10.9%) White patients had diabetes. In adjusted analysis, Black ethnicity was not associated with mortality.

IQR, interquartile range.

POTENTIAL PREDISPOSING FACTORS FOR ETHNIC DISPARITIES IN COVID-19

Ethnic disparities in rate, severity, and mortality from COVID-19 infection were evident early in the pandemic. Understanding the impact of ethnicity on COVID-19–related outcomes was initially hampered by a lack of data reporting patient ethnicity. However, with a greater appreciation, as the pandemic evolved, of associations of ethnicity with poorer COVID-19 outcomes, studies are now shedding light on the potential factors predisposing ethnic minorities to poorer clinical COVID-19 outcomes. The exact reasons for the higher incidence and severity of COVID-19–related outcomes in minority ethnic groups are complex and involve social, economic, cultural, and lifestyle factors and pathophysiological differences (28). These parameters then modulate, within ethnic populations, exposure to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), vulnerability to the disease, social environment, control measures, and biological differences (Fig. 1).

Increased Exposure to COVID-19

Greater exposure to the virus raises the likelihood individuals will contract COVID-19. During the pandemic, workers with essential occupations had increased frequency of contact with other individuals, for example, workers in health care settings, those who work indoors in crowded spaces, or workers making frequent contact with multiple people, such as those in transport and retail. Indeed, ethnic minority groups were overrepresented in a nationwide investigation of occupations classified as essential during the pandemic (29). This included medical staff, such as registered nurses, medical assistants, and bus drivers. A study of frontline health care workers (n = 99,795) versus the general community (n = 2,035,395) found higher risk of a positive COVID-19 test result for frontline health care workers (hazard ratio [HR] 3.40) after adjusting for multiple parameters, including their elevated likelihood of receiving a COVID-19 test (30). Secondary post hoc analyses found that frontline minority workers are at increased risk of a positive COVID-19 test compared with White coworkers. In New York City (NYC), frontline workers were overrepresented in Black (29.4%) and Hispanic (35.5%) populations (31). Therefore, one possible reason predisposing ethnic minorities to poorer outcome is greater exposure to the virus through overrepresentation of these groups in essential frontline jobs.

Increased Vulnerability to COVID-19

Another potential contributing factor to adverse COVID-19 outcomes, which was considered relatively early in the pandemic, is the high prevalence of comorbid conditions in ethnic minority populations (32), which is associated with increased hospitalization rate, ICU admission, and mortality. A study of UK Biobank data with 5,623 COVID-19 cases found that BMI was associated with a positive test in all patients, but that higher BMI (>30 kg/m^2) was a stronger determinant of a positive test in Black and minority ethnic patients than in White patients (33). Evaluation of NYC data found a relationship in the two boroughs with the highest COVID-19 mortality rate and the highest obesity rate, which was

most prevalent among Black and Hispanic residents (34). Notably, however, the study did not fully adjust for all potential risk factors. Another NYC study found that poorer neighborhoods had greater hypertension risk among Black residents (relative risk [RR] 3.4) and diabetes risk among Hispanic residents (RR 5.5) compared with residents of poorer White neighborhoods (31). Furthermore, poorer predominantly Black and Hispanic neighborhoods had more ICU admissions than poorer predominantly White neighborhoods. In addition, a nationwide U.S. county-level investigation found, after multiple adjustments, that counties with higher percentages of Black residents had a greater prevalence of comorbid conditions and COVID-19 diagnoses (RR 1.24) and deaths (RR 1.18) (35).

Disadvantaged Social Environment

Beyond potential health determinants, such as comorbidities, on COVID-19 outcomes for Black and Hispanic patients, several socioeconomic factors have been investigated. Urban setting, household crowding, income, lack of transportation, health insurance availability, and health care access could conceivably impact COVID-19 outcomes (29–31,35,36), although there is some discordance across studies (37). These determinants may also be differentially present by ethnicity, although few COVID-19 studies have been stratified by ethnicity.

Analysis of NYC electronic health records (n = 23,300) found a correlation between social disadvantage (compared by quintiles) and higher likelihood of Black or Hispanic ethnicity, of chronic comorbid conditions (e.g., diabetes, obesity, and hypertension), and higher hospitalization risk from COVID-19 (38). County-level analysis also found, after multiple adjustments, correlations between counties with greater burden of COVID-19 cases and the proportion of Black and Hispanic residents and counties with greater burden of COVID-19 deaths and the proportion of Black and Native American residents (36). A greater proportion of multiunit households and households lacking a vehicle correlated positively with cases and deaths, respectively. Another study also found a relationship between public transportation use (i.e., household lacking vehicles) (39) and mean household size (40) with COVID-19 cases, which are likely contributors in disadvantaged communities. In a nationwide U.S. county-level study, lack of health insurance was a greater risk factor for COVID-19 diagnosis in counties with a percentage of Black residents above the national average (35).

In addition to housing, transportation, income, and insurance status, opioid and other substance use disorders are contributors to adverse COVID-19 outcomes in the U.S. Nationwide, Black individuals with opioid use disorders (odds ratio [OR] 4.16) and substance use disorders (OR 2.17) were at higher COVID-19 risk than White individuals (41), although the analysis did not adjust for comorbidities.

Poor Control Measures

Control measures are used to limit viral spread in the community through awareness campaigns. However, ethnic minorities may experience language barriers, lower access to public health messaging, poor uptake or access to screening, and structural discrimination, leading to suboptimal control measures. County-level analysis by a U.S. study found that individuals with limited English proficiency were more likely to suffer COVID-19 deaths after multiple adjustments (36). In a nationwide study, ethnic minority status and language subindex correlated positively with COVID-19 incidence and mortality rates after adjusting for population density, urbanicity, and COVID-19 testing rate (42). Regarding uptake of public health messaging, a cross-sectional U.S. survey of 1,435 adults found that non-Hispanic White (30.7%) and Asian (25.0%) participants were likelier to correctly answer all 14 questions concerning COVID-19 versus Hispanic (19.7%) and non-Hispanic Black (15.8%) participants (43). Thus, it is possible that preventative control measures through public health campaigns are failing in ethnic minority communications.

An additional possible predisposing factor is medical mistrust, which can result from prior experience of unethical medical practices. Though understandable, this mistrust can represent a barrier to seeking medical care in the present. In a California cohort of Black individuals with HIV (n = 101), most (97%) held at least one general COVID-19 mistrust belief and over 50% held COVID-19 vaccine or treatment hesitancy beliefs (44). In a large U.K. study of 32,361 adults in the University College London COVID-19 Social Study, distrust of vaccines was higher among people of ethnic minority backgrounds than among White people (45). Therefore, overall, in addition to greater exposure and susceptibility, people from ethnic minorities may also be predisposed to more serious COVID-19 outcomes due to poorer control measures.

Biological Differences

Finally, it is important to note that although systematic reviews and meta-analyses associate ethnicity with poorer COVID-19 outcomes, some studies report no disparities or even protective effects (46–49). Nevertheless, in studies that do identify risk in Black, Hispanic, or other minority ethnic groups, this risk persists even after adjusting for comorbidities and socioeconomic factors (2,50–53). This suggests there are biological differences underlying differential responses of ethnicity to COVID-19. One possibility, given its pivotal role in promoting viral entry into host cells, is differential ACE2 expression by ethnicity (54) as well as of other molecules related to SARS-CoV-2 pathophysiology, e.g., immune function. Another possible aspect is single nucleotide polymorphisms in genes involved in SARS-CoV-2 infection, such as TMPRSS2, in addition to ACE2 (55,56). Caution in interpretation is required, however, because these potential mechanisms require further work. It is also possible that plausible biological mechanisms will be politicized to minimize criticisms of structural racism, which underpins social inequalities driving long-standing health inequalities in ethnic minority populations.

Overall, emerging evidence implicates multiple potential determinants of ethnic disparity in COVID-19 outcomes. Moving forward, a better understanding will be facilitated by stratifying study data sets by ethnicity (the most granular ethnic group data should be used when available). Additionally, most studies to date have been correlative. Although it will be challenging, future investigations should establish causality in order to implement evidence-based policies to alleviate disparities.

NEXT STEPS AND FUTURE RESEARCH PRIORITIES

As we now plan for recovery, improved surveillance, and risk factor management, it will be imperative that primary and specialist care services urgently address the disproportionate impact the pandemic has had on ethnic minority groups. Recommended interventions for diabetes patients during the pandemic, which has disproportionately impacted ethnic minority populations, focused on individual-level strategies and barriers to diabetes care (57–60) but excluded the larger structural barriers, which placed ethnic minorities with diabetes at particular risk for poor COVID-19 outcomes from the outset. These barriers include structural inequities in adequate housing, food, education, employment opportunities, and neighborhood resources, among others, which are important determinants of health for both diabetes and COVID-19 independently but particularly for individuals in high-risk populations within both groups (e.g., ethnic minorities).

Prioritizing affordable housing, a living wage, economic investments in ethnic minority communities, and policy changes to mitigate ethnic residential segregation are some long-term strategies to address the underlying housing and related economic challenges faced by ethnic minorities, particularly low-income minorities. Implementing these changes would strengthen the resilience of this population in weathering pandemics and natural disasters as well as in managing chronic diseases, such as diabetes, which require stable housing, refrigeration (for many types of insulin storage), and safe spaces for physical activity as part of optimal self-management.

Structural interventions, like equal access to high-quality education and employment opportunities, implementing a living wage, and job retraining for those impacted by the changing economy or who are reentering the workforce, can affect the short-term and long-term health trajectories of ethnic minority individuals with diabetes. Regular employment usually provides access to health insurance (for U.S. residents), and the use of supporting federal policies to provide paid sick leave and quarantine leave for COVID-19 is another way, along with pandemic mitigation, to ensure individual assistance reaches patients.

The pandemic also impacted food insecurity, which saw a large rise during this period. Before the pandemic, over 35 million Americans faced food insecurity, which rose to over 50 million, disproportionately affecting families and children (61). Food insecurity also disproportionately impacts ethnic minorities, low-income individuals, and other socially marginalized populations. Previous studies showed that for patients with diabetes, food insecurity is associated with worse diabetes self-management, up to twice the odds of poor diabetes control, and higher hospitalization rates (62). Supporting economic policies that reduce poverty and food policies that reduce food insecurity, such as increased eligibility for the Supplemental Nutrition Assistance Program in the U.S., will help improve diabetes outcomes.

As we move into the recovery phase, postpandemic research should focus on developing and evaluating interventions to address these disparities in the short and long term for all ethnic minority populations with long-term conditions such as diabetes. This should involve both individual-level and wider systems-level approaches. In addition, a number of other priorities require further attention. Given limited published reports, there is a need to utilize large population cohorts to further examine disparities in COVID-19 outcomes in ethnic minority populations with diabetes. It will also be important to further examine the impact of the pandemic on diabetes care for ethnic minorities, as limited work has been done in this area. Other outstanding issues include whether there are therapeutic differences in patients from ethnic minority populations with diabetes who were admitted with COVID-19 or who are positive for COVID-19 compared with White populations and if there are differential effects of therapies in ethnic minority groups with diabetes. Are new models of care, such as telemedicine, widening health disparities for ethnic minority populations with diabetes?

In summary, the structural inequities highlighted by the coronavirus pandemic, which have driven many of the disparities in COVID-19 morbidity and mortality, have exacerbated existing health disparities in diabetes among ethnic minority populations. While there have been many helpful guidelines and approaches for diabetes self-management as well as outpatient and inpatient care during the pandemic, few have recommended addressing structural drivers. Only by taking a long-term, holistic view of health and health care will we, and particularly our most vulnerable populations, be better able to weather future pandemics.

References

1. Sze S, Pan D, Nevill CR, et al. Ethnicity and clinical outcomes in COVID-19: a systematic review and meta-analysis. EClinicalMedicine 2020;29: 100630

2. Williamson EJ, Walker AJ, Bhaskaran K, et al. Factors associated with COVID-19-related death using OpenSAFELY. Nature 2020;584:430–436

3. Mathur R, Rentsch CT, Morton CE, et al.; OpenSAFELY Collaborative. Ethnic differences in SARS-CoV-2 infection and COVID-19-related hospitalisation, intensive care unit admission, and death in 17 million adults in England: an observational cohort study using the OpenSAFELY platform. Lancet 2021;397:1711–1724

4. Nafilyan V, Islam N, Mathur R, et al. Ethnic differences in COVID-19 mortality during the first two waves of the coronavirus pandemic: a nationwide cohort study of 29 million adults in England. Eur J Epidemiol 2021;36:605–617

5. Gu T, Mack JA, Salvatore M, et al. Characteristics associated with racial/ethnic disparities in COVID-19 outcomes in an academic health care system. JAMA Netw Open 2020;3:e2025197

6. Canedo JR, Miller ST, Schlundt D, Fadden MK, Sanderson M. Racial/ethnic disparities in diabetes quality of care: the role of healthcare access and socioeconomic status. J Racial Ethn Health Disparities 2018;5:7–14

7. Whyte MB, Hinton W, McGovern A, et al. Disparities in glycaemic control, monitoring, and treatment of type 2 diabetes in England: a retrospective cohort analysis. PLoS Med 2019;16: e1002942

8. Lee W, Lloyd JT, Giuriceo K, Day T, Shrank W, Rajkumar R. Systematic review and meta-analysis of patient race/ethnicity, socioeconomics, and quality for adult type 2 diabetes. Health Serv Res 2020;55:741–772

9. Karter AJ, Laiteerapong N, Chin MH, et al. Ethnic differences in geriatric conditions and diabetes complications among older, insured adults with diabetes: the diabetes and aging study. J Aging Health 2015;27:894–918

10. Coles B, Zaccardi F, Ling S, Davies MJ, Samani NJ, Khunti K. Cardiovascular events and mortality in people with and without type 2 diabetes: an observational study in a contemporary multi-ethnic population. J Diabetes Investig 2021;12: 1175–1182

11. Tao X, Li J, Zhu X, et al.; CCMR-3B STUDY Investigators. Association between socioeconomic status and metabolic control and diabetes complications: a cross-sectional nationwide study in Chinese adults with type 2 diabetes mellitus. Cardiovasc Diabetol 2016;15:61

12. Rawshani A, Svensson AM, Rosengren A, Eliasson B, Gudbjörnsdottir S. Impact of socio-economic status on cardiovascular disease and mortality in 24,947 individuals with type 1 diabetes. Diabetes Care 2015;38:1518–1527

13. Saydah SH, Imperatore G, Beckles GL. Socioeconomic status and mortality: contribution of health care access and psychological distress among U.S. adults with diagnosed diabetes. Diabetes Care 2013;36:49–55

14. Mercado C, Beckles G, Cheng Y, et al. Trends and socioeconomic disparities in all-cause mortality among adults with diagnosed diabetes by race/ethnicity: a population-based cohort study - USA, 1997-2015. BMJ Open 2021;11:e044158

15. Carr MJ, Wright AK, Leelarathna L, et al. Impact of COVID-19 restrictions on diabetes health checks and prescribing for people with type 2 diabetes: a UK-wide cohort study involving 618 161 people in primary care. BMJ Qual Saf 2022;31:503–514

16. Carr MJ, Wright AK, Leelarathna L, et al. Impact of COVID-19 on diagnoses, monitoring, and mortality in people with type 2 diabetes in the UK. Lancet Diabetes Endocrinol 2021;9: 413–415

17. Kim E, Kojima N, Vangala S, et al. Impact of COVID-19 on primary care quality measures in an academic integrated health system. J Gen Intern Med 2022;37:1161–1168

18. Haynes SC, Kompala T, Neinstein A, Rosenthal J, Crossen S. Disparities in telemedicine use for subspecialty diabetes care during COVID-19 shelter-in-place orders. J Diabetes Sci Technol 2021;15:986–992

19. Hartmann-Boyce J, Rees K, Perring JC, et al. Risks of and from SARS-CoV-2 infection and COVID-19 in people with diabetes: a systematic review of reviews. Diabetes Care 2021;44:2790–2811

20. Holman N, Knighton P, Kar P, et al. Risk factors for COVID-19-related mortality in people with type 1 and type 2 diabetes in England: a population-based cohort study. Lancet Diabetes Endocrinol 2020;8:823–833

21. Dennis JM, Mateen BA, Sonabend R, et al. Type 2 diabetes and COVID-19-related mortality in the critical care setting: a national cohort study in England, March-July 2020. Diabetes Care 2021; 44:50–57

22. Corcillo A, Cohen S, Game D, Karalliedde J. High prevalence of Afro-Caribbean ethnicity and hypoglycaemia in patients with diabetes and end stage renal disease hospitalized with COVID-19. Nephrology (Carlton) 2021;26:252–254

23. O'Malley G, Ebekozien O, Desimone M, et al. COVID-19 hospitalization in adults with type 1 diabetes: results from the T1D Exchange multi-center surveillance study. J Clin Endocrinol Metab 2021;106:e936–e942

24. Ebekozien O, Agarwal S, Noor N, et al. Inequities in diabetic ketoacidosis among patients with type 1 diabetes and COVID-19: data from 52 US clinical centers. J Clin Endocrinol Metab 2021;106:e1755–e1762

25. Gregory JM, Slaughter JC, Duffus SH, et al. COVID-19 severity is tripled in the diabetes community: a prospective analysis of the pandemic's impact in type 1 and type 2 diabetes. Diabetes Care 2021;44:526–532

26. Crouse AB, Grimes T, Li P, Might M, Ovalle F, Shalev A. Metformin use is associated with reduced mortality in a diverse population with COVID-19 and diabetes. Front Endocrinol (Lausanne) 2021; 11:600439

27. Myers AK, Kim TS, Zhu X, Liu Y, Qiu M, Pekmezaris R. Predictors of mortality in a multi-racial urban cohort of persons with type 2 diabetes and novel coronavirus 19. J Diabetes 2021;13:430–438

28. Khunti K, Singh AK, Pareek M, Hanif W. Is ethnicity linked to incidence or outcomes of Covid-19? BMJ 2020;369:m1548

29. Hawkins D. Differential occupational risk for COVID-19 and other infection exposure according to race and ethnicity. Am J Ind Med 2020;63: 817–820

30. Nguyen LH, Drew DA, Graham MS, et al.; COronavirus Pandemic Epidemiology Consortium. Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. Lancet Public Health 2020;5: e475–e483

31. Arasteh K. Prevalence of comorbidities and risks associated with COVID-19 among Black and Hispanic populations in New York City: an examination of the 2018 New York City community health survey. J Racial Ethn Health Disparities 2021;8:863–869

32. Feldman EL, Savelieff MG, Hayek SS, Pennathur S, Kretzler M, Pop-Busui R. COVID-19 and diabetes: a collision and collusion of two diseases. Diabetes 2020;69:2549–2565

33. Razieh C, Zaccardi F, Davies MJ, Khunti K, Yates T. Body mass index and the risk of COVID-19 across ethnic groups: analysis of UK Biobank. Diabetes Obes Metab 2020;22:1953–1954

34. El Chaar M, King K, Galvez Lima A. Are Black and Hispanic persons disproportionately affected by COVID-19 because of higher obesity rates? Surg Obes Relat Dis 2020;16:1096–1099

35. Millett GA, Jones AT, Benkeser D, et al. Assessing differential impacts of COVID-19 on black communities. Ann Epidemiol 2020;47:37–44

36. Samuel LJ, Gaskin DJ, Trujillo AJ, Szanton SL, Samuel A, Slade E. Race, ethnicity, poverty and the social determinants of the coronavirus divide: U.S. county-level disparities and risk factors. BMC Public Health 2021;21:1250

37. Miller J, Fadel RA, Tang A, et al. The impact of sociodemographic factors, comorbidities, and physiologic responses on 30-day mortality in coronavirus disease 2019 (COVID-19) patients in metropolitan Detroit. Clin Infect Dis 2021;72: e704–e710

38. Zhang Y, Khullar D, Wang F, et al. Socio-economic variation in characteristics, outcomes, and healthcare utilization of COVID-19 patients in New York City. PLoS One 2021;16:e0255171

39. McCoy D, Mgbara W, Horvitz N, Getz WM, Hubbard A. Ensemble machine learning of factors influencing COVID-19 across US counties. Sci Rep 2021;11:11777

40. Figueroa JF, Wadhera RK, Lee D, Yeh RW, Sommers BD. Community-level factors associated with racial and ethnic disparities in COVID-19 rates in Massachusetts. Health Aff (Millwood) 2020;39:1984–1992

41. Wang QQ, Kaelber DC, Xu R, Volkow ND. COVID-19 risk and outcomes in patients with substance use disorders: analyses from electronic health records in the United States. Mol Psychiatry 2021;26:30–39

42. Karmakar M, Lantz PM, Tipirneni R. Association of social and demographic factors with COVID-19 incidence and death rates in the US. JAMA Netw Open 2021;4:e2036462

43. Jones J, Sullivan PS, Sanchez TH, et al. Similarities and differences in COVID-19 awareness, concern, and symptoms by race and ethnicity in the United States: cross-sectional survey. J Med Internet Res 2020;22:e20001

44. Bogart LM, Ojikutu BO, Tyagi K, et al. COVID-19 related medical mistrust, health impacts, and potential vaccine hesitancy among Black Americans living with HIV. J Acquir Immune Defic Syndr 2021;86:200–207

45. Paul E, Steptoe A, Fancourt D. Attitudes towards vaccines and intention to vaccinate against COVID-19: implications for public health communications. Lancet Reg Health Eur 2021;1: 100012

46. Petrilli CM, Jones SA, Yang J, et al. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease

2019 in New York City: prospective cohort study. BMJ 2020;369:m1966

47. Kabarriti R, Brodin NP, Maron MI, et al. Association of race and ethnicity with comorbidities and survival among patients with COVID-19 at an urban medical center in New York. JAMA Netw Open 2020;3:e2019795

48. Suleyman G, Fadel RA, Malette KM, et al. Clinical characteristics and morbidity associated with coronavirus disease 2019 in a series of patients in metropolitan Detroit. JAMA Netw Open 2020;3:e2012270

49. Bhargava A, Fukushima EA, Levine M, et al. Predictors for severe COVID-19 infection. Clin Infect Dis 2020;71:1962–1968

50. Lassale C, Gaye B, Hamer M, Gale CR, Batty GD. Ethnic disparities in hospitalisation for COVID-19 in England: the role of socioeconomic factors, mental health, and inflammatory and pro-inflammatory factors in a community-based cohort study. Brain Behav Immun 2020;88:44–49

51. Azar KMJ, Shen Z, Romanelli RJ, et al. Disparities in outcomes among COVID-19 patients in a large health care system in California. Health Aff (Millwood) 2020;39:1253–1262

52. Raisi-Estabragh Z, McCracken C, Bethell MS, et al. Greater risk of severe COVID-19 in Black, Asian and minority ethnic populations is not explained by cardiometabolic, socioeconomic or behavioural factors, or by 25(OH)-vitamin D status: study of 1326 cases from the UK Biobank. J Public Health (Oxf) 2020;42:451–460

53. Barron E, Bakhai C, Kar P, et al. Associations of type 1 and type 2 diabetes with COVID-19-related mortality in England: a whole-population study. Lancet Diabetes Endocrinol 2020;8: 813–822

54. Singh U, Hernandez KM, Aronow BJ, Wurtele ES. African Americans and European Americans exhibit distinct gene expression patterns across tissues and tumors associated with immunologic functions and environmental exposures. Sci Rep 2021;11:9905

55. Li Q, Cao Z, Rahman P. Genetic variability of human angiotensin-converting enzyme 2 (hACE2) among various ethnic populations. Mol Genet Genomic Med 2020;8:e1344

56. Hou Y, Zhao J, Martin W, et al. New insights into genetic susceptibility of COVID-19: an ACE2 and TMPRSS2 polymorphism analysis. BMC Med 2020;18:216

57. Wicaksana AL, Hertanti NS, Ferdiana A, Pramono RB. Diabetes management and specific considerations for patients with diabetes during coronavirus diseases pandemic: a scoping review. Diabetes Metab Syndr 2020;14:1109–1120

58. Banerjee M, Chakraborty S, Pal R. Diabetes self-management amid COVID-19 pandemic. Diabetes Metab Syndr 2020;14:351–354

59. Singh AK, Gupta R, Ghosh A, Misra A. Diabetes in COVID-19: prevalence, pathophysiology, prognosis and practical considerations. Diabetes Metab Syndr 2020;14:303–310

60. Sinclair A, Dhatariya K, Burr O, et al. Guidelines for the management of diabetes in care homes during the Covid-19 pandemic. Diabet Med 2020;37:1090–1093

61. Feeding America. The impact of the coronavirus on food insecurity in 2020. FeedingAmerica.org. Accessed 17 August 2021. Available from https://www.feedingamerica.org/sites/default/files/2020-10/Brief_Local%20Impact_10.2020_0.pdf

62. Berkowitz SA, Baggett TP, Wexler DJ, Huskey KW, Wee CC. Food insecurity and metabolic control among U.S. adults with diabetes. Diabetes Care 2013;36:3093–3099

63. Gold JAW, Wong KK, Szablewski CM, et al. Characteristics and clinical outcomes of adult patients hospitalized with COVID-19—Georgia, March 2020. MMWR Morb Mortal Wkly Rep 2020;69:545–550

64. Price-Haywood EG, Burton J, Fort D, Seoane L. Hospitalization and mortality among Black patients and White patients with Covid-19. N Engl J Med 2020;382:2534–2543