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Physical attractiveness and cardiometabolic risk

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Abstract

Objectives: There is only limited evidence suggesting that physical attractiveness and individuals' actual health are causally linked. Past studies demonstrate that characteristics related to physical attractiveness are more likely to be present in healthy individuals, including those with better cardiovascular and metabolic health, yet many of these studies do not account for individuals' initial health and socioeconomic characteristics, which are related to both physical attractiveness and later life health.

Methods: We use panel survey data from the National Longitudinal Study of Adolescent to Adult Health in the United States to examine the relationship between interviewer-rated in-person physical attractiveness and actual cardiometabolic risk (CMR) based on a set of relevant biomarkers: LDL cholesterol, glucose mg/dL, C-reactive protein, systolic and diastolic blood pressure, and resting heart rate.

Results: We identify a robust relationship between individuals' physical attractiveness and 10-year follow up actual health measured by the levels of CMR. Individuals of above-average attractiveness appear to be noticeably healthier than those who are described as having average attractiveness. We find that individuals' gender and race/ethnicity do not have a major effect on the described relationship. The link between physical attractiveness and health is affected by interviewers' main demographic characteristics. We carefully address the possibility of confounders affecting our results including sociodemographic and socioeconomic characteristics, cognitive and personality traits, initial health problems and BMI.

Conclusion: Our findings are largely in line with the evolutionary perspective which assumes that physical attractiveness is linked to individuals' biological health. Being perceived as physically attractive might also imply, among other aspects, high levels of satisfaction with life, self-confidence and ease of finding intimate partners, all of which can positively affect individuals' health.

1 | INTRODUCTION

It has been long argued that physical attractiveness may be linked to individuals' health (Andersson, 1995; de Jager et al., 2018; Thornhill & Gangestad, 2006; Weeden & Sabini, 2005). Evolutionary explanations of mate selection suggest that characteristics associated with physical attractiveness help individuals find better partners because the link between attractiveness and health implies that more attractive individuals are healthier, have higher fertility,

and have offspring with better survival chances (Buss & Schmitt, 1993; Grammer et al., 2003).

The evolutionary perspective is supported by studies showing that facial characteristics related to attractiveness, including symmetry, dimorphism, averageness, skin tone, and quality, are more likely to be present in healthy individuals (Fink et al., 2001; Fink et al., 2006; Foo et al., 2017; Hönekopp et al., 2004; Hume & Montgomerie, 2001; Law Smith et al., 2006; Rhodes et al., 2003). Individuals with attractive faces are also more likely to be perceived as healthier than those with unattractive faces (Henderson et al., 2016). Many other studies find an association between observer-rated overall physical attractiveness and health (Cunningham, 1986; Grammer & Thornhill, 1994; Singh, 1995). For instance, research using a wide array of self-reported health measures reveals that physical attractiveness rated by survey interviewers is associated with numerous health outcomes in the United States (Nedelec & Beaver, 2014).

Despite the described evidence, the reliability of the identified associations between physical attractiveness and health can be questioned from both theoretical and methodological standpoints. First, it is likely that some traits are only perceived as attractive because they benefited our ancestors' survival but may presently be no longer associated with better health outcomes (Tooby & Cosmides, 1990). The evolutionary explanations can also be challenged from a more contemporary perspective, which implies that the described association must be weak because assessments of physical attractiveness mirror societal images influenced by media, the fashion industry, and the broader culture (Englis et al., 1994; Fallon, 1990; Freedman, 1984). The latter forces might be shaping the traits of physical attractiveness, with no obvious survival and health benefits, but they can still be preferred by members of the opposite sex (Darwin, 1871; Miller, 2001).

The nature of the relationship between physical attractiveness and health can vary across gender because women and men differ by the identifiable cues of attractiveness such as body size and shape including height, body mass index (BMI), and waist-to-hip ratio (WHR), sexually dimorphic face characteristics, face averageness, hair quality, skin quality and coloration, and eye brightness/clarity (Weeden & Sabini, 2005). One of the described mechanisms is that sex-specific hormones which are manifested in physical appearance can also affect immune functioning of both women and men. It is argued that an immune system can perform better among those individuals who have high sex-specific hormone loads. For instance, estrogen is a category of sex hormone thought to be critical for the regulation of the female reproductive system. Another example is women's hair length which can serve as an indicator of past health problems and malnutrition (Grammer et al., 2001; Hinsz et al., 2001). Further, high muscularity among men can often indicate their history of engaging in health-enhancing physical activities and it also correlates with a low level of body fat – a well-established risk factor for a number of serious diseases and mortality (Jayedi et al., 2022).

On the other hand, research suggests that the certain standards of physical attractiveness promoted in the era of digital and social media can have a particularly detrimental effect on various aspects of psychological health among women, such as eating disorders, narcissistic attitudes, dissatisfaction with appearance, and physical perfectionism (Kholmogorova et al., 2018). In addition, health-related behaviors associated with the prevalent standards of attractiveness and low levels of BMI can lead to various adverse health outcomes, such as anemia, colorectal cancer, and cardiovascular death (Balakrishnan, 2015; Bellizzi et al., 2021; Kremers et al., 2004). Among men, in turn, various features of attractiveness might not necessarily reflect better health. For instance, men's facial attractiveness is significantly associated with facial symmetry, but the latter has no relationship with men's health outcomes (de Jager et al., 2018). Furthermore, increased muscular body size is often positively associated with physical attractiveness but it can be also linked to worse health outcomes. The promotion of the hypermuscular male body in various media outlets is linked with low self-esteem and consumption of dietary supplements used to build muscle mass (Barlett et al., 2008; Hartmann et al., 2018; Hatoum & Belle, 2004).

Race/ethnicity, as individuals' central demographic characteristic, may also play an important role in the relationship between physical attractiveness and health. What is perceived to be attractive might vary by the race/ethnicity of both those who are assessed and those who are assessing others' physical attractiveness. If so, then the effect of physical attractiveness on health outcomes might be conditioned by individuals' race/ethnicity. Hamermesh (2011), for instance, suggests that physical attractiveness may be less important for various life outcomes among African-Americans in comparison to Whites. However, more recent evidence indicates that the opposite relationship is more likely. Because the perception of physical attractiveness is unequally distributed among racial/ethnic groups, White individuals are often considered more attractive (Entman & Rojecki, 2010; Johnson & King, 2017), physical attractiveness might matter more for Blacks and other racial/ethnic minorities (Monk et al., 2021). On the other hand, some evidence suggests that stereotypes associated with physical attractiveness, such as being smart or friendly, matter more for peer preferences than individuals' race/ethnicity (Langlois & Stephan, 1977). Given the inconclusive evidence on the topic, it is important to further examine the race/ethnicity-specific association between physical attractiveness and health outcomes.

In addition to the relevance of gender and race/ethnicity, the previous studies have not adequately addressed two important aspects of the association between physical attractiveness and health. First, it is known that there is a connection between individuals' socioeconomic position (SEP) and physical attractiveness. For instance, people might seem more attractive if they drive an expensive car, yet it is difficult to test if there is a causal association and what its direction is (Frevert & Walker, 2014). Second, individuals' initial health not only affects later life health but is also known to be associated with a multitude of key socioeconomic outcomes, including educational attainment, better employment opportunities and higher wages (Kröger et al., 2015; Rolheiser et al., 2022). The latter means that initial health can indirectly influence both later life health and physical attractiveness (Hakim, 2010; Hamermesh & Biddle, 1994; Mobius & Rosenblat, 2006; Sugiyama, 2015; Umberson & Hughes, 1987). Therefore, individuals' SEP and initial health should be accounted for when scholars investigate the links between physical attractiveness and health outcomes.

Furthermore, research in this field is largely limited by data availability, resulting in reliance on small samples and picture-assessed physical attractiveness often by several raters, which ignores some of the key components of physical attractiveness such as movement patterns, body language, voice or smell (Fink et al., 2007; Grammer et al., 2001; Symons et al., 1995). Physical attractiveness assessed by survey interviewers, therefore, can be a complementary method of measuring a person's attractiveness. Interviewers, on the other hand, can be biased in their assessments and therefore it is important to control for interviewers' characteristics such as gender and race/ethnicity. Lastly, there is only limited evidence that physical attractiveness at a certain period of time is related to individuals' actual health measured later through biomarkers such as cardiovascular and metabolic health (Shackelford & Larsen, 1999; Żelaźniewicz et al., 2020). Our study aims to address the described shortcomings of the previous research by using a longitudinal dataset from the United States to examine the relationship between interviewer-rated in-person physical attractiveness and actual health based on a set of relevant biomarkers measured around 10 years after the assessment of individuals' physical attractiveness was made.

2 | METHODS

2.1 | Data

To explore the association between physical attractiveness and health, we use the United States National Longitudinal Study of Adolescent to Adult Health (Add Health), a longitudinal study of a nationally representative sample of adolescents in grades 7–12 during the 1994–95 school year, Wave I. Add Health provides vital information about individuals included in the survey. The most recent Waves IV (participants' average age of 28) and V (participants' average age of 38) conducted 10 years apart in 2007–2008 and 2016–2018 collected data on, respectively, physical attractiveness and biological health based on anthropometric, cardiovascular, metabolic, and inflammatory measures.

2.2 | Physical attractiveness

In Wave IV, interviewers at the end of the in-person interview rated the physical attractiveness of their respondents using a one-to-five scale, where "very unattractive" = 1 and "very attractive" = 5. Each respondent's physical attractiveness was assessed by one out of 330 Add Health interviewers. The average number of interviews conducted by an interviewer was equal to 16. To identify any potential non-linear associations between physical attractiveness and health, in the main analysis we focus on this measure with average attractiveness set as the reference category. Table S1 in the supplementary materials shows descriptive statistics for physical attractiveness. Most individuals were rated as about average looking (47% of the sample), followed by physically attractive (37% of the sample). Those rated as very unattractive were the smallest group (3% of the sample). In the analysis for the supplementary materials, Table S2, we create a binary indicator that is equal to 1 if individuals are rated as above average in terms of physical attractiveness. Analysis with this binary physical attractiveness variable leads to broadly similar results as reported in the main text.

2.3 | Health outcome

We aimed to identify a measure that adequately and comprehensively describes participants' physical health at a relatively young age. Because we evaluated health outcomes of individuals who were in their 30s, rather than examining hard endpoints of cardiovascular events (relatively rare occurrence at this age), we selected measures that are associated with known cardiometabolic risk (CMR) (Sipola-Leppanen et al., 2015; Skinner et al., 2015). For this reason, we constructed a comprehensive measure of the body's health, CMR, based on Wave V information on biomarkers from a blood test and medical examinations. CMR reflects individuals'

immunity, and metabolic and cardiovascular health, and is a valid predictor of morbidity and mortality (Juster et al., 2010). CMR is considered to capture multidimensional physiological dysregulations preceding health problems and it is significantly affected by exposures in the early stages of life course (McEwen, 1993; Najman et al., 2020; Ogunsina et al., 2018).

To construct CMR, we used the following measures: lipids (LDL Cholesterol); glucose (glucose mg/dL); inflammation (C-reactive protein (CRP)); and cardiovascular indicators (systolic and diastolic blood pressure and resting heart rate). Based on past operationalization of this measure (Bulczak & Gugushvili, 2022; Gugushvili et al., 2021; McCrory et al., 2019; Präg & Richards, 2019; Vie et al., 2014), we z-transformed each of the biomarkers and calculated the mean score to obtain the final CMR outcome measure.

We deliberately omitted BMI from the CMR calculation because it is easily observed visually by interviewers, and there is a clear expectation that individuals outside of the BMI range which is considered normal, especially in the upward direction, would be perceived as less attractive. Yet, as described below, we still account for the impact of BMI on both physical attractiveness and CMR.

2.4 | Predictors of CMR

The Add Health dataset is rich in information regarding individuals' SEP, cognitive abilities and personality characteristics. We account for individuals' education and occupation, based on the Nam-Power-Boyd scale score (Bulczak et al., 2022; Nam & Boyd, 2004), and their household income because these SEP measures are known to be linked with health and may also affect how attractive individuals are perceived (Anderson, 2018; Haas, 2006; Gugushvili et al., 2019; Meier & Mutz, 2020). We convert these categorical (education and occupation) and continuous (income) measures into quintiles for ease of interpretation and comparison across SEP indicators. The first and the fifth quintiles represent, respectively, the least and the most advantageous SEP attainment.

There are also reasons to believe that perceived physical attractiveness may be affected by individuals' personality characteristics and intelligence. To address this issue we include measures capturing respondents' Big Five personality traits: agreeableness, conscientiousness, extraversion, openness to experience, and neuroticism (Jerram & Coleman, 1999). In addition, we also account for a proxy for individuals' IQ with the use of the Peabody vocabulary test score measured at Wave I (Zigler et al., 1973). The Peabody vocabulary test is an imperfect measure but it has been shown to be closely associated with individuals' intelligence in various settings and contexts (Ezard et al., 2022; Hodapp & Gerken, 1999).

For the operationalization of BMI, we use Wave IV WHO categorization with the following six categories: underweight (below 18.5), normal weight (18.5–24.9), overweight (25.0–29.9), obesity class 1 (30.0–34.9), obesity class 2 (35.0–39.9) and obesity class 3 (above 40) (WHO, 2010). All models also account for individuals age, gender and race/ethnicity (White, Black, Hispanic and Other racial/ethnic categories).

2.5 | Health selection measures

To account for the health selection process potentially biasing results in our models, we control for Wave I self-rated health and individuals' chronic health conditions because data for creating the initial CMR measure are unavailable in Add Health. We create binary indicators equal to 1 if self-reported general health is rated below very good or if any chronic health condition is present. The binary variable for chronic conditions takes the value of 1 if respondents answered "yes" to any of the four following questions: "Do you have difficulty using your hands, arms, legs, or feet because of a permanent physical condition?" "Do you have a permanent physical condition involving a heart problem?" "Do you have a permanent physical condition involving asthma?" "Do you have a permanent physical condition involving other breathing difficulties?" All CMR predictor and health-selection variables are presented in supplementary materials, Table S1.

2.6 | Statistical analysis

With our analytical strategy, we test how well Wave IV attractiveness predicts Wave V CMR, with and without accounting for covariates of both physical attractiveness and health (Hume & Montgomerie, 2001; Żelaźniewicz et al., 2020). Presenting descriptive associations can be informative, but it remains to be seen to what extent the identified differences can be explained by sociodemographic and socioeconomic characteristics of individuals in various attractiveness categories. To answer the latter question, we rely on multivariable analysis. Based on the continuous nature of our outcome variable, CMR, we fit linear regression models to examine the robustness of the relationship between individuals' attractiveness and health. Due to missing data, primarily for Wave IV

occupation and income variables (approximately 9% of the sample), we used imputed data to preserve the sample size by employing the Multiple Imputation by Chained Equations (MICE) procedure (Rubin, 1987). All the analyses reported in the main text are based on the imputed data.

We start fitting the models with only a baseline specification and a limited set of covariates of CMR, such as age, gender, race/ethnicity and the proxy variable for IQ (all these variables are derived from Wave I). This is followed by a stepwise introduction of personality characteristics, measures of SEP, variables related to individuals' initial health, and the Wave IV BMI measure. These variables are expected to affect the relationship of interest, as they are known to be linked to both physical attractiveness and later life health.

To understand if there are gender and race/ethnicity differences in the association between physical attractiveness and CMR, we fit interaction models with the variables that are of interest to us. Importantly, in all our models, we account for interviewer-related fixed effects. This helps to mitigate any risk of interviewers' explicit or implicit biases in evaluating the attractiveness of individuals who might belong to a different gender or ethnic/racial group. Furthermore, to understand if interviewers' gender (Females 86%) and race/ethnicity (White 66%) moderate the association between physical attractiveness and CMR, we also fit separate models with only female and male interviewers, and White and non-White interviewers. In the latter part of the analysis, we are not able to fit models by non-White race/ethnicity categories due to the low number of individuals in the sample representing these racial/ethnic groups.

3 | RESULTS

3.1 | Descriptive associations

Figure 1 presents descriptive associations between physical attractiveness at Wave IV, on the one hand, and individuals' initial health outcome and CMR, at Waves I and V respectively, on the other hand. These associations disaggregated by gender are shown in Table S3 in the supplementary materials. For CMR, we observe a gradient in health between unattractive individuals, who have the highest risk, and attractive and very attractive individuals, who have the lowest risk. Individuals who are described by interviewers as having average physical attractiveness have CMR between the values of unattractive and (very) attractive individuals. In addition, Figure 1 shows that individuals who are assessed as very unattractive also score low in CMR; in fact, they come close to individuals who are described as very attractive.

As for initial health and its relationship with physical attractiveness, we observe a similar gradient as is the case for CMR; more attractive individuals have a lower prevalence of poor health at Wave I, except for those who are described as very unattractive. The latter group of individuals has the lowest prevalence of poor health. As for initial chronic health problems, little variation is observed by attractiveness categories and prevalence is less than 3%.

3.2 | Multivariable analysis

In Table 1 we show the main findings of this study. All presented models include the baseline controls and fixed

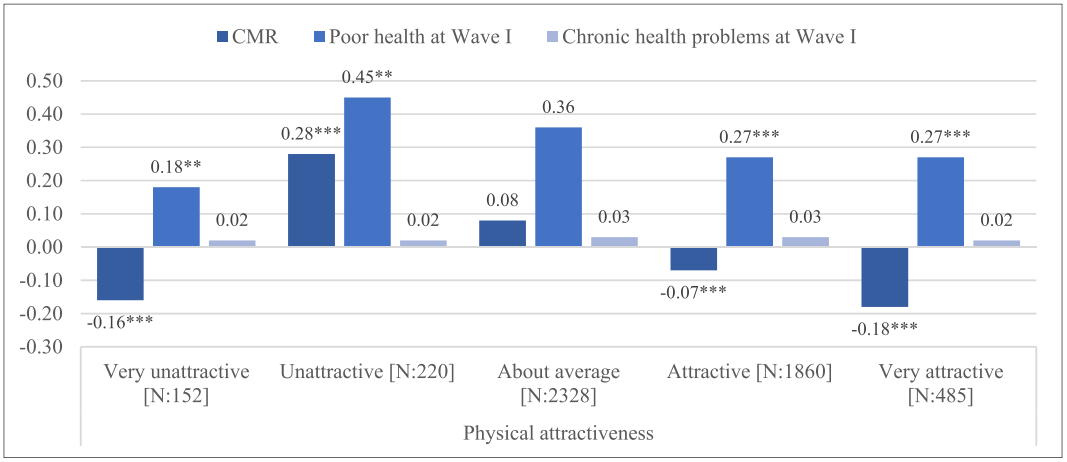

FIGURE 1 Mean values of selected health measures across different physical attractiveness groups. *Source:* Number of observations 4160. Significant differences in reference to the average attractiveness category *$p < .05$, **$p < .01$, ***$p < .001$. The values represent means of the three health measures estimated separately for the five attractiveness categories.

TABLE 1 Linear regression models of physical attractiveness and CMR

	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	CI95%	β	CI95%	β	CI95%	β	CI95%	β	CI95%
Physical attractiveness										
Very unattractive (ref. = average)	−0.37***	[−0.57,-0.16]	−0.36***	[−0.57,-0.15]	−0.36**	[−0.58,-0.15]	−0.34**	[−0.56,-0.12]	−0.23*	[−0.44,-0.03]
Unattractive	0.12	[−0.18,0.41]	0.09	[−0.20,0.38]	0.10	[−0.18,0.38]	0.12	[−0.16,0.39]	−0.05	[−0.26,0.16]
Attractive	−0.26***	[−0.37,-0.16]	−0.25***	[−0.36,-0.15]	−0.24***	[−0.36,-0.13]	−0.22***	[−0.33,-0.11]	−0.14**	[−0.24,-0.04]
Very attractive	−0.40***	[−0.54,-0.26]	−0.38***	[−0.51,-0.24]	−0.35***	[−0.50,-0.20]	−0.32***	[−0.47,-0.17]	−0.13	[−0.28,0.03]
Age	0.02	[−0.00,0.04]	0.02	[−0.00,0.04]	0.02*	[0.00,0.04]	0.02*	[0.00,0.04]	0.02	[−0.01,0.04]
Gender (Male = 1, female = 0)	0.24***	[0.15,0.33]	0.27***	[0.18,0.36]	0.25***	[0.16,0.34]	0.26***	[0.17,0.35]	0.28***	[0.18,0.37]
Race/ethnicity										
Black	0.35***	[0.20,0.50]	0.36***	[0.21,0.51]	0.37***	[0.22,0.53]	0.37***	[0.21,0.53]	0.21***	[0.09,0.33]
Hispanic (Ref. = White)	−0.05	[−0.23,0.13]	−0.04	[−0.22,0.14]	−0.05	[−0.23,0.13]	−0.07	[−0.25,0.11]	−0.18*	[−0.32,-0.04]
Other non-Hispanic	−0.15	[−0.34,0.03]	−0.12	[−0.30,0.06]	−0.08	[−0.27,0.10]	−0.10	[−0.28,0.08]	−0.08	[−0.29,0.12]
IQ	−0.10***	[−0.15,-0.05]	−0.09***	[−0.14,-0.04]	−0.06*	[−0.11,-0.01]	−0.06*	[−0.11,-0.01]	−0.03	[−0.08,0.01]
Big Five personality traits										
Agreeableness			0.01	[−0.01,0.03]	0.01	[−0.01,0.03]	0.01	[−0.01,0.03]	0.01	[−0.01,0.03]
Conscientiousness			−0.03***	[−0.05,-0.01]	−0.03***	[−0.05,-0.01]	−0.03**	[−0.04,-0.01]	−0.02**	[−0.04,-0.01]
Extraversion			0.01	[−0.00,0.03]	0.01	[−0.01,0.02]	0.01	[−0.01,0.03]	0.01	[−0.01,0.02]
Openness			−0.01	[−0.03,0.01]	−0.01	[−0.03,0.01]	−0.01	[−0.03,0.01]	−0.01	[−0.02,0.01]
Neuroticism			0.03**	[0.01,0.04]	0.02*	[0.01,0.04]	0.02	[−0.00,0.03]	0.02*	[0.00,0.04]
Income quintiles										
Bottom (ref. = middle)					−0.08	[−0.22,0.05]	−0.09	[−0.23,0.04]	−0.01	[−0.14,0.12]
Next to bottom					0.00	[−0.12,0.12]	−0.00	[−0.12,0.12]	0.02	[−0.09,0.13]
Next to top					−0.04	[−0.17,0.10]	−0.04	[−0.18,0.09]	0.00	[−0.13,0.13]
Top					−0.17**	[−0.30,-0.05]	−0.17**	[−0.30,-0.05]	−0.11	[−0.22,0.01]
Education quintiles										
Bottom (ref. = middle)					0.13	[−0.07,0.34]	0.12	[−0.09,0.33]	0.10	[−0.07,0.28]
Next to bottom					0.02	[−0.11,0.15]	0.01	[−0.12,0.14]	−0.02	[−0.13,0.09]
Next to top					−0.12*	[−0.23,-0.01]	−0.08	[−0.19,0.03]	−0.13**	[−0.23,-0.04]
Top					−0.17*	[−0.30,-0.04]	−0.12	[−0.25,0.01]	−0.16**	[−0.27,-0.06]
Occupation quintiles										
Bottom (ref. = middle)					0.08	[−0.07,0.22]	0.07	[−0.07,0.22]	0.04	[−0.09,0.18]

TABLE 1 (Continued)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	CI95%	β	CI95%	β	CI95%	β	CI95%	β	CI95%
Next to bottom					0.14*	[0.02,0.26]	0.13*	[0.01,0.26]	0.08	[−0.05,0.20]
Next to top					0.17**	[0.05,0.28]	0.16*	[0.04,0.27]	0.10	[−0.01,0.22]
Top					0.05	[−0.08,0.18]	0.03	[−0.10,0.17]	0.00	[−0.12,0.12]
Poor health W1							0.23***	[0.15,0.32]	0.14**	[0.05,0.22]
Chronic health problem W1							0.22*	[0.03,0.40]	0.23*	[0.04,0.42]
BMI W4										
Underweight (ref. overweight)									−0.42***	[−0.66,-0.18]
Normal									−0.28***	[−0.39,-0.17]
Obese class I									0.27***	[0.16,0.39]
Obese class II									0.34***	[0.19,0.48]
Obese class III									0.63***	[0.43,0.84]
Intercept	−1.06***	[−1.50,-0.62]	−0.72*	[−1.40,-0.04]	−0.73*	[−1.45,-0.02]	−0.83*	[−1.55,-0.12]	−0.40	[−0.99,0.19]
Adjusted R^2	0.08		0.09		0.11		0.12		0.20	
Observations	4160		4160		4160		4160		4160	

Note: 95% confidence intervals in parentheses.
*$p < .05$; **$p < .01$; ***$p < .001$.

effects for individuals conducting the interviews. Model 1 shows that physical attractiveness assessed at Wave IV is significantly associated with Wave V CMR. In line with descriptive associations, individuals rated above average have lower CMR levels. We also observe that those rated as very unattractive appear to still enjoy better health (−0.37, $p < .001$) than individuals with average attractiveness, even after age, gender, and race/ethnicity are accounted for.

Point estimates from regression models show that males and Blacks in our analytical sample have higher CMR (Geronimus et al., 2006; Upchurch et al., 2015) than females and other racial/ethnic groups. The results also suggest that the level of IQ, proxied by the Peabody vocabulary test, is significantly associated with later life health. Model 2, when personality characteristics are introduced, suggests that conscientiousness is linked with lower, and neuroticism with higher CMR levels at Wave V. Nonetheless, the relationship of interest between physical attractiveness and health remains largely unaffected.

Next, in Model 3, we introduce SEP related variables at Wave IV. The association between attractiveness and CMR remains robust despite the expected links between SEP and physical attractiveness. The results show that being in the top quintile of income distribution or educational attainment is associated with substantially better health among individuals. The corresponding coefficients for income (−0.17, $p < .001$) and education (−0.17, $p < .05$) are approximately half the size of the coefficient for being rated as very attractive. Individuals' occupational attainment also matters but the nature of the association is different; those in the second lowest and the second highest quintiles of occupational attainment have higher CMR when compared to individuals in the middle occupational quintile.

To address the issue of initial health selection potentially biasing our estimates, in Model 4 we introduce individuals' health characteristics at Wave I. The main results stay largely unaffected. Model 5 also includes the variable for Wave IV BMI. The main coefficients of interest are reduced but physical attractiveness still remains a statistically significant predictor of CMR at Wave V. The coefficient capturing the impact of being rated as very unattractive also stays statistically significant at the 95% significance level. Individuals' BMI is, as expected, a valid predictor of health. We observe a strong health gradient with respect to this measure.

3.3 | Gender and racial/ethnic differences

To test heterogeneous effects of physical attractiveness on health by individuals' gender and race/ethnicity, we take Model 5 specifications from Table 1 and interact individuals' physical attractiveness with the demographic characteristics that are of interest. The mean levels of CMR across different attractiveness categories by gender and race/ethnicity are shown in the supplementary materials, Table S4. In Table 2 we only present point estimates for the interaction coefficients between physical attractiveness, on the one hand, and individuals' gender, and race/ethnicity, on the other hand. The full models are shown in the supplementary materials, Table S5. The presented results suggest that there are no heterogenous gender effects in terms of the identified relationship between physical attractiveness and CMR. Models 2 and 4 show that unattractive Blacks and Hispanics have lower CMR than unattractive Whites. Unattractive individuals in the other race/ethnicity category have higher CMR than unattractive Whites. The gender and racial/ethnicity effects can be further explored by explicitly accounting for interviewers' demographic characteristics and checking whether their gender and race/ethnicity affect the

TABLE 2 Linear regressions models of interaction terms between individuals' attractiveness and their gender and race/ethnicity

	Model 1: Males		Model 2: Blacks		Model 3: Hispanics		Model 4: Others	
	β	CI95%	β	CI95%	β	CI95%	β	CI95%
Attractiveness (ref. = average)								
Very unattractive	0.09	[−0.28,0.45]	−0.39	[−0.93,0.14]	−0.05	[−0.64,0.53]	−0.06	[−0.82,0.70]
Unattractive	−0.23	[−0.68,0.21]	−0.53*	[−1.06,-0.00]	−0.54*	[−1.06,-0.02]	0.78*	[0.01,1.54]
Attractive	−0.01	[−0.18,0.17]	−0.10	[−0.44,0.23]	−0.21	[−0.48,0.05]	−0.06	[−0.37,0.25]
Very attractive	0.10	[−0.18,0.37]	−0.08	[−0.46,0.30]	0.17	[−0.15,0.49]	0.07	[−0.44,0.59]
Adjusted R^2	0.20		0.20		0.20		0.20	
Observations	4160		4160		4160		4160	

Note: 95% confidence intervals in parentheses; * $p < .05$, ** $p < .01$, *** $p < .001$.
Models account for all variables included in Model 5 of Table 1.

association between physical attractiveness and later life health.

3.4 | Interviewers' gender and race/ethnicity effects

The aim of this section is to unravel potential patterns emerging from different combinations of interviewers' and respondents' demographic characteristics (Nedelec & Beaver, 2011). As described above, most of the interviewers in the study were White females. Therefore, we test how splitting the sample by gender and race/ethnicity affects the association between physical attractiveness and health. The interviewers' gender and race/ethnicity may affect the assessment of respondents' attractiveness and can also be linked to differences in the association between attractiveness and CMR (Duru et al., 2012; Geronimus et al., 2006; Nedelec & Beaver, 2011).

In the first column of Table 3, we show the point estimates from the samples divided by interviewers' gender and race/ethnicity, irrespective of respondents' gender or race/ethnicity. We also explore the links between

TABLE 3 Linear regression models of CMR with separate samples for. interviewers' gender and race/ethnicity

	Female interviewers					
	Model 1: All respondents		**Model 2: Female respondents**		**Model 3: Male respondents**	
	β	**CI95%**	**β**	**CI95%**	**β**	**CI95%**
Attractiveness (ref. = average)						
Very unattractive	−0.15	[−0.37,0.07]	−0.33*	[−0.62,-0.05]	0.01	[−0.28,0.29]
Unattractive	0.08	[−0.14,0.31]	0.18	[−0.20,0.55]	0.17	[−0.10,0.44]
Attractive	−0.14*	[−0.25,-0.03]	−0.15*	[−0.29,-0.02]	−0.07	[−0.22,0.07]
Very attractive	−0.15	[−0.32,0.02]	−0.21*	[−0.41,-0.01]	−0.09	[−0.36,0.18]
Adjusted R^2	0.18		0.17		0.13	
Observations	3430		2082		1348	
	White interviewers					
	Model 4: All respondents		Model 5: White respondents		Model 6: Non-White respondents	
	β	CI95%	β	CI95%	β	CI95%
Attractiveness (ref. = average)						
Very unattractive	−0.15	[−0.47,0.17]	−0.16	[−0.55,0.23]	0.12	[−0.45,0.68]
Unattractive	0.00	[−0.24,0.24]	0.00	[−0.24,0.25]	−0.25	[−0.95,0.45]
Attractive	−0.17**	[−0.29,-0.05]	−0.08	[−0.21,0.04]	−0.27*	[−0.49,-0.06]
Very attractive	−0.11	[−0.32,0.10]	−0.11	[−0.36,0.14]	−0.04	[−0.40,0.32]
Adjusted R^2	0.16		0.16		0.17	
Observations	2488		1788		700	
	Non-White interviewers					
	Model 7: All respondents		Model 8: White respondents		Model 9: Non-White respondents	
	β	CI95%	β	CI95%	β	CI95%
Attractiveness (ref. = average)						
Very unattractive	−0.16	[−0.41,0.09]	0.05	[−0.28,0.38]	−0.32	[−0.76,0.13]
Unattractive	0.44**	[0.14,0.74]	0.54*	[0.05,1.04]	0.31	[−0.19,0.82]
Attractive	0.03	[−0.12,0.18]	0.02	[−0.17,0.21]	0.30*	[0.03,0.57]
Very attractive	−0.14	[−0.33,0.05]	−0.03	[−0.30,0.24]	0.02	[−0.29,0.33]
Adjusted R^2	0.20		0.23		0.15	
Observations	1496		725		771	

Note: 95% confidence intervals in parentheses; * $p < .05$, ** $p < .01$, *** $p < .001$.
Models account for all variables included in Model 5 of Table 1.

physical attractiveness and CMR for selected sub-samples based on the different combinations of interviewer and respondent gender. We rerun the final model from Table 1 for females rating females and males separately. Due to the small sample size, we present results with male interviewers rating males and females separately only in the supplementary materials, Table S6. Our results suggest that being rated as very unattractive by a female interviewer is no longer associated with better health in the pooled sample, yet this association is significant in the case of female interviewers rating female respondents (−0.33, $p < .05$). Overall, when female interviewers rate female respondents, the coefficients are consistent with the final model of Table 1. In the case of females rating male respondents, we do not observe any associations between health and being rated as attractive.

Lastly, we focus on the interviewers' and respondents' race/ethnicity. In Models 4–6, showing the results from the sample of only White interviewers, the positive health effect of being perceived as physically attractive is largely unaffected. In addition, it appears that this effect is noticeably larger for non-White respondents. In the last three models of Table 3, when interviewers are non-White, being rated as unattractive is linked to a higher CMR level (0.44, $p < .01$). When we explore the links between attractiveness and health for selected sub-samples based on combinations of interviewers' and respondents' race/ethnicity, we see that the effect is only present in the case of non-White interviewers rating White respondents. In the case of non-White interviewers rating non-White respondents, we see no relationship between physical attractiveness and CMR except the attractive category.

4 | DISCUSSION

In this study, we attempted to generate new evidence on the relationship between physical attractiveness and health using the Add Health longitudinal dataset for the United States. The evolutionary perspectives on human biology entail that physical attractiveness serves as a cue for individuals' health reducing the likelihood of disease transmission to following generations and unhealthy offspring (Buss & Schmitt, 1993; de Barra et al., 2013; Kanazawa, 2019; Symons et al., 1995). It is unclear, though, what is the exact nature of this relationship and if it is moderated by the standards of physical attractiveness perpetuated in the contemporary culture and media.

For the measure of physical attractiveness, in our study, we used an in-person interviewer-assessed measure, which is complementary to the often used measure of attractiveness based on individuals' pictures, and also accounted for interviewer-related fixed effects in the analysis. Our health outcome measure of CMR is widely accepted as a valid indicator of health and provides sufficient variation in health, even at a relatively early stage of individuals' lives. In addition, the previous research has largely ignored health selection mechanisms potentially biasing the association between initial health, on the one hand, and later life attractiveness and health, on the other hand. Further, since there is an association between individuals' SEP and how attractive they are perceived, we account for the most important indicators of SEP and investigate individuals' health outcomes roughly 10 years after the interviewers assessed the respondents' physical attractiveness.

The results of our analysis suggest that physical attractiveness at Wave IV is significantly associated with CMR in the subsequent Add Health survey wave. Being assessed as attractive is linked to significantly lower CMR among individuals, even when an extensive set of predictors of health is accounted for. Our models include some of the most important socio-demographic explanations of health, such as age, gender, race/ethnicity, personality characteristics, education, occupation, income, initial health, and BMI. Although accounting for BMI decreases the effect size of the coefficients for physical attractiveness and health, they remain statistically significant. The moderating role of BMI is visible in our results, expectedly, as its links with attractiveness and related characteristics such as voice quality and body odor, are well established (Rikowski & Grammer, 1999; Wang et al., 2015; Weeden & Sabini, 2005). The fact that BMI measure significantly decreases the effect sizes of physical attractiveness variable might suggest that individuals' height and weight proportion is one of the central components of physical attractiveness and it is also an independent predictor of CMR. As for the magnitude of the association, the effect sizes are not trivial, and being rated as attractive comes close to the effect size of being in the top educational quintile.

We also find that being rated as very unattractive is linked to lower CMR. This is not an entirely unexpected finding as previous research using the Add Health data has also identified that people considered to be very unattractive perform better in terms of various life outcomes (Kanazawa et al., 2018; Kanazawa & Still, 2018). Interestingly, we find that there are racial/ethnic differences in the described associations for unattractive individuals but these effects are not systematic and consistent. We confirm that consistently with past studies, males and Blacks have higher CMR than females and other racial/ethnic groups (Geronimus et al., 2006; Upchurch et al., 2015). Furthermore, when we analyzed separate samples by interviewers' gender, we found that the positive health

effect of being rated as very unattractive stems from female interviewers assessing female respondents and male interviewers assessing both male and female respondents. In addition, females' assessment of females' attractiveness is a more consistent predictor of CMR than any other combination of interviewers' and respondents' gender. We do not know why this effect takes place, but we speculate that females are better than males at evaluating the attractiveness of other females, or at least they pinpoint those aspects of physical attractiveness which are important for health. White interviewers' assessment of non-White respondents' attractiveness is also a better predictor of CMR than White interviewers assessment of White respondents. It is possible that aspects of attractiveness more appreciated by White interviewers are more important for various life outcomes which eventually also affect non-White respondents' health.

Some of the limitations of the previous research have been the use of physical attractiveness measures without in-person assessment, not accounting for some of the key predictors of physical attractiveness and health, using self-rated measures of health, and ignoring the potential channels of reverse causation between physical attractiveness and health (de Jager et al., 2018; Nedelec & Beaver, 2014; Shackelford & Larsen, 1999; Żelaźniewicz et al., 2020). We have addressed these concerns, but the presented study has its own limitations. Interviewer-assessed physical attractiveness has been previously criticized as an imperfect indicator of attractiveness, as it might be biased by interviewers' perceptions of attractiveness and their sociodemographic characteristics. Yet, we mitigate this problem by accounting for interviewer-related fixed effects in the main analysis and then by also splitting the sample by interviewers' gender and race/ethnicity. Although we account for individuals' initial health and other important socioeconomic characteristics, we cannot exclude the possibility of reverse causation from our dependent variable to our explanatory variable. We mitigated this concern by analyzing physical attractiveness in Wave IV of Add Health while looking at Wave V health outcome. Lastly, we investigated racial/ethnic inequalities in our analysis, but some of the racial/ethnic subgroups are too small to divide and analyze by the interviewers' and respondents' race/ethnicity.

Regardless of the described limitations, the main finding of this study is that, after 10 years of the assessment, individuals who are described as attractive have significantly better health than individuals who are described as average looking. The mechanisms linking the two are speculative but the findings are consistent with the evolutionary perspective that physical attractiveness reflects well how biologically healthy individuals are. On the other hand, being perceived as physically attractive might also imply, among other aspects, high levels of satisfaction with life, self-confidence, and ease of finding intimate partners, all of which might positively affect individuals' health. It is more puzzling, theoretically, to explain the positive association between being assessed as very unattractive and having better health than those described as average looking. One of the potential explanations could be that, as others have speculated (Kanazawa et al., 2018; Kanazawa & Still, 2018), those who are judged as very unattractive might be more heterogeneous in individual traits, or also more conscientious and extraverted and less neurotic than other individuals. Lower neuroticism, in turn, is likely to have a positive effect on health and, for instance, very unattractive individuals who are less neurotic might indeed have better health (as our additional checks suggest in the supplementary materials, Tables S7 and S8).

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Add Health. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from https://addhealth.cpc.unc.edu/ with the permission of Add Health.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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