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The good, the bad, and the utilitarian: attitudes towards genetic testing and implications for disability

Alexandra Maftei[1] · **Oana Dănilă**[1]

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Abstract
The present study focused on the link between the attitudes towards genetic testing and views on selective reproduction choices following genetic testing. First, we explored the potential demographical (age, gender, number of children, relationship status) and personal factors (perceived morality, religiosity, parenting intentions, instrumental harm) underlying these attitudes using a specific moral psychology approach, i.e., the two-dimension model of utilitarianism (i.e., instrumental harm and impartial beneficence). Next, we investigated participants' hypothetical reproduction choices depending on the future child's potential future condition, assessed through genetic screening. Our sample consisted of 1627 Romanian adults aged 17 to 70 ($M = 24.46$). Results indicated that one's perceived morality was the strongest predictor of positive attitudes towards genetic testing, and instrumental harm was the strongest predictor of negative attitudes. Also, more religious individuals with more children had more moral concerns related to genetic testing. Participants considered Down syndrome as the condition that parents (others than themselves) should most take into account when deciding to have children (35%), followed by progressive muscular dystrophy (29.1%) and major depressive disorder (29%). When expressing their choices for their future children (i.e., pregnancy termination decisions), participants' knowledge about potential deafness in their children generated the most frequent (37.7%) definitive termination decisions (i.e., "definitely yes" answers), followed by schizophrenia (35.8%), and major depressive disorder (35.2%). Finally, we discuss our results concerning their practical implications for disability and prenatal screening ethical controversies.

Keywords Genetic testing · Prenatal screening · Utilitarianism · Morality · Attitudes · Disability

Introduction

As society evolves and technology reveals previously unimagined progress towards exploring the human mind and body, genetic testing naturally became common practice (Hughes, 2017). Predictive genetic screening nowadays assesses the risk for specific problematic conditions, such as deafness or muscular dystrophy. Through these genetic tests, individuals are informed about the chances to develop future conditions, though these tests also carry some amount of uncertainty (Evans, 2001). In addition to the more common genetic screening (e.g., for different types of cancers, Down syndrome; Kazemi et al., 2016; Raoof et al., 2021), multiple lines of evidence indicated a substantial genetic contribution to testing neurobehavioral disorders (e.g., autism spectrum disorders; Shen et al., 2010), pathological mood disturbances (e.g., bipolar disorder; Craddock & Sklar, 2013), depressive disorders (Lohoff, 2010), or schizophrenia (Ayalew et al., 2012).

The importance of exploring the attitudes towards genetic testing, the associated factors, expectations, and related anticipated consequences lies in the significant medical, social, and psychological consequences of these procedures. For example, a systematic review conducted in 2000 by Broadstock and their collaborators suggested that individuals who undergo predictive genetic testing do not specifically experience adverse psychological consequences. Fifteen years later, a similar systematic review conducted by Crozier et al. (2015) on genetic screening for Huntington's disease (i.e., neurodegenerative genetic condition) suggested

✉ Alexandra Maftei
alexandra.maftei@uaic.ro

Oana Dănilă
danila.oana@uaic.ro

[1] Department of Educational Sciences, Faculty of Psychology and Education Sciences, Alexandru Ioan Cuza University of Iaşi, 3 Toma Cozma Street, Iasi, Romania

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similar results. An overview of these reviews and similar others highlighted the generally assessed psychosocial consequences (Wade, 2019). Among these, the most common adverse outcomes seem to be related to psychological distress (i.e., stress, depression, and anxiety), disrupted familial relationships, genetic discrimination, and stigmatization. At the same time, the usual benefits related to genetic testing include, according to Wade (2019), relief from uncertainty and guilt, increased levels of family support, and optimistic empowerment.

As genetic screening technologies and procedures rapidly evolve, researchers highlighted the need to underline the positive and negative implications of genetic testing (Waltz et al., 2020). Genetic screening procedures have essential consequences for medical decisions, health-related behaviors, and clinical practices (Wade, 2019). For example, genetic screening progress, evolution, and outcomes might shape risk communication strategies, health-related policies, preventive behaviors, and particular applications related to genetic counseling (Oliveri et al., 2018). However, despite the increased interest in genetic testing, the actual availability of these tests and costs might raise several concerns (Phillips et al., 2018), in addition to the lack of specific EU or unitary national legislation regulations addressing these issues (Kalokairinou et al., 2018).

Attitudes towards Genetic Testing

Genetic screening is generally subject to controversy and attitude analysis, considering that two main misconceptions drive the related polemics. On the one hand, genetic screening is not considered the same as diagnostic, as most tests do not reach 100% accuracy (Allyse et al., 2015). On the other hand, the primary purposes for genetic screening are to inform/ raise awareness of future parents about the possible outcomes of pregnancy, help them prepare emotionally for the related consequences, and provide them with the opportunity to get educated/counseled on how to better cope with a particular congenital disability (Allyse et al., 2015). When efficiently used by physicians, one significant immediate effect is to plan for early post-delivery interventions (e.g., in the case of spina bifida, congenital heart abnormality).

Nevertheless, even if not necessarily meant to encourage abortion, genetic screening has been more associated with this option in the collective mental, rather than the possibility to better address a specific condition, leading to the complex discussion of an ethical dilemma. This is because attitudes, "the most distinctive and indispensable concept in social psychology" (Allport, 1935, p. 798), define a psychological reality implying an evaluative judgment which further allows us to explain how people build positions and actions in regard to all essential aspects of their day to day life. Its evaluative nature makes attitudes subject to two main qualities, i.e., valence and strength. Thus, people can hold positive, negative, or relatively neutral attitudes regarding a particular matter, some of which can be relatively strong and resistant compared to others that are more flexible and easier to change.

Since attitude is a multi-level construct (Eagly & Chaiken, 1993; Rosenberg & Hovland, 1960; Zanna & Rempel, 1988), we need to address three main components further: (1) beliefs, attributes, knowledge regarding genetic testing, i.e., the cognitive dimension; (2) feelings or emotions regarding the use of genetic testing, i.e., the affective dimension, and (3) conducts concerning the use of genetic testing, i.e., the behavioral dimension. Smith et al. (1956) (according to Haddock et al., 2008, p. 120) suggested that attitudes serve three primary functions or needs, i.e., object appraisal, social adjustment, and externalization. When it comes to genetic testing, object appraisal delineates the ability of future parents' attitudes towards genetic testing to summarize the positive and negative attributes of this specific form of testing for them and the world around them. As such, attitudes can help people approach beneficial things and avoid harmful things. Social adjustment refers to how the same attitudes help individuals identify with people they like (because they share the same attitudes as theirs) and reject those who hold other opinions. At the same time, people might change their position if specific other qualities of the person holding an attitude prevail. Also, externalization is fulfilled by attitudes that defend the self against internal conflict.

Prenatal Screening and Selective Reproduction

The American College of Obstetricians and Gynecologists (ACOG, 2020) states that there are two primary types of prenatal genetic tests: (1) Prenatal screening tests, i.e., investigations that offer information related to the chances of the fetus having an aneuploidy and a few other disorders, and (2) Prenatal diagnostic tests (i.e., done on cells from the fetus or placenta) that can tell future parents whether their fetus actually has specific disorders. According to Ravitsky (2017), prenatal screening has been integrated into many health care systems based on two competing rationales. The first model refers to *the reproductive autonomy rationale* (i.e., "access to prenatal testing supports and promotes women's informed choices, empowering them to manage their pregnancies—and hence their lives—in ways that align with their preferences and values"; p.34). The second model refers to *the public health rationale*, which considers prenatal screening as designed "to reduce the incidence of certain conditions in the population to reduce the burden of disease". This second model emphasizes "the societal consequences of reproduction and the aggregate impact of women's individual reproductive decisions on the overall health of future populations" (p. 34). However, both these models (also described

as idealized paradigms, since real-life situations generally merge their theoretical bases; Begović, 2019) raised a series of moral concerns through their practical implications.

One of the widely discussed issues concerns the idea that prenatal screening may be considered a form of selective reproduction (Rehmann-Sutter, 2021). More specifically, one of the potential implications of genetic testing and prenatal screening lies in the choice of pregnancy termination following the discovery of a disability and/or genetic diseases risks (Wilkinson, 2010). Some related justifications supporting these concerns shaped a cluster of arguments that even qualified prenatal genetic screening as a form of eugenics (Cavaliere, 2018). These arguments are based on the idea that prenatal screening procedures are immoral because they assume that (a) lives are less worth living than others (Begović, 2019); (b) these procedures shape a negative view on the lives of people affected by the conditions tested for (Parens & Asch, 2000); (c) they rely on "'the assumption that any child with a disability would necessarily be a burden to the family and society, and therefore would be better off not being born" (Saxton, 2000, p. 147).

Does the Condition Matter in the Pregnancy Termination Decision?

Previous studies explored whether the type of condition identified through genetic screening procedures matters for future parents' pregnancy termination decisions. For example, Brooks et al. (2019) suggested that over 60% of the investigated pregnant women reported interest in termination pregnancies upon genetic testing for anencephaly, early infant death, severe intellectual disability, hemoglobinopathy, and amelia. Overall, women were more likely to terminate their pregnancy for conditions associated with a shortened lifespan. Additionally, Norton et al. (2014) interviewed women who delivered healthy infants within the past year and assessed their attitudes towards prenatal screening, diagnostic testing, and pregnancy termination for specific conditions such as Down syndrome, fragile X, cystic fibrosis, spinal muscular atrophy, phenylketonuria, and congenital heart defects. Their results suggested that almost all participants (up to 98%) indicated that they would have screening for each condition, and most would have an amniocentesis. Regarding pregnancy termination, results suggested that these intentions seemed to vary by condition: 10% reported they would terminate a pregnancy for congenital heart defects, 41% for Down Syndrome, and 62% for spinal muscular atrophy. Additionally, participants were least inclined to terminate treatable disorders versus those associated with intellectual disability (like Down Syndrome, fragile X) and were most likely to terminate a pregnancy for spinal muscular atrophy, typically lethal in childhood.

The current research aimed to challenge these ethical concerns by exploring the links between people's attitudes towards genetic testing (i.e., positive or negative) and their views on selective reproduction choices following genetic testing. In contrast to other studies exploring these beliefs, attitudes, and behavioral cues in the context of genetic testing/prenatal screening, we proposed a different approach, based on hypothetical scenarios, similar to the moral dilemmas' structure that moral psychologists generally use in their explorations.

Genetic Testing and Screening in Romania

In Romania, maternal serum marker screening or ultrasound imaging (ultrasonography) to detect chromosome aneuploidies or other birth abnormalities became a routine part of prenatal care in the first and/or second trimesters, especially for the urban population (Simionescu & Stanescu, 2020). However, the important implications of newer practices such as genetic testing are also of high interest. Given these significant implications of genetic testing in various personal and interpersonal areas, in the current study, we aimed to explore the associated factors concerning people's attitudes towards prenatal genetic testing and their implications for disability. To our knowledge, there are no published studies that previously examined these variables among Romanian adults. Additionally, we aimed to explore the mechanisms underlying genetic testing attitudes through the lenses of disability and a specific moral psychology paradigm, i.e., utilitarianism.

Utilitarian Perspectives and Implications for Disability

When discussing disability risks assessed during prenatal genetic testing, the literature generally highlighted subsequent selective abortion practices, primarily in the case of Down syndrome (Pop-Tudose et al., 2018) or intellectual disability (Gould, 2019). Generally, selective abortion is considered morally acceptable in Western cultures, based on opinions related to the future child's (low) quality of life (Vehmas, 2002).

These controversial implications related to prenatal screening are often discussed through the moral lenses of morality. For example, Birnbacher (2007) detailed the contradictory stance between prenatal diagnosis versus pre-implantation genetic diagnosis using three ethical orientations: (1) the pragmatic orientation, which prioritizes parents' concerns and interests; (2) the deontological orientation, which prioritizes the protection of human life, and (3) the consequentialist (i.e., utilitarian) orientation, which prioritizes the overall societal risks and benefits. In contrast to common-sense morality, *utilitarianism* pursuits

the best overall outcomes, regardless of one's personal interest and rights (Kahane, 2012). Furthermore, utilitarian tendencies are generally driven by controlled processing, which generally involves explicit conscious thinking (Haidt, 2012). Thus, the utilitarian approach is a highly rational, analytical process (Cellini et al., 2021) and, as Smith suggested (Smith, 2019), "particularly powerful as a tool for deciding whether the risk-benefit ratio of a proposed course of action is favourable—a central issue in much clinical and research ethics work" (p.2). Furthermore, "utilitarians believe moral decisions should be decided by calculating a burden/benefit ratio from a societal viewpoint", promoting "the good of society over that of the individual" (Fulda, 2006, p. 145).

The utilitarian perspective related to prenatal genetic screening and potential subsequent related actions has been explored in various studies. For example, Savulescu and Kahane (2008) argued, based on The Principle of Procreative Beneficence (Savulescu, 2001) that, "if couples (or single reproducers) have decided to have a child, and selection is possible, then they have a significant moral reason to select the child, of the possible children they could have, whose life can be expected, in light of the relevant available information, to go best or at least no worse than any of the others" (Savulescu & Kahane, 2008, p. 274). However, as the authors suggested, though this principle is, in technical terms, consequentialist, it does not necessarily reflect utilitarian deliberation grounds.

However, Savulescu and Kahane's principle raised many questions, challenged ethical practices, and generated a significant amount of criticism and support (e.g., Holland, 2016). Therefore, in the current paper, we did not directly address the Principle of Procreative Beneficence per se. Instead, we aimed to explore the links and implications of two specific utilitarian dimensions, i.e., *impartial beneficence* and *instrumental harm*, as conceptualized by Kahane et al. (2018). As the authors theoretically employed these different dimensions, impartial beneficence refers to utilitarianism's "positive" dimension, i.e., the impartial concern for the greater good or those who help for the greater good.

In other words, impartial beneficence refers to "impartially maximize the well-being of all sentient beings on the planet" (Everett et al., 2018, p. 201) for the greater (overall) good. On the other hand, instrumental harm shapes the "negative" utilitarian dimension, i.e., people's permissive attitude toward instrumental harm, those who harm for the greater good (for example, they choose to sacrifice one to save more). Both dimensions reflect the core of the consequentialist (i.e., utilitarian) perspective, that being – the greater good, though in different ways: impartial beneficence involves sacrificing one's personal benefits for the overall good of others. In contrast, instrumental harm involves sacrificing others (other people, things) for the greater good.

The link between utilitarianism and disability was explored in a growing and a various number of studies, from Bentham (1970/2015) and Singer (1979/2012) and until more recently (e.g., Mills, 2011). Bentham, similar to Singer, suggested that "the life of the mother takes precedence over the life of the fetus or baby" (Dardenne, 2010, p.7), and the general view pointed out instrumental harm. More specifically, both views considered a future child with a disability the source of parents' unhappiness, thus supporting the sacrifice of one (baby or fetus) for the overall (parental/society) "good". Other utilitarians routinely accepted this perspective, such as Dworkin (2000) or Sen (1992). However, many other scholars also highlighted several critiques concerning these views, especially in prenatal genetic testing. Some focused on the subsequent consequences, while others were concerned about these procedures' intrinsic goodness or wrongness. For example, Scully (2008) pointed out that "genetic science might exacerbate the deep ambivalence that society as a whole has towards physical difference and anomaly" (p. 797), while Cavaliere (2018) detailed on the eugenics argument when debating screening procedures and practices.

In the present study, however, our aim was not to argue on the morality of genetic testing but to explore the way the two-dimensional utilitarian model developed by Kahane and their collaborators (2018) might be associated with people's knowledge, attitudes, and future expectations towards genetic testing (prenatal screening in particular), and the potential implications for disability.

Knowledge, Attitudes, and Beliefs Related to Genetic Testing

Research regarding the attitudes towards prenatal genetic testing highlighted a growing number of relevant associated factors. For example, some scholars suggested that participants with an intermediate level of education tended to have more favorable attitudes towards mandatory genetic testing than participants holding a university degree (Aro et al., 1997; Saucier et al., 2005). Additionally, the knowledge about genetic testing also seems to have a significant role in shaping people's attitudes (Pop-Tudose et al., 2018).

Pivetti and Melotti (2012), similar to Chapman et al. (2019), suggested that more knowledge increases people's positive attitudes towards genetic testing, while lower levels might determine the opposite (Yamamoto et al., 2020). In addition, other significant previously suggested factors were related to participants' parental status (Saastamoinen et al., 2020) and the medical risk investigated (Johannessen et al., 2017). On a similar note, Henneman et al. (2004) suggested that high self-rated knowledge and familiarity with genetic testing, younger age, high educational level, female gender, and having children were positively associated with genetic

knowledge and more favorable related attitudes. Nevertheless, as Etchegary (2014) suggested, "a well-informed public may, in fact, be more discriminating and display a critical attitude toward specific issues within science, particularly those of a socially or morally sensitive nature" (p.519).

At the same time, people's personal values and experiences might as well play a significant role in shaping people's beliefs and attitudes about genetics (e.g., Condit, 2010). As Savulescu and Kahane (2008) highlighted, "some believe that reproduction is a private matter, immune to moral scrutiny. Others think that morality allows people to aim at less than the best, or gives people complete freedom when making procreative decision" (p. 275). Various scholars also assessed moral and religious influences as significant factors related to the attitudes towards genetic screening. For example, Pivetti and Melotti (2012) suggested that less religious women favored prenatal testing. Similary, Modell et al. (2014) emphasized that faith-based values are essential when discussing individual decisions and collective policies related to genetic testing and prenatal screening. In general, scholars suggested that religiousness is negatively correlated with favorable attitudes towards genetic screening (e.g., Meisenberg, 2009).

The Present Study

Given the growing scientific interest related to prenatal screening, as well as the moral, social, and controversial personal implications related to the subsequent outcomes (primarily shaped by future parents' decisions), our research focused on the link between people's attitudes towards genetic testing (i.e., positive or negative) and their views on selective reproduction choices following genetic testing. More specifically, we investigated the associated factors and underlying psychological mechanisms related to people's attitudes towards prenatal genetic testing and their implications for disability, given the lack of scientific research in this area involving Romanian adults. Our empirical investigation was based on the previous findings suggested by well-known scholars, such as Henneman et al. (2004), Henneman et al. (2006), or Godard et al. (2003), as well the two-dimensional utilitarian model developed by Kahane and their collaborators (2018). Building on this theoretical basis, we assumed the following:

H1. People familiar with a genetic disease or genetic testing (i.e., experiences with hereditary diseases and tests) would be more likely to support the availability and use of genetic tests.
H2. Consequentialist tendencies (i.e., instrumental harm and impartial beneficence) would significantly relate to attitudes towards genetic testing and the potential outcomes following specific prenatal testing results. Given the previous findings in the area and the conceptualization proposed by Kahane et al. (2018), we assumed that instrumental harm would be positively associated, and impartial beneficence would be negatively associated with participants' endorsement of genetic testing.
H3. We also assumed that contrary to impartial beneficence, instrumental harm would be positively associated with pregnancy termination choices following possible genetic screening results that would indicate risks for specific conditions.
H4. Demographical factors such as participants' age, gender, education level, and the number of children would significantly be related to the attitudes towards genetic testing (Henneman et al., 2004).

We aimed for a more comprehensive view of the psychological factors related to the attitudes towards genetic testing. Thus, we also investigated participants' hypothetical reproduction choices depending on the future child's potential future condition, assessed through genetic screening. Finally, we tested two prediction models for both the positive and negative attitudes towards genetic testing.

Method

Research Procedure and Materials

The study was designed following the Helsinki Declaration ethical guidelines and the ethical research requirements approved by the authors' institution's institutional board. The data were gathered using an online, anonymous, cross-sectional survey during spring 2021. The online form used to collect the answers was available for four weeks. Bachelor, Masters, and Ph.D. students from a Romanian university located in the country's eastern side were invited to complete the study for course credits. They were also invited to share the survey with their family and friends and advertise the online form through different social media and communication platforms (e.g., WhatsApp and Facebook groups). Informed consent was provided at the beginning of the survey, participants being informed about the confidentiality of their answers, as well as the possibility to withdraw from the study at any time, with no subsequent consequences. Following the survey, participants were given a debriefing form and the contact details from the research team in case they experienced distress during data collection or had any additional related questions; however, no such cases were reported.

Participants

Our sample consisted of 1627 Romanian adults aged 17 to 70 ($M = 24.46$, $SD = 8.64$). Table 1 presents the related descriptive statistics (i.e., gender, relationship status, education level, number of children). The only inclusion criterion was related to participants' age (>18). Otherwise, anyone could participate in the study. Participation was voluntary.

Instruments

1. *Belief in personal benefits and genetic determinism* was measured using eight items (four for each of the two dimensions), as previously suggested by Henneman et al. (2006). Belief in personal benefits measured a personal interest in genetic tests, using items such as "To prevent disease I would want to know my risk of getting certain diseases". Participants answered in a 5-point Likert scale, ranging from 1 (completely disagree) to 5 (completely agree). The second dimension, belief in genetic determinism, measured the perceived unfavorable consequences of genetic testing on individuals' self-determination. Example items included "When people know their genetic make-up they will not be able to lead their own lives", and "When people know their genetic make-up they will take less responsibilities". A higher score suggested a higher interest in genetic testing.
2. Participants' *attitude toward the availability and use of genetic tests* was measured using a 4-item scale (Henneman et al., 2006). Participants answered on a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree) to items such as "The use of genetic tests among people of genetic tests should be stimulated", and "Genetic tests should be offered to all pregnant women". Higher scores indicated more positive attitudes toward the availability and use of genetic tests.
3. *Experiences with hereditary diseases and tests*. As in the research conducted by Henneman et al. (2006), we assessed participants' familiarity with genetic diseases and genetic tests using their responses to the following questions: (1) *Do you know anyone with a genetic disorder (self, in the family)?*, and (2) Did you, your partner or any of your children ever have a genetic test? We scored yes answers with *1* and no answers with *0*. Thus, a higher cumulative score to the two questions indicated a higher familiarity with genetic diseases and tests.
4. Participants' *beliefs about genetic testing* were measured using the seven items proposed by Henneman et al. (2006), related to (1) Worries about the societal impact ("I am worried that genetic tests will result in a society where disabled people are no longer accepted"), (2) worries related to the freedom of choice ("I am worried that people will be forced to undergo genetic testing"), and other related beliefs concerning the nature and outcomes of genetic testing: (3)" Knowledge about the genetic background of disease will help people to live longer", (4) "Genetic testing is tampering with nature", (5) "Genetic testing does more good than harm", (6) "Pregnancy termination for a genetic disorder is unacceptable", (7) "The use of genetic tests is discriminating". The last four items (4–7) are considered moral beliefs related to genetic screening. Participants answered on a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree). We computed a total score for the moral beliefs dimensions; a higher score indicated a more negative moral perception of genetic screening. Additionally, we computed an overall score for all seven items, following the necessary recoding procedures, considering a whole dimension related to *worries related to genetic screening*. Within this overall dimension, higher scores indicated higher levels of worry concerning the negative impact of the genetic screening procedures.
5. The *expected consequences of medical genetic developments* in the next 10–15 years were assessed using the

Table 1 Descriptive statistics for the participants ($N = 1627$)

	N	%
Gender		
male	443	27.2
female	1184	72.8
Relationship status		
not in a romantic relationship	606	37.2
in a romantic relationship	728	44.7
married	261	16
divorced	22	1.4
widowed	10	0.6
Education level		
high school	1165	71.6
Bachelor	357	21.9
Master's	97	6.0
Ph.D.	8	0.5
Number of children		
0	1347	82.8
1	120	7.4
2	120	7.4
3	29	1.8
4	7	0.4
5	2	0.1
6	1	0.1
8	1	0.1
Parenting intentions in the next 5 years	Yes: $N = 766$ (47.1%)	No: $N = 861$ (52.9%)

seven questions proposed by Henneman et al. (2013). These items addressed the impact on society and anticipated use of genetic information (e.g., "Our genetic information will be stored in computers (databanks)"; "There will be a dichotomy in our society: people with a 'good' and people with a 'bad' genetic predisposition"), participants answering on a 5-point scale (1 = very unlikely, to 5 = very likely).

6. *Consequentialist Tendencies* were measured using the Oxford Utilitarian scale (OUS; Kahane et al., 2018). According to its developers, OUS assesses individual differences related to Impartial Beneficence (impartial concern for the greater good, i.e., endorsing the impartial maximization of the greater good even at the cost of personal self-sacrifice - 5 items (e.g., "If the only way to save another person's life during an emergency is to sacrifice one's own leg, then one is morally required to make this sacrifice"), and Instrumental Harm (permissive attitude toward instrumental harm, i.e., willingness to cause harm for the greater good - 4 items, e.g., "It is morally right to harm an innocent person if harming them is a necessary means to helping several other innocent people"). Participants rated their answers on a Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree), and we computed the mean scores of both subscales.

Scenarios

Next, we also presented participants with *fourteen scenarios* related to different possibilities following the prenatal genetic screening. These scenarios were built on seven different conditions (i.e., progressive muscular dystrophy; Down syndrome; schizophrenia; autism; major depressive disorder; deafness; bipolar disorder). We chose these conditions for two primary reasons: a) we wanted to explore a variety of scenarios, not a specific one, to increase the generalizability of our findings, and b) we wanted to include both "visible" and "invisible" conditions. For example, Down syndrome is more "visible" than schizophrenia because it has specific physical features (e.g., small chin, slanted eyes). As research highlighted, "invisible" disabilities, like mental conditions (chronic illnesses included), are subject to biased perceptions and cultural beliefs. Additionally, as Moss and Dyck (2002) suggested because people with invisible disabilities do not necessarily "fit" into the visible category of disabilities, they are often perceived "not quite ill but not quite healthy, almost disabled and almost abled, both very nearly normal and very nearly deviant" (Moss & Dyck, 2002, p.33). Thus, we included both visible and invisible conditions.

The dilemmas were as follows:

"*A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely progressive muscular dystrophy.* ***When*** *do you think they should have a baby, given that they know about this risk?*"

Participants choices were:

"a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances; b) when genetic screening results show that the chances of transmitting that disease are less than 5%; c) when genetic screening results show that the chances of transmitting that disease are less than 25%; d) when genetic screening results show that the chances of transmitting that disease are less than 50%; e) when genetic screening results show that the chances of transmitting that disease are less than 75%; f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted."

Thus, ranging from 0% (which we scored "0") to 100% (which we scored 5), participants' answers assessed their agreement related to the decision of having a baby with a 0 to 100% risk for a specific condition. Therefore, the lower the score, the lower their agreement to other people's related choices. Following each scenario related to participants' perspectives on what should other people do in this position, they were asked whether or not they would choose the termination of pregnancy following prenatal screening test results that would confirm these conditions, e.g., "*If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following the prenatal screening, that your future child could develop, after giving birth/ or could be born with progressive muscular dystrophy, would you continue the pregnancy?* (5-point Likert scale, ranging from 1 = Definitely no, 5 = Definitely yes). All scenarios and questions are detailed in *Appendix A*.

Two additional questions rated participants' agreement concerning people with physical and intellectual disabilities and their choice to have children, on a scale ranging from 1 (Strongly disagree) to 5 (Strongly agree): (a) "People with a physical disability should not have children"; (b) "People with an intellectual disability should not have children".

Additionally, similar to the research conducted by Scheufele et al. (2017), participants' rated their *religiosity* ("How much guidance does religion provide in your everyday life?") on a scale from 0 (no guidance at all) to 10 (a great deal of guidance) and *perceived morality* ("Do you consider yourself a moral person?" Yes/No). Finally, a demographic scale assessed participants' age, gender, education level, relationship status, and the number of children.

All the instruments used in the present study were self-reported. Before the actual research procedure, we ran a pre-testing procedure in a similar sample of adults ($M = 23.80$, $SD = 2.25$) to assess the potential difficulties of the scales and scenario that we used. No issues were reported during this procedure.

Results

The present research used a non-experimental cross-sectional data research design. We used the SPSS (v. 26) program to analyze the data, and there was no missing data within the collected answers.

Preliminary Analyses

To test the normality of the distributions of our variables, we computed the Skewness and Kurtosis measures. According to Kim (2013), these indicators (i.e., normality indicators: Skewness between −1 and 1, and Kurtosis between −3 and 3). Since the variables were normally distributed, we did not conduct any other transformations. We further computed the overall scores for the scales and subscales that measured participants' beliefs in personal benefits and genetic determinism, attitude toward the availability and use of genetic tests, experiences with hereditary diseases and tests, beliefs about genetic testing, and utilitarianism. Table 2 details the descriptive statistics and zero-order correlations between these variables, along with religiosity and perceived morality.

High scores on the beliefs in the personal benefits subscale reflected participants' interest in genetic testing and, generally, a positive, open (explorative) attitude towards genetic testing. Similarly, high scores at the attitude toward the availability and use of genetic tests scale reflected positive attitudes in this regard. In contrast, high scores on the genetic determinism dimension and the worries (related to genetic testing) scale reflected more negative attitudes. Zero-order correlations suggested that participants' beliefs in personal benefits were significantly and positively correlated with the attitude toward the availability and use of genetic tests and participants' perceived morality. At the same time, the attitudes toward the availability and use of genetic tests were significantly and positively correlated with participants' perceived morality and familiarity with genetic testing. Thus, individuals who perceived themselves as more moral and familiar with these procedures had more positive attitudes towards genetic testing.

Participants' scores at the genetic determinism dimension were significantly and positively correlated with both impartial beneficence and instrumental harm, i.e., the utilitarian dimensions that we measured. Participants' age and the number of children also correlated with genetic determinism and negatively correlated with their perceived morality. At the same time, worries about genetic testing were significantly and positively associated with age, the number of children, and religiosity and negatively associated with perceived morality and familiarity with genetic testing procedures. Thus, older individuals, with a higher number of children, who perceived themselves as more religious and less moral and were more familiar with these procedures had more negative attitudes towards genetic testing.

We also computed a total score for the moral beliefs dimensions concerning the negative attitudes related to genetic testing, i.e., moral worries. Henneman et al. (2006) suggested that this particular dimension highlights specific moral concerns such as pregnancy termination following genetic testing. Thus, higher scores indicated higher levels of worry concerning the adverse morally relevant outcomes of the genetic screening procedures. We were particularly interested in participants' answers to these items since the second part of our study focuses on such issues. Table 3 details participants' answers to these items and the correlations with the main variables. Results suggested that participants' related moral worries (i.e., negative attitudes towards genetic testing, from a moral point of view) were positively and significantly associated with both dimensions of utilitarianism (instrumental harm and impartial beneficence), as well as religiosity and number of children. More interestingly, it seemed that these moral worries were negatively associated with participants' perceived morality. In other words, the higher the perceived morality and the lower the self-reported religiosity, the lower the related moral worries. Thus, more religious individuals, with more children and more utilitarian, had more moral concerns related to genetic testing, and more morally self-reported individuals had less.

To better explore our data, we also examined the potential gender differences between our main variables of interest. For the positive attitudes towards genetic screening dimensions (i.e., personal interest in genetic testing and the attitude toward the availability and use of genetic tests), t-test results suggested significant gender differences, with females having more positive attitudes than men significantly. For the negative attitudes towards genetic screening dimensions (i.e., genetic determinism and the worries concerning genetic tests), t-test results also suggested significant differences, with males having more negative attitudes than females in our sample. Finally, male participants scored significantly higher than female participants at the instrumental harm utilitarian dimension.

Participants' answers related to the expected consequences of medical genetic developments in the next 10–15 years assessed the perceived impact on society and anticipated use of genetic information. Table 4 presents specific details related to these answers.

Table 2 Descriptive statistics, zero-order correlations between the main variables, and gender differences ($N = 1627$)

	M	*SD*	*Min*	*Max*	1	2	3	4	5	6	7	8	9	10	11	Gender (*t*)
1. Benefits[1]	15.99	3.22	5	20	1											−4.17** (F > M)
2. Determinism[2]	9.26	4.01	4	20	−.324**	1										3.98** (M > F)
3. Attitude[3]	15.95	3.47	4	20	.557**	−.192**	1									−5.37**(F > M)
4. Impartial B.	19.10	5.86	5	35	.023	.158**	.047	1								1.68
5. Instrumental H.	13.60	5.09	4	28	−.073**	.251**	−.031	.745**	1							3.49**(M > F)
6. Worries[4]	17.29	5.17	7	35	−.428**	.524**	−.464**	.145**	.198 **	1						3.27**(M > F)
7. Age	24.46	8.64	17	70	−.089**	.066**	−.083**	−.108**	−.062*	.065**	1					−.3
8. Children (no.)	.30	.77	0	8	−.088**	.080**	−.100**	−.038	−.010	.111**	.723**	1				−3.24** (F > M)
9. Religiosity	5.98	3.06	0	10	.027	.040	−.058*	.226**	.086**	.229**	.040	.095**	1			−6.58**(F > M)
10. Morality	7.18	2.05	0	10	.264**	−.107**	.195**	.138**	.036	−.145**	.033	.043	.278**	1		−6.48**(F > M)
11. Experiences[5]	.35	.53	0	2	.037	.028	.073**	.010	.029	−.058*	.065**	.097**	−.020	.014	1	−.96

*p < .05; **p < .001 (2-tailed)

[1]Beliefs in personal benefits

[2]Beliefs in Genetic Determinism

[3]Att. = Attitudes towards the availability and use of genetic tests

[4]Worries = Worries related to genetic screening

[5]Experiences with hereditary diseases and tests

Table 3 The moral worries related to genetic testing: descriptive statistics and correlations ($N = 1627$)

Item	Answer (Range: 1 = totally disagree to 5 = totally agree)							
	1	2	3		4		5	
	N (%)	*N* (%)	*N* (%)		*N* (%)		*N* (%)	
Genetic testing is tampering with nature.	458 (28.1)	380 (23.4)	483 (29.7)		167 (10.3)		139 (8.5)	
Genetic testing does more good than harm.	374 (23)	368 (22.6)	544 (33.4)		205 (12.6)		136 (8.4%)	
Pregnancy termination for a genetic disorder is unacceptable.	360 (22.1)	265 (16.3)	516 (31.7)		211 (13)		275 (16.9)	
The use of genetic tests is discriminating.	640 (39.3)	386 (23.7)	427 (26.2)		108 (6.6)		66 (4.1)	
Zero-order correlations	1	2	3	4	5	6	7	8
1. Moral worries (overall score)	1							
2. Impartial beneficence	.166**	1						
3. Instrumental harm	.202**	.745**	1					
4. Religiosity	.246**	.226**	.086**	1				
5. Morality	−.101**	.138**	.036	.278**	1			
6. Age	.047	−.108**	−.062*	.040	.033	1		
7. No. of children	.090**	−.038	−.010	.095**	.043	.723**	1	
8. Experiences	−.025	.010	.029	−.020	.014	.065**	.097**	1

*p < .05; **p < .001

Most of the participants' answers reflect the idea that, generally, genetic testing will be a common practice soon. For example, 22% of the participants considered that children would be tested at young ages to determine what disease they would get later. However, the idea of a potential dichotomy in society, i.e., people with a 'good' and people with a 'bad' genetic predisposition, was mainly considered unlikely by our sample participants.

Demographic differences

We further investigated potential differences in our main variables of interest, depending on participants' education level, relationship status, and parenting intentions (see Table 5). Our data suggested that participants with a high-school degree had the lowest levels of worry towards genetic testing ($M = 17.72$), while participants with a Ph.D. degree had the highest ($M = 21.25$).

Regarding relationship status, participants in a romantic relationship were the most interested in the benefits of genetic testing ($M = 16.25$), while those who were widowed were the least interested ($M = 15.93$). Significant differences also emerged between participants who were not involved in a romantic relationship and those who were divorced ($M_{dif} = 2.21$, $p = .015$) and those who were in a romantic relationship and those who were divorced ($M_{dif} = 2.53$, $p = .003$). The highest scores related to beliefs in genetic determinism were among divorced participants ($M = 11.22$),

Table 4 Expected consequences of medical genetic developments in the next 10–15 years ($N = 1627$)

Item	Answer (Range: 1 = very unlikely to 5 = very likely)				
	1	2	3	4	5
	N (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
It will be common to have a genetic test.	66 (4.1)	163 (10)	576 (35.4)	419 (25.8)	403 (24.8)
We will all get a genetic passport.	164 (10.1)	280 (17.2)	593 (36.4)	304 (18.7)	286 (17.6)
Our genetic information will be stored in computers (databanks).	133 (8.2)	243 (14.9)	523 (32.1)	369 (22.7)	359 (22.1)
All children will be tested at young age to find out what disease they get at later age.	113 (6.9)	233 (14.3)	544 (33.4)	376 (23.1)	361 (22.2)
Future employees will have to do a genetic test before they are hired.	347 (21.3)	373 (22.9)	479 (29.4)	226 (13.9)	202 (12.4)
There will be a dichotomy in our society: people with a 'good' and people with a 'bad' genetic predisposition.	314 (19.3)	357 (21.9)	575 (35.3)	224 (13.8)	157 (9.6)
Insurance companies will ask for a genetic test before the height of the premium is set.	272 (16.7)	317 (19.5)	546 (33.6)	262 (16.1)	230 (14.1)

Table 5 Demographic differences related to the main variables ($N = 1627$)

	Benefits (+)	Determinism (−)	Attitude (+)	Worries (−)
Education level	$F(3, 1623) = 2.08$	$F(3, 1623) = 3.33$	$F(3, 1623) = 1.87$	$F(3, 1623) = 2.90$*
Relationship status	$F(4, 1626) = 6.09$**	$F(4, 1626) = 3.15$*	$F(4, 1626) = 1.89$	$F(4, 1626) = 4.69$*
Parenting intentions	$t(1625) = 0.34$	$t(1625) = 0.83$	$t(1265) = -2.13$*	$t(1265) = 4.95$**

"+" = positive attitude towards genetic testing; "- "= negative attitude towards genetic testing

*p < .05; **p < .001

while the lowest were among those in a romantic relationship ($M = 9.03$). At the same time, worries related to genetic testing were the highest among widowed participants ($M = 19$) and the lowest among those in a romantic relationship ($M = 16.88$). In this regard, results suggested significant differences between individuals who were not involved in a romantic relationship ($M = 17.24$) and those who were married ($M = 18.40$), $M_{dif} = -1.16$, $p = .02$, as well as between those involved in a romantic relationship ($M = 16.88$) and those who were married ($M = 18.40$), $M_{dif} = -1.52$, $p < .001$.

Parenting intentions within the next five years also contributed to some of the significant differences suggested by our data. For example, the positive attitude towards the availability and use of genetic testing was significantly higher ($p = .03$) among participants who did not intend to have any (more) children in the next five years ($M = 16.13$) compared to those who did ($M = 15.76$). Also, the related worries about genetic testing were lower among participants who did not intend to have any (more) children in the next five years ($M = 16.69$), compared to those who did ($M = 17.96$).

Prediction Models

We further explored prediction models for each of the two potential attitudes towards genetic testing, i.e., positive and negative. Given that (a) high scores on the beliefs in personal benefits subscale and the attitude toward the availability and use of genetic tests scale shaped participants' positive attitude towards genetic testing, and (b) high scores on the genetic determinism dimension and at the worries (related to genetic testing) scale reflected more negative attitudes, we computed a total score for each of the two dimensions. Based on the results from our preliminary analyses, we used both demographical and personal factors as potential predictors.

a. *Predictors of positive attitudes towards genetic testing*

We conducted a hierarchical linear regression analysis to evaluate the prediction of positive attitudes towards genetic testing. Based on the results from our preliminary analyses, we examined participants' age, gender, number of children, relationship status, parenting intentions, experience/familiarity with genetic testing, religiosity, morality, and instrumental harm as predictors. We used the demographic variables (age, gender, number of children, relationship status) and parenting intentions for the first block, results suggesting a significant model, $F(5, 1625) = 12.15$, $p < .001$. The variables included in this model accounted for 3.6% of the variation in participants' positive attitudes towards genetic testing (our dependent variable). In the second model, we added participants' experience/familiarity with genetic testing, and this model was also significant, $F(6, 1925) = 11.64$, $p < .001$. This change was significant, $F(1, 1619) = 8.77$, $p = .003$, and this second model accounted for 4.1% of the variation in our dependent variable. In the third block, we added religiosity, and this model was also significant, $F(7, 1625) = 10.05$, $p < .001$. However, this change was not significant, $F(1, 1618) = .58$, $p = .445$. Next, we added participants' perceived morality. This change was significant, $F(1, 1617) = 124.69$, $p < .001$, and this fourth model accounted for 11% of the variation in our dependent variable. Finally, we added instrumental harm in the final regression block, and this change was also significant, $F(1, 1616) = 4.82$, $p = .02$. This final significant model ($F(9, 1625) = 22.86$, $p < .001$), including all predictors, accounted for 11.3% of the variation in participants' positive attitudes towards genetic testing.

In this final model (see Table 6), all the included predictors were significant, except for participants' age and relationship status. Among these predictors, perceived morality ($\beta = .27$) was the strongest predictor. Conversely, participants' number of children, parenting intentions, religiosity, and instrumental harm negatively predicted the dependent variable.

b. *Predictors of negative attitudes towards genetic testing.*

We further conducted a similar hierarchical linear regression analysis to evaluate the prediction of negative attitudes towards genetic testing. Based on the results from our preliminary analyses, we included participants' age, gender, number of children, relationship status, parenting intentions, education level, experience/familiarity with genetic testing, religiosity, morality, impartial beneficence, and instrumental harm as predictors. We used the demographic variables (age, gender, number of children, relationship status, education level) and parenting intentions for the first block. The first block results revealed a significant model,

Table 6 Summary of hierarchical regression analysis for variables predicting the positive attitudes towards genetic testing (N = 1267) (*N* = 1627)

	Model 1			Model 2			Model 3			Model 4			Model 5		
Variables	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	−.02	.02	−.04	−.02	.02	−.03	−.02	.02	−.03	−.03	.02	−.04	−.03	.02	−.04
Gender	1.88	.32	.14**	1.87	.32	.14**	1.91	.33	.14**	1.48	.32	.11**	1.40	.32	.10**
No. of children	−.94	.28	−.12*	−.98	.28	−.12*	−.95	.28	−.12*	−.94	.27	−.12*	−.91	.27	−.11*
Relationship status	.29	.24	.03	.21	.24	.02	.21	.24	.02	.25	.23	.03	.25	.23	.03
Parenting intentions	−.68	.29	−.05*	−.72	.29	−.06*	−.67	.30	−.05*	−.74	.29	−.06*	−.70	.29	.06*
Exp./familiarity				.81	.27	.07*	.80	.27	.07*	.75	.26	.06*	.77	.26	.06*
Religiosity							−.03	.04	−.01	−.17	.04	−.09**	−.16	.04	−.08*
Perceived morality										.78	.07	.27**	.79	.07	.27**
Instrumental Harm													−.06	.02	−.05*
R^2	.036			.041			.042			.110			.113		
F for change in R^2			12.15**			8.77*			.58			124.69**			4.82*

*p < .05; **p < .001

$F(6, 1625) = 10.64$, $p < .001$. The variables included in this model accounted for 3.8% of the variation in participants' positive attitudes towards genetic testing (our dependent variable). In the second model, we added participants' experience/familiarity with genetic testing, and this model was also significant, $F(7, 1925) = 9.54$, $p < .001$. This change, however, was not significant, $F(1, 1618) = 2.84$, $p = .09$, and this second model accounted for 4% of the variation in our dependent variable. In the third block, we added religiosity, and this model was also significant, $F(8, 1625) = 13.78$, $p < .001$, as well as the change brought by this variable $F(1, 1617) = 41.79$, $p < .001$. Next, we added participants' perceived morality. This change was also significant, $F(1, 1616) = 66.05$, $p < .001$, and this fourth model accounted for 10.1% of the variation in our dependent variable. Finally, we added instrumental harm and impartial beneficence in the final regression block, and this change was also significant, $F(2, 1614) = 55.22$, $p < .001$. This final significant model ($F(11, 1625) = 26.97$, $p < .001$), including all predictors, accounted for 15.5% of the variation in participants' negative attitudes towards genetic testing.

In this final model (see Table 7), all the included predictors were significant, except for participants' age, relationship status, experience/familiarity with genetic testing, and impartial beneficence. Among these predictors, instrumental harm ($\beta = .27$) was the strongest predictor. In contrast to the previous prediction model (i.e., dependent variable = positive attitudes towards genetic testing), participants' number of children, parenting intentions, religiosity, and instrumental harm positively predicted the dependent variable.

Table 7 Summary of hierarchical regression analysis for variables predicting the negative attitudes towards genetic testing (*N* = 1267)

	Model 1			Model 2			Model 3			Model 4			Model 5		
Variables	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	−.03	.03	−.03	−.03	.03	−.03	−.02	.03	−.03	−.02	.03	−.02	−.007	.03	−.007
Gender	−2.01	.44	−.11**	−2.00	.44	−.11**	−2.44	.44	−.13**	−1.99	.43	−.11**	−1.53	.42	−.08**
No. of children	1.70	.39	.16**	1.74	.39	.16**	1.46	.38	.14**	1.45	.38	.14**	1.24	.37	.12*
Education	.30	.34	.02	.34	.34	.02	.41	.34	.03	.64	.33	.05	.73	.32	.05*
Relationship status	−.06	.32	−.007	−.009	.32	−.001	−.017	.32	−.002	−.07	.318	−.007	−.05	.30	−.005
Parenting intentions	1.82	.40	.11**	1.85	.40	.11**	1.27	.41	.07*	1.30	.40	.08*	1.09	.39	.06*
Exp./familiarity				−.63	.37	−.04	−.52	.37	−.03	−.49	.36	−.03	−.61	.35	−.04
Religiosity							.42	.06	16**	.56	.06	.21**	.53	.06	.20**
Perceived morality										−.78	.09	−.20**	−.80	.09	−.20**
Instrumental Harm													.42	.05	.27**
Imp. Beneficence													−.06	.04	−.05
R^2	.03			.04			.06			.10			.15		
F for change in R^2			10.64**			2.84			41.79**			66.05**			52.22**

*p < .05; **p < .001

The summary of findings from the hierarchical multiple regression analyses is captured in Fig. 1.

According to Kahane et al. (2018), "empathic concern, identification with the whole of humanity, and concern for future generations were positively associated with impartial beneficence but negatively associated with instrumental harm; and although instrumental harm was associated with subclinical psychopathy, impartial beneficence was associated with higher religiosity". Thus, the OUS scale shapes two dimensions of utilitarianism, almost dichotomic (*positive*, i.e., impartial beneficence, and *negative* utilitarianism, i.e., instrumental harm). Interestingly, our results suggested positive correlations between both utilitarian dimensions and moral concerns related to genetic testing. Generally, as seen in Table 2, positive attitudes towards genetic screening (high scores on perceived benefits/interests in genetic testing and high scores on the attitudes towards the availability and use of genetic tests scale) were associated with higher impartial beneficence. At the same time, negative attitudes towards genetic screening (high scores at the genetic determinism and the related worries scales) significantly and positively correlated with instrumental harm. These specific relations are detailed in Fig. 2.

Furthermore, the findings from the hierarchical multiple regression analyses predicting positive and negative attitudes towards genetic testing, as captured in Fig. 1, suggested that instrumental harm is a positive predictor for the negative attitudes and a negative predictor for the positive attitudes. Impartial beneficence was not a significant predictor for neither positive nor negative attitudes towards genetic testing. Given these findings, we were further interested in exploring participants' choices and answers concerning the scenarios presented in our second part of the survey.

Before presenting the scenarios, we rated participants' agreement concerning people with physical and intellectual disabilities and their choice to have children. Table 8 details the participants' answers reflecting perceived reproduction constraints depending on one's disability.

As results suggested, participants generally considered that people with a physical disability should have children. However, their answers were less approving when discussing intellectual disability. More specifically, participants considered significantly more that people with intellectual disabilities ($M = 2.41$) should not have children ($t(1626) = -19.29$, $p < .001$), compared to people with physical disabilities ($M = 1.83$).

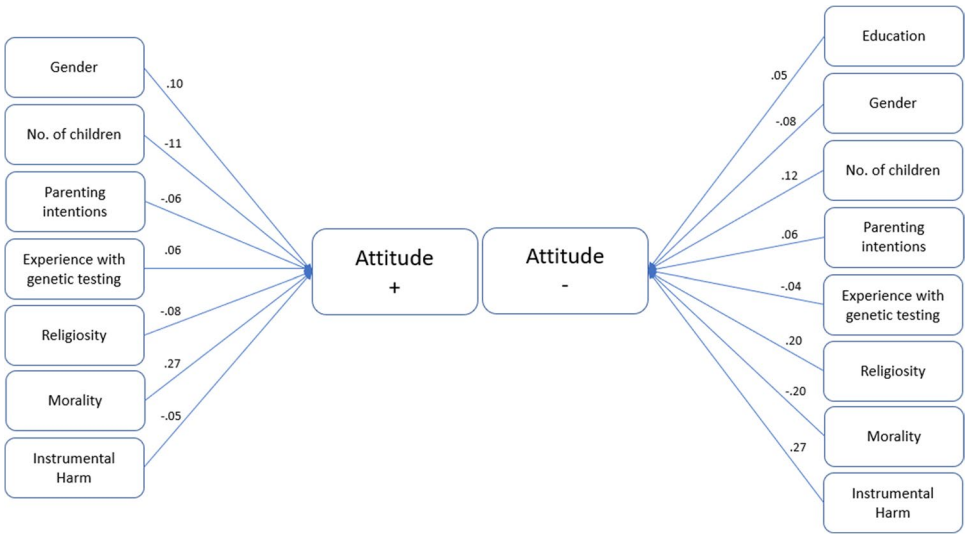

Fig. 1. A path model for positive (+) and negative (-) aatitudes towards genetic testing from hierarchical multiple regression analyzes. Values represent significant (p<.05) β coefficients

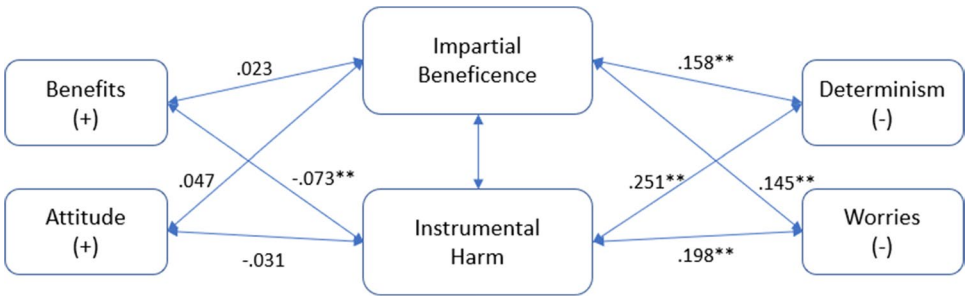

Fig. 2. The associations between utilitarian dimensions and participants attitudes towards genetic testing ["+" and "-" underline positive and negative attitudes]; **p<.001

Table 8 Participants' agreement to reproduction choices depending on one's disability ($N = 1267$)

Item	Answer (Range: 1 = totally disagree to 5 = totally agree)				
	1	2	3	4	5
	N (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
People with a physical disability should not have children	926 (56.9)	284 (17.5)	248 (15.2)	100 (6.1)	69 (4.2)
People with an intellectual disability should not have children	559 (34.4)	358 (22)	360 (22.1)	179 (11)	171 (10.5)

We further asked participants about their own choices and what other people should choose following the genetic screening to reveal the possibility of future children with different conditions. Participants' answers to each scenario are detailed in Table 9.

When expressing their choices concerning other future parents' potential decisions related to the possibility of future children with different conditions, participants considered Down syndrome as the condition that parents should most take into account when deciding to have children (35%), followed by progressive muscular dystrophy (29.1%), and major depressive disorder (29%). When expressing their choices for their future children (i.e., pregnancy termination decisions), participants' knowledge about potential deafness in their children generated the most frequent (37.7%) definitive termination decisions (i.e., "definitely yes" answers), followed by schizophrenia (35.8%), and major depressive disorder (35.2%).

Our primary interest in this second part of our research was to explore the associations between participants' attitudes (positive and negative, overall computed scores) towards genetic testing, utilitarian dimensions, i.e., instrumental harm and impartial beneficence, perceived morality and religiosity, and the potential (termination) choices following genetic screening procedures. We explored these potential correlations in our sample for each of the seven conditions, and we also computed an overall score for participants' termination choices, regardless of the condition

Table 9 Participants' answers to reproduction scenarios ($N = 1267$)

Condition	*When do you think they should have a baby, given that they know about this risk?* Answer (Range: 0 = 0% chances (risk) to 5 = 100% chances (risk)					
	0 0% risk	1 <5% risk	2 <25% risk	3 <50% risk	4 <75% risk	5 [regardless] 100% risk
	N (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
progressive muscular dystrophy	474 (29.1)	324 (19.9)	203 (12.5)	183 (11.2)	81 (5)	362 (22.2)
Down syndrome	569 (35)	326 (20)	206 (12.7)	159 (9.8)	74 (4.5)	293 (18)
schizophrenia	468 (28.8)	294 (18.1)	207 (12.7)	176 (10.8)	80 (4.9)	402 (24.7)
deafness	452 (27.8)	295 (18.1)	195 (12)	199 (12.2)	99 (6.1)	387 (23.8)
bipolar disorder	452 (27.8)	295 (18.1)	195 (12)	199 (12.2)	99 (6.1)	387 (23.8)
autism	452 (27.8)	295 (18.1)	195 (12)	199 (12.2)	99 (6.1)	387 (23.8)
major depressive disorder	472 (29)	309 (19)	207 (12.7)	185 (11.4)	92 (5.7)	362 (22.2)
	Pregnancy termination choice (self) Answer (Range: 1 (definitely no) to 5 (definitely yes)					
Condition	1		2	3	4	5
	N (%)		*N* (%)	*N* (%)	*N* (%)	*N* (%)
progressive muscular dystrophy	214 (13.2)		198 (12.2)	477 (29.3)	274 (16.8)	464 (28.5)
Down syndrome	197 (12.1)		175 (10.8)	435 (26.7)	268 (16.5)	552 (33.9)
schizophrenia	148 (9.1)		157 (9.6)	418 (25.7)	321 (19.7)	583 (35.8)
deafness	155 (9.5)		163 (10)	430 (26.4)	266 (16.3)	613 (37.7)
bipolar disorder	160 (9.8)		175 (10.8)	441 (27.1)	297 (18.3)	554 (34.1)
autism	253 (15.6)		222 (13.6)	426 (26.2)	244 (15)	482 (29.6)
major depressive disorder	194 (11.9)		182(11.2)	418 (25.7)	261 (16)	572 (35.2)

(the higher the score, the higher the willingness to terminate a pregnancy following genetic testing if any of the seven conditions are probable). Table 10 offers a detailed perspective concerning these specific variables.

Results suggested that the negative attitudes towards genetic testing were significantly and positively correlated with the overall willingness to terminate a "risky" pregnancy. However, the positive attitudes were not significantly associated with these choices. In addition, instrumental harm, impartial beneficence, religiosity, and morality were also significantly and positively correlated with the overall willingness to terminate a "risky" pregnancy. This result is specifically interesting since higher levels of religiosity and morality usually correspond to lower levels of pregnancy termination acceptance (Frohwirth et al., 2018).

Discussion

The primary purpose of our study was to explore the psychological mechanisms underlying people's attitudes towards genetic testing and prenatal screening, primarily since some of the most controversial related implications refer to selective reproduction following the prenatal screening. Noninvasive prenatal testing is a way of determining the risk for a future child to be born with specific genetic abnormalities (i.e., information about potential genetic disorders of the unborn child). Building on previous related theoretical approaches (e.g., Godard et al., 2003; Henneman et al., 2004; Henneman et al., 2006) and the two-dimensional utilitarian (Kahane et al., 2018), we tested several assumptions and prediction models to explore the associated factors of positive and negative attitudes towards genetic screening.

We first assumed that participants who had more experiences with hereditary diseases and tests would be more likely to support the availability and use of genetic tests. Our assumption was confirmed, in line with previous similar findings (e.g., Henneman et al., 2004). This specific result joins the line of research that entitles the need for genetic literacy (Goda et al., 2019; Kawasaki et al., 2021). As Kawasaki et al. (2021) suggested, "under conditions of low genetic literacy, the development of genetic tests and access to genetic information can lead to increased discrimination and prejudice among the public" (p. 31). Thus, we believe that accurate information related to genetic testing would address potentially biased beliefs through targeted educational programs.

Next, we assumed that consequentialist tendencies would be significantly associated with genetic testing attitudes and the potential outcomes following specific prenatal testing results. More specifically, we assumed that instrumental harm, contrary to impartial beneficence, would be positively associated with pregnancy termination choices following possible genetic screening results that would indicate risks for specific conditions. Our results suggested that instrumental harm (and not impartial beneficence) was the most significant predictor for negative attitudes and a negative predictor for positive attitudes towards genetic screening. This result is particularly interesting since instrumental harm is conceptualized in the two-dimensional utilitarian model as the "negative" utilitarian dimension, i.e., people's permissive attitude toward harming others for the greater good. Considering previous utilitarian paradigms related to

Table 10 Zero-order correlations between utilitarian dimensions, attitudes towards genetic testing, and termination choices following potential genetic screening procedures ($N = 1627$)

	1	*2*	*3*	*4*	5	6	7	8	9	10	11	12	13	14
1. Attitude +	1													
2. Attitude -	−.47**	1												
3. Impartial B.	.04	.17**	1											
4. Instrumental H.	−.05*	.25**	.74**	1										
5. Religion	−.01	.16**	.22**	.08**	1									
6. Morality	.25**	−.14**	.13**	.03	.278**	1								
7. M. dystrophy	.01	.16**	.20**	.09**	.36**	.15**	1							
8. Down	−.01	.12**	.18**	.09**	.30**	.14**	.72**	1						
9. Schizophrenia	.05*	.02	.14**	.05*	.22**	.155**	.64**	.76*	1					
10. Deafness	.07**	.02	.17**	.07**	.26**	.18**	.61**	.78**	.76**	1				
11. Bipolar	.04	.04	.17**	.06**	.24**	.16**	.64**	.76**	.84**	.78**	1			
12. Autism	−.02	.12**	.18**	.09**	.30**	.15**	.70**	.78**	.76**	.75**	.80**	1		
13. M. depressive d.	−.01	.10**	.18**	.09**	.30**	.16**	.67**	.84**	.76**	.79**	.79**	.82**	1	
14. Termination (total)	.02	.10**	.20**	.09**	.32**	.18**	.80**	.91**	.89**	.88**	.90**	.90**	.91**	1

*p < .05; **p < .001 (2-tailed)

disability (e.g., Bentham, 1970/2015; Mills, 2011; Singer, 1979/2012) and the eugenics argument argued by Cavaliere (2018), these results might seem counterintuitive. According to our results, it seems that "the greater good" would be to engage and support genetic testing. This idea might be an interesting turning point for future studies exploring these mechanisms.

Finally, the demographical and personal factors that we accounted for in our analyses were also suggested to be significantly associated with participants' attitudes toward genetic testing, in line with the previous findings suggested by Henneman et al. (2004). More specifically, our data suggested that older individuals with children who perceived themselves as more religious and less moral had more negative attitudes towards genetic testing. Furthermore, we found that the higher the perceived morality and the lower the self-reported religiosity, the lower the moral concerns regarding genetic screening. There are several potential explanations that we could consider in this regard: (1) Older individuals might have had less access or fewer experiences related to genetic testing and screening procedures when they became parents, given that these technologies are rather new and not fully accessible (and, as previously observed in our data, lower familiarity was correlated with more negative attitudes). Second, though we did not explore this dimension, each individual's dominant model of disability might shape their attitudes towards genetic screening. For example, in our case, more religious individuals might be more prone to align with the moral and/or religious model of disability (a paradigm that views disability as an act/a punishment from God; Retief & Letsosa, 2018). Furthermore, religious anchors such as" God gives people the challenge they can bear" might also significantly account for their potential decisions related to pregnancy termination following the genetic screening.

Also, protecting the common well-being and reputation of the family unit, sometimes referred to as" saving face", was repeatedly proved as a significant factor in genetic decisions making processes, which also involve pregnancy termination, testing, and/or disclosure of family medical history (Chin et al., 2005; Glenn et al., 2012). In collective cultures such as Romania, children, especially *sons,* are associated with carrying on the family lineage and thus honor the family name (Mittman et al., 1998; Widayanti et al., 2011). This being considered, a child with a genetic condition might be considered as a source of shame for the family. Furthermore, in line with the moral and religious model of disability, he might also be considered a" curse" or a punishment from God (Chin et al., 2005; Widayanti et al., 2011). If so, the child's autonomy and participation in decision-making are compromised when the idea of 'parents as the universal surrogate decision-makers is rigidly adhered to. Nevertheless, future studies might benefit from including an overview of participants' models of disability when exploring these mechanisms.

Our results also suggested that participants with a high-school degree had the lowest levels of worry towards genetic testing, while participants with a Ph.D. degree had the highest. This specific result is in line with previous findings that suggested a tendency to be less inclined to use and accept genetic testing when one's educational level is higher (e.g., Aro et al., 1997; Saucier et al., 2005). However, it contradicts the findings suggested by Henneman et al. (2004), who argued that high educational levels seemed to be positively associated with genetic knowledge and more favorable related attitudes.

The present data also suggested that participants in a romantic relationship were the most interested in the benefits of genetic testing, while those who were widowed were the least interested. Furthermore, parenting intentions within the next five years also contributed to some of the significant differences suggested by our data, i.e., a positive attitude towards the availability and use of genetic testing was significantly higher among participants who did not intend to have any (more) children in the next five years, compared to those who did. Additionally, the related worries about genetic testing were lower among participants who did not intend to have any (more) children in the next five years, compared to those who did. One of the potential explanations that we considered was the psychological distance that might have determined more positive attitudes and lower levels of concern towards a procedure that could uncover difficult news. In other words, since no children are planned in the future, participants might be more open and less concerned because the potentially revealed medical conditions would not affect them directly, and, therefore, they would not subsequently be morally challenged.

In the second part of our research, we investigated whether some potential debilitating conditions might shape participants' choices considering pregnancy termination choices following genetic screening procedures. When expressing choices concerning other future parents' potential decisions regarding a problematic pregnancy, participants considered Down syndrome as the condition that parents should most consider when deciding to have children. In other words, participants reported that future parents should mostly consider terminating the pregnancy in the case of Down Syndrome. This result is in line with previous studies that suggested high termination rates in the case of Down Syndrome prenatal diagnosis (e.g., >95%, Lou et al., 2018). Thus, the implications are significant for both cultural and societal norms related to the perception of this specific disability.

When expressing their choices for their own potential future children (i.e., pregnancy termination decisions

following genetic screening), participants' knowledge about potential deafness in their children generated the most frequent definitive termination decisions, followed by schizophrenia and major depressive disorder. One potential explanation might be related to the anticipated personal, medical, and social challenges associated with raising a deaf child by hearing potential parents (Plotkin et al., 2014), including the difficulties and medical challenges of choosing a cochlear implant, a hearing aid device (or none) (Haddad et al., 2019, Jackson & Turnbull, 2004). Nevertheless, the social construction of deafness (Kara & Harvey, 2017) might be another potential explanation for this specific result, potentially connected to the models of disability our participants generally adhere to, and future studies might benefit from further exploring it. In line with these results, another future research direction might explore the identity of the future child, as conceptualized by Solomon (2014). The use of genetic tests could help parents uncover elements of vertical identity (Ginn, 2014) even before the child is born and identify dimensions related to the future child's horizontal identity, some of which they might not easily integrate into their everyday lives.

Limitations

The present study has several limitations that need to be addressed. First, empirical studies that attempt to measure preferences, attitudes, and decision-making processes often encounter situational limitations that undermine the results' generalizability. One common limitation is that attitudes or preferences are elicited using hypothetical scenarios that may not reflect the actual decision-making situation (FeldmanHall et al., 2012). Another limitation is related to the cross-sectional design that we used, which did not allow us to test the causality and the dynamics between the personal and demographical factors explored and participants' attitudes towards genetic testing and their responses to the hypothetical scenarios. Future research might benefit from systematically exploring these associations over time in extended longitudinal studies.

Furthermore, our data were gathered using self-report measures that may suffer from desirability. Therefore, future research might benefit from using alternative measurement strategies, such as experimental designs. Additionally, by adding qualitative research instruments, future investigations might benefit from using mixed-method approaches (e.g., Online Photovoice (OPV; Tanhan, 2020; Tanhan & Strack, 2020). Additionally, future studies might also use more extensive and more gender-balanced samples of participants. Finally, it is important to mention that our study was conducted during the Covid-19, which might have also impacted people's perceptions and representations about various social aspects, the subject of this paper included (e.g., Krings et al., 2021).

Implications

We live in controversial, challenging, and yet extraordinary technological times that create significant opportunities for people to better assess their health status before reproduction. However, we consider it essential to investigate better the underlying moral concerns, psychological mechanisms, ethical challenges, and especially – the implications of genetic testing and prenatal screening, particularly for the future of people with disabilities. In addition, the present findings might bring significant insight into future genetic counseling and literacy explorations and extended discussions related to the underlying psychological mechanisms.

Appendix A

Scenarios and questions

1. A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely ***progressive muscular dystrophy***. **When** do you think they should have a baby, given that they know about this risk?

a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances;
b) when genetic screening results show that the chances of transmitting that disease are less than 5%;
c) when genetic screening results show that the chances of transmitting that disease are less than 25%;
d) when genetic screening results show that the chances of transmitting that disease are less than 50%;
e) when genetic screening results show that the chances of transmitting that disease are less than 75%;
f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted.

1.a. If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following prenatal screening, that your future child could develop, after giving birth/ or could be born with ***progressive muscular dystrophy***, would you continue the pregnancy? (5-point Likert scale, ranging from 1=Definitely no, 5=Definitely yes).

2. A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely ***Down syndrome***. **When** do you think they should have a baby, given that they know about this risk?

a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances;
b) when genetic screening results show that the chances of transmitting that disease are less than 5%;
c) when genetic screening results show that the chances of transmitting that disease are less than 25%;
d) when genetic screening results show that the chances of transmitting that disease are less than 50%;
e) when genetic screening results show that the chances of transmitting that disease are less than 75%;
f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted.

2 a. If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following prenatal screening, that your future child could develop, after giving birth/ or could be born with ***Down syndrome***, would you continue the pregnancy?

(5-point Likert scale, ranging from 1=Definitely no, 5=Definitely yes).

3. A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely ***schizophrenia***. **When** do you think they should have a baby, given that they know about this risk?

a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances;
b) when genetic screening results show that the chances of transmitting that disease are less than 5%;
c) when genetic screening results show that the chances of transmitting that disease are less than 25%;
d) when genetic screening results show that the chances of transmitting that disease are less than 50%;
e) when genetic screening results show that the chances of transmitting that disease are less than 75%;
f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted.

3.a. If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following prenatal screening, that your future child could develop, after giving birth/ or could be born with ***schizophrenia***, would you continue the pregnancy?

(5-point Likert scale, ranging from 1=Definitely no, 5=Definitely yes).

4. A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely ***deafness***. **When** do you think they should have a baby, given that they know about this risk?

a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances;
b) when genetic screening results show that the chances of transmitting that disease are less than 5%;
c) when genetic screening results show that the chances of transmitting that disease are less than 25%;
d) when genetic screening results show that the chances of transmitting that disease are less than 50%;
e) when genetic screening results show that the chances of transmitting that disease are less than 75%;
f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted.

4.a. If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following prenatal screening, that your future child could develop, after giving birth/ or could be born with ***deafness***, would you continue the pregnancy?

(5-point Likert scale, ranging from 1=Definitely no, 5=Definitely yes).

5. A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely ***bipolar disorder***. **When** do you think they should have a baby, given that they know about this risk?

a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances;
b) when genetic screening results show that the chances of transmitting that disease are less than 5%;
c) when genetic screening results show that the chances of transmitting that disease are less than 25%;
d) when genetic screening results show that the chances of transmitting that disease are less than 50%;
e) when genetic screening results show that the chances of transmitting that disease are less than 75%;
f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted.

5.a. If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following prenatal

screening, that your future child could develop, after giving birth/ or could be born with ***bipolar disorder***, would you continue the pregnancy?

(5-point Likert scale, ranging from 1=Definitely no, 5=Definitely yes).

6. A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely ***autism***. **When** do you think they should have a baby, given that they know about this risk?

a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances;
b) when genetic screening results show that the chances of transmitting that disease are less than 5%;
c) when genetic screening results show that the chances of transmitting that disease are less than 25%;
d) when genetic screening results show that the chances of transmitting that disease are less than 50%;
e) when genetic screening results show that the chances of transmitting that disease are less than 75%;
f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted.

6.a. If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following prenatal screening, that your future child could develop, after giving birth/ or could be born with ***autism***, would you continue the pregnancy?

(5-point Likert scale, ranging from 1=Definitely no, 5=Definitely yes).

7. A couple who really wants to have a child finds out, through prenatal genetic screening, that there might be a risk for their future child to be born with/develop a specific condition, namely ***major depressive disorder***. **When** do you think they should have a baby, given that they know about this risk?

a) when genetic screening results show that there is no risk, of any kind, for the child to be born with this condition, i.e., 0% chances;
b) when genetic screening results show that the chances of transmitting that disease are less than 5%;
c) when genetic screening results show that the chances of transmitting that disease are less than 25%;
d) when genetic screening results show that the chances of transmitting that disease are less than 50%;
e) when genetic screening results show that the chances of transmitting that disease are less than 75%;
f) I think that the couple should have a baby regardless of whether the condition will be 100% transmitted.

7.a. If you found out, after a routine check-up at the doctor who monitors the pregnancy, or following prenatal screening, that your future child could develop, after giving birth/ or could be born with ***major depressive disorder***, would you continue the pregnancy?

(5-point Likert scale, ranging from 1=Definitely no, 5=Definitely yes).

Data Availability The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics Statement This study's protocol was designed in concordance with ethical requirements specific to the Faculty of Psychology and Educational Sciences," Alexandru Ioan Cuza" University (Iasi, Romania), before beginning the study and supervised by Alexandra Maftei. All participants voluntarily participated in the study and gave written informed consent following the Declaration of Helsinki and the national laws from Romania regarding ethical conduct in scientific research, technological development, and innovation.

Conflict of Interest The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.
The authors declare no financial interests/personal relationships, which may be considered as potential competing interests.

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