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Full Length Research Paper

Effect of demographic variables on public attitudes towards genetically modified insulin

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Earlier studies on public attitude and risk perception have concluded that the public's attitudes towards biotechnology was primarily driven by several factors such as familiarity, perceived benefits, perceived risks, risk acceptance, moral concerns and encouragement. Demographic characteristics have been known to affect attitudes towards science. The purpose of this paper is to compare the attitude of the Malaysian public towards genetically modified (GM) insulin across several background variables such as religion, race, education level and age. A survey was carried out on 1017 respondents stratified according to various stakeholder groups in the Klang Valley region. Analyses of Variance (ANOVAs) showed significant differences in the mean scores for familiarity of GM insulin across religions, races and ages but not across education levels and gender. Both perceived benefits and perceived risks were found to differ across races, education levels and gender but not across religions and ages. On the other hand, moral concern was found to differ in all four background variables except gender while risk acceptance differed across races and gender and encouragement only differed across education levels. In conclusion, background variables do have a significant effect on some of the dimensions of Malaysians' attitudes towards modern biotechnology. The research findings will be useful for understanding the effect of background variables on public attitudes towards the application of gene technology in medicine. More in-depth empirical studies should be carried out to understand the underlying causes behind the differences.

Key words: Attitude, gene technology, medicine, GM (genetically modified) insulin, background variables, Malaysia.

INTRODUCTION

Biotechnology has been identified as one of the five core technologies that will accelerate Malaysia's transformation into a highly industrialised nation by 2020 (Ninth Malaysia Plan, 2006). Accordingly, it has received strong governmental support and commitment through financial support for its research and development (R and D), infrastructure and human resource development. Although, medical biotechnology products developed by Malaysian researchers have not yet been commercialised,

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Abbreviations: GM, Genetically modified; **GMOs**, genetically modified organisms.

GM (genetically modified) medicines from other countries are slowly coming into the country. At least 26 biopharmaceutical products of modern biotechnology techniques have already been registered with the Ministry of Health Malaysia (MOH) for use in this country (Latifah et al., 2007). The list ranges from different types of insulin for the treatment of diabetes, growth hormones, drugs for the treatment of various kinds of cancers, hepatitis, infertility, autoimmune disorders, organ transplants and infectious diseases.

Modern biotechnology has been viewed by many as the frontier of the 21st century revolution. It is a powerful tool that presents a range of potential environmental, social and economic benefits that demands rigorous oversight (Kamaldeen and Powell, 2000). However, because the advancement in biotechnology has been so rapid in the past ten years, it has been the object of an intense and divisive debate in advanced countries. The debate was typically seen as a conflict between supporters who envisage the potential benefits and the opposition groups who view GM products as tampering with nature (Bloomfield, 2011). Costa-Font and Gil (2009) claim that public controversy related to GM foods has arisen due to uncertainties and perceived risks to health and the environment. Sagar et al. (2000) suggested that, a major factor in the emergence of controversies surrounding biotechnology has been the neglect of the needs, interests and concerns of the primary stakeholders, the commoners. Public perceptions, understanding and acceptance of genetically modified organisms (GMOs) can both promote and hamper the commercial introduction and adoption of new technologies (Kamaldeen and Powell, 2000).

Modern biotechnology has been classified as a complex emerging issue that exhibits high salience combined with limited knowledge on the part of the public. Various studies have shown that consumer acceptance of modern biotechnology tends to be conditional and dependent on many factors (Pardo et al., 2002). With respect to the public perception of biotechnology, Kelley (1995) proposed that attitudes to genetic engineering were determined by the worth of potential benefits offered, knowledge of genetic engineering and having a scientific world-view, minus the perceived risk (rational worries) and anxieties or fears (irrational worries) and plus/minus various minor factors.

Other studies also concluded that the public's main concerns about biotechnology were primarily driven by ethical, value and safety concerns (Einsiedel, 1997). Meanwhile, according to Hoban (1997), the major influences on acceptance seemed to be knowledge level, awareness of benefits, confidence and trust. Gaskell et al. (2000, 2003) used four dimensions of attitude: Perceived use, risks, moral acceptability and encouragement to model patterns of European public response to biotechnology.

Demographic characteristics have been known to affect attitudes towards science (Connor and Siegrist, 2010). According to Kelley (1995), demographic characteristics such as age and gender must be included, because some researchers have argued that the continuing process of scientific discovery leaves older people behind (perhaps because, for many people, scientific knowledge acquired at school is rarely updated), and because men and women are known to differ on a number of science-related and technology-related topics. Education needs to be included because of its strong connections with knowledge and learning. With regard to risk perceptions, women have been shown to perceive more risk from a hazard than men (Grobe et al., 1999; Frewer, 2000; Christoph et al., 2007) and perceived risk tends to increase with age, up to a point, and then decrease, possibly due to health concerns or ageing (Grobe et al., 1999). Gaskell et al. (2000, 2003) have also found that supporters of biotechnology in Europe were more likely to be less than 25 years of age, male and better educated while the rejecters were more likely to be female and over 35 years of age. People's occupation and religious beliefs are also enduring characteristics that shape many social and political opinions on a wide range of topics (Kelley, 1995). Consequently, in a multiracial country like Malaysia, it is also important to see whether there is any effect of race on attitudes towards biotechnology. People from different races usually have a different culture that may affect their attitudes.

The objective of this paper is to study the attitudes of Klang Valley stakeholders, across several demographic variables, towards an example of a medical biotechnology product already available in the Malaysian market: GM insulin (which involves the transfer of human genes into bacteria).

MATERIALS AND METHODS

Survey data collection

This is one of the first in-depth studies on public attitudes towards modern biotechnology in Malaysia. The people in the Klang Valley region were chosen as the targeted population as they are in the centre of the country's economic and social development. There are numerous existing universities, R and D institutions, and biotechnology-related industries located in this region. In addition, and most importantly, the respondents in this region meet the requirement of the diversity of backgrounds that uniquely represent the Malaysian population.

In this study, the stakeholder-based approach recommended by Aerni (1999, 2002) was adopted but a wider range of interest groups including producers, biotechnologists, biologists, policy makers, non-governmental organizations (NGOs), the media, politicians, religious experts, university students and the general public were surveyed. The respondents (n = 1017) were adult representatives (aged 18 years old and above) from various interest or stakeholders' groups mentioned earlier (Table 1). Since the respective populations for the stakeholders involved were unknown, the respondents were chosen using a stratified purposive sampling technique, as recommended by Monroe and Monroe (1993). The ratios for different gender, races and religion of the residents in the Klang Valley were also taken into account. ANOVAs were also carried out for attitudes across races, religions, ages and education

Table 1. Background of respondents surveyed.

Background	Frequency	Percentage (%)	Background	Frequency	Percentage (%)
Stakeholders' group			**Age**		
Producers	36	3.5	18 - 29 years	464	47.6
Biotechnologists	30	2.9	30 - 39 years	233	23.9
Biologists	43	4.2	40 - 54 years	231	24.3
Policy maker	40	3.9	≥ 55 years	47	4.2
NGOs	41	4.0			
Media	38	3.7	**Gender**		
Politician	38	3.7	Male	463	45.9
Islamic experts	47	4.6	Female	546	54.1
Buddhist expert	28	2.8			
Christian expert	26	2.6	**Race**		
Hindu expert	26	2.6	Malay	609	60.5
Biology students	46	4.5	Chinese	215	21.4
General public	578	56.8	Indian	167	16.6
			Others	15	1.5
Education			**Religion**		
Secondary	251	26.0	Islam	616	61.3
Pre-University/diploma	197	20.4	Buddha	133	13.2
Tertiary	519	53.7	Hindu	150	14.9
			Christian	95	9.5
			Others	11	1.1

levels. The attitudes among the three major races in the Klang Valley (Malay, Chinese and Indian) and three levels of education (secondary, pre-university and tertiary) were compared. In order to have a medium effect size (f = 0.25) at P = 0.05, u = 2, a sample of 52 subjects per group was required to obtain a power of 0.80 (Cohen, 1969). Each race and category of education was allocated at least a minimum sample size of 52. As for religion and age, four major religions (Islam, Buddha, Hindu and Christian) and four categories of age (18 to 29, 30 to 39, 40 to 54 and ≥ 55 years) were compared. In order to have a medium effect size (f = 0.25) at P = 0.05, u = 3, a sample of 44 subjects per group was required to obtain a power of 0.80 (Cohen, 1969). Each religion and category of age needed at least a minimum sample size of 44. A t-test was carried out on attitudes across gender. Again, in order to have a medium effect size (d = 0.50) at P = 0.05, a sample of 64 subjects per group was required to obtain a power of 0.80 (Cohen, 1969). Each gender was allocated a minimum sample size of at least 64.

Instrument

The multi-dimensional instrument measuring specific attitudes to modern biotechnology applications used in this study was constructed based on the work of earlier research (Gaskell et al., 2000; Macer, 2000; Rohrmann, 1994; Kirk et al., 2002) and validated in an earlier study (Latifah et al., 2004). The instrument measuring attitudes towards GM insulin incorporated six dimensions or factors: familiarity; perceived benefits; perceived risks; encouragement; moral concerns; and risk acceptance. Each dimension or factor comprised of several items measured on seven point Likert scales.

The total six factors were able to account for the majority of the variances in attitude responses (72.7%), indicating that, it is a good instrument that can measure attitudes towards biotechnology. A multivariate analysis by Pardo et al. (2002) on the four factors included the widely used Eurobarometer instrument (Gaskel et al., 2000) which only showed a total of about 38.3% variance in attitude responses. A closely-related study by Marris et al. (1996) on factors predicting risk perception (which include familiarity and other risk aspects) found that the combined factors were able to explain 50% of the variances among his respondents. Another study by Kirk et al. (2002) showed that the two main components of risk perception towards food safety (dread and familiarity) accounted for 43% of the variation in responses. Table 2 shows the results of principal component factor analyses using varimax rotation. This rotation yielded meaningful item groupings or dimensions with strong unambiguous loadings. The entire factor loading values was either equal to or greater than 5.0, which can be considered as more significant (Hair et al., 1992). The first factor or dimension clearly reflected the beneficial aspects of biotechnology and was named as perceived benefits. Five items strongly loaded highly on it. The second dimension with five items also strongly loaded on it was labelled as perceived risk. Four items were salient to the third factor and labelled as encouragement. Another four items loaded heavily on the fourth factor and were interpreted as familiarity. The fifth factor, which was made up of another three items, appeared to relate to moral aspects and was called moral concerns. Another three items were strongly loaded on to the sixth factor which represented the acceptance of the risks related to biotechnology applications. Hence, this dimension was named risk acceptance. Cronbach's coefficient alpha was used to calculate the reliability of all six dimensions and attitude items scales. As Table 2 shows, the standardised alpha coefficients of all dimensions were above 0.70, which can be considered as good (De Vellis, 1991).

Statistical analysis

Initially, reliability tests and confirmatory factor analysis were carried

Table 2. Factor loadings and Cronbach's alpha values for measurement scale of attitude towards GM Insulin.

Constructs and observed variables	Factor loading	α
Perceived benefit		0.91
Benefit to Malaysian society	0.80	
Enhance product quality.	0.80	
Enhance quality of life.	0.80	
Enhance Malaysian economy	0.77	
Benefits exceed risks	0.67	
Perceived risk		0.91
Feelings of anxiety	0.81	
Harm to health	0.84	
Long term effect	0.85	
Catastrophic potential	0.84	
Overall risk magnitude	0.65	
Encouragement		0.92
More rigorous R&D	0.79	
Should be commercialized	0.79	
Should be given monetary support by govt.	0.83	
Overall encouragement	0.80	
Familiarity		0.74
Easy to know	0.82	
Easy judgement	0.83	
Effect known	0.78	
Controllability	0.50	
Moral concern		0.82
Threaten natural order of things	0.78	
'Play god'	0.88	
Commodify life.	0.85	
Risk acceptance		0.80
Accept if it can boost Malaysian economy	0.74	
Societal acceptance	0.84	
Comparison with other risk	0.67	

out using SPSS version 12.0 to assess the consistency and unidimensionality of the constructs. ANOVAs were also carried out using the same statistical package to compare the differences in mean for attitude between respondents of different age, education level, religion and race, and a T-test was carried out to see the differences in the mean value for attitudes between the different genders. When ANOVAs showed significant differences, Post Hoc tests were then carried out to detect the differences between specific groups. Before running Post Hoc tests, tests of homogeneity of variances were employed to determine suitable Post Hoc tests. For variables with homogenous variances, Scheffe Post Hoc tests were chosen. On the other hand, for variables whose variances were not homogenous, Games-Howell Post Hoc tests were selected. The minimum significant level accepted in all ANOVAs and Post Hoc tests was 0.05.

RESULTS

Comparison of attitudes across religions

The respondents were not very familiar with GM insulin, with their familiarity ratings below the mid-point level of 4.0 (Table 3). Comparing the familiarity of GM insulin across religions, the Hindus led the groups on the familiarity aspects of GM insulin (mean score 3.80) (Table 3). ANOVA for the familiarity of GM insulin was significant ($F = 7.78$, $p < 0.001$). The Scheffe Post Hoc test showed that the Hindu's rating was significantly higher than the respondents from the other religions. The Muslims' rank-

Table 3. Attitude towards GM insulin across religions.

Attitude dimension	Mean score* ± Std dev.	Interpretation
Familiarity		
Islam	3.39 ± 1.26	Moderate
Buddha	3.27 ± 1.20	Moderate
Hindu	3.80 ± 1.22	Moderate
Christian	3.08 ± 1.10	Moderate
Perceived benefit		
Islam	4.39 ± 1.42	Moderate
Buddha	4.66 ± 1.18	Moderate
Hindu	4.47 ± 1.52	Moderate
Christian	4.74 ± 1.39	Moderate
Perceived risk		
Islam	4.58 ± 1.36	Moderate
Buddha	4.27 ± 1.20	Moderate
Hindu	4.62 ± 1.45	Moderate
Christian	4.43 ± 1.21	Moderate
Risk acceptance		
Islam	3.99 ± 1.31	Moderate
Buddha	4.23 ± 1.16	Moderate
Hindu	3.84 ± 1.56	Moderate
Christian	4.14 ± 1.34	Moderate
Moral concern		
Islam	3.77 ± 1.56	Moderate
Buddha	4.40 ± 1.50	Moderate
Hindu	4.53 ± 1.69	Moderate
Christian	4.43 ± 1.56	Moderate
Encouragement		
Islam	4.43 ± 1.54	Moderate
Buddha	4.55 ± 1.26	Moderate
Hindu	4.45 ± 1.61	Moderate
Christian	4.45 ±1.42	Moderate

* Mean score: 1 - 2.99 low, 3.0 - 5.0 moderate, 5.1 - 7.0 high; Std dev., Standard deviation.

ing on familiarity was the second highest (mean score 3.39). Their mean score was significantly lower than the Hindus.

The benefits, risks, risk acceptance and encouragement of GM insulin surveyed were perceived as moderate by respondents from all religions (Table 3). ANOVAs did not show any significant differences in their opinion at $p < 0.05$.

ANOVA was significant for moral concerns of GM insulin across religions ($F = 14.73$, $p < 0.001$). Muslims judged the moral aspects of GM insulin as the lowest and the Scheffe Post Hoc test confirmed that their ranking was significantly lower than respondents from other races.

Comparison of attitudes across races

Respondents from all races were not familiar with GM insulin. Their familiarity ratings were lower than the mid-point value of 4.0 (Table 4). ANOVA was significant for the familiarity of GM insulin across races ($F = 7.64$, $p < 0.001$). The Indians were more familiar with GM insulin compared to the Chinese and the Malays. The Scheffe Post Hoc test confirmed that the perceived familiarity of GM insulin was significantly different between the Indians and other races.

All races perceived moderate benefits of GM insulin (Table 4). ANOVA was significant for the perceived benefits of GM insulin across races. The Games Howell Post Hoc test showed that the Chinese were more familiar with GM insulin compared to the Malays and Indians.

The respondents perceived moderate risks of GM insulin (Table 4). ANOVA was significant for perceived risks of GM insulin ($F = 6.36$, $p < 0.01$) across races. The Games Howell Post Hoc test showed significant differences in the risk opinion of GM insulin by the Chinese compared to the Malays and Indians (Table 4).

The risk acceptance levels of GM insulin by respondents from all races were in the moderate range (Table 4). ANOVA was significant for risk acceptance of GM soybean across races ($F = 4.54$, $p < 0.05$). The Games Howell Post Hoc test showed that the Chinese acceptance of the risk associated with GM soybean was significantly higher than the Malays' and the Indians'.

All races perceived the moral aspects of GM soybean as moderate (Table 4). ANOVA was significant for the moral concerns of GM soybean across races ($F = 18.18$, $p < 0.001$). The Games Howell Post Hoc test showed that the Malays significantly showed the lowest concerns of the moral aspects of GM soybean, followed by the Chinese and the Indians. Respondents from the three races professed moderate encouragement for GM soybean (Table 4). Although the highest mean score for encouragement of GM soybean was scored by the Malays, ANOVA did not show any significant differences across races.

Comparison of attitudes across ages

The familiarity level of the respondents with GM insulin was below the mid-point value of 4.0 (Table 5). ANOVA was significant for the familiarity of GM insulin across ages ($F = 4.82$, $p < 0.01$). The Scheffe Post Hoc tests showed that the youngest age group surveyed (18 to 29 years) had a significantly higher familiarity with GM insulin compared to the oldest group (≥ 55 years).

Respondents from all age groups considered GM

Table 4. Attitude towards GM insulin across races.

Attitude dimension	Mean score* ± Std dev.	Interpretation
Familiarity		
Malay	3.38 ± 1.26	Moderate
Chinese	3.22 ± 1.16	Moderate
Indian	3.70 ± 1.24	Moderate
Perceived benefit		
Malay	4. 40 ± 1.42	Moderate
Chinese	4.76 ± 1.16	Moderate
Indian	4.42 ± 1.57	Moderate
Perceived risk		
Malay	4.57 ± 1.36	Moderate
Chinese	4.21 ± 1.16	Moderate
Indian	4.62 ±1.50	Moderate
Risk acceptance		
Malay	3.99 ± 1.31	Moderate
Chinese	4.25 ± 1.18	Moderate
Indian	3.85 ± 1.59	Moderate
Moral concern		
Malay	3.79 ± 1.57	Moderate
Chinese	4.31 ± 1.56	Moderate
Indian	4.46 ± 1.71	Moderate
Encouragement		
Malay	4.42 ± 1.54	Moderate
Chinese	4.62 ± 1.28	Moderate
Indian	4.35 ± 1.63	Moderate

*Mean score: 1 - 2.99, low; 3.0 - 5.0, moderate; 5.1 - 7.0, high; Std dev., standard deviation.

Table 5. Attitude towards GM insulin across ages.

Attitude dimension	Mean score* ± Std dev.	Interpretation
Familiarity		
18 - 29 years	3.50 ± 1.20	Moderate
30 - 39 years	3.27 ± 1.26	Moderate
40 - 54 years	3.33 ± 1.29	Moderate
≥ 55 years	2.86 ± 1.33	Low
Perceived benefit		
18 - 29 years	4.47 ± 1.39	Moderate
30 - 39 years	4.54 ± 1.33	Moderate
40 - 54 years	4.48 ±1.42	Moderate
≥ 55 years	4.21 ± 1.77	Moderate
Perceived risk		
18 - 29 years	4.48 ± 1.28	Moderate
30 - 39 years	4.43 ± 1.37	Moderate
40 - 54 years	4.55 ± 1.42	Moderate
≥ 55 years	4.73 ±1.60	Moderate
Risk acceptance		
18 - 29 years	4.07 ± 1.24	Moderate
30 - 39 years	4.05 ± 1.29	Moderate
40 - 54 years	4.00 ± 1.45	Moderate
≥ 55 years	3.60 ± 1.82	Moderate
Moral concern		
18 - 29 years	3.96 ± 1.49	Moderate
30 - 39 years	4.00 ± 1.68	Moderate
40 - 54 years	4.08 ± 1.73	Moderate
≥ 55 years	4.65 ± 1.64	Moderate
Encouragement		
18 - 29 years	4.51 ± 1.47	Moderate
30 - 39 years	4.46 ±1.47	Moderate
40 - 54 years	4.39 ± 1.53	Moderate
≥ 55 years	4.16 ±1.83	Moderate

* Mean score: 1 - 2.99 low; 3.0 - 5.0, moderate; 5.1 - 7.0, high; Std dev., standard deviation.

insulin as having moderate moral concerns (Table 5). ANOVA showed significant differences in the moral aspects of GM insulin across ages ($F = 2.74$, $p < 0.05$). The Scheffe Post Hoc test confirmed that the youngest group of respondents perceived lower moral concerns than the oldest group with respect to GM insulin. GM insulin was perceived as having moderate benefits, risks, risk acceptance and encouragement by the respondents from all age groups (Table 5). ANOVAs did not show any significant differences across ages for the four dimensions of attitude.

Comparison of attitudes across education

The mean scores for those surveyed indicated that respondents from all categories of education were not familiar with GM insulin (the mean scores were below the mid-point value of 4.0) and ANOVA did not show any significant differences in their ratings across education levels.

A moderate level of perceived risks and moral concerns were professed by the three groups of respondents based on education levels (Table 6). When ANOVAs were carried out, the results showed significant differences in their concerns towards the risks of GM insulin ($F = 11.17$, $p < 0.001$) and moral concerns ($F = 3.97$, $p < 0.05$). The Scheffe Post Hoc test reflected the

Table 6. Attitudes towards GM insulin across education levels.

Attitude dimension	Mean score* ± Std dev.	Interpretation
Familiarity		
Secondary	3.46 ± 1.38	Moderate
Diploma/pre-University	3.33 ± 1.16	Moderate
Tertiary	3.38 ±1.21	Moderate
Perceived benefit		
Secondary	4.41 ± 1.29	Moderate
Diploma/pre-University	4.18 ± 1.47	Moderate
Tertiary	4.65 ± 1.43	Moderate
Perceived risk		
Secondary	4.69 ± 1.30	Moderate
Diploma/pre-University	4.72 ± 1.27	Moderate
Tertiary	4.29 ± 1.40	Moderate
Risk acceptance		
Secondary	4.03 ± 1.29	Moderate
Diploma/pre-University	3.91 ± 1.28	Moderate
Tertiary	4.09 ± 1.41	Moderate
Moral concern		
Secondary	4.15 ± 1.61	Moderate
Diploma/pre-University	4.23 ± 1.46	Moderate
Tertiary	3.90 ± 1.66	Moderate
Encouragement		
Secondary	4.43 ± 1.48	Moderate
Diploma/pre-University	4.16 ± 1.51	Moderate
Tertiary	4.60 ± 1.51	Moderate

*Mean score: 1 - 2.99, low; 3.0 - 5.0, moderate; 5.1 - 7.0, high; Std dev., standard deviation.

significant differences in the opinion of the degree holders towards the perceived risks of GM insulin compared to those with lower levels of education. The degree holders seemed to be less concerned with the risks of GM insulin. Although the degree holders tended to be less concerned with the moral aspects of GM insulin (mean score lower, Table 6) compared to those with lower levels of education, Post Hoc tests could not detect the differences.

The respondents perceived a moderate level of benefits; moderately accepting the risks associated with GM insulin and was moderately encouraging of it. ANOVAs were significant for perceived benefits and encouragement, but not for risk acceptance across education levels. The Games Howell Post Hoc test showed that the respondents with a degree level of education or higher was inclined to see more benefits of GM insulin. The Scheffe Post Hoc test confirmed that they were also more encouraging of GM insulin compared to those with only a diploma/pre-university level of education.

Comparison of attitudes across gender

Both the male and female respondents were not familiar with GM insulin (mean score below the mid-point level of 4.0) and rated five attitudinal dimensions (perceived benefits, perceived risks, moral concerns, risk acceptance and encouragement) as moderate (Table 7). In order to compare differences in attitudes across gender, T-tests were carried out. The results of the T-tests showed that the males perceived less risks ($t = -2.27$, $p < 0.05$) and saw more benefits of GM insulin ($t = 2.62$, $p < 0.01$) compared to the females. However, both genders were more in agreement in their opinion on the familiarity, moral aspects, risk acceptance and encouragement of GM insulin.

DISCUSSION

Ethnicity is referred to as shared origins and culture (Loustaunau and Sobo, 1997). Therefore, ethnicity or race formulates a cultural/social network. In Malaysia, religion is almost synonymous with race, though there are exceptions of the same religion but different races. The majority of Malays are Muslims, Chinese are Buddhists, and Indians are Hindu, so in the following discussion they will be treated as such. The Chinese/Buddhists and the Malays/Muslims were found to be more positive towards modern biotechnology compared to the Indians/Hindus. The Chinese/Buddhists rated the risks associated with GM insulin as the lowest, the most accepting of its risks and the most encouraging of its application. On the other hand, the Malays/Muslims rated the moral aspects of GM insulin as the lowest. Although the Indians/Hindus claimed to be the most familiar with GM insulin compared to the other races/religions, their ratings of the other attitude variables were lower than the above two races/religions but the mean scores were still within the moderate levels. Differences in some dimensions of attitude towards GM insulin across religions and races are supported by earlier theory and studies. According to the cultural approach of risk research, the evaluative process of risk perception is determined by the norms, value systems and cultural idiosyncrasies of societies or societal groups (Rohrmann, 1994). Macer et al. (2000) also noticed that there was diversity of opinion and reasoning across different cultures. Lorence et al. (2006) reported an association between race and health information-seeking behaviour while Tucker et al. (2006) found that white respondents tended to perceive lower levels of perceived food risks compared to non-white respondents. More in-depth study is needed to understand these differences in attitudes across religions and races.

Table 7. Attitude towards GM insulin across gender.

Attitude dimension	Mean score ± Std dev.	t-value	Significance
Familiarity			
Male	3.38 ± 1.29	0.42	0.675
Female	3.41 ± 1.21	-	-
Benefit			
Male	4.61 ± 1.39	2.62	0.009**
Female	4.37 ± 1.41	-	-
Risk			
Male	4.40 ± 1.38	-	0.024*
Female	4.59 ± 1.33	2.27	-
Risk acceptance			
Male	4.12 ± 1.32	2.11	0.036*
Female	3.94 ± 1.36	-	-
Moral concern			
Male	3.99 ± 1.69	-	0.575
Female	4.05 ± 1.54	0.56	-
Encouragement			
Male	4.54±1.52	1.78	0.076
Female	4.37±1.50		

***p < 0.001, **p < 0.01, *p < 0.05, Std dev., standard deviation.

Younger respondents (18 to 29 years) were found to have more familiarity with GM insulin compared to the older groups. This could be due to the fact that the younger generation were either still studying in universities or just beginning their career, where they were more likely to be involved in information seeking. Lorence and Park (2006) reported that younger participants (18 to 29) exhibited the highest rates in the use of the internet. Although, the younger respondents claimed to be more familiar with GM insulin, there were no significant differences in their attitude towards GM insulin except for the dimension and moral concerns. The younger subjects seemed to see lower moral aspects of the three modern biotechnology applications, compared to older respondents. Lin et al. (2004), Hossain et al. (2002), and Chern and Rickertsen (2002) also found that age does not have a statistically significant effect on the acceptance of selected biotech foods.

Education has a significant impact on attitudes towards GM insulin. ANOVA showed some indications that respondents with higher education tended to be more positive about GM insulin. The subjects with a tertiary level of education seemed to perceive lower risks and moral concerns associated with GM insulin and were more encouraging of its applications compared to those with a lower level of education. Although ANOVAs were not significant, the mean scores for perceived benefits and risk acceptance of GM insulin were also higher for the respondents with a tertiary education compared to those with lower education levels. The Eurobarometer 52.1 survey (INRA (Europe) – ECOSA, 2000) also reported an increase in the mean score for the item beneficial aspect and risk acceptance of GM food with an increase in the level of education. On the other hand, there was a decrease in the mean score for the items related to risk (GM food causes great alarm and GM food is simply not necessary) and items related to moral concerns (GM food threatens the natural order of things and even if GM food has an advantage, it is basically against nature). In a more recent study, Tucker et al. (2006) found that respondents with higher levels of education tended to perceive lower levels of perceived risk. The positive effect of a higher education level could be due to more exposure to the culture and power of science, as suggested by Priest (2000).

Although there was no significant difference in the familiarity towards GM insulin across gender, males were found to be less critical with a significantly lower risk rating, higher benefits and higher risk acceptance of GM insulin compared to females. Gender has been strongly associated with risk judgement and attitude (Slovic, 2004). Many studies have found that men tend to judge risks as smaller as and less problematic than women (Brody, 1984; De Joy, 1992; Sjoberg and Drotz-Sjoberg, 1994). Women were found to be more concerned about human health and safety because they are socialised to nurture and maintain life (Sterger and Witte, 1989). On the other hand, Slovic (2004) proposed that, the reason why women see the world as more dangerous is because, in many ways, they are more vulnerable and they have less power and control over what happens in their communities and their lives. However, both genders were more in agreement in their opinion of the moral aspects and encouragement of GM insulin. Hossain et al. (2002) and Chern and Rikertsen (2002) found no effect of gender on the acceptance of biotech food while Lin et al. (2004) found a low impact of gender on only one biotech product (livestock products fed with biotech corn) but no effect of gender on the other three biotech products surveyed (biotech soybean oil, input-trait biotech rice and neutraceutical biotech rice).

Conclusion

The empirical results of this study indicate that background variables such as religion, race, age, education level and gender have significant effect on some of the dimensions of Malaysians' attitudes towards modern biotechnology. These differences should be taken into consideration constructively rather than negatively by the government policy makers and regulators to understand the social construct of public attitudes towards the application of gene technology in medicine. More in-depth empirical studies should be carried out to understand the underlying causes behind the differences so that appropriate measures can be confidently introduced to address the issues on what is lacking and what needs further improvement.

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