Genetic screening for quality-of-life improvement and post–genetic testing consideration in Saudi Arabia

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Abstract
The Saudi genome project started in 2013 with a great hope to improve medical care and disease prevention. Among the genes are those related to nutrition and fitness that can optimize an individual’s lifestyle. Our aim was to review the knowledge and acceptance of nutrition and fitness genetic testing to enhance the quality of life among the population of Saudi Arabia. For the study an electronic questionnaire consisting of 27 questions was prepared, and it was answered by 302 respondents. The respondents’ demographics showed about 50% of respondents were aged 18–25 years and about 50% of respondents were aged 26–60 years. More than 50% of respondents were interested in having a genetic test to enhance their health, while 40% were interested in having a genetic test to enhance their fitness. Less than 50% of respondents had an understanding of the effects of coffee, macronutrition and micronutrition, elements, and enzyme activity. These results represented a contribution to the discussion on the relevance of genetic testing validity and acceptance among the population of Saudi Arabia. The results might help in producing specific guidelines on genetic testing and genomic analysis and help in the implementation of fitness and future health plans in cooperation with Saudi genome projects. Future study will focus on population structure and genetic frequency related to specific diets or fitness.

Keywords: Genetic screening; diet; fitness; nutrition

Significance statement: The availability of genetic information in the era of omics has made it possible to use genetic information beyond rare genetic diseases. To test the population’s acceptance and knowledge of genetic testing use in disease prevention and improvement of wellness, we conducted a survey study. The outcomes indicate great acceptance and knowledge that will help us in the future to detect the frequency of different genes related to nutrition and fitness. These results might help in producing specific guidelines on genetic testing and genomic analysis and help in the implementation of fitness and future health plans in cooperation with Saudi genome projects.

Introduction
Genetic mapping has caused a unique revolution in the world of medicine and can be used to enhance the quality of life [1]. Screening for specific genes that affect nutrition and fitness can help optimize the lifestyle of an individual. The genotype of an individual can identify the relationship between health problems and the chances of injury and the interaction of the body with food and various sports [2].
Genetic screening is an examination done by the taking of a blood sample or swab from the patient’s mouth to collect DNA. Scientists in the laboratory then examine single nucleotide forms, or multiple forms, as multiple forms of single nucleotides are the most common type of genetic variation among people [1–3]. Weight control is manageable by a genetic screening test to identify the optimum diet for an individual and determine the best calorific intake. In addition, a genetic test will provide information about genes related to metabolism and absorption of fat, thus determining the effect of nutrients on the body, and help create a special diet for each individual. By focus on genes that play a role in weight gain, an individual might be helped to lose weight [4–7]. Lebanon among Arab countries specifically formulated a regulation concerning genetic testing. The other Arab countries, including Saudi Arabia, have used genetic testing in forensic or premarital screening and reproductive medicine [8].

To perform a genetic screen of the Saudi population and increase the sample size and diversity, we created an electronic questionnaire to gain insight into knowledge and acceptance of genetic testing. The questionnaire respondents were random and diverse, with age ranging from 18 to 61 years and older.

**Material and methods**

Methods based on descriptive analysis were used to analyze the questionnaires completed by 302 respondents electronically using SurveyMonkey (www.surveymonkey.com). With use of SPSS Statistics version 17, the arithmetic means and standard deviations for the participants were computed for multiple dimensions for further assessment of the questionnaires. The questionnaire consisted of two main parts. The first part asked the participants about their demographics (age, country of residence, and knowledge of genetic testing). The second part consisted of 27 Likert scale items. The Likert scale consisted of five choices: “strongly agree,” “agree,” “neutral,” “disagree,” and “strongly disagree.” The 27 items were divided into four subcategories: the influence of genetic testing on fitness and weight control, the influence of genetic testing on nutrition and energy, the relationship between genetic testing and nutrition elements, and the response toward the importance of genetic testing. Throughout the questionnaire, the participants were asked to rate their responses regarding those four subcategories.

**Statistical analysis**

Testing method validity and reliability were assessed with SPSS Statistics version 17. To ensure the reliability of the instrument, the Cronbach’s alpha test was performed for the total number of items in the questionnaire. The Cronbach’s alpha score was 0.894, which represents a very high level of reliability. Moreover, the validity of the instrument’s items was calculated through the Pearson score.

**Results**

To understand the Saudi population’s view of genetic screening and its importance, we created an electronic questionnaire. The questionnaire consisted of 27 items, and was answered by 302 individuals. The descriptive statistics in the form of arithmetic means and standard deviations for the participants were computed for the multiple dimensions that were assessed through the questionnaire. The respondents aged 18–60 years knew about genetic testing (Table 1). The respondents’ views of the influence of genetic testing on fitness and weight control (Table 2) and on nutrition and energy (Table 3) were highly significant in all categories. The views about the relationship between genes and fitness (Table 4) and the importance of genetic testing (Table 5) were highly significant, and the respondents were willing to follow the test recommendations regarding food and supplement intake.

The participants’ choices regarding the influence of genetic testing on fitness and weight control consisted of six items, with a total mean score for these six items of 4.13/5, which was highly significant (Table 6). The item with the highest score (4.33/5) was “It is important to know if I can improve my health through genetic testing,” and the item with the second highest score (4.32/5) was “It is important for me to know how to control my weight by genetic testing” (Table 6). Table 7 shows the participants’ choices regarding the second category, the influence of genetic testing on nutrition and energy, which consisted of six items. The total mean score for these six items was 3.58/5, which was highly significant. The item with the highest score (3.58/5) was “Increasing your metabolism...
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Table 1. The descriptive statistics for the demographics and the number and percentage of the respondents

| Category                        | Choices | Number | Percentage (%) |
|---------------------------------|---------|--------|----------------|
| Age                             | 18–25   | 141    | 49.6           |
|                                 | 26–33   | 60     | 21.1           |
|                                 | 34–41   | 45     | 15.8           |
|                                 | 42–49   | 20     | 7.0            |
|                                 | 50–60   | 16     | 5.6            |
|                                 | 61+     | 2      | 0.7            |
| Country of residence            | Saudi Arabia | 237 | 83.5 |
|                                 | Other specified countries | 25 | 8.8 |
|                                 | Other nonspecified countries | 22 | 7.7 |
| Do you know anything about the concept (genetic testing)? | Yes | 159 | 56.0 |
|                                 | No      | 125    | 44.0           |

Table 2. Pearson correlation regarding participants’ responses concerning the influence of genetic testing on fitness and weight control

| Item                                                                 | Pearson correlation score |
|----------------------------------------------------------------------|----------------------------|
| Are you aware of gaining fitness or muscles through genetic testing?  | 0.709*                     |
| It is important to know if I can improve my health through genetic testing | 0.744*                     |
| It is important for me to know how to control my weight by genetic testing | 0.811*                     |
| I am interested to know if some allergies can be diagnosed by genetic testing | 0.638*                     |
| Weight is a combination of genetic ability and lifestyle             | 0.630*                     |
| You can get the optimum weight by knowing your diet on the basis of a genetic test | 0.697*                     |

*Correlation is significant at the 0.01 level (two-tailed).

Table 3. Pearson correlation regarding participants’ responses concerning the influence of genetic testing on nutrition and energy

| Item                                                                 | Pearson correlation score |
|----------------------------------------------------------------------|----------------------------|
| Increasing your metabolism rapidly and the ability to transform food into energy is linked to genes | 0.647*                     |
| The effect caused by coffee is a genetic ability                      | 0.708*                     |
| The additional need for some vitamins is linked to genetic testing     | 0.806*                     |
| The need for some minerals for your body is related to genetic testing | 0.825*                     |
| The response to core nutrition elements such as protein, carbohydrates, and fats is related to genetic testing | 0.809*                     |
| The accumulation of toxic products in our body is caused by the lack of enzymes related to genes | 0.710*                     |

*Correlation is significant at the 0.01 level (two-tailed).

rapidly and the ability to transform food into energy is linked to genes,” and the item with the second highest score (3.67/5) was “The response to core nutrition elements such as protein, carbohydrates, and fats is related to genetic testing.” Thus this shows the participants’ awareness regarding nutrition facts and the importance of genetic testing. The participants’ choices regarding the third category, the relationship between genetic testing and nutrition elements, consisted of eight items (Table 8). The total mean score for these eight items was 3.58/5, which was significantly high. The items with the highest scores (both 3.73/5) were “Muscle building needs nutrition and exercise in line with genetic ability” and “Lactose
Table 4. Pearson correlation regarding participants’ responses concerning the relationship between genes and fitness

| Item                                                                 | Pearson correlation score |
|----------------------------------------------------------------------|--------------------------|
| Genes can be defined on the basis of the environment and lifestyle  | 0.609*                   |
| Carbohydrate allergy is linked to genes                             | 0.708*                   |
| Lactose intolerance is linked to genes                              | 0.629*                   |
| Some sports endurance is related to genes                           | 0.733*                   |
| Muscle building needs nutrition and exercise in line with genetic ability | 0.683*                  |
| Fat rate in the body is linked to genes                             | 0.673*                   |
| Losing weight by doing sports is related to genes                   | 0.713*                   |
| Fast recovery from injuries is related to genes                     | 0.726*                   |

*Correlation is significant at the 0.01 level (two-tailed).

Table 5. Pearson correlation regarding participants’ responses concerning the importance of genetic testing

| Item                                                                 | Pearson correlation score |
|----------------------------------------------------------------------|--------------------------|
| If I have a chance to have a genetic test, I will have one           | 0.325*                   |
| I do not care for the recommendations to reduce or add a specific kind of food because of my genetic test results | 0.658*                   |
| When my genetic test result recommends my reducing my intake of specific food types, I will follow the recommendation | 0.638*                   |
| The recommendation of taking extra vitamins because of my genetic test results does not interest me | 0.509*                   |
| When my genetic test result requires me to take antioxidants, I will take them | 0.594*                   |
| Genetic testing has no relationship with muscle building             | 0.382*                   |
| Genetic testing has no relationship with following a diet            | 0.580*                   |

*Correlation is significant at the 0.01 level (two-tailed).

Table 6. The participants’ responses regarding the influence of genetic testing on fitness and weight control

| Item                                                                 | Number or percentage | Likert scale category |
|----------------------------------------------------------------------|----------------------|-----------------------|
| Are you aware of gaining fitness or muscles through genetic testing? | n 4                  | Strongly disagree 1   |
|                                                                      | % 1.4                | Disagree 2           |
|                                                                      |                      | Neutral 3            |
|                                                                      |                      | Agree 4             |
|                                                                      |                      | Strongly agree 5     |
| It is important to know if I can improve my health through genetic testing | n 3                  | Strongly disagree 1   |
|                                                                      | % 1.1                | Disagree 2           |
|                                                                      |                      | Neutral 3            |
|                                                                      |                      | Agree 4             |
|                                                                      |                      | Strongly agree 5     |
| It is important for me to know how to control my weight by genetic testing | n 2                  | Strongly disagree 1   |
|                                                                      | % 0.7                | Disagree 2           |
|                                                                      |                      | Neutral 3            |
|                                                                      |                      | Agree 4             |
|                                                                      |                      | Strongly agree 5     |
| Are you interested to know if some allergies can be diagnosed by genetic testing? | n 1                  | Strongly disagree 1   |
|                                                                      | % 0.4                | Disagree 2           |
|                                                                      |                      | Neutral 3            |
|                                                                      |                      | Agree 4             |
|                                                                      |                      | Strongly agree 5     |
| Weight is about a genetic ability and a lifestyle                    | n 4                  | Strongly disagree 1   |
|                                                                      | % 1.4                | Disagree 2           |
|                                                                      |                      | Neutral 3            |
|                                                                      |                      | Agree 4             |
|                                                                      |                      | Strongly agree 5     |
| You can get the perfect weight by knowing your diet on the basis of genetic testing | n 4                  | Strongly disagree 1   |
|                                                                      | % 1.4                | Disagree 2           |
|                                                                      |                      | Neutral 3            |
|                                                                      |                      | Agree 4             |
|                                                                      |                      | Strongly agree 5     |
intolerance is related to genes.” This shows the participants’ awareness regarding the relationship between nutrition and genetic testing (Table 8). Table 9 contains seven items. The total mean score for these seven items was 3.39/5, which is considered high. The item with the highest score (4.36/5) was “If I have a chance to have a genetic test, I will have one.” This
Table 9. The participants’ responses regarding the importance of genetic testing

| Item                                                                 | Number or percentage | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---------------------------------------------------------------------|----------------------|-------------------|----------|---------|-------|----------------|
| If I have a chance to have a genetic test, I will have one           | n 2                  | 1                 | 10       | 23      | 97    | 152            |
|                                                                     | % 0.7                | 3.5               | 8.1      | 34.2    | 53.5  |
| I do not care for the recommendations to reduce or add a specific kind of food because of my genetic test results | n 13                 | 68                | 107      | 61      | 35    |
|                                                                     | % 4.6                | 23.9              | 37.7     | 21.5    | 12.3  |
| When my genetic test result recommends my reducing intake of specific food types, I will follow the recommendation | n 18                 | 69                | 109      | 60      | 28    |
|                                                                     | % 6.3                | 24.3              | 38.4     | 21.1    | 9.9   |
| The recommendation of taking extra vitamins because of my genetic test results does not interest me | n 3                  | 22                | 86       | 111     | 62    |
|                                                                     | % 1.1                | 7.7               | 30.3     | 39.1    | 21.8  |
| When my genetic test result requires me to take antioxidants, I will take them | n 28                 | 103               | 78       | 48      | 27    |
|                                                                     | % 9.9                | 36.3              | 27.5     | 16.9    | 9.5   |
| Genetic testing is not associated with muscle building               | n 5                  | 12                | 49       | 130     | 88    |
|                                                                     | % 1.8                | 4.2               | 17.3     | 45.8    | 31.0  |
| Genetic testing is not associated with a specific diet               | n 42                 | 107               | 57       | 53      | 25    |
|                                                                     | % 14.8               | 37.7              | 20.1     | 18.7    | 8.8   |

The item with the second highest score (4.00/5) was “Genetic testing is not associated with muscle building.” This also shows the participants’ awareness regarding the effects of genetic testing was highly significant (Table 9).

**Discussion**

Recent advances in genetics and human medicine have improved medical care related to genetically inherited conditions but have not improved disease prevention. Some diseases can be prevented or reduced by an insightful test to screen persons for individual genes related to nutrition or fitness. The genome project in Saudi Arabia started in 2013 with a focus on genetic disease screening in the Saudi population. On the other hand, there are an enormous number of diseases that can be managed through individual gene screening to optimize wellness. In the current study, on the basis of the questionnaire, we noticed that the Saudi population has knowledge and understanding of the importance of gene screening to optimize health. About 50% of respondents were aged 18–25 years and about 50% of respondents were aged 26–60 years of demographics reflecting most of youth population Saudi residents. The understanding was highly significant in terms of the relationship between genes and fitness, the importance of genetic testing, and the relationship between genetic testing and muscle building and weight control. Above all, more than 50% of the respondents were willing to have a genetic test if they got the chance to have one. More than 50% of the respondents were considering following the genetic test food intake and supplement recommendations. These findings are similar to those of a previous study showing that most athletes use supplements to improve their health and performance [9]. The creation of the electronic questionnaire and the random sample represented a valid and reliable tool to measure the Saudi population’s acceptance and view of genetic testing regarding wellness via nutrition and fitness. The purpose of the study was to obtain insight into knowledge and acceptance of genetic testing and to promote genetic testing for enhancement and optimization of lifestyle. In a further study we will conduct screening for specific genes related to diet and fitness. The genetic population structure and genetic frequency will also be measured in the Saudi population.

**Conflict of interest**

The authors declare no conflict of interest.
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**Funding**
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Author contributions**
Faten Dhawi developed the idea, created the questionnaire, and wrote the manuscript. Faisal Shehab Alotaibi edited the questionnaire, performed the analytical methods, and compiled the results. Both authors contributed to the final manuscript.

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