**Results and Discussion**

We managed to collect 184 responses from Indonesian people with various academic background and age. **Figure 1** shows profiles of the respondents (please note that not all respondents fill their age, academic background, opinion, and others so some data are probably missing).

**Figure 1.** Profiles of Indonesian respondents.

In addition, here are the responses given by Indonesian people who fill the questionnaire.

**Figure 2.** Level of confidence of the respondents about their recognition of people having genetic disorder(s) (1 for the lowest until 5 for the highest).

**Figure 3.** Level of agreement of the respondents about genetic impairment causes several diseases (1 for the lowest until 5 for the highest).

We found that about 42.9% respondents were confident (level of confidence 4-5) about knowing someone with genetic disorder(s), while 26.4% were fairly confident (level of confidence 3) and 30.8% were unsure (level of confidence 1-2) about it (Figure 2). In addition, we also found most of the respondents agreed (57.7% with level of agreement 4-5) that some disorders are caused by genetic impairment (Figure 3). When asked to mention some of genetic disorders, they quite successfully mentioned some of them – the top three were Down syndrome (29 respondents), diabetes (27 respondents), and cancer (26 respondents), although some of them mentioned multifactorial diseases and even diseases caused by infective agents (e.g. HIV and diphtheria).

When we saw a trend of people saying they agree that several disorders are caused by genetic impairment, we were curious whether their agreement was associated to their academic background. Therefore, we analyzed the data with analytical statistics, particularly with Kruskal-Wallis test due to multiple (>2) independent groups data being analyzed and data were not in normal distribution (p value of Kolgomorov-Smirnov test for bachelor group with respondents more than 50 was <0.001; p value of Shapiro-Wilk test for other groups with number of respondents less than 50 was <0.05). Data without academic background or level of agreement were excluded from analysis. Data with PhD as academic background were also excluded due to limited number of data (only two respondents). Kruskal-Wallis test showed at least there is one group with mean that is statistically different with other groups (p = 0.015). Furthermore, post-hoc analysis with Mann-Whitney test showed that the differences were observed between high school and diploma (p = 0.028), diploma and bachelor (p = 0.011), also diploma and master (p = 0.003). Hence, from these results, we infer that their agreement was associated with their academic background.

In addition, we also investigated for association of their level of agreement regarding etiology of several diseases being genetic-related with their age. We created five age groups with age of 17-26, 27-36, 37-46, 47-56, and 57-66. Data of level of agreement from each group were also not in normal distribution (p value of Kolgomorov-Smirnov test for age group 17-26 was <0.001; p value of Shapiro-Wilk test for other groups was <0.05) so we used Kruskal-Wallis test for analysis. The test showed insignificant differences among groups (p = 0.154) so post-hoc Mann-Whitney test is unnecessary to be conducted.

**Figure 4.** Level of agreement of the respondents regarding gene modification application in human.

Regarding questions about gene modification to be applied in some respects (such as curing disease, enhancing intelligence, and beautifying physical appearance), we found that most of Indonesian people were neither agree nor disagree with the statements (Figure 4). However, the trend showed that people agreed gene modification to be applied for curing disease, but not for improving physical appearance. In our opinion, this is not surprising and can be explained from religious viewpoint as most of Indonesian people have a strong belief to religions. From religion viewpoint, sophisticated technological advancements could be applied for the betterment of mankind (e.g. curing or preventing mortality or diseases), but not to manipulate what they have since they were born.

**Figure 5.** Level of agreement/confidence of the respondents to undergo gene modification therapy if diagnosed with genetic disorder (1 for the lowest until 5 for the highest).

**Figure 6.** Factors influencing respondent’s decision to undergo gene therapy.

When asked their agreement/confidence to undergo gene therapy if having genetic disorder, most of Indonesian people were neutral (63 respondents, 35.4%). Some of them were agree/confident (38.8%) and a few people were against it (25.9%) (Figure 5). When factors affecting their decision for gene therapy were investigated, most of them also neutral, but trend showed cost and safety were their main concern (Figure 6). This may be due to Indonesia is a developing country with most people having low-middle income, also these kinds of technologies are relatively new and unfamiliar among them. An interesting phenomenon observed is that ethic was somewhat being factor influencing gene therapy decision in some people with relatively equal proportion to those who did not think ethic was a factor. This may be due to ethic being a factor that is situational, which means whether it is morally accepted or not depends on the purpose/reason (cure disease, improve appearance, and others). Moreover, when asked if there is another factor influencing their decision, most of them considered the prognosis after gene therapy as additional factor. This may be due to lack of information or evidence regarding complications post-gene therapy so it is understandable that people are still skeptical.

We tried to investigate whether their agreement/confidence to undergo gene therapy was associated with their academic background and age. When tested for normality, only data in age group 27-36, 37-46, and 57-66 were distributed normally (p value of Shapiro-Wilk test >0.05). Therefore, we performed Kruskal-Wallis test and we found no association between age and their agreement/confidence for undergo gene therapy (p = 0.622). On the other hand, normality was only found in master academic background group (p value of Shapiro-Wilk test >0.05). Kruskal-Wallis test on this variable showed no association between academic background and their agreement/confidence as well (p = 0.28).

**Figure 7.** Gene therapy preference from Indonesian respondents.

**Figure 8.** Opinions from Indonesian respondents whether they wish their genetic changes to be inherited to their children.

When the respondents were asked to choose one gene therapy, most of them chose one-off treatment with permanent and irreversible effect, followed with they were unsure to choose (Figure 7). Furthermore, they were unsure whether their wish of genetic changes after gene therapy to be inherited to their children (Figure 8). From these results, it can be implied that Indonesian people prefer to apply gene therapy for treatment and cure disease permanently, also they want to make sure only their “good genes” are inherited to their children or uncertain about this.

Finally, some of the respondents gave their additional opinions/suggestions regarding gene modification. Most of them wished for gene modification to be tested first for its efficacy and safety so it could be utilized for life improvements and adverse effects could be prevented. Some of them also concerned the ethical aspects of gene modification as they wanted such advancement is going to be applicated in morally acceptable fashion and not for crimes. Therefore, policy regulating such issue must be enforced.

**Conclusion**

To sum up, there are diverse opinions from Indonesian respondents with various age group, gender, and academic background. Most of them are either neutral or supporting gene therapy and modification to be applied in human. However, purpose of therapy, safety, cost, ethical issue, and several other factors should be considered.