The Social Determinants of Health for Infertility:

How financial, educational, racial, and social disparities affect access and outcomes of fertility treatment.

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In 2005, the World Health Organization (WHO) established a Commission on Social Determinants of Health (CDSH) to promote health equity between and within countries. After several years, the WHO CDSH published the report, *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health*. The report defines the social determinants of health as "the conditions in which people are born, grow, live, work and age." The organization asserts, "these circumstances are shaped by the distribution of money, power, and resources at global, national, and local levels."[1] The circumstances are associated with health inequities, based on race, gender, sexual orientation, geographic location, and socioeconomic status. In the United States, these inequities are most often associated with chronic disease and life expectancy.[2] However, health inequities occur in all medical specialties, including infertility prevention and treatment. When considering the cost of treatment, access of care, and differences in success rates, the social determinants of health have profound effects on infertile individuals.[3] Therefore, it is important to consider how financial, educational, racial, and social disparities affect access and outcomes of fertility treatment in the United States.

Since the WHO established the CDSH, there has been an advance of research on the social determinants of health. From 2006 to 2016, the annual number of papers indexed with the term 'social determinants' increased from 88 to 1,024.[2] The expansion of research corresponded with several initiatives on the social determinants of health and disease. The Healthy People initiative by the United States Department of Health and Human

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[1] World Health Organization, *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health*, 9-10.
[2] Cockerham, Hamby, and Oates, "The Social Determinants of Chronic Disease," 2-9.
[3] Ethics Committee of the American Society for Reproductive Medicine, "Disparities in Access to Effective Treatment for Infertility in the United States," 1-5.

Services provides a theoretical perspective on health promotion and disease prevention. It includes five important social determinants of health, outlined as "economic stability, education, social and community context, health and health care, and neighborhood and built environment." Each of the determinants represents a number of issues that have been used to identify resources and objectives. From these efforts, the Healthy People 2000 goal of "reduce health disparities" was strengthened to "eliminate health disparities" in Healthy People 2010. This initiative was furthered in Healthy People 2020, with the goal of "eliminating health disparities by creating social and physical environments that promote good health for all. "[4] Despite these initiatives, there remain significant health disparities in the United States that should be discussed.

In the past decade, data from the Centers for Disease Control and Prevention (CDC) have demonstrated that education, income, and race are social determinants that lead to health inequities. These data show that when comparing life expectancy by educational attainment, 25 year old men with "less than high school" education had a life expectancy of 47.1 years, compared to 56.4 for male "college graduates." Similarly, 25 year old women with "less than high school" education had a life expectancy of 51.7 years, compared to 60.3 for female "college graduates"(Figure 1).[5] In regard to income, CDC data on adolescent health found that 30.4% of children had "less than very good health" in families at <100% federal poverty level, compared to 6.9% of children in families at >400% federal poverty level (Figure 2). Similar data on adult health found that 32.2% of adults had "activity-limiting chronic disease" in families at <100% federal poverty level, compared to 9.4% of

[4] Healthy People 2020, "Social Determinants of Health."
[5] Braveman and Gottlieb, "The Social Determinants of Health," 2-5.

adults in families at >400% federal poverty level (Figure 3). Further studies demonstrate health inequities between racial and ethnic groups in the United States. When controlling for educational attainment, the "percent of adults aged 25-74 years old in poor/fair health" was significantly higher in Black, Hispanic, and American Indian groups than in White and Asian groups.[6] While these data establish that social determinants of health lead to health inequities, there have been few studies focused on reproductive endocrinology and infertility.

In order to discuss disparities in access and outcomes of fertility treatment, it is important to understand infertility. The CDC defines infertility as "not being able to get pregnant (conceive) after one year (or longer) of unprotected sex."[7] According to the National Institute of Health, "Studies suggest that after one year of having unprotected sex, 12% to 15% of couples are unable to conceive, and after two years, 10% of couples still have not had a live-born baby." In the United States, about 11% of women and 9% of men of reproductive age experience problems with fertility.[8] Infertility in women is often caused by conditions affecting the ovaries, fallopian tubes, and uterus, while infertility in men is often caused by disruption of testicular or ejaculatory function, hormonal disorders, and genetic disorders.[6] In both women and men, fertility declines with age, though more gradually in men than women. In the multicenter clinical trial "Assessment of Multiple Intrauterine Gestations from Ovarian Stimulation" (AMIGOS), researchers found that age is the primary predictor of fertility outcomes in patients with unexplained infertility.[9]

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[6] Braveman and Gottlieb, "The Social Determinants of Health," 2-5.
[7] Centers for Disease Control and Prevention, "Reproductive Health."
[8] National Institute of Health, "Fertility and Infertility."
[9] Diamond M, et al. "Assessment of Multiple Intrauterine Gestations from Ovarian Stimulation (AMIGOS) Trial," 970-972.

An infertility evaluation is often initiated after one year of unprotected intercourse without pregnancy. The evaluation may be considered earlier when pre-existing medical conditions, such as pelvic inflammatory disease or amenorrhea, could cause infertility. Additionally, evaluation may be initiated when the female partner is older than 35 years, "as advanced maternal age decreases fertility rates and increases spontaneous miscarriage and chromosomal abnormality rates."[10] According to the American Academy of Family Physicians, evaluation for both female and male patients should include medical history, physical exam, and laboratory tests for hormone function. Female patients should also be assessed for ovulatory dysfunction, ovarian reserve, and anatomical abnormalities, while male patients should undergo semen analysis, post-ejaculatory urinalysis, and scrotal and transrectal ultrasonography. During evaluation, both partners should be counseled to avoid alcohol, tobacco, and fertility-impairing medications. Additionally, women should be advised to limit caffeine intake.[10] These recommendations, in combination with healthy weight, diet, and exercise, should promote fertility.

Following evaluation, infertility can be treated with medicine, surgery, intrauterine insemination, or assisted reproductive technology. Individual treatment is recommended based on age of the woman, duration of infertility, and factors contributing to infertility.[11] In women, common medicines used to treat infertility include clomiphene citrate, letrozole, and human menopausal gonadotropin. The surgical treatments for female infertility include repairing blocked or damaged fallopian tubes, treating endometriosis, or removing polyps or fibroids in the uterus.[12] For male infertility, surgical treatment includes repairing

[10] Jose-Miller A, Boyden J, and Frey M, "Infertility," 849-856.
[11] Centers for Disease Control and Prevention, "Reproductive Health."
[12] American College of Obstetricians and Gynecologists. "Treating Infertility."

swollen veins in the scrotum. If the patient pursues intrauterine insemination (IUI), sperm is introduced into the uterus at the time of ovulation. Alternatively, assisted reproductive technology (ART) processes both the sperm and egg. This often involves in vitro fertilization (IVF), where the sperm and egg are combined in a laboratory before the embryo is transferred into the uterus.[13] In the AMIGOS study, researchers found that the method of infertility treatment is the second strongest predictor of fertility outcomes.[14]

In "Social Determinants of Infertility: Beyond the Obvious," Dr. Sarah Begra analyzes the results of the AMIGOS study. She concludes that following age and treatment, income is the third strongest predictor of fertility outcomes. In the study, couples reporting their annual income as >$50,000 had higher conception rates, live birth rates, and lower miscarriage rates. The rate of clinical pregnancy loss in higher income patients was 11.9%, compared to 28.6% in lower income patients. Through the analysis, Dr. Begra discusses how chronic low level stress delays conception and increases infertility. She states, "While income disparity may not be sufficiently stressful to typically elicit complete anovulation and amenorrhea, it may induce subtle ovarian impairment that is clinically difficult to detect and thus cause ''unexplained'' infertility." Dr. Begra asserts that the physiological effects of chronic stress continue after conception, which "have the potential to impair implantation, induce epigenetic changes in the placenta, and to increase the probability of pregnancy loss."[15] Therefore, income disparities must be addressed to reduce health inequities and improve fertility treatment outcomes. This includes addressing the cost and associated financial stress of infertility for low-income patients.

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[13] American College of Obstetricians and Gynecologists. "Treating Infertility."
[14] Diamond M, et al. "Assessment of Multiple Intrauterine Gestations from Ovarian Stimulation (AMIGOS) Trial," 970-972.
[15] Begra S, "Social Determinants of Infertility: Beyond the Obvious,"

The financial implications of infertility are discussed in the cross-sectional study, "Sociocultural Determinants of Infertility Stress in Patients Undergoing Fertility Treatments." Data from 300 patients with infertility in low-income countries in South Asia suggest that financial constraints significantly predict stress in both women and men undergoing fertility treatment. The study found that one IUI cycle costs 10,000–15,000 rupees ($130-200 USD), with a success rate of 10–15% per cycle. Alternatively, one IVF cycle costs 1.5-2.5 lakhs* ($2,000-3,300 USD) with a success rate of 30-40% per cycle. As the average income was 15,000–25,000 rupees per month ($200-330 USD), fertility treatment was not affordable for most patients. Further, treatment cost was associated with patient stress.[16] In the United States, the cost of fertility treatment is higher. The American Society of Reproductive Medicine (ARSM) reports that the average cost of one IVF cycle is $12,400. Additionally, there are fees for embryo genetic and chromosomal testing at $2,000-5,000, as well as an annual fee for egg and embryo storage at $1,000.[17] As IVF in the United States is often paid out of pocket,[18] the cost of fertility treatment is a barrier for low-income patients. Given this financial barrier, increased insurance coverage could reduce health disparities for fertility evaluation and treatment.

In the United States, there are sixteen states that have infertility coverage mandates for private insurers. However, only six states provide comprehensive coverage that includes all or most costs associated with IVF. Despite these private insurance mandates,

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[16] Patel A, Sharma P, Kumar P, and Binu, V. S., "Sociocultural Determinants of Infertility…" 172-179.
[17] Insogna I and Ginsburg E, "Infertility, Inequality, and How Lack of Insurance Coverage Compromises Reproductive Autonomy," 1152-1159.
[18] Ethics Committee of the American Society for Reproductive Medicine, "Disparities in Access to Effective Treatment for Infertility in the United States," 2.
**Lakh is a unit in the Indian numbering system equal to one hundred thousand*

there is no fertility coverage for patients with public and federal insurance.[16] This means that low-income patients enrolled in Medicaid have no coverage for fertility treatment. According to the Centers for Medicare and Medicaid Services, there were 64.1 million patients enrolled in Medicaid in March 2020.[19] Therefore, the lack of coverage for fertility evaluation and treatment could be preventing many infertile individuals from receiving appropriate care. As infertility services increased three fold in states with private insurance mandates,[20] public insurance coverage for infertility could increase access to fertility treatment for low-income patients.

Though there is an association between income and educational attainment, it is significant to consider how education affects access and outcomes of fertility treatment. In the study "Health Disparities and Infertility," researchers evaluated data for 31,047 women age 15-44 from the National Survey of Family Growth (NSFG). The study found that both "infertility and impaired fecundity are more common for high school dropouts and high school graduates with no college than for four-year college graduates." Despite higher rates of infertility, women with lower levels of education were less likely to pursue treatment. The data from NSFG showed "high school dropouts are 25% less likely to report treatment than college graduates, while high school graduates are 12% less likely to report treatment."[21] The authors discuss how lower education could be associated with lower socioeconomic status, with low-income patients having few resources to pursue evaluation

[19] Medicaid, "Medicaid and CHIP Enrollment Data."
[20] Ethics Committee of the American Society for Reproductive Medicine, "Disparities in Access to Effective Treatment for Infertility in the United States," 2.
[21] Bitler M and Schmidt L, "Health Disparities and Infertility," 858-865.

and treatment. Alternatively, patients with lower levels of education may have less fertility awareness.[22] This means that they may not be as informed about symptoms, prevention, and treatment options for infertility.

The association between educational attainment and fertility awareness was further studied in "The Effect of Age, Ethnicity, and Level of Education on Fertility Awareness and Duration of Infertility." The cross-sectional survey evaluated fertility awareness and collected information on ethnicity, education, and the patient's duration of infertility. In the study, fertility awareness was evaluated with questions about causes, prevalence, and treatment of infertility. For all patients, the mean fertility awareness score was 49.9%. The data showed that fertility awareness scores were significantly associated with educational attainment, as fertility awareness increased linearly with level of education. Further, the data showed an association between the patient's fertility awareness and the duration of infertility before pursuing medical treatment. This suggests that patients who are more educated are more likely to pursue treatment for infertility. From these findings, the authors conclude, "education about risks and prevention of infertility is needed to prevent fear and unnecessary delay in seeking help when people are faced with problems conceiving."[23] Therefore, public education about symptoms, prevention, and treatment options for infertility could encourage patients to pursue fertility evaluation and treatment. If the education is directed towards patients with low educational attainment, it could reduce health disparities due to low fertility awareness.

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[22] Bitler M and Schmidt L, "Health Disparities and Infertility," 858-865.
[23] Swift B and Liu K, "The Effect of Age, Ethnicity, and Level of Education on Fertility Awareness and Duration of Infertility," 990-996.

In the study "The Effect of Age, Ethnicity, and Level of Education on Fertility Awareness and Duration of Infertility," researchers also found that fertility awareness is associated with ethnicity. The data showed that women who identified as Caucasian had the highest fertility awareness, followed by women who identified with 'Asian descent,' then 'Hispanic descent.' Finally, women who identified with 'African descent' had the lowest score for fertility awareness.[24] These findings are consistent with a publication in the American Medical Association Journal of Ethics, which reported that African American, Hispanic, and Asian patients were less likely to pursue fertility treatment than Caucasian patients. The authors state that after failing to conceive, it took an average of 4.3 years for African American women to present to an infertility clinic, compared to 3.3 years for Caucasian women. Though data suggest that African American women experience higher rates of infertility, this patient population is underrepresented in the field of reproductive endocrinology and infertility.[25] This supports the need for public education on infertility symptoms, prevention, and treatment, to increase fertility awareness for underserved patient populations.

In addition to fertility awareness, there are cultural differences that contribute to racial disparities in fertility treatment. In the study "Racial Disparities in Seeking Care for Help Getting Pregnant," researchers collected data from a population based cohort study. The data showed that Black women were less likely to visit a doctor than White women.[26] Additionally, Black women waited twice as long as White women to pursue treatment.

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[24] Swift B and Liu K, "The Effect of Age, Ethnicity, and Level of Education on Fertility Awareness and Duration of Infertility," 990-996.
[25] Insogna I and Ginsburg E, "Infertility, Inequality, and How Lack of Insurance Coverage Compromises Reproductive Autonomy," 1152-1159.
[26] Chin HB, et al., "Racial Disparities in Seeking Care for Help Getting Pregnant," 426-425.

The study controlled for the patient's discomfort with assisted reproductive technology, in order to "capture the stigmatization that may surround infertility for some women." The results showed that when compared with White women, "Black women were more likely to report that they were concerned about social stigmatization and disappointing a spouse because of their infertility." Further, "Black women were more likely to report concern about friends and family finding out about treatment." [27] Therefore, the authors propose that Black women may delay fertility evaluation and treatment due to low social support for infertility.

Given lower fertility awareness and social support for African American women, there are significant racial disparities in fertility treatment. In the study "Disparities in Assisted Reproductive Technology Utilization by Race and Ethnicity," the authors analyzed data from the Center for Disease Control National ART Surveillance System (NASS) in 2014. The study compared rates of assistive reproductive technology procedures per million women age 15–44 years, with census defined racial and ethnic groups in the United States. The NASS data showed that women who identified as Asian/Pacific Islander had the highest number of ART procedures at 5,883.0, followed by non-Hispanic White women at 2,888.4. Alternatively, non-Hispanic Black, Hispanic, and American Indian women had lower than average ART procedure rates, at 1,434.0, 996.7, and 806.8, respectively. Although ART utilization was higher for all racial and ethnic groups in states with fertility insurance mandates, racial disparities persisted. [28] This suggests that additional insurance

[27] Chin HB, et al., "Racial Disparities in Seeking Care for Help Getting Pregnant," 426-425.
[28] Dieke A, et al., ""Disparities in Assisted Reproductive Technology Utilization by Race and Ethnicity," 605-608.

mandates could increase access to fertility treatments but would not improve racial and ethnic disparities for underrepresented patients.

In addition to racial disparities in access to fertility treatment, there are further disparities in assistive reproductive technology outcomes for African American patients. In a study on ART utilization and live birth rates by racial and ethnic groups, researchers analyzed data from the Society for Assisted Reproductive Technologies Clinic Outcome Reporting System (SART CORS). The SART CORS data showed that between 2004-2013, 1,132,844 ART cycles resulted in 335,462 live births (29.6%). The highest live birth rate was among non-Hispanic White women at 31.2%. This was followed by Hispanic and Asian women, at 29.3% and 25.8% respectively. Finally, non-Hispanic Black women had the lowest live birth rate at 22.5%. These data were attributed to Black women having "significantly lower clinical pregnancy rates and higher spontaneous abortion rates." The rate of spontaneous abortion was highest for Black women at 26.6%, compared to 17.5% for White women. In the discussion, the authors pose that "Socioeconomic barriers likely amplify this phenomenon among those minority women who desire fertility services but are unable to utilize them due to lack of access, affordability or social acceptance in their communities." [29] However, additional research is needed to understand the persistent racial disparities in access and outcomes of assistive reproductive technology.

The issue of racial disparities in outcomes of fertility treatment is further discussed by the Ethics Committee of the American Society for Reproductive Medicine. [30] The authors

[29] Shapiro A, et al., "Effect of Race and Ethnicity on Utilization and Outcomes of Assisted Reproductive Technology in the USA," 2-11.
[30] Ethics Committee of the American Society for Reproductive Medicine, "Disparities in Access to Effective Treatment for Infertility in the United States," 3-4.

reviewed IVF outcomes by race and ethnicity, including three SART database studies. The results were consistent, as African American, Asian, and Hispanic women had lower ART success rates than non-Hispanic White women. Additionally, minority women experienced lower implantation and clinical pregnancy rates, with higher miscarriage rates. The authors state, "these differences in treatment success are concerning; they are poorly understood and insufficiently studied, with explanations ranging from biological factors to modifiable behavioral factors." Further, the authors conclude, "rectification is critical to achieving reproductive health equity among women and men of different racial and ethnic backgrounds."[31] Therefore, further research is needed to identify causes and initiate responses for reducing racial disparities in fertility outcomes.

In "Disparities in Access to Effective Treatment for Infertility in the United States," the Ethics Committee also discusses social disparities in fertility evaluation and treatment. In the discussion on geographic location, the authors address the shortage of obstetricians and gynecologists in the United States. This leaves many communities with limited or no access to reproductive endocrinology and infertility specialists. In 2015, sixteen states had five or less fertility clinics accredited by the Society for Assisted Reproductive Technology. The states that reported the most accredited fertility clinics also had mandated infertility insurance and high median income.[32] This suggests that low-income patients in rural areas must travel further distances to access fertility services. Therefore, geographic unavailability may be a social barrier for patients pursuing infertility evaluation and treatment.

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[31] Ethics Committee of the American Society for Reproductive Medicine, "Disparities in Access to Effective Treatment for Infertility in the United States," 3-4.
[32] *Id*

In the population-based study, "Geographic Access to Assisted Reproductive Technology Health Care in the United States," researchers evaluated the distribution of ART clinics and estimated access to fertility services. The data showed that from 2009-2013, there were 510 ART clinics in the United States. While multiple ART clinics were present in 76 metropolitan areas with a median population of 1.45 million, only one ART clinic was present in 68 metropolitan areas with a median population of 454,000. Given these data, researchers estimated that 60.4% of reproductive age women lived in an area with multiple ART clinics, while 10.8% lived in an area with one ART clinic and 28.8% lived in an area with no ART clinics. Therefore, geographic access to reproductive endocrinology and infertility clinics was limited or absent for 39.6% of the United States population.[33] This suggests 25 million reproductive age women are affected by geographic unavailability. These findings demonstrate the need for increased fertility specialists, in order to reduce geographic disparities and increase access to assisted reproductive technology.

The Ethics Committee also discusses social disparities based on sexual orientation, as gay, lesbian, and non-binary couples experience challenges accessing fertility treatment. Patients in the LGTBQ+ community may be denied fertility evaluation and treatment if the medical institution opposes homosexual reproduction. This opposition could be due to religious affiliations or complications associated with donors or surrogate mothers. According to the article "Access to Fertility Treatment by Gays, Lesbians, and Unmarried Persons," some states do prohibit provider discrimination on the basis of marital status or sexual orientation.[34] As medical offices are public accommodations under civil rights laws,

[33] Harris J, et al., "Geographic Access to Assisted Reproductive Technology," 1023-1027.
[34] Ethics Committee of the American Society for Reproductive Medicine, "Access to Fertility Treatment by Gays, Lesbians, and Unmarried Persons," 1-4.

half of states have banned discrimination on the basis of marital status, while another third have banned discrimination on the basis of sexual orientation. However, these laws do not exist at the federal level, which limits protection against sexual orientation discrimination. In response, the Ethics Committee of the American Society of Reproductive Medicine affirms "that the ethical duty to treat persons with equal respect requires that fertility programs treat single persons and gay and lesbian couples equally to heterosexual married couples in determining which services to provide."[35] Despite support from the ASRM, federal laws prohibiting provider discrimination are needed to reduce disparities for LGTBQ+ patients.

In addition to discrimination based on sexual orientation, LGBTQ+ patients have sex specific treatment decisions to make throughout fertility evaluation and treatment. In the study "Utilization of Fertility Treatment and Reproductive Choices by Lesbian Couples," researchers analyzed outcomes of 306 lesbian couples requesting reproductive assistance. According to preconception plans, 85.1% of couples planned for single partner conception, with 68% achieving a live birth. Alternatively, 14.9% planned for dual partner conception, with 88.9% achieving a live birth. These data suggest that lesbian couples may increase the likelihood of a live birth if both partners plan to conceive and carry.[36] Therefore, it is important for infertility specialists to be experienced and knowledgeable about the unique treatment options for same sex couples. This would reduce health disparities and improve outcomes for LGBTQ+ patients undergoing fertility treatment.

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[35] Ethics Committee of the American Society for Reproductive Medicine, "Access to Fertility Treatment by Gays, Lesbians, and Unmarried Persons," 1-4.

[36] Carpinello O, et al., "Utilization of Fertility Treatment and Reproductive Choices by Lesbian Couples," 1709-1713.

Given the financial, educational, racial, and social disparities for fertility treatment, international organizations, including the United Nations and World Health Organization, have made reproductive health a global priority.[37] Additionally, the Centers for Disease Control and Prevention have issued a National Action Plan for the Detection, Prevention, and Management of Infertility in the United States. The plan reviews the importance of understanding and addressing factors that contribute to population level infertility for women and men. The action plan has three main initiatives, outlined as:

1. Promoting healthy behaviors that can help maintain and preserve fertility.
2. Promoting prevention, early detection, and treatment of medical conditions that can threaten fertility.
3. Reducing exposures to environmental, occupational, infectious, and iatrogenic agents that can threaten fertility.[38]

Further, the CDCs public health initiative calls for improving pregnancy outcomes by managing infertility, developing fertility treatments, and promoting healthy pregnancy.[38] This includes addressing the social determinants of health for infertility, as well as maternal and infant mortality. Given the disparities, there is significant work to be done. However, continued effort from the organizations should reduce, and eventually eliminate, health disparities in the access and outcomes of fertility treatment in the United States.

[37] Ethics Committee of the American Society for Reproductive Medicine, "Disparities in Access to Effective Treatment for Infertility in the United States," 5.
[38] Centers for Disease Control and Prevention, "National Action Plan for the Detection, Prevention, and Management of Infertility in the United States."

Figure 1: **Life expectancy in the U.S. at age 25, by education and gender, 2006[a]**

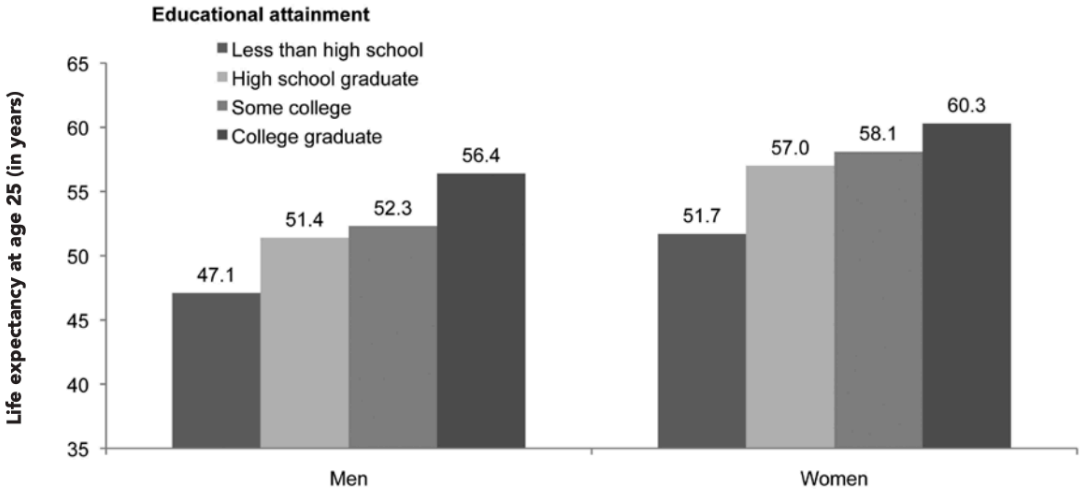


Figure 2: **U.S. children aged <17 years with less than very good health, by family income, 2011–2012[a]**

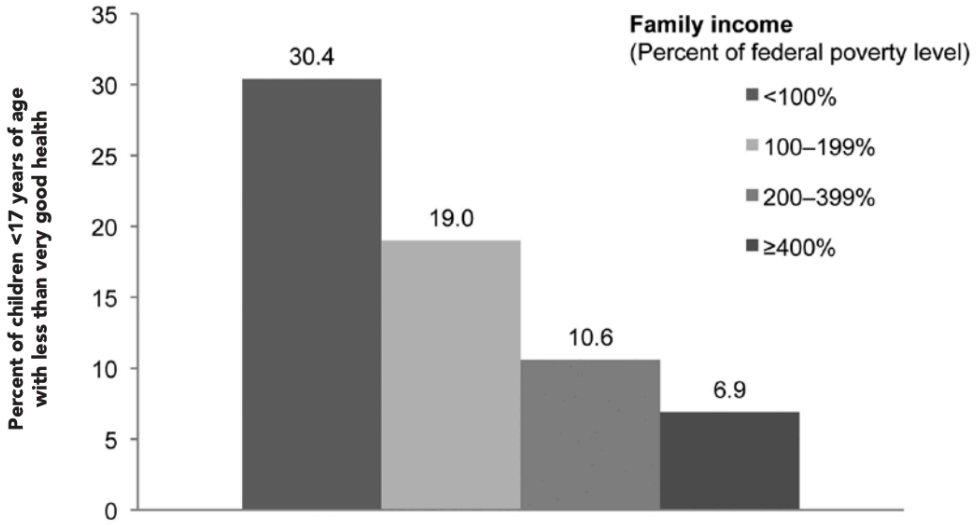
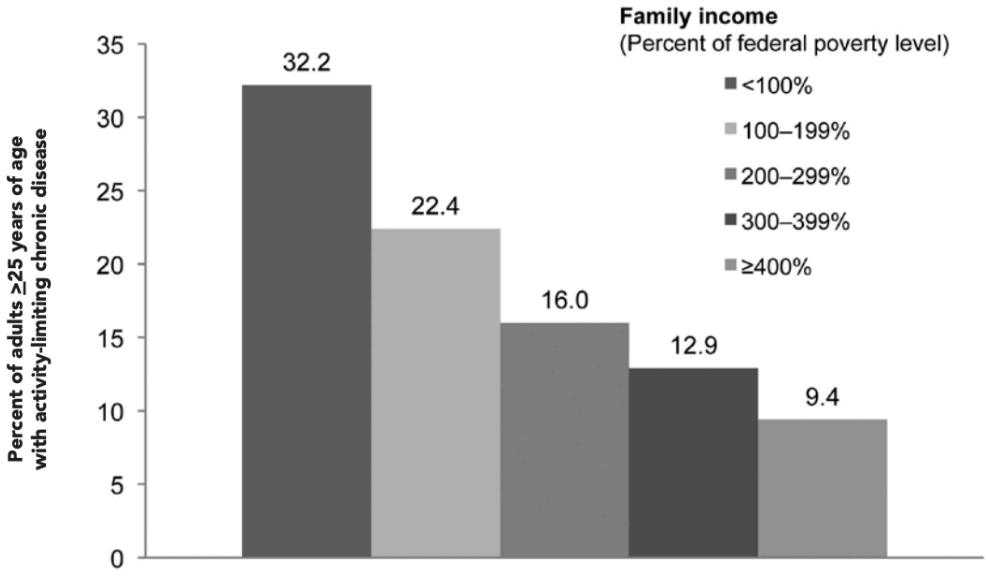


Figure 3: **Percent of U.S. adults aged ≥25 years with activity-limiting chronic disease, by family income, 1988–1998[a]**



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