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Physical attractiveness as a phenotypic marker of health: An assessment using a nationally representative sample of American adults

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Abstract

Evolutionary explanations regarding the differential preference for particular traits hold that preferences arose due to traits' association with increased potential for reproductive fitness. Assessments of physical attractiveness have been shown to be related to perceived and measured levels of health, an important fitness-related trait. Despite the robust association between physical attractiveness and health observed in the extant literature, a number of theoretical and methodological concerns remain. Specifically, the research in this area possesses a lack of specificity in terms of measures of health, a reliance on artificial social interactions in assessing physical attractiveness, a relatively infrequent use of non-student samples, and has left unaddressed the confounding effects of raters of attractiveness. Using these concerns as a springboard, the current study employed data from the National Longitudinal Study for Adolescent Health (N ≈ 15,000; aged 25 to 34 years) to assess the relationship between physical attractiveness and various specific and overall measures of health. Logistic and OLS regression models illustrated a robust association between physical attractiveness and various measures of health, controlling for a variety of confounding factors. In sum, the more attractive a respondent was rated, the less likely he or she was to report being diagnosed with a wide range of chronic diseases and neuropsychological disorders. Importantly, this finding was observed for both sexes. These analyses provide further support for physical attractiveness as a phenotypic marker of health. The findings are discussed in reference to evolutionary theory and the limitations of the study and future research suggestions are also addressed.

Keywords: physical attractiveness; health; sexual reproduction; sexual behaviors

1. Introduction

One of the key theoretical foundations of an adaptationist approach to the study of mating behaviors is that traits found to be attractive by members of a species are indicative of evolutionarily important phenotypes (Sugiyama, 2005). In short, the perspective holds that sexual selection processes produced an evolved suite of mechanisms related to mate choice in order to maximize reproductive success and the fitness of offspring (Buss & Schmitt, 1993; Grammer, Fink, Møller, & Thornhill, 2003). Indeed, the adaptive problem of mate selection is one of the most fundamental factors related to reproductive success (Tovée, Edmonds, & Vuong, 2012). A significant component within the adaptive problem of mate selection is maximizing the likelihood of obtaining a healthy mate (Buss & Schmitt, 1993; Symons, 1995). Ensuring that a mating partner is healthy aids reproductive success in a number of ways; for example, it can help decrease the likelihood of infection from a partner (for oneself and one's offspring), it can reduce the risk of losing potential shared investment in offspring due to an unhealthy partner's illness or death, and it can increase the chance that offspring will inherit the genetic material that provides resistance to parasitic infection and other pathogens (de Barra, DeBruine, Jones, Mahmud, & Curtis, 2013; Grammer et al., 2003). Given the weight ascribed to health in maximizing reproductive success, an adaptationist approach would predict preferential attraction towards phenotypic markers of good health (Rhodes, Simmons, & Peters, 2005; Sugiyama, 2005). Consequently, the connection between physical attractiveness and health-related outcomes has received considerable assessment from a variety of researchers using both human and non-human samples (Kalick, Zebrowitz, Langlois, & Johnson, 1998). The current study seeks to add to this literature by empirically examining whether physical attractiveness represents a phenotypic marker for specific health-related outcomes in a nationally representative sample of American adults.

There is a growing body of literature indicating a connection between various indices of physical attractiveness and health in humans. For example, a line of research employing judgmental assessments of health has shown that respondents who rate targets as more physically attractive also rate the same targets as healthier than those judged to be less physically attractive (Cunningham, 1986; Grammer & Thornhill, 1994; Singh, 1995). The bulk of studies assessing the link between attractiveness and health in humans, however, are derived from research using facial characteristics. The focus of these studies has generally been on three facial properties: averageness, masculinity/femininity, and symmetry (Grammer et al., 2003; Weeden & Sabini, 2005; see also Stephen, Coetzee, & Perrett, 2011 for an assessment of facial pigment, attractiveness, and perceived health). Overall, the results of these studies have shown that average faces, relative to distinctive faces, are rated as appearing healthier (Rhodes et al., 2001); male faces with more masculine features and female faces with more feminine features are associated with increased perceptions and indications of health (Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Rhodes, Chan, Zebrowitz, & Simmons, 2003; Scott, Swami, Josephson, & Penton-Voak, 2008; Thornhill & Gangestad, 2006; but see Boothroyd, Jones, Burt, Cornwell, et al., 2005, Boothroyd, Jones, Burt, & Perrett, 2007, Shackelford & Larsen, 2003); and those faces rated/measured as asymmetrical have been rated as less healthy than faces approaching symmetry (Fink, Manning, Neave, & Grammer, 2006; Gangestad & Thornhill, 2003; Jones et al., 2001; Rhodes et al., 2001; Thornhill & Gangestad, 2006; Zaidel, Aarde, & Baig, 2005). Research employing non-facial indices of physical attractiveness has also shown a link to health-related outcomes. For example, Manning and colleagues (1997) illustrated that asymmetry in women's breasts (a health-related correlate) was negatively associated with marriage and number of offspring (correlates of attractiveness). Other bodily indices of health (e.g., BMI) have also been shown to be related to ratings of attractiveness (Hume & Montgomerie, 2001; Perilloux, Cloud, & Buss, 2013). Overall, the literature indicates that those facial and bodily traits found to be attractive are also perceived to indicate some information about the health of the individual.

Although the current literature tends to support a link between physical attractiveness and health, a number of methodological concerns remain relatively unaddressed. For example, while some studies have employed specific health-related variables as outcomes (cf., de Barra et al., 2013; Kalick et al., 1998; Shackelford & Larsen, 1999; Thornhill & Gangestad, 2006), the vast majority of the studies reviewed above employ a generalized operationalization for health. Left relatively unaddressed is the question of whether physical attractiveness is related to specific indices of health or if the association is only evident with global measures of health. Consequently, there is a need for greater specificity in terms of how studies measure health-related outcomes. Indeed, Grammer and colleagues (2003) highlight this gap in the literature noting, "[w]e still need to know which kinds of diseases are reflected by signals of beauty [and] [h]ow well . . . different signals predict risks of disease and parasitism" (p. 402). Additionally, with the exception of a handful of studies (e.g., de Barra et al., 2013; Fink et al., 2006; Kalick et al., 1998; Scott et al., 2008), the majority of empirical analyses of the association between physical attractiveness and health have been conducted using college and university samples. Therefore, there is a need to assess the relationships beyond samples derived from college and universities. Moreover, a number of the studies in the extant literature employ assessments of physical attractiveness using pictures, drawings, or videos of human faces and bodies. However, there is reason to suspect that limiting raters' assessment of physical attractiveness in this way may generate an unrealistic evaluation as it focuses the raters' attention to a limited number of traits (Grammer, Fink, Møller, & Manning, 2005; Grammer et al., 2003). As a result, studies which employ live interaction between rater and target may help illuminate if past research is off base. Finally, past research has shown that raters' characteristics can have a systematic impact on the assessments of physical attractiveness (Marcus & Miller, 2003; Nedelec & Beaver, 2011), yet the studies which have assessed the link between physical attractiveness and health-related outcomes generally do not control for the influence of rater characteristics. Therefore, to the extent that rater characteristics affect the relationship between attractiveness and health the association may be biased to an unknown degree.

With these methodological and theoretically relevant concerns in mind, the current study adds to the current literature in at least four ways. First, the study employs a wide range of *specific* health-related outcomes as well as aggregated indexes of health to provide a robust assessment of the association between physical attractiveness and health. Second, the current study is unique in that it examines the relationship between attractiveness and health using a large nationally representative sample of adults. Third, the current study incorporates a measure of physical attractiveness that is based on interviewer assessment after an approximately 90-minute *in-person* interview. Therefore, this measure improves on past operationalizations of attractiveness based solely on pictures, drawings, or videos. Fourth, the current study employs an analytical strategy wherein rater characteristics are controlled thus eliminating the potential confounding effects of nonrandom differences between raters of physical attractiveness. Overall, the current study provides a rigorous assessment of the relationship between physical attractiveness and health hitherto absent from the extant literature.

2. Methods

2.1 Data

The current study employs data from the National Longitudinal Study for Adolescent Health (Add Health; Harris et al., 2009). Detailed information about the data and the sampling procedure are described elsewhere (Harris et al., 2009; Harris, Halpren, Smolen, & Haberstick, 2006). Briefly, the Add Health is a nationally representative prospective study of American youth who were assessed at four different time points. The first wave of data was collected during the 1994-1995 school year and included approximately 90,000 students in over 80 different high schools. A subsample of 20,745 respondents aged 12 to 21, were administered follow-up questionnaires during a 90-minute in-home survey to collect more detailed information on a wide range of topics including sexual behaviors, drug and alcohol use, physical activities, and antisocial conduct. During the in-home interviews at wave 1 the respondent's parent (typically the mother) or primary care-giver also completed a questionnaire covering topics such as academic achievement, living arrangements, employment, and income. After about one-and-a-half years, the second wave of questionnaires was administered to 14,738 youths who ranged in age from 13 to 22 years old. The third wave of data was collected in 2001-2002 when the respondents reached young adulthood (aged 18 to 28) and included 15,197 participants. The final wave of data collection occurred in 2007-2008 when the 15,701 respondents were between ages 24 and 32 years old. Of the original wave 1 respondents, approximately 80% were eligible for inclusion at wave 4 and were successfully re-interviewed (Harris et al., 2009). The data employed in the current study is derived from the wave 4 interviews (two demographic variables, race and parents' income, are from wave 1). The analytical sample in the current study ranges in size from 14,923 to 15,700 for the full sample, 6,997 to 7,349 for males, and 6,243 to 8,352 for females.

2.2 Measures

2.2.1 Physical Attractiveness

At the conclusion of the wave 4 interview session and after interviewers were separated from the respondents, interviewers completed a number of questions about individual respondent characteristics. Included within these items was the following question, "How physically attractive is the respondent?". The item was coded such that 1 = very unattractive, 2 = unattractive, 3 = about average, 4 = attractive, and 5 = very attractive. The physical attractiveness measure is commonly employed by researchers using the Add Health and assessing the influence of personal appearance (e.g., French, Robins, Homer, & Tapsell, 2009; Nedelec & Beaver, 2011).

2.2.2 Health Items

Following literature indicating that self-reported assessments of health are valid measures of both physical and mental health (Bond, Dickinson, Matthews, Jagger, & Brayne, 2006; Ford, Spallek, & Dobson, 2008; Idler & Benyamini, 1997), we employ a variety of self-reported items regarding the health of respondents derived from the wave 4 interviews. Specifically, respondents were provided a series of questions asking whether they had ever been diagnosed by a health-care professional with any of the following 11 health-related items: cancer, high cholesterol, high blood pressure, diabetes, heart disease, asthma, migraine headaches, depression, anxiety, epilepsy, and attention deficit disorder/attention deficit-hyperactivity disorder (ADD/ADHD). Additionally, respondents were asked if they have ever had problems with stuttering or stammering and if, in the past 12 months, they had ever been bothered by ringing or buzzing in their ears that lasted for more than five minutes (tinnitus). Each of these 13 health items was coded dichotomously such that 0 = no and 1 = yes.

2.2.3 Health Indexes

In addition to the dichotomous health items, the current study includes a number of continuous measures and one count measure of health-related outcomes derived from the wave 4 interviews. Specifically, respondents were asked to report how their health was in general. The general health item was reverse coded such that 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent. In order to obtain a robust assessment of respondent health a measure of the consequence of ill health is included. Respondents were asked to report the number of days, in the past 30 days, they missed school or work due to a health-related problem. The number of sick days item was coded such that 0 = never, 1 = a few times, 2 = about once a week, 3 = almost every day, and 4 = every day. In addition to general health-related outcomes, a specific measure of sexual health is also included in the current study. Respondents were presented a series of questions asking whether or not they had been diagnosed with any of the following 14 sexually transmitted diseases/infections: chlamydia, gonorrhea, trichomoniasis, syphilis, genital herpes, genital warts, hepatitis B (HBV), human papilloma virus (HPV), pelvic inflammatory disease (PID), cervicitis or mucopurulent cervicitis (MPC), urethritis, vaginitis, HIV infection or AIDS, or any other sexually transmitted disease/infection. Each of these dichotomously coded items were coded such that 0 = no and 1 = yes. The items were then summed together to create the sexually transmitted disease/infection (STD) index where higher values indicate a greater number of sexually transmitted diseases. These three health indexes were also supplemented by three more indexes created using the individual health items outlined in section 2.2.2 above. An overall measure of disease (diseases index) was created by summing together all of the individual health items. The health items were then demarcated into two categories of health-related outcomes, chronic diseases and neuropsychological disorders. Following definitions provided by the World Health Organization (www.who.int/topics/chronic_diseases; accessed October 30, 2013) the chronic diseases index was generated by summing together the following six health items: cancer, high cholesterol, high blood pressure, diabetes, heart disease, and asthma. While the etiological pathways for some of the remaining health items are somewhat controversial (Banaschewski et al., 2005; Büchel & Sommer, 2004; Gianfrancesco & Esposito, 2006; Nigg, 2010; Sullivan, Neale, & Kendler, 2000; Wessman, Terwindt, Kaunisto, Palotie, & Ophoff, 2007) we followed evidence from the medical sciences indicating that migraines, depression, anxiety, epilepsy, ADD/ADHD, stuttering, and tinnitus are related to or are manifestations of neuropsychological malfunctioning (Büchel & Sommer, 2004; Hiller & Goebel, 1999; Mantella et al., 2007; Nigg, 2010; Jacoby, Snape, & Baker, 2005; Johnston-Wilson et al., 2000; Song, Vanneste, Schlee, Van de Heyning, & Ridder, 2013; Wessman et al., 2007). Consequently, we summed these seven items together to form the neuropsychological disorders index. Each of these three summative health indexes was coded such that higher values indicate a greater number of disease or disorder diagnoses.

2.2.4 Control Variables

In conducting the multivariate analyses, the following control variables were included: age (measured in years), race (coded such that 0 = nonwhite and 1 = white), and sex (coded such that 0 = female and 1 = male). Additionally, following the literature on both physical attractiveness (Hamermesh & Biddle, 1994; Judge, Hurst, & Simon, 2009) and health (Deaton, 2003; Furnée, Groot, & Pfann, 2010), we include controls for personal income and respondents' parents' income. Importantly, both of the income measures were z-transformed prior to analyses. While the personal income measure was obtained from wave 4, the measure tapping the parents' income was derived from the parent questionnaire given during the wave 1 in-home interview session. Given that there is no measure of respondent race at wave 4 the race variable is also obtained from wave 1. Finally, in order to control for the effect of interviewer characteristics and differential assessment of physical attractiveness by interviewers we employed a hierarchical analysis, clustered by interviewer for all of the regression models (the standard errors in the clustered analyses were adjusted for 322 interviewers using the unique interviewer identification number).

2.3 Analytical Plan

After first producing descriptive statistics, including an assessment of the average difference between males and females, we then provide the zero-order associations between physical attractiveness, the individual health items, the health indexes, and the control variables (Pearson's *r* and tetrachoric correlations). The final steps of the analysis employed logistic regression models in order to predict the likelihood of a diagnosis on each of the individual health items and OLS regression models to assess the relationship between physical attractiveness and the overall and grouped indices of health. Although OLS regression techniques require a normally distributed error term, the large sample size included in the current study justifies violation of this requirement and the use of OLS regression techniques is therefore appropriate (McClendon, 1994). As mentioned above, we clustered by interviewer for each of the regression models (logistic and OLS) in order to adjust the standard errors in recognition of the influence of nonrandom assignment of respondents to interviewers (Hox, 1994; Nedelec & Beaver, 2011).

3. Results

Summary statistics for all of the study variables as well as an assessment of the average differences between males and females are presented in Table 1. As illustrated, all of the respondents in the sample were of adult age (Mean ± SD = 29.09 ± 1.74, N = 15,690) and the study sample was comprised of approximately 47% males and 53% females, with the majority of respondents indicating their race as white (approximately 62%). In terms of physical attractiveness, a significant difference between males and females was found (two-sample t-test, $t_{15,671} = 6.06$, $p < .001$) with females receiving higher average ratings of physically attractiveness. Overall, there were low base-rates of diagnoses of the individual health items but these observations did not differ substantially from national estimated rates for 2006-2008 for people aged 25 to 44 as reported by the Centers for Disease Control and Prevention (http://www.cdc.gov/DataStatistics; accessed November 1, 2013). Males and females also differed on the majority of the health items where statistically significant differences in diagnoses arose for all but two health items (heart disease and epilepsy; two-sample t-test, $t_{15,697} = .91$, $p = .36$; $t_{15,697} = 1.43$, $p = .15$, respectively). In terms of the overall measures of health as indicated by the health indexes, males and females differed significantly on all but one of the indexes (chronic disease index; two-sample t-test, $t_{15,697} = 1.15$, $p = .25$). In general, females reported a lower average level of general health (two-sample t-test, $t_{15,699} = -5.43$, $p < .001$), a greater average number of days of school or work missed due to illness (two-sample t-test, $t_{15,618} = 6.94$, $p < .001$), a poorer sexual health history, on average, as measured by the STD index (two-sample t-test, $t_{15,368} = 28.06$, $p < .001$), a greater average number of disease diagnoses overall (two-sample t-test, $t_{15,692} = 12.85$, $p < .001$), and a greater average number of neuropsychological disorder diagnoses (two-sample t-test, $t_{15,694} = 16.40$, $p < .001$). Given these observed differences between males and females, the bivariate and multivariate analyses were bifurcated by sex.

The zero-order associations between the control variables, physical attractiveness, and the health-related measures are provided in Table 2. In general, there is a negative relationship between physical attractiveness and the individual health items for both males and females. In terms of the health indexes the pattern for males and females is almost identical: physical attractiveness is significantly associated with each of the health indexes at the bivariate level. Table 2 also illustrates that a number of the individual health items and the health indexes are statistically associated with the various control variables. Consequently, these potentially confounding factors may have an influence on the observed association between physical attractiveness and the health-related outcomes and were thus included in the multivariate regression analyses.

As indicated above, the third analytical step incorporated logistic regression methods to assess the probability of a diagnosis on the individual health items based on variant levels of physical attractiveness (controlling for the effects of age, race, sex, income, parents' income, and clustering by interviewer). As illustrated in Table 3, variance in physical attractiveness predicted the likelihood of diagnosis for eight of the 13 health items for the full sample, six of the 13 health items for males, and seven of the 13 health items for females (see Table 3). More specifically, for each level of increase in ratings of physical attractiveness for males there was a 13% reduction in the likelihood of a diagnosis for high cholesterol, a 20% reduction in the likelihood of a diagnosis for high blood pressure, a 15% reduction in the probability of being diagnosed for depression, a 23% reduction in the likelihood of an ADD/ADHD diagnosis, and a 21% reduction in the likelihood of suffering from problems associated with stuttering. Similar findings were discovered for females, although the pattern differed somewhat. Specifically, those females who were rated as more attractive were also 21% less likely to be diagnosed with high blood pressure, 22% less likely to be diagnosed with diabetes, 12% less likely to receive a diagnosis of asthma, 17% less likely to suffer from clinical depression, 18% less likely to receive an ADD/ADHD diagnosis, 18% less likely to suffer problems associated with stuttering, and 13% less likely to be experiencing the symptoms of tinnitus. In order to more clearly illustrate these patterns of results, the predicted probabilities of a diagnosis of the individual health items as a function of physical attractiveness are displayed in Fig. 1 (full sample), Fig. 2 (males), and Fig. 3 (females). Importantly, the predicted probabilities were estimated with the control variables (age, race, sex, income, and parents' income) set to their means. Despite the relatively low effect sizes displayed in Table 3, the statistically significant associations illustrated in Fig. 1, Fig. 2, and Fig. 3 all point to a consistent pattern: the more physically attractive a respondent was rated, the less likely she or he was to report ever receiving a diagnosis of an individual disease or disorder.

As illustrated in Table 4, the pattern of results seen in the logistic regression models remained for the OLS regression analyses of the health indexes. For both males and females, those respondents who were rated as more physically attractive also reported a more positive perception of their general health, a fewer number of days of school or work missed due to illness, a reduced number of disease diagnoses overall, a reduced number of chronic disease diagnoses, and a reduced number of neuropsychological disorder diagnoses (see Table 4) net of the effect of age, race, sex, personal income, and their parents' income. Interestingly, however, those males and females who were rated as more physically attractive also reported poorer sexual health histories as measured by the STD index (see Table 4).

4. Discussion

As a phenotypic marker of fitness quality, physical attractiveness has been shown to be related to perceptions and measures of health in prior research. However, as outlined above numerous shortcomings are evident in the extant literature. The current study sought to address these shortcomings by assessing the link between physical attractiveness and numerous specific and generalized measures of health from a nationally representative sample wherein attractiveness ratings were derived from in-person interviews. Furthermore, the statistical models employed in the current study controlled for the systematic influence of interviewer characteristics highlighted in past research on ratings of physical attractiveness (Marcus & Miller, 2003; Nedelec & Beaver, 2011). After addressing these concerns, the current analysis illustrated a statistically significant association between physical attractiveness and various indices of health thereby providing support for an adaptationist approach to attraction.

In addition to the general finding supporting a link between physical attractiveness and health a number of interesting specific results relevant to an adaptationist approach arose. For instance, authors have noted that extreme masculine and feminine facial and bodily characteristics (e.g., broad chins and shoulders in males, small chins and larger pelvic regions in females; also known as secondary sex characteristics) are driven by high hormone levels – testosterone in males and estrogen in females (Grammer et al., 2003; Jasieńska, 2013). Researchers have also linked these traits to semen quality in males (Soler et al., 2003) and fecundity in females (Jasieńska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004), factors key to reproductive success. Further, given that hormones like testosterone and estrogen have been shown to reduce components of immunocompetence (Muehlenbein & Bribiescas, 2005; Thornhill & Gangestad, 1993), physical attractiveness may be an honest marker of one's ability to be resistant to parasitic infection and other deleterious processes related to health (Grammer et al., 2003; Thornhill & Gangestad, 1993, 2008). Additionally, these hormones have also been shown to provide protection from certain immunopathological effects (e.g, testosterone and malarial infection; see Muehlenbein & Bribiescas, 2005). Therefore, concerns regarding the selection of a healthy mate should be illustrated by the preferential ratings of attractiveness of *both* males and females. This claim was supported by the results of the current study. For instance, for the six specific chronic illnesses physical attractiveness was significantly associated (i.e., $p < .10$) with four illnesses in the full sample (high cholesterol, high blood pressure, diabetes, and asthma), two illnesses in the male subsample (high cholesterol and high blood pressure), and three illnesses in the female subsample (high blood pressure, diabetes, and asthma). Likewise, the association between physical attractiveness and the seven neuropsychological disorders was statistically significant for four disorders in the full sample (migraines, depression, ADD/ADHD, and stuttering), the exact same four disorders in the male subsample, and four disorders in the female subsample (depression, ADD/ADHD, stuttering, and tinnitus). This pattern of similarity was replicated in the OLS regression models where the associations between physical attractiveness ratings and the various health indexes were almost identical, in terms of statistical significance and effect size, between males and females. Consequently, the pattern of association between both specific and more general indices of health and physical attractiveness appears similar for males and females. These findings highlight the concern that both sexes place on health when selecting potential mating partners, as indicated by ratings of physical attractiveness.

Beyond the overall association between physical attractiveness and health observed in the current study another interesting finding arose regarding levels of attractiveness and the STD index. For both males and females, the more attractive a respondent was rated the greater the number of sexually transmitted illnesses he or she reported (see Table 3). This was the only instance wherein higher levels of physical attractiveness were associated with poorer levels of health. Given the link between sexual transmitted illnesses and number of sexual partners (Kelley, Borawski, Flocke, & Keen, 2003), we conducted post-hoc analyses to assess if the observed association between attractiveness and the STD index was a function of the number of sex partners. Using a measure of number of lifetime sexual partners from wave 4 (number of vaginal sex partners) we found that even after accounting for the number of sexual partners the association between physical attractiveness and the STD index remained (Full sample: $\beta = .04$, $SE = .01$, $p < .001$; Males: $\beta = .04$, $SE = .01$, $p = .005$; Females: $\beta = .04$, $SE = .01$, $p = .002$). Future research in this area would benefit from unpacking the association between physical attractiveness and sexually transmitted illnesses.

While the results provide support for the assertion that physical attractiveness is a phenotypic marker of health the findings of the current study should be tempered by the following limitations. First, while the sample of respondents included in the Add Health study was selected to be nationally representative the interviewer sample was not. Therefore, it is conceivable that there is something unique to the interviewers in the Add Health study which could influence the results. However, given that the results are congruent with theoretical expectations and past research it is unlikely that characteristics unique to the Add Health researchers are biasing the findings derived in the current analysis. Second, given that the interview was a professional encounter, the ratings of physical attractiveness may not be representative of a mate-selection dynamic. Therefore, the results may differ from an analysis wherein the association between physical attractiveness and health is examined among a sample of raters assessing potential mates. However, there are two potential counter-points to this limitation; first, the interviewers who rated the respondents' physical attractiveness still possessed the evolved psychological adaptations which guide their perceptual constructs of beauty (adaptations which have been shown to be cross-cultural in nature; Buss et al., 1990); and second, it is reasonable to assume that individuals assessing physical attraction rather than mate potential may be more generous in their assessments of physical attractiveness. Therefore, to the extent that the ratings of physical attraction are more generous the observed associations between physical attractiveness and the various indices of health may in fact be attenuated. Additionally, while the results indicate support for an adaptationist approach to physical attraction such as the 'good-genes' hypothesis (see Thornhill & Gangestad, 2008) the current study does not provide information about whether similar genetic material influence the phenotypic expression of attractiveness and susceptibility to ill health. Future research would benefit from an examination of the genetic overlap between various measures of ill health and physical attractiveness.

Finally, the results of the current study have relevance to evolutionary perspectives on health and medicine (see Nesse & Stearns, 2008; Nesse & Williams, 1994; Stearns, Nesse, Govindaraju, & Ellison, 2010). This expanding literature has highlighted that organisms are "bundles of compromises shaped by natural selection to maximize reproduction, not health" (Stearns et al., 2010, p.1691); thus, traits which provide a benefit to fitness during reproductive age may be detrimental to health later in life (see Jasieńska, 2013). Therefore, to the extent that physical attractiveness (a fitness enhancing trait) is associated with ill-health later in life the association observed in the current study may be altered to an unknown degree by the inclusion of a sample of older adults. Future research is encouraged to assess this relationship beyond the age range of the current study. As for now, the findings of the current analysis support the argument that physical attractiveness is a phenotypic marker for both specific and generalized measures of health in males and females.

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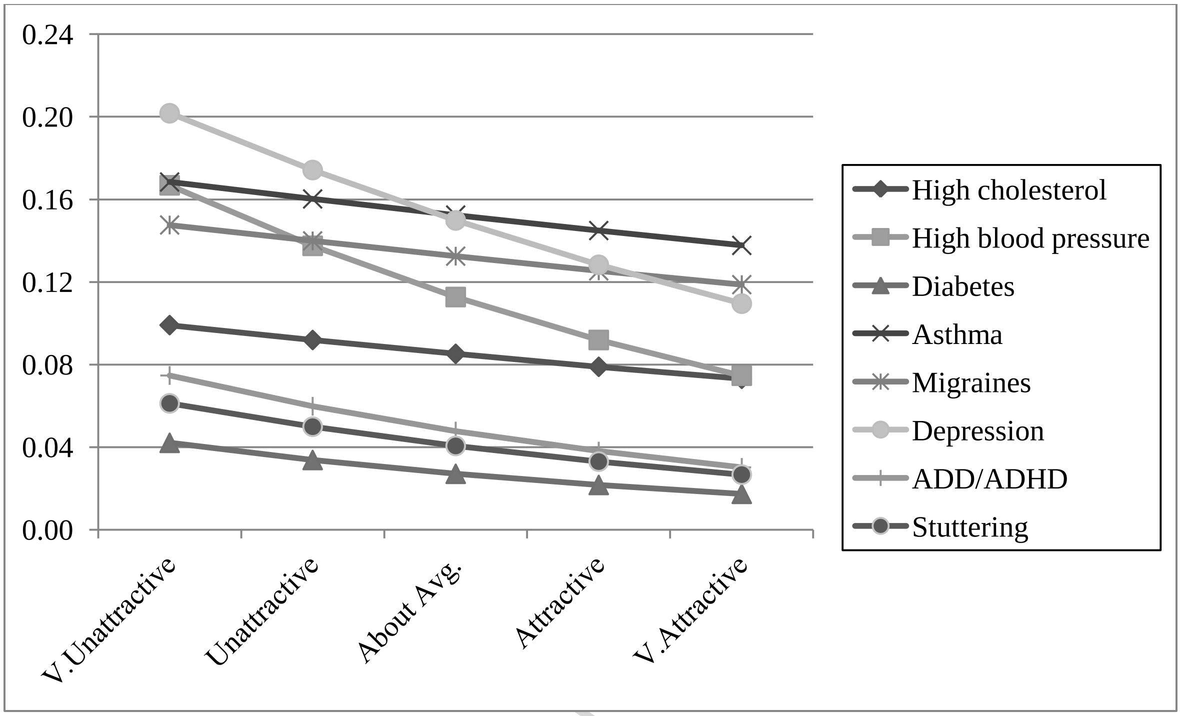

Fig. 1. Predicted probabilities of a disease diagnosis as a function of physical attractiveness for the full sample.

Notes: Predicted probabilities were estimated with age, sex, race, income, and parents' income set to their means. Only those health-related diagnoses which were significantly related to physical attractiveness ($p < .10$) in the multivariate logistic analyses are illustrated (see Table 3).

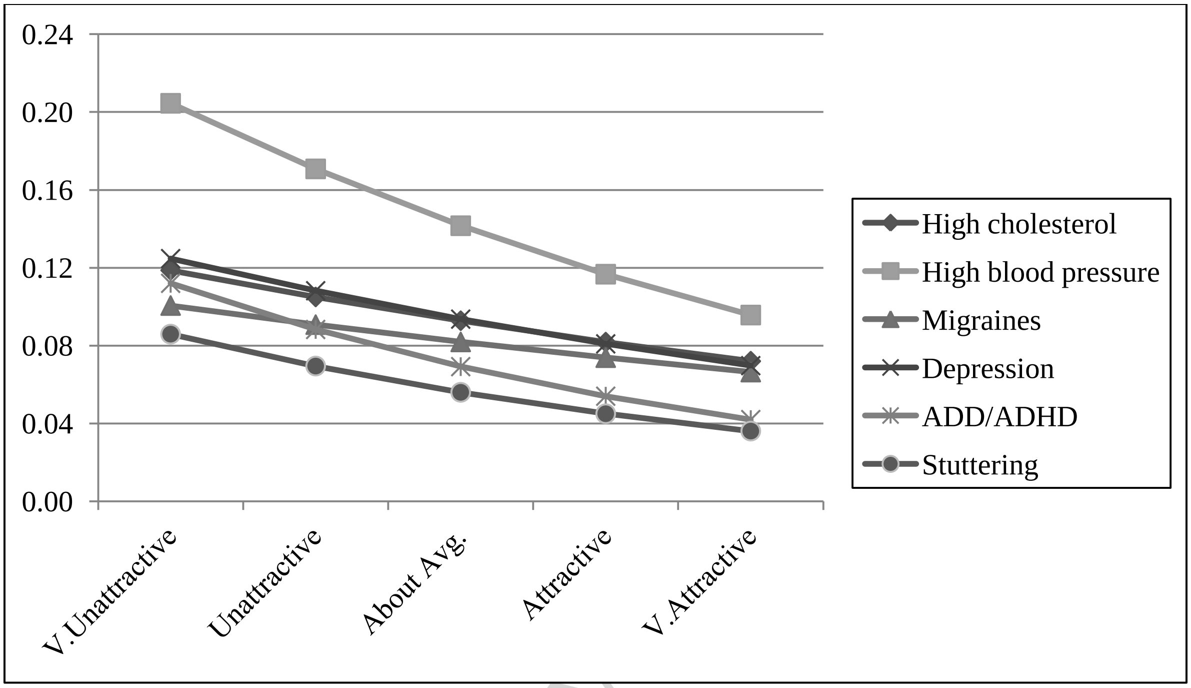

Fig. 2. Predicted probabilities of a disease diagnosis as a function of physical attractiveness for males.
Notes: Predicted probabilities were estimated with age, race, income, and parents' income set to their means. Only those health-related diagnoses which were significantly related to physical attractiveness ($p < .10$) in the multivariate logistic analyses are illustrated (see Table 3).

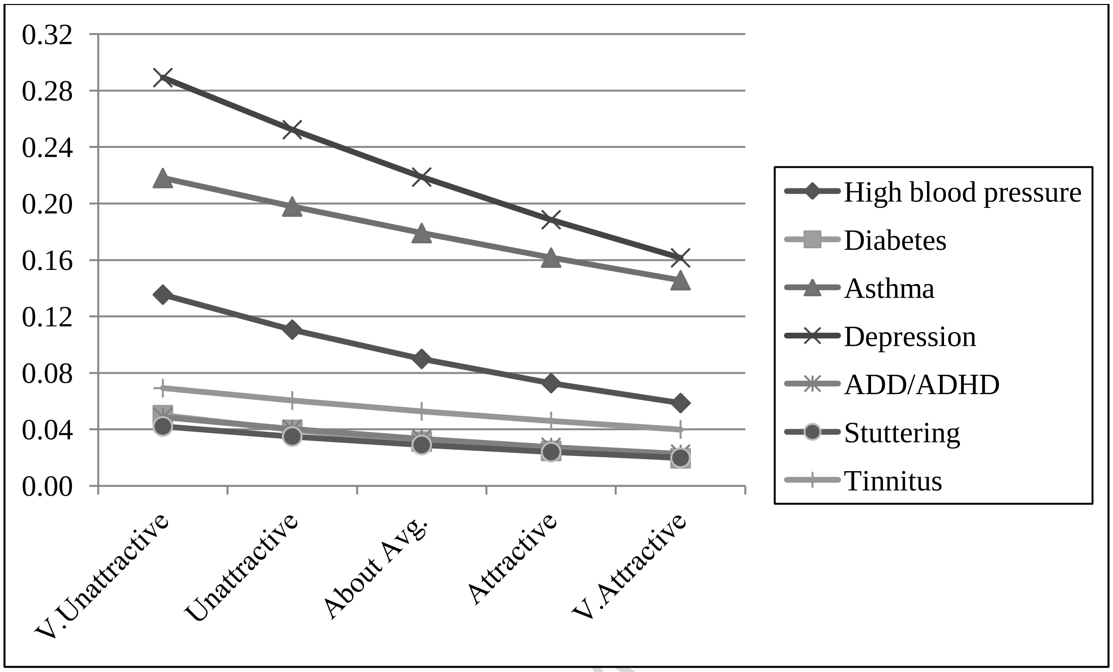

Fig. 3. Predicted probabilities of a disease diagnosis as a function of physical attractiveness for females.

Notes: Predicted probabilities were estimated with age, race, income, and parents' income set to their means. Only those health-related diagnoses which were significantly related to physical attractiveness ($p < .10$) in the multivariate logistic analyses models are illustrated (see Table 3).

Table 1. Summary statistics for all study variables for the full sample, males, and females.

	Full Sample			Males			Females			*t*-value †
	Mean (%)	SD	Range	Mean (%)	SD	Range	Mean (%)	SD	Range	
Physical attractiveness	3.45	.83	1-5	3.40	.79	1-5	3.49	.86	1-5	6.06
Health Items										
Cancer	.01 (1.34)	.12	0-1	.01 (.61)	.08	0-1	.02 (1.98)	.14	0-1	7.43
High cholesterol	.08 (8.10)	.27	0-1	.09 (8.89)	.29	0-1	.07 (7.40)	.26	0-1	-3.41
High blood pressure	.11 (10.59)	.31	0-1	.13 (12.81)	.33	0-1	.09 (8.63)	.28	0-1	-8.50
Diabetes	.03 (2.85)	.17	0-1	.02 (2.20)	.15	0-1	.03 (3.41)	.18	0-1	4.54
Heart disease	.01 (.79)	.09	0-1	.01 (.72)	.09	0-1	.01 (.85)	.09	0-1	.91
Asthma	.15 (14.80)	.36	0-1	.13 (12.62)	.33	0-1	.17 (16.72)	.37	0-1	7.23
Migraines	.14 (14.21)	.35	0-1	.08 (8.06)	.27	0-1	.20 (19.63)	.40	0-1	21.00
Depression	.15 (15.33)	.36	0-1	.10 (9.49)	.29	0-1	.21 (20.46)	.40	0-1	19.27
Anxiety	.12 (11.64)	.32	0-1	.07 (7.02)	.26	0-1	.16 (15.70)	.36	0-1	17.07
Epilepsy	.01 (1.39)	.12	0-1	.01 (1.25)	.11	0-1	.02 (1.52)	.12	0-1	1.43
ADD/ADHD	.05 (4.94)	.22	0-1	.07 (6.68)	.25	0-1	.03 (3.40)	.18	0-1	-9.50
Stuttering	.04 (4.22)	.20	0-1	.06 (5.53)	.23	0-1	.03 (3.08)	.17	0-1	-7.63
Tinnitus	.06 (6.36)	.24	0-1	.07 (7.09)	.26	0-1	.06 (5.71)	.23	0-1	-3.53
Health Indexes										
General health	3.66	.92	1-5	3.70	.91	1-5	3.62	.92	1-5	-5.43
Number of sick days	.22	.57	0-4	.19	.55	0-4	.25	.59	0-4	6.94
STDs	.34	.71	0-7	.17	.47	0-6	.49	.84	0-7	28.06
Diseases	.97	1.25	0-10	.83	1.14	0-9	1.09	1.34	0-10	12.85
Chronic diseases	.38	.65	0-5	.38	.65	0-4	.39	.65	0-5	1.15

Neuropsych. disorders	.58	.94	0-6	.45	.83	0-6	.70	1.01	0-6	16.40*
Control variables										
Age	29.09	1.74	25-34	29.19	1.74	25-34	29.01	1.74	25-34	-6.47*
Race	.62	.49	0-1	.64	.48	0-1	.63	.48	0-1	-1.71
Sex	.47	.50	0-1	--	--	--	--	--	--	--
Income	.00	1.00	-.78-21.4	.15	1.13	-.78-21.43	-.13	.85	-.78-21.43	-17.28*
Parents' income	.00	1.00	-.89-18.5	.01	.89	-.89-18.47	.02	1.05	-.89-18.47	.57
N (range)	14,923 - 15,700			6,997 - 7,349			6,243 - 8,352			

Notes: All variables are from Wave 4 (race and parents' income are from Wave 1); Income and parents' income are z-transformed variables; Diseases index is the sum of all the individual health items; Chronic diseases index is the sum of cancer, high cholesterol, high blood pressure, diabetes, heart disease, and asthma; Neuropsychological disorders index is the sum of migraines, depression, anxiety, epilepsy, ADD/ADHD, stuttering, and tinnitus; Percentage of the sample diagnosed with a disease (individual health items only) in parentheses; 'Neuropsych.' – neuropsychological; SD: standard deviation.

† Mean difference between females and males ($\bar{X}_{female}$ - $\bar{X}_{male}$).

* p < .05 (two-tailed test).

Table 2. Bivariate associations between physical attractiveness, health-related outcomes, and the control variables.

Health-Related Outcomes	Physical Attractiveness			Control Variables (Full Sample)				
	Full Sample	Males	Females	Age	Race†	Sex†	Income	Parents' Income
Health Items								
Cancer	-.01	.01	-.01	-.01	.14***	-.27***	-.01^	-.01
High cholesterol	-.02*	-.03*	-.01	.06***	.04*	.06***	.01	.01
High blood pressure	-.06***	-.06***	-.06***	.03**	-.08***	.14***	-.02^	-.01
Diabetes	-.04***	-.03*	-.05***	.03**	-.05^	-.12***	-.03***	-.03**
Heart disease	-.01	-.01	-.01	.02*	-.02	-.04	-.02*	-.01
Asthma	-.02^	.01	-.03**	-.05***	.01	-.11***	-.04***	.02*
Migraines	-.01	-.03*	-.02	-.01	.13***	-.33***	-.06***	-.01
Depression	-.05***	-.05***	-.06***	-.03***	.24***	-.30***	-.07***	.02
Anxiety	-.01	-.01	-.01	-.03***	.28***	-.28***	-.06***	.01
Epilepsy	-.01	-.01	-.02	-.01	.08*	-.05	-.03***	-.02^
ADD/ADHD	-.04***	-.05***	-.02*	-.02*	.31***	.20***	-.02**	.03***
Stuttering	-.05***	-.05***	-.04***	.01	-.10***	.17***	-.03***	-.02*
Tinnitus	-.02**	-.01	-.03**	.01^	.09***	.07***	-.02**	-.03**
Health Indexes								
General health	.13***	.13***	.14***	-.02	.07***	.04***	.09***	.09***
Number of sick days	-.03***	-.04**	-.04**	-.01	-.01	-.06***	-.03***	-.01
STDs	.04***	.04***	.02*	-.03***	-.15***	-.22***	-.03***	-.02*
Diseases	-.07***	-.07***	-.08***	-.01	.10***	-.10***	-.09***	.01
Chronic diseases	-.06***	-.05***	-.07***	.02*	-.01	-.01	-.04***	.01
Neuropsychological disorders	-.05***	-.06***	-.06***	-.02**	.14***	-.13***	-.09***	.01
Physical attractiveness	--	--	--	.01	-.02	.02	.06**	.08***

Notes: All variables are from Wave 4 (race and parents' income are from Wave 1); Income and parents' income are z-transformed variables; Race: 0 = nonwhite, 1 = white; Sex: 0 = female, 1 = male.
†Tetrachoric correlation employed between these control variables and the dichotomous health items.
^ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed test).

Table 3. Logistic regression models assessing the probability of a diagnosis for the individual health items by physical attractiveness for the full sample, males, and females.

Health Items	Full Sample			Males			Females		
	b	OR	SE	b	OR	SE	b	OR	SE
Chronic diseases									
Cancer	-.05	.95	.10	.16	1.18	.19	-.09	.91	.11
High cholesterol	-.08*	.92	.04	-.14*	.87	.06	-.04	.97	.06
High blood pressure	-.23***	.80	.04	-.22***	.80	.05	-.23***	.79	.05
Diabetes	-.23**	.80	.07	-.20	.82	.11	-.24**	.78	.09
Heart disease	.03	1.03	.12	-.02	.98	.18	.09	1.09	.16
Asthma	-.06^	.94	.04	.05	1.05	.06	-.12**	.88	.04
Neuropsychological disorders									
Migraines	-.06^	.94	.03	-.11^	.89	.07	-.05	.96	.04
Depression	-.18***	.84	.03	-.16**	.85	.06	-.19***	.83	.03
Anxiety	-.04	.96	.03	-.02	.98	.07	-.04	.96	.04
Epilepsy	-.09	.92	.09	-.15	.86	.15	-.05	.96	.13
ADD/ADHD	-.24***	.79	.05	-.26***	.77	.06	-.20*	.82	.08
Stuttering	-.22***	.81	.05	-.23**	.79	.08	-.20*	.82	.09
Tinnitus	-.08	.93	.05	.01	1.00	.07	-.14*	.87	.07

Notes: All models control for age, sex (full sample models only), race, income, parents' income and are clustered by interviewer (i.e., robust standard errors are employed); OR: odds ratio; SE: standard error.
^ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed test).

Table 4. Multivariate associations between physical attractiveness and health indexes (OLS regression models).

Health Indexes	Full Sample			Males			Females		
	b	β	SE	b	β	SE	b	β	SE
General health	.14***	.13	.01	.14***	.12	.02	.15***	.14	.02
Number of sick days†	-.10***	.91	.03	-.10*	.90	.05	-.10**	.91	.03
STDs	.03***	.04	.01	.03***	.04	.01	.03**	.03	.01
Diseases	-.11***	-.07	.02	-.10***	-.07	.02	-.12***	-.08	.02
Chronic diseases	-.04***	-.06	.01	-.04**	-.04	.01	-.05***	-.07	.01
Neuropsychological disorders	-.07***	-.06	.01	-.06***	-.06	.01	-.07***	-.06	.02

Notes: All models control for age, sex (full sample models only), race, income, parents' income and are clustered by interviewer (i.e., robust standard errors are employed); Diseases index is the sum of all the individual health items; Chronic diseases index is the sum of cancer, high cholesterol, high blood pressure, diabetes, heart disease, and asthma; Neuropsychological disorders index is the sum of migraines, depression, anxiety, epilepsy, ADD/ADHD, stuttering, and tinnitus; SE: standard error.
† Poisson regression model; IRR (incident rate ratio) reported in place of Beta.
* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed test).