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Effect of Education Level and Religion on Attitude to Stem Cells in Malaysia

Kesan Tahap Pendidikan dan Agama ke atas Sikap terhadap Sel Stem di Malaysia

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ABSTRACT

The issue of using stem cells derived from human embryos and adult tissues to treat diseases has been divisively debated mainly due to ethical concerns. The objective of this article was to assess and compare the attitude level of the Malaysian public in the Klang Valley region towards human adult stem cells (hASCs) and human embryonic stem cells (hESCs). Results of the survey on 509 adult respondents revealed that the Malaysian public expressed higher support for hASCs, perceived the application as having lower moral concern and more acceptable by their religion as compared to hESCs. Univariate analysis following Multivariate Analysis of Variance (MANOVA) confirmed that there were significant differences for perceived benefits and religious acceptance of hASCs across education level. Respondents who hold tertiary education level tended to perceive both hESCs and hASCs as more beneficial and believed the applications as more acceptable from their religious point of view. Their opinion of hASCs differed significantly compared to the respondents who hold pre-university education. Respondents from all religions perceived both hESCs and hASCs as having moderate benefits and risks. Significant differences were only detected for perceived moral concerns and encouragement of hESCs across religion. The Christians expressed greater moral concern of both hESCs and hASCs compared to other religions but post hoc test only detected significant difference in their opinion on hESCs from the Buddhists. The Buddhists were found to be more supportive towards both hESCs and hASCs but their support level for hESCs only differed significantly from the Muslims.

Keywords: Attitude; stem cells; education level; religion; Malaysia

ABSTRAK

Isu penggunaan sel stem yang diperolehi dari embrio dan tisu dewasa manusia untuk merawat penyakit telah dibahaskan akibat kebimbangan masyarakat terhadap aspek etika. Tujuan utama kajian ini adalah untuk menilai dan membandingkan sikap orang awam di Lembah Klang, Malaysia terhadap penggunaan sel stem dewasa manusia (hASCs) dan sel stem janin manusia (hESCs). Hasil survei ke atas 509 responden mendapati masyarakat Malaysia telah menyatakan tahap sokongan yang lebih tinggi terhadap hASCs dan berpandangan bahawa aplikasi yang melibatkan hASCs mempunyai tahap kebimbangan moral yang lebih rendah dan lebih diterima oleh agama berbanding hESCs. Analisis univariat susulan dari MANOVA mengesahkan bahawa terdapat perbezaan yang signifikan bagi faedah dan penerimaan agama hASCs berdasarkan tahap pendidikan. Responden yang memiliki tahap pendidikan yang lebih tinggi cenderung untuk melihat kedua-dua hESCs dan hASCs sebagai lebih berfaedah dan berpandangan bahawa kedua-dua aplikasi lebih diterima dari sudut agama. Persepsi mereka terhadap hASCs berbeza secara signifikan berbanding responden yang hanya memiliki pendidikan pra-universiti. Responden dari semua agama menganggap kedua-dua hESCs dan hASCs sebagai mempunyai tahap faedah dan risiko yang sederhana. Perbezaan yang signifikan hanya dikesan bagi kebimbangan moral dan galakan hESCs dari sudut agama. Responden beragama Kristian telah melahirkan kebimbangan moral yang lebih tinggi terhadap hESCs dan hASCs dan pandangan mereka terhadap hESCs berbeza secara signifikan berbanding responden beragama Buddha. Responden beragama Buddha amat menyokong kedua-dua hESCs dan hASCs tetapi tahap sokongan mereka terhadap hESCs berbeza secara signifikan dengan responden beragama Islam.

Kata kunci: Sikap; sel stem; tahap pendidikan; agama; Malaysia

INTRODUCTION

Tissues for the purpose of transplantation to treat human diseases or damaged tissue area could be derived from stem cells which are a group of undifferentiated cells that have a potential to develop into specialized or differentiated cell in the body (National Institutes of Health 2009, Martínez-Morales et al. 2013). These group of undifferentiated cells can be further classified according to their differentiation potential known as cell potency. There are five degree of stem cells potency which are totipotent (omnipotent), pluripotent, multipotent, oligopotent and unipotent. Where totipotent is a group of stem cells that can differentiate into embryonic and extraembryonic cell types, pluripotent is a group of stem cells that are the descendants of totipotent cells and can differentiate into nearly all cells while multipotent is a group of stem cells that can differentiate into only limited number of cells that are close to their family (Schöler 2007).

Besides cell potency, stem cells also can be classified according to where they are obtained. In accordance to this criteria, two types of stem cells correspond to human cells.These are human embryonic stem cells (hESCs) retrieved from embryo (isolated from the inner cell mass of blastocysts) and human adult stem cells (hASCs) retrieved from various tissue in human (for example bone marrow) (Schöler 2007, Ratajczak et al. 2007). hESCs were first obtained as early as 1998 by retrieving them from the inner cell mass of the blastocyst. Having pluripotent properties, these cells are regarded as an optimal cell source for cell-replacement therapies (Thomson et al. 1998). Meanwhile, hASCs or somatic stem cells exist throughout the body after embryonic development and are found in different tissues such as the brain, bone marrow, blood, liver, heart, ovarian epithelium and testis (National Institutes of Health 2009). Most of hASCs are multipotent, meaning that they can only differentiate into limited number of cells that are close to their type (Schöler 2007). This limited feature has made hASCs as less favorable option for cell-replacement therapy as compared to hESCs (Thomson et al. 1998). However, nowadays scientists are opting to reprogram adult somatic cells so that they will have the same properties as embryonic stem cells; the technique is called induced pluripotent stem cells or iPSCs, through the introduction of embryonic genes. If accomplished, a source of pluripotent cells can be generated for a specific individual, thus increasing the chance of compatibility for tissue transplant and regeneration (National Institutes of Health 2009).

Stem cell research is improving from time to time and they may soon become useful for treating diseases such as Parkinson's disease, diabetes, and heart disease. It was reported in November 2013 that The National Health Security Office (NHSO) of Thailand will begin to treat patients with leukemia and lymphoma disease by using the stem cell transplantation in an attempt to improve patient care and at the same time to reduce the operational expenses. Whereas in Malaysia, the application is still being regulated and overseen cautiously before it can be fully carried out throughout the nation. When speaking at the country's first national stem cell congress in 2012, the former health minister said that it is necessary for the Malaysian scientists and clinicians to gather enough scientific evidence before the therapies or medicine are put into clinical use (Yang 2012).

Despite their potential to combat diseases, the issue surrounding stem cells are still being discussed intensely among the public worldwide. The embryonic stem cell is regarded by some parties as controversial due to the extraction of the cell line from the embryo; a procedure which could risk the embryo itself. Those who disagree with the application may argue that preimplantation ex utero human embryos should be accorded equal moral status to fully developed humans (Hudson et al. 2005, American Academy of Pediatrics 2012). Those who disagree that human embryo have lesser moral status may argue that they have no moral status since they lack relevant characteristics, such as sentience or ability to feel pain, and instead placing their moral status hierarchy along with other biologically alive entities like nonhuman animals (American Academy of Pediatrics 2012). Furthermore, the ethical issues associated with haematopoietic stem cell transplantation can be classified into four categories which are the source of the stem cells, the procurement, the use and the systems (Sugarman 2012).

Attitude towards the use of hESCs in medical treatment along with research related to it seems to vary across different countries. Previously, Australian and European studies have suggested that the attitude towards stem cell research is negatively correlated with low level of awareness (engagement) and high level of religiosity (Gaskell

TABLE 1. Background of the Respondents

Background	Frequency	Percentage	Background	Frequency	Percentage
Stakeholder group			Age		
Producers	40	7.9	18-25 years old	181	35.6
Scientists	50	9.8	26-40 years old	231	45.4
Policy makers	32	6.3	≥41 years old	97	19.1
NGOs	36	7.1			
Media	46	9.0			
University students	41	8.1	Race		
Islamic scholars	34	6.7	Malay	275	54.0
Buddhists scholars	33	6.5	Chinese	111	21.8
Christian scholars	31	6.1	Indian	97	19.1
Hindu scholars	36	7.1	Sabah natives	8	1.6
Consumer	130	25.5	Sarawak natives	9	1.8
			Others	9	1.8
Gender					
Male	244	47.9			
Female	265	52.1	Religion		
			Muslim	290	57.0
Education level			Buddhist	85	16.7
Secondary schools	77	15.1	Hindus	73	14.3
Diploma/pre-university	111	21.8	Christian	58	11.2
University	318	62.5	Others	3	0.8
Others	3	0.6			

et al. 2010; Critchley et al. 2013). The Australian public were found to be more likely to support research using iPSCs than hESCs, suggesting that the public is not entirely comfortable with the use of embryonic material (Critchley et al. 2013). Meanwhile, the Eurobarometer conducted in 2010 revealed that those who say they are a member of one of Europe's major religious denominations are less less supportive of hESC research, and more likely to support governance based on ethics rather than science (Gaskell et al. 2010). Moreover, moral acceptability of hESCs seems to be proportional with the level of education of the participants. Those with postgraduate degrees tend to perceive higher moral acceptability compared to those with less advanced college background and those with a high school education (Saad 2006). Those with a college degree or higher were also found to be supportive to hESCs research as those with no college degree (Hudson et al. 2005, Evans & Kelley 2011).

Meanwhile in Malaysia, Mathana Amaris Fiona & Siti Nurani (2016) reported ethical dilemmas emerged from the Embryonic Stem Cell Research (NHSO) may include sanctity of life, do no harm or *ahimsa* prohibits all acts of violence, and the 'intention' of the stem cell research. The study also found the 'intention' of the research as a viable determinant that would permit NHSO among the Buddhists and Hindus whereas the Catholics oppose NHSO based on the inviolability of human life (Mathana Amaris Fiona & Siti Nurani 2016). The study is however limited on investigating the ethical views of three religious leaders in Malaysia (Buddhist, Hindu and Catholic leaders) and other factors such as education level is also interesting to be explored as previous studies also found its noteworthiness on shaping the public support towards stem cell research (Hudson et al. 2005, Saad 2006, Evans & Kelley 2011). Thus the objective of this research is to assess and compare the attitudes of the Malaysian public in the Klang

TABLE 2. Measurement Scales and Reliability (hESCs)

Factor	Items	Standardized factor loading	Corrected item-total correlated	α
Perceived Benefits	Enhance quality of life	0.65	0.52	0.75
	Future research will deal with existing danger	0.60	0.41	
	Ought to be regulated by the government	0.73	0.51	
	Solve problems that cannot be solved by the traditional method	0.75	0.55	
	Benefits exceed risks	0.57	0.58	
Perceived Risks	Worry of risk to health	0.70	0.61	0.88
	Feeling of anxiety	0.71	0.67	
	Long-term effect	0.76	0.65	
	Pose threat to future generation	0.78	0.72	
	May give rise to unknown consequences	0.77	0.69	
	Catastrophic potential	0.69	0.63	
	Overall risk magnitude	0.78	0.70	
Perceived Moral Concerns	Over the limit	0.70	0.63	0.78
	"Play god"	0.82	0.68	
	Reduce the status of living things to machines	0.69	0.53	
Religious Acceptance	Accepted by religion	0.80	0.72	0.84
	Accepted by customs	0.82	0.72	
Encouragement	Intensive research should be encouraged	0.80	0.70	0.87
	Should be commercialized	0.79	0.73	
	Should be given monetary support by government	0.84	0.78	
	Overall encouragement	0.74	0.63	
	Government's responsibility to ensure it is beneficial	0.67	0.66	

Valley region towards the use of both hASCs and hESCs as part of the biological material to treat human diseases or damaged tissue area. With the advancement of the stem cell research, this study aims to assess the current level of public attitude towards two different types of stem cells in accordance to their origin, hence in turn the finding could guide its development and regulation in this region.

MATERIALS AND METHOD

SURVEY DATA COLLECTION

The research data was collected by a survey on 509 adult respondents (above 18 years old) from various interest or stakeholders groups in the Klang Valley, Malaysia (Table 1). The Klang Valley region had been chosen as the targeted population as it is the centre of country's economic and social development as well as the respondents in this region meets the requirement of diverse background of the research. The minimum sample size required for each statistical analysis was considered since this study was quantitative in nature. Comparison of attitude across education levels (3 groups) and religions (4 groups) were carried out using one-way Multivariate Analysis of Variance (MANOVA). In order to have a medium effect size (f=0.25) at p=0.05, u=2, a sample of 52 subjects per education level group is required in order to obtain a power of 0.80, whereas a sample of 44 subjects per group is required under religion category (f=0.25 at p=0.05, u=3) (Cohen 1969).

TABLE 3. Measurement scales and reliability (hASCs).

Factor	Items	Standardized factor loading	Corrected item-total correlated	α
Perceived Benefits	Enhance quality of life	0.62	0.49	0.73
	Future research will deal the existing danger	0.75	0.41	
	Ought be regulated by the government	0.70	0.50	
	Solve problems that cannot be solved by the traditional method	0.60	0.54	
	Benefits exceed risks	0.47	0.54	
Perceived Risks	Worry of risk to health	0.78	0.62	0.87
	Feeling of anxiety	0.80	0.65	
	Long-term effect	0.70	0.66	
	Pose threat to future generation	0.70	0.67	
	May give rise to unknown consequences	0.75	0.65	
	Catastrophic potential	0.43	0.59	
	Overall risk magnitude	0.69	0.67	
Perceived Moral Concerns	Over the limit	0.70	0.69	0.79
	"Play god"	0.78	0.68	
	Reduce the status of living things to machines	0.73	0.55	
Religious Acceptance	Accepted by religion	0.69	0.65	0.79
	Accepted by customs	0.79	0.65	
Encouragement	Intensive research should be encouraged	0.77	0.64	0.86
	Should be commercialized	0.80	0.70	
	Should be given monetary support by government	0.82	0.76	
	Overall encouragement	0.74	0.63	
	Government's responsibility to ensure it is beneficial	0.66	0.63	

Prior to data collection, a set of questionnaire was distributed to the respondents by a group of trained enumerators. A brief introduction about the application of human stem cells were presented to the respondent and they were also allowed to ask a few questions to give them some overview of the study and to assure they understand the risks and benefits related to hASCs and hESCs as part of medical therapy to treat human diseases and damaged tissue.

INSTRUMENT

The multi-dimensional instrument measuring attitude towards stem cells in this study was constructed based on the earlier work (Latifah et al. 2013, 2014, 2015). The instrument included six dimensions of attitude towards stem cells consisting of the four dimensions used by the Eurobarometer surveys (Gaskell et al. 2000, 2003): perceived benefits, perceived risks, perceived moral concerns, and encouragement with an additional dimension i.e. religious acceptance (Kelley 1995, Nicholas 2000). The items listed in Table 2 and Table 3 were measured in 7-point Likert scales from the lowest to the highest level of agreement.

DATA ANALYSIS

Reliability (Cronbach's alpha) tests were carried out using SPSS version 20.0 to evaluate the consistency and uni-dimensionality of the constructs. Descrete statistics on average (mean score) and standard deviation of each factor, as well as One-way MANOVA were also carried out using SPSS version 20.0.

VALIDITY

Validity measure was assessed by the factor loadings. The standardized loadings of all items were greater than 0.5 except for 2 items for hASCs; benefits exceed risks (perceived benefits) and catastrophic potential (perceived risks), indicating a good validity (Hair et al. 2010) (Table 2 and 3).

RELIABILITY

Two reliabilities measured in this study are internal consistency (Cronbach's alpha) and corrected item-total correlation reliability. The Cronbach's alpha coefficients for the all constructs in this study were considered good (above 0.70) (Table 2 and 3). The corrected item-total correlations for all items in each dimension were considered good as well (correlation coefficients greater than 0.4) (Hair et al. 2010) (Table 2 and 3).

RESULTS

Attitude towards stem cells was analyzed based on five dimensions;perceived benefits, perceived risks, perceived moral concerns, religious acceptance, and encouragement. One-way MANOVA was performed to explore the effect of education levels and religions towards attitude to hESCs and hASCs. The variance-covariance matrices were found to be not homogenous ($p < .001$, Table 4) hence the Pillai's trace was utilised as recommended by previous researchers (Hair et al. 1998, Tabachnick & Fidell 2001, Pallant 2001). One-way MANOVA has detected significant differences of attitude towards hASCs across education levels and religions (Education level, Pillai's Trace = 0.056, $F = 2.837$, $p < 0.05$; Religion, Pillai's Trace = 0.062, $F = 2.084$, $p < 0.05$) (Table 5), however one-way MANOVA has only detected significant differences of attitude across religion for hESCs (Pillai's Trace = 0.065, $F = 2.192$, $p < 0.05$) (Table 5). Following MANOVA, the univariate ANOVA's with Bonferroni correction ($\alpha = 0.01$) was applied in order to circumvents the inflation of Type I errors (Tabachnick & Fidell, 2001). Univariate one-way ANOVA were significant for the perceived benefits ($F=8.424$, $p<0.01$) and religious acceptance ($F=7.952$, $p<0.01$) of hASCs across education level (Table 6), whereas significant differences were detected for perceived moral concerns ($F=4.445$, $p<0.01$) and encouragement ($F=3.991$, $p<0.01$) of hESCs across religion (Table 7). Post hoc test was carried out for the related factors following a significant of Univariate one-way ANOVA and the result is presented with in the following section.

PERCEIVED BENEFITS

Overall, the Malaysian perceived both hESCs and hASCs as beneficial. Both applications have their mean scores for perceived benefits above the mid-point of 4.0 (mean score of 4.43) (Table 8). Respondents who hold a tertiary education level was shown to have the highest level of perceived benefits towards both hESCs and hASCs (mean score of 4.54 and 4.55 respectively) as compared to other education levels (Table 8). Post hoc test confirmed that significant difference for perceived benefits exist between respondents who hold a tertiary education level and pre-university education for hASCs (Table 8).

Meanwhile, the Christians have the highest level of perceived benefits towards both hESCs and hASCs (mean score of 4.57 and 4.52) as compared to other religious denomination, however Univariate one-way ANOVA previously could not detect significant differences in the benefit ratings of hESCs and hASCs across religion (Table 9).

PERCEIVED RISKS

The Malaysian risk perception towards both hESCs and hASCs were considered as moderate and were about the same level (mean score of 4.18 and 4.20 respectively) (Table 8). Respondents who posess a pre-university education has predisposited both hESCs and hASCs with highest level of risks (mean score of 4.32 and 4.38 respectively) as compared to other education levels (Table 8).

Meanwhile, the Christian was shown to perceive both hESCs and hASCs as risky (mean score of 4.35 and 4.46 respectively) as compared to the Buddhist, Hindu and Muslim; Muslim has been shown to have the lowest level of perceived risk towards hESCs (mean score of 4.03) (Table 9). Univariate analysis could not detect any significant differences in the risk ratings of biobank for different both education levels and religious groups (Table 6 & 7).

TABLE 4. Box's M Test to Determine the Homogeneity of Variance-Covariance within the Attitude Variable across Education Level and Religion.

Category	Box's M	F	DF 1	DF 2	Sig.
Education level (hESCs)	93.223	3.041	30	175475.412	0.000
Education level (hASCs)	84.099	2.744	30	179451.810	0.000
Religion (hESCs)	86.725	1.875	45	151697.954	0.000
Religion (hASCs)	96.602	2.088	45	147451.479	0.000

*p<0.05

TABLE 5. One-way MANOVA to Determine Attitude towards Human Embryonic Stem Cells (hESCs) and Human Adult Stem Cells (hASCs) across Education Level and Religion.

Effect	Pillai's Trace	F	DF.h	DF.e	Sig.
Education Level (hESCs)	0.027	1.334	10	992	0.207
Education Level (hASCs)	0.056	2.837	10	988	0.002*
Religion (hESCs)	0.065	2.192	15	1488	0.005*
Religion (hASCs)	0.062	2.084	15	1482	0.009*

*p<0.05

TABLE 6. Univariate One-way ANOVA of Attitude towards Human Adult Stem Cells (hASCs) across Education Level

Dependent Variable	Main Effect	Type III Sum of Squares	D.F	Mean Square	F	Sig.
Perceived benefits	Education Level	15.558	2	7.779	8.424	0.000*
	Error	458.941	497	0.923		
	Total	474.499	499			
Perceived risks	Education Level	4.617	2	2.308	2.265	0.105
	Error	506.442	497	1.019		
	Total	511.058	499			
Perceived moral concerns	Education Level	8.812	2	4.406	2.829	0.060
	Error	774.003	497	1.557		
	Total	782.814	499			
Religious acceptance	Education Level	24.724	2	12.362	7.952	**0.000***
	Error	772.658	497	1.555		
	Total	797.382	499			
Encouragement	Education Level	11.309	2	5.654	4.413	0.013
	Error	636.792	497	1.281		
	Total	648.101	499			

*p<0.01

TABLE 7. Univariate One-way ANOVA of Attitude towards Human Embryonic Stem Cells (hESCs) and Human Adult Stem Cells (hASCs) across Religion

	Dependent Variable	Main Effect	Type III Sum of Squares	D.F	Mean Square	F	Sig.
hESCs	Perceived benefits	Religion	2.715	3	0.905	0.887	0.448
		Error	508.244	498	1.021		
		Total	510.959	501			
	Perceived risks	Religion	4.266	3	1.422	1.245	0.293
		Error	568.866	498	1.142		
		Total	573.131	501			
	Perceived moral concerns	Religion	21.669	3	7.223	4.445	0.004*
		Error	809.237	498	1.625		
		Total	830.906	501			
	Religious acceptance	Religion	9.722	3	3.241	1.743	0.157
		Error	925.921	498	1.859		
		Total	935.643	501			
	Encouragement	Religion	18.574	3	6.191	3.991	**0.008***
		Error	772.637	498	1.551		
		Total	791.211	501			
hASCs	Perceived benefits	Religion	0.784	3	0.261	0.275	0.844
		Error	471.883	496	0.951		
		Total	472.667	499			
	Perceived risks	Religion	6.344	3	2.115	2.084	0.101
		Error	503.177	496	1.014		
		Total	509.521	499			
	Perceived moral concerns	Religion	17.271	3	5.757	3.741	0.011
		Error	763.304	496	1.539		
		Total	780.575	499			
	Religious acceptance	Religion	8.675	3	2.892	1.831	0.141
		Error	783.320	496	1.579		
		Total	791.995	499			
	Encouragement	Religion	7.495	3	2.498	1.922	0.125
		Error	644.607	496	1.300		
		Total	652.102	499			

*p<0.01

PERCEIVED MORAL CONCERNS

When confronted with the moral aspects of stem cells, the Malaysian public were more concerned with the moral aspects hESCs (mean score of 3.80) than the moral aspects of hASCs (mean score of 3.75) (Table 8). Respondents who posess a pre-university education expressed greater concern to both hESCs and hASCs (mean score of 3.95 and 3.99 respectively) as compared to other education levels (Table 8). Univariate analysis however could not detect any significant differences in the moral ratings of hASCs across education levels (Table 6). The Christians meanwhile expressed greater concern to both hESCs and hASCs (mean score of 4.24) as compared to the Buddhists, Hindus and Muslims (Table 9). Post hoc test confirmed that their opinion regarding the moral concern of hESCs has differed significantly with the Buddhists (Table 9).

TABLE 8. Mean Scores and Post Hoc Test Results for Attitude towards Human Embryonic Stem Cells (Hescs) and Human Adult Stem Cells (Hascs) across Educational Level

Factors	hESCs (Embryonic)		hASCs (Adult)	
	Mean score ± Std. deviation	Interpretation*	Mean score ± Std. deviation	Interpretation*
Perceived benefits				
1. Secondary schools	4.22 ± 0.99	Moderate	4.32 ± 0.98	Moderate
2. Pre-university	4.26 ± 0.90	Moderate	4.13 ± 0.91[3]	Moderate
3. University	4.54 ± 1.04	Moderate	4.55 ± 0.97	Moderate
Overall	4.43 ± 1.01	Moderate	4.43 ± 0.97	Moderate
Perceived risks				
1. Secondary schools	4.14 ± 1.00	Moderate	4.12 ± 0.92	Moderate
2. Pre-university	4.32 ± 1.14	Moderate	4.38 ± 1.06	Moderate
3. University	4.15 ± 1.06	Moderate	4.15 ± 1.01	Moderate
Overall	4.18 ± 1.07	Moderate	4.20 ± 1.01	Moderate
Perceived moral concerns				
1. Secondary schools	3.69 ± 1.29	Moderate	3.76 ± 1.25	Moderate
2. Pre-university	3.95 ± 1.21	Moderate	3.99 ± 1.22	Moderate
3. University	3.79 ± 1.31	Moderate	3.66 ± 1.26	Moderate
Overall	3.80 ± 1.29	Moderate	3.75 ± 1.25	Moderate
Religious acceptance				
1. Secondary schools	3.90 ± 1.39	Moderate	4.08 ± 1.16	Moderate
2. Pre-university	3.66 ± 1.22	Moderate	3.65 ± 1.26[3]	Moderate
3. University	3.96 ± 1.41	Moderate	4.20 ± 1.26	Moderate
Overall	3.88 ± 1.37	Moderate	4.06 ± 1.26	Moderate
Encouragement				
1. Secondary schools	4.77 ± 1.14	Moderate	4.77 ± 1.14	Moderate
2. Pre-university	4.72 ± 1.16	Moderate	4.80 ± 1.10	Moderate
3. University	4.92 ± 1.31	Moderate	5.10 ± 1.14	High
Overall	4.86 ± 1.25	Moderate	4.99 ± 1.14	Moderate

*p<0.01

*1.00- 2.99, Low; 3.00-5.00, Moderate; 5.01-7.00, high; Post hoc test results showing significant differences at least $P < 0.05$ between the indicated group (numbered in superscript). Scheffe's test was carried out for perceived benefits and religious acceptance of hASCs following a significant test of MANOVA and Univariate one-way ANOVA; Code of educational level: [1]secondary schools, [2]pre-university, [3]university.

RELIGIOUS ACCEPTANCE

Overall, the Malaysian public believed that hASCs is more acceptable by their religion (mean score above the mid-point of 4.0) as compared to the hESCs (mean score below 4.0) (Table 8). Respondents who posess a pre-university education has scored the lowest mean score of religious acceptance for both hESCs and hASCs (mean score of 3.66 and 3.65 respectively) and post hoc test confirmed that their opinion for hASCs differed significantly with the respondents who hold a tertiery education (Table 8).

Moreover, the Christians have the lowest mean score of religious acceptance of hESCs and hASCs among four religions tested in this study (mean score below the mid-point value of 4.0, Table 9). Meanwhile, the Buddhists expressed the highest level of religious acceptance for both hESCs and hASCs (Table 9). These differences of opinion however do not differ significantly since univariate analysis could not detect any significant differences of the tested variable across religions (Table 7).

ENCOURAGEMENT

The overall mean score for encouragement of hASCs (4.99) by the Malaysian public was found higher than hESCs (maen score of 4.86) (Table 8). Across education level, the most supportive group for both hESCs and hASCs was found to be those who possess the tertiary education (mean scores of 4.92 and 5.10, respectively) (Table 8).

TABLE 9. Mean Scores and Post Hoc Test Results for Attitude towards Human Embryonic Stem Cells (Hescs) and Human Adult Stem Cells (Hascs) across Religion

Factors	hESCs (Embryonic)		hASCs (Adult)	
	Mean score ± Std. deviation	Interpretation	Mean score ± Std. deviation	Interpretation
Perceived benefits				
1. Muslim	4.41 ± 1.01	Moderate	4.42 ± 1.00	Moderate
2. Buddhist	4.51 ± 0.93	Moderate	4.43 ± 0.78	Moderate
3. Hindu	4.31 ± 1.06	Moderate	4.36 ± 1.09	Moderate
4. Christian	4.57 ± 1.04	Moderate	4.52 ± 0.97	Moderate
Perceived risks				
1. Muslim	4.21 ± 1.08	Moderate	4.13 ± 1.03	Moderate
2. Buddhist	4.03 ± 1.01	Moderate	4.29 ± 0.94	Moderate
3. Hindu	4.10 ± 1.01	Moderate	4.13 ± 0.97	Moderate
4. Christian	4.35 ± 1.18	Moderate	4.46 ± 1.04	Moderate
Perceived moral concerns				
1. Muslim	3.79 ± 1.33	Moderate	3.67 ± 1.29	Moderate
2. Buddhist	3.46 ± 1.09[4]	Moderate	3.61 ± 1.12	Moderate
3. Hindu	3.90 ± 1.23	Moderate	3.80 ± 1.19	Moderate
4. Christian	4.24 ± 1.30	Moderate	4.24 ± 1.21	Moderate
Religious acceptance				
1. Muslim	3.85 ± 1.38	Moderate	4.06 ± 1.22	Moderate
2. Buddhist	4.12 ± 1.34	Moderate	4.28 ± 1.23	Moderate
3. Hindu	3.96 ± 1.25	Moderate	4.05 ± 1.28	Moderate
4. Christian	3.60 ± 1.46	Moderate	3.78 ± 1.42	Moderate
Encouragement				
1. Muslim	4.74 ± 1.28[2]	Moderate	4.89 ± 1.16	Moderate
2. Buddhist	5.26 ± 1.12	High	5.20 ± 0.98	High
3. Hindu	4.77 ± 1.30	Moderate	5.02 ± 1.24	High
4. Christian	4.96 ± 1.17	Moderate	5.12 ± 1.10	High

These differences of support level however do not differ significantly since multivariate analysis and univariate analysis could not detect any significant differences of the tested variable across education levels (Table 5 & 6).

On the other hand, the Buddhists were found to be more supportive towards both hESCs and hASCs (mean scores of 5.26 and 5.20 respectively) as compared to other religious adherents (Table 9). Post hoc test confirmed that their support level towards hESCs has differed significantly with the Muslims (Table 9).

*1.00- 2.99, Low; 3.00-5.00, Moderate; 5.01-7.00, high; Post hoc test results showing significant differences at least $P < 0.05$ between the indicated group and numbered in superscript. Scheffe's test was carried out for perceived moral concerns and encouragement of hESCs following a significant test of MANOVA and Univariate one-way ANOVA; Code of religion group: [1]Muslim, [2]Buddhist, [3]Hindu, [4]Christian.

DISCUSSION

This study reveals the Malaysian public opinion towards human stem cells as part of the biological material to treat human diseases or damaged tissue area varies not only according to the intricate relationships between the attitude dimensions and demographic variables, but also according to the type of stem cells involved. The study found

that the Malaysian public has expressed higher support level for hASCs, while at the same time also believe that the application has lower level of moral concern and more acceptable by their religion as compared to hESCs (Table 8). This is due to the fact that the hESCs is regarded as more controversial than hASCs since it involves the extraction of the cell line from the embryo; a procedure which could risk the embryo itself. Therefore, those who probably disagree with the application may argue that human embryos should be accorded equal moral status to fully developed humans, and subsequently exhibit higher level of moral concern and less favored with the application (Hudson et al. 2005; American Academy of Pediatrics 2012). The survey in 2013 revealed that the Australian public were significantly more likely to support research using iPSCs (derived from hASCs) than hESCs, suggesting that the source of stem cells is important in terms of the level of public support and trust (Critchley et al. 2013). In addition, previous studies show that religiosity has an inverse relationship with support or overall attitude to human embryonic stem cells (Gaskell et al. 2010; Frewer et al. 1998; Bronfman et al. 2009; Evans & Kelley 2011; Liu & Priest 2009). As a conservative country, religion plays an important part in Malaysian's life and majority of them have claimed to to be highly religious (Latifah et al. 2011; House et al. 2004). Therefore, it is not surprising to see if majority of the public here agree that the stem cell research and application centered on hASCs are much more acceptable that hESCs.

Although the study has not emphasized the interrelationship of the factors in detail through in depth regression analysis such as the structural equation modeling, the causal of each factor can be observed and comparable with previous studies. For example, the overall mean scores of perceived benefits for both hESCs and hASCs (4.43) in this study is much higher than perceived risks (4.18 and 4.20 respectively) and perceived moral concerns (3.80 and 3.75 respectively) of both, suggesting that the public believed both application of human stem cells are still beneficial thus their support level towards them are the mid point (Table 8). This intricate balancing relationship of the attitudinal factors has been explained minutely by previous researchers (Gaskell et al. 2000; Pardo et al. 2002; Latifah et al. 2011; Latifah et al. 2014). It is also worth to mention that at some point, the Malaysian public tend to be critical upon expressing their views towards complex matter such as the use of human embryonic stem cells as a means of treatment. This has been well observed in this study; in spite of the fact that Malaysian public has expressed higher mean scores of perceived benefit and encouragement for hESCs, they are substantially critical when it comes to religious consideration of the application, and therefore believe the application is less acceptable and less favored by their religions (Table 8).

Other than type of stem cells and relationships between the attitude dimensions, this study also demonstrates the significant possibility of education level and religion in influencing the public attitude towards hESCs and hASCs. Univariate analysis following Multivariate Analysis of Variance (MANOVA) confirmed that there are significant differences exist for perceived benefits and religious acceptance of hASCs across education level (Table 6). Respondents who hold a tertiary education level tended to perceive both hESCs and hASCs as beneficial and believe the applications are acceptable from their religious point of view, and their opinion for hASCs differ significantly with the respondents who hold pre-university education (Table 8). There are not many previous studies that discuss the role of education level in shaping the religious acceptability of the public towards stem cells application, however moral acceptability seems to be proportional with the level of education of the participants. Those with postgraduate degrees tend to perceive higher moral acceptability compared to those with less advanced college background and those with a high school education (Saad 2006). Furthermore, those with a college degree or higher were also found to be supportive to hESC research as those with no college degree (Hudson et al. 2005, Evans & Kelley 2011). Higher education level also has been linked to a better public understanding on certain matters, for example environmental issues (Jamilah et al. 2011).

Meanwhile, significant differences were also detected for perceived moral concerns and encouragement of hESCs across religion (Table 7). The Christians expressed greater concern to both hESCs and hASCs and their opinion for hESCs differs significantly with the Buddhist (Table 9). Previous studies have found conservatives, white evangelical Christians, as well as those who attend religious services every week slightly oppose the idea of embryonic stem cell research

(Roberts 2005). Besides, those who agree that stem cell research is ethically wrong are the Muslims, Orthodox Christians and Catholics; while majority of the Muslims express their ethical objection to human embryonic stem cell research, about half of the Orthodox Christians and Catholics agree that embryonic stem cell research is ethically wrong (Gaskel et al. 2010). Moreover, the Europeans and the Americans with the least religious involvement were also found to be less in favor in believing that hESCs research should be forbidden (Gaskel et al. 2010; Blendon et al. 2011). The opposition towards the use of hESCs as a medical treatment was triggered because the opponents believed it involves taking away of an unborn human life (Saad 2006). However the results also contradict with the findings by Hudson et al. (2005) which reported more than two-thirds of Catholics approve or strongly approve of hESCs Research. On the other hand, the Buddhists were found to be more supportive towards both hESCs and hASCs and their support level for hESCs differed significantly with the Muslims (Table 9). Previous studies have shown that Muslims were less supportive towards technology compared to the Christians and Buddhists (Latifah et al. 2013). Muslim respondents in Europe were also less optimistic towards technology compared to the Christians (Gaskel et al. 2010).

CONCLUSION

This study concludes that the Malaysian public attitude towards hASCs was more positive compared to hESCs. Atthe same time they also believed that hASCs had lower moral concern and more acceptable by their religion as compared to hESCs. The study also reveals the Malaysian public opinion towards human stem cells (as part of the biological material to treat human diseases or damaged tissue area) varies not only according to the type of stem cells involved, but also according to the intricate relationships between the dimensions of attitude as well as demographic variables. Respondents who hold tertiary education level tended to perceive both hESCs and hASCs as more beneficial and believed the applications were more acceptable from their religious point of view, and their opinion to hASCs differed significantly from the respondents who only hold pre-university education. In addition, the Christian expressed greater concern to both hESCs and hASCs and their opinion for hESCs differed significantly from the Buddhist. Finally, the research finding serves as a useful benchmark to understand the social acceptance of two different types of human stem cell which are commonly used nowadays as a means of treatment and research.

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