The Allocation of a Scarce Medical Resource: A Cross-Cultural Study Investigating the Influence of Life Style Factors and Patient Gender, and the Coherence of Decision-making

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Abstract

This study examined how lifestyle factors and gender affect kidney allocation to transplant patients by 99 Britons and Singaporeans. Thirty hypothetical patients were generated from a combination of six factors (alcohol intake, smoking frequency, weight, exercise frequency, diet, and gender) and randomly paired four times. Participants saw 60 patient pairings and, in each pair, chose which patient would receive treatment priority. A Bradley-Terry model was used to derive coefficients for each factor per participant. A mean factor score (MFS) was then calculated across all participants for each factor. Participants gave lower priority to patients who drank more, were overweight, smoked more and exercised less. A patient's diet and gender had no significant effect on allocation. There were no significant cross-cultural differences. There were moderate correlations between participants' self-reported pre- and post-experiment ordering of decision criteria, and these measures and factor coefficients, suggesting a modest level of decision-making consistency. Between participants, moderate levels of concordance with respect to factor importance were observed for self-reported orderings of factors, and weaker agreement for model-derived coefficients. Very similar results were obtained for both British and Singaporean participants, and the implications of the findings are discussed.

Introduction

Medical resource scarcity has resulted in ethical dilemmas such as how and who to allocate donor organs for transplant. Allocation decisions are usually guided by two ethical theories – deontology and teleology. Egalitarianism is a popular deontological concept that emphasises equality in treatment – it focuses on the morality and intention behind decisions, regardless of the outcome. However, with scarce medical resources, one patient will be selected to receive a scarce resource over another patient. Conversely, utilitarianism is a well-known teleological concept that advocates a decision that results in the greatest benefit for the maximum number of individuals; it focuses on the outcome of actions rather than the actions themselves (Grover et al., 2020; Mandal et al., 2016; Persad et al., 2009). This means that a scarce medical resource should be allocated based on the patient's capacity to bring about the greatest benefit or happiness in society (Selvaraj et al., 2019).

Medical resource allocation is complex and challenging and other ethical principles beyond egalitarianism and utilitarianism have been considered. Just deserts is a third principle meaning 'that which one deserves', where people ascribe fairness based on the concept of proportionality (von Hirsch, 1990). Allocation based on reciprocity is congruent with the principle of just deserts. For instance, from a medical perspective, a common opinion is that patients with unhealthy lifestyle behaviours should be given lower priority for a treatment such as a transplant (Moss & Siegler, 1991). It relates to the idea that priority should be given to individuals who live responsibly, by adopting healthy lifestyle behaviours, that reduce their need for scarce medical resources (Persad et al., 2009). A recent study Nguyen Huynh et al. (2020) focussed exclusively on the impact of lifestyle on the allocation decisions for kidney dialysis, and concluded that lay participants prioritised patients who led healthy lifestyles (i.e. did not smoke, were of normal weight, exercised frequently and were not heavy drinkers) for kidney dialysis, which is consistent with the just deserts principle.

Using lifestyle factors, which supports the theory of just deserts, as allocation criteria has not been widely explored. Since the 1990s, studies on scarce medical resource allocations have primarily explored the effects of social factors and patient demographics. For instance, Engaging in voluntary work (Furnham et al., 2000) and even being better-looking (Selvaraj et al., 2019) increased the likelihood of being prioritised. Patients who were younger (Furnham & Briggs, 1993; Furnham, Thomson & McClelland, 2002; Furnham, et al., 2007; Gajre et al., 2018; Lenton, et al. 2006; Wiseman, 2007; Wong, 2019), married (Furnham & Briggs, 1993; Furnham et al., 2011), and had dependents (Furnham & Ofstein, 1997; Furnham, Thomson and McClelland, 2002; Wiseman, 2006; Wiseman, 2007) were prioritised for life-saving treatment.

However, more people are becoming increasingly aware of lifestyle factors as risk factors for health issues and potentially, the need for scarce medical resources. Nguyen Huynh et al. (2020) provided evidence that those who maintained their health responsibly should be prioritised in the event a scarce medical resource needs to be allocated. Hence, it is critical to further examine the role of a patient's lifestyles choices in ethical decision making.

Within-subject consistency in decisions

Another important aspect of ethical decision-making is the consistency of an individual's decisions. Internal consistency is a measure of the degree of variance in an individual's response to the same stimulus over time (MacDonald & Trafimow, 2013). One study by Holyoak and Simon (1999) on judicial decision-making required participants to rate their agreement with several pieces of information presented to them before and after evaluating a legal case. Changes in participants' agreement ratings were measured before and after they reached a verdict. The results showed that participants' ratings shifted after the case was assessed, suggesting that people do not necessarily commit themselves to a decision criterion before a decision is made. The decision criterion or criteria may also change throughout the decision-making process when more information is provided (Simon et al., 2001).

Wong (2019) explored this in the allocation of scarce medical resources and investigated whether participants' patient selections were consistent with their self-reported decision-making criteria. In his study, participants accessed the importance of each factor before and after the main task. The pre-experiment ratings were correlated with participants' main experiment factor coefficients derived from a Bradley-Terry model (Bradley & Terry, 1952) to obtain the pre-experiment correlation coefficients while the post-experiment rankings were correlated with factor coefficients to obtain post-experiment correlation coefficients. These correlation coefficients reflected the participants' consistency and results revealed that participants showed low to moderate consistency in their decisions.

Current study

This study investigates medical resource allocation criteria by laypeople from two countries and the coherence of their decisions, again using a Bradley-Terry model.

The first aim is to examine the effect of specific lifestyle factors on the allocation of donor kidneys. Kidney transplant was used as the scarce medical resource as it is the most common transplant procedure where allocations decisions typically have to be made (WHO, 2020). Six patient factors will be explored: smoking frequency, alcohol intake, weight, exercise frequency, diet choice and gender. The first four are lifestyle factors typically associated with health well-being and were previously investigated by Nguyen Huynh et al. (2020), but each factor was constrained to two levels. Several modifications will be made in this study to increase ecological validity. Alcohol intake will have three levels to distinguish between non-drinkers, occasional drinkers and excessive drinkers while both smoking and exercise will be based on the number of times the patient smokes and exercises each week. Using continuous variables will better reflect lifestyle behaviours that vary on a continuum, thereby increasing the ecological validity of the study.

The effect of diet choice, which has not been examined before, will be included since improving health is a possible reason for switching to a vegetarian diet (Radnitz et al., 2015). A combined systematic review and meta-analytic study reported that across 86 cross-sectional and 10 prospective cohort studies, vegetarians and vegans showed significantly lower body mass index, lower glucose levels, reduced risks of suffering and/or dying from ischemic heart disease and lower total incidence of different cancers (Dinu et al., 2017). Hence, with diet being viewed as an increasingly important lifestyle factor associated with health, the effect of patient diet will be investigated.

Lastly, the effect of patient gender will be re-investigated since previous studies have reported varying results. Females were mostly prioritised over males in studies investigating the allocation of kidney dialysis machines (Furnham, 1996; Furnham & Briggs, 1993; Furnham et al., 1998; Furnham et al., 2010; Furnham, Hassomal & McClelland, 2002) but gender had no effect in studies investigating the allocation of other resources such as liver transplant (Wong, 2019), heart transplant and HIV treatment (Furnham et al., 2007).

The second aim is to explore cross-cultural differences in allocation decisions, comparing how Singaporean and British citizens may differ when allocating kidneys to transplant patients. British and American participants were mainly used in previous studies and this study will be the first to recruit Asian participants. Different cultures have unique disease attribution systems and beliefs about the causal roles of the individual and the environment in the onset of disease, which influence healthcare decisions (Vaughn et al., 2009). Hence, as lifestyle factors that influence ethical decision-making vary across countries (Furnham, Hassomal & McClelland, 2002; Ip et al., 1998; Nguyen Huynh et al. 2020), it is critical to examine the cross-cultural differences in allocation decisions.

The third aim is to re-investigate the consistency of laypeople's decisions. In this study, the actual importance of patient factors derived from the model will be compared to the participants' self-reported ratings of factors to determine consistency in their decisions. We will also examine whether individuals are consciously aware of possible shifts in their criteria over the course of the decision-making process.

Use of a Bradley-Terry model

A pairwise comparison decision-making task will be used to investigate the effects of patient lifestyle factors and gender on the allocation of donor kidneys and the results analysed using a Bradley-Terry model. This model had been successfully employed in a recent liver transplant allocation study (Wong, 2019). It is a mathematical model that applies a logistic regression to the data obtained from repeated pairwise comparisons of items and produces a coefficient estimate, *z*-value, and probability for each manipulated factor (Bradley & Terry, 1952). A ranking ordering based on the importance of each factor can then be derived. This method has several advantages over the traditional methodology employed in the earlier studies by Furnham and colleagues, where participants ranked the patients in terms of treatment priority. The ranking method relied on participants' memory abilities to recall and rank all the hypothetical patients, each with a unique combination of lifestyle choices. As such, only four categorical patient factors were used as having more than four factors would make the experiment cognitively too demanding. The alternative pairwise method will thus be employed in the current study, where participants will be shown pairs of patients and have to choose who to prioritise for treatment. The Bradley-Terry model will then be applied to derive the relative importance of each patient factor in determining participants' allocation decisions.

Hypotheses

Four sets of hypotheses have been established; i) for the main effects of allocation criteria, ii) for the interactions between nationality and specific patient factors, iii) for the within-subject consistency, and iv) for between-participant concordance.

Main effects

H1a: Patients who have higher alcohol intake will be given lower priority for a kidney transplant.

H1b: Patients who smoke more frequently in a week will be given lower priority for a kidney transplant.

H1c: Patients who are overweight will be given lower priority for a kidney transplant.

H1d: Patients who exercise less frequently in a week will be given lower priority for a kidney transplant.

H1e: Patients who are non-vegans/non-vegetarians will be given lower priority for a kidney transplant.

H1f: The effect of a patient's gender on allocation decisions will be explored and a specific hypothesis has not been defined.

Interactions

H2a: There will be an interaction between smoking frequency and nationality, where the effect of smoking frequency on allocation decisions is larger in Singapore than in the UK due to lower smoking prevalence in Singapore[1].

H2b: There will be an interaction between alcohol intake and nationality, where the effect of alcohol intake on allocation decisions is larger in Singapore than in the UK due to lower drinking prevalence in Singapore[2].

Consistency

H3: There will be a moderate degree of consistency between the self-reported and actual importance of each patient factor in participants' allocation decisions.

Concordance

H4: There will be a moderate degree of concordance across participants with respect to pre- and post-experimental orderings of factor importance, and the factors derived from the Bradley-Terry model.

Method

Participants

One-hundred and sixty-six participants were recruited either through opportunity sampling or the UCL Subject Pool system (SONA). Forty-six participants were excluded for not completing the experiment, which could be due to the large number of trials (ie. 60 trials) during the experimental task. Six were excluded as they were not British or Singaporean. Eight were excluded as more than half of their trials were completed in less than one second each, and seven were excluded for having at least one trial over four minutes, which suggested that they may have been making random selections during each trial or may not have been paying attention to the experimental task. Of the 99 remaining participants, 62 were female and 37 were male, aged between 18 and 66 years old, with a mean age of 29.01 years (*SD* = 13.15). The British sample consisted of 37 participants, 27 females and 10 males, aged between 18 to

66 years old, with a mean age of 24.24 years (*SD* = 11.63). The Singaporean sample consisted of 62 participants, 35 females and 27 males, aged between 18 and 58 years old, with a mean age of 31.85 years (*SD* = 13.27)[3]. All participants gave consent to participate in this study which has ethical approval from the UCL Department of Experimental Psychology Ethics Committee.

Stimuli

The study was created on Gorilla Experiment Builder (https://gorilla.sc/), a platform developed to design and conduct behavioural studies online (Anwyl-Irvine et al., 2019). The stimuli consisted of the descriptions of 30 hypothetical patients, each requiring a kidney transplant due to kidney failure (see Appendix A). The attributes of each patient were generated based on a unique combination of six factors (see Table 1). Due to software limitations, it was not possible to generate different random patient pairings for each participant. Instead, the 30 hypothetical patients were randomly paired four times to form two sets of 60 patient pairings. Participants were then randomly assigned to one of two groups, each with a different set of 60 pairs. Within each set, the information about each patient was displayed twice on the left-hand and twice on the right-hand side of the screen.

Insert Table 1 here

Procedure

Participants were told that they will be shown pairs of hypothetical patients who are suffering from kidney failure and had to select the patient to receive priority for a kidney transplant based on six patient factors. Each factor was explained to participants (e.g., “patients are either normal weight or obese”). It was made known that other than these six factors, patients did not have any other comorbid health issues, had a similar chance of benefitting from the transplant, and had been on the transplant waiting list for a similar length of time. Participants were randomly assigned to either Group 1 (n = 51) or Group 2 (n = 48), each presented with one of the two sets of 60 pairs. Participants completed a pre-experiment questionnaire where they had to rate, on a 1 to 10 Likert scale, how important each factor was in determining a patient's priority for a kidney transplant. On each trial, participants saw a description of a pair of patients and selected which patient to prioritise for a kidney transplant. Each participant completed 60 trials which were presented in random order. The participants then completed a post-experiment questionnaire, ranking the factors from the most to least used in determining their decisions. Participants were debriefed with respect to the aims of the study.

Results

Bradley Terry Model

The primary analysis involved fitting the Bradley Terry Model from the BradleyTerry2 package in R to the pairwise comparison data for each participant (Turner & Firth, 2012). A logistic regression was applied to obtain a coefficient estimate and *z*-value for each factor per participant. As standardized coefficient estimates were not available in the model output, the *z*-values which measure the ratio between the estimates and their standard errors were used as a proxy measure of the importance of each factor in the allocation decisions[4]. A mean factor score (MFS) was calculated from the *z*-values for each factor across all participants (see Table 2). Values close to 0 indicated that the predictor had a small effect on the allocation decision.

Insert Table 2 here

t-tests

One-sample *t*-tests were conducted on each MFS to investigate if the factor was a significant predictor of allocation decisions across the total sample and within the British and Singaporean samples separately. In addition, two-sample *t*-tests were conducted for each factor to test for significant differences between the British and Singaporean samples.

Alcohol intake

Overall, the alcohol intake of the patient was a significant predictor of transplant priority, with patients who drank more given lower priority, $t(98) = 8.27$, $p < .001$, $d = 0.83$. This was true in both the British sample, $t(36) = 4.84$, $p < .001$, $d = 0.80$ and the Singaporean sample, $t(61) = 6.67$, $p < .001$, $d = 0.85$. There was no significant difference between the British and Singaporean samples, $t(97) = 0.38$, $p = .970$, $d = 0.01$.

Smoking frequency

Overall, the smoking behaviour of the patient was a significant predictor of transplant priority, with patients who smoked more frequently per week being given lower priority, $t(98) = 10.55$, $p < .001$, $d = 1.06$. This was true in both the British sample, $t(36) = 6.12$, $p < .001$, $d = 1.01$, and the Singaporean sample, $t(61) = 8.54$, $p < .001$, $d = 1.08$. There was no significant difference between the British and Singaporean samples, $t(97) = 0.42$, $p = .675$, $d = 0.09$.

Weight

Overall, the weight of the patient was a significant predictor of transplant priority, with patients who were overweight given lower priority, $t(98) = 5.29$, $p < .001$, $d = 0.53$. This was true in both the British sample, $t(36) = 4.25$, $p < .001$, $d = 0.70$ and the Singaporean sample, $t(61) = 3.52$, $p = .001$, $d = 0.45$. There was no significant difference between the British and Singaporean samples, $t(97) = 0.76$, $p = .447$, $d = 0.16$.

Exercise frequency

Overall, the amount of exercise the patient engaged in was a significant predictor of transplant priority, with patients who exercised less frequently per week given lower priority,

$t(98) = 5.93$, $p < .001$, $d = 0.60$. This was true in both the British sample, $t(36) = 3.91$, $p < .001$, $d = 0.64$ and the Singaporean sample, $t(61) = 4.52$, $p < .001$, $d = 0.57$. There was no significant difference between the British and Singaporean samples, $t(97) = 0.26$, $p = .794$, $d = 0.06$.

Diet

Overall, the patient's type of diet, vegan/vegetarian diet or non-vegan/non-vegetarian, did not significantly affect a patient's transplant priority, $t(98) = 0.40$, $p = .688$, $d = 0.04$. This was true in both the British sample, $t(36) = 1.14$, $p = .262$, $d = 0.19$ and the Singaporean sample, $t(61) = 1.46$, $p = .149$, $d = 0.19$. There was no significant difference between the British and Singaporean samples, $t(97) = 1.81$, $p = .074$, $d = 0.37$.

Gender

Overall, the gender of the patient did not significantly affect a patient's transplant priority, $t(98) = 0.73$, $p = .467$, $d = 0.07$. This was true in both the British sample, $t(36) = 0.03$, $p = .976$, $d = 0.005$ and the Singaporean sample, $t(61) = 0.89$, $p = .379$, $d = 0.11$. There was no significant difference between the British and Singaporean samples, $t(97) = 0.60$, $p = .553$, $d = 0.13$.

Correlations between factors

Pearson product-moment correlations were computed between the z-values for each factor across all participants to determine if the participants had made any implicit associations between the factors during the decision-making process (see Table 3). The results showed that in both the British and Singaporean samples, four factors (i.e., alcohol intake, smoking frequency, weight and exercise frequency) were significantly correlated, suggesting that participants who selected a patient who drank less frequently would likely prioritise a patient who did not smoke frequently, who exercised more frequently and was of normal weight.

Insert Table 3 here

Within-subject consistency

Three separate correlational analyses were conducted to investigate within-subject consistency. The mean pre-experimental ratings and post-experimental factor rankings are presented in Table 2.

Pre-experiment correlation coefficient (PRC)

The PRC is the strength of correlation between each participant's pre-experiment factor ratings and their derived factor *z*-values. Kendall's rank correlation was used to measure the monotonic relationship between the ratings and *z*-values for each participant. The mean PRC across participants was .48 (SD = .30), $t(94) = 15.51$, $p < .001$, $d = 1.59$, indicating moderate within-subject coherence[5]. For the British sample, the mean PRC was .50 (SD = .32), $t(34) = 9.19$, $p < .001$, $d = 1.55$, and .47 (SD = .29) for the Singaporean sample, $t(59) = 12.45$, $p < .001$, $d = 1.61$. A two-sample *t*-test showed that there was no significant difference between the British and Singaporean samples, $t(93) = .50$, $p = .615$, $d = 0.11$.

Post-experiment correlation coefficient (POC)

The POC is the strength of correlation between each participant's post-experiment factor rankings and their derived factor *z*-values. A Kendall's rank correlation was conducted for each participant and the mean POC was across all participants .36 (SD = .36), $t(94) = 9.81$, $p < .001$, $d = 1.01$, indicating borderline moderate within-subject coherence[5]. The mean POC was .41 (SD = .36) for the British sample, $t(34) = 6.87$, $p < .001$, $d = 1.16$, and .33 (SD = .36) for the Singaporean sample, $t(59) = 7.12$, $p < .001$, $d = 0.92$. A two-sample *t*-test showed that there was no significant difference between the British and Singaporean samples, $t(93) = 1.08$, $p = .284$, $d = 0.23$.

Pre- to post-experiment correlation (PPC)

The PPC is the strength of correlation between each participant's pre-experiment ratings and post-experiment rankings. A Kendall's rank correlation was conducted for each participant and the mean PPC across participants was .45 (SD = .35), $t(94) = 12.47$, $p < .001$, $d = 1.28$. This suggests a moderate degree of coherence between participants' self-reported importance of each patient factor before and after the allocation task. The mean PPC was .62 (SD = .21) for the British sample, $t(34) = 17.09$, $p < .001$, $d = 2.89$, and .35 (SD = .37) for the Singaporean sample, $t(59) = 7.17$, $p < .001$, $d = 0.93$. There was a significant difference between the British and Singaporean samples, with consistency being considerably higher in the British sample, $t(93) = 4.51$, $p < .001$, $d = 0.89$.

Between-participant concordance

Kendall's test of concordance was used to assess the degree of agreement amongst participants with respect to the relative importance of each factor in determining allocation decisions. For the pre-ratings, there was moderate agreement amongst the British participants $W = .56$, p < .001, the Singaporean participants, $W = .52$, $p < .001$ and overall, $W = .53$, $p < .001$. This was also true for the post-rankings; British participants, $W = .67$, $p < .001$, Singaporean participants, $W = .50$, $p < .00$ and overall, $W = .55$, $p < .001$. For the participants' derived z-values there was generally a weaker but significant level of agreement; $W = .41$, $p < .001$ for the British participants, $W = .38$, $p < .001$ for the Singaporean participants, and $W = .38$, $p < .001$ overall. The ranking of factors based on the derived z-values – from most to least important – was alcohol intake, smoking frequency, weight, exercise, diet, and gender. The same rank order was found in the British sample, and it was largely similar in the Singaporean sample, except that gender and diet which were ranked 5th and 6th respectively.

Discussion

The results supported hypotheses 1a, 1b, 1c, and 1d, but not 1e. After controlling for factors such as comorbid health issues, prognosis and transplant wait time list, with the exception of diet, each of the other four lifestyle factors – alcohol intake, smoking frequency, weight, and exercise frequency – had a significant impact on how laypeople allocated scarce medical resources. The patient’s gender did not influence the allocation decisions.

British and Singaporean participants gave lower priority to patients who drank excessively, with large effect sizes. This supports the results from previous studies where non-alcoholics (Furnham et al., 1998; Wong, 2019) or light drinkers (Nguyen Huynh et al., 2020**)** were favoured, suggesting that participants adopted a distributive justice principle (i.e., just deserts) during allocation. The large effect size obtained indicates that alcohol is a key consideration should lifestyle factors be included in allocation decisions. Alcoholism is viewed as a self-inflicted problem brought about by irresponsible behaviour and those who abuse alcohol are perceived as less deserving of prioritised medical treatment (Schomerus, Matschinger, & Angermeyer, 2006). There is also evidence that some individuals support a reduction in healthcare expenditure to treat alcoholism, suggesting that alcoholics should face the consequences of their unhealthy lifestyle behaviours, and should not be allocated priority for scarce medical resources (Beck et al., 2003).

British and Singaporean participants gave lower priority to patients who smoked more frequently, again with large effect sizes, which is consistent with previous studies where non-smokers were favoured over smokers (Furnham, 1996; Furnham et al., 2000; Furnham et al., 2011; Furnham, Hassomal & McClelland, 2002; Furnham, Thompson & McClelland, 2002; Nguyen Huynh et al., 2020). Once again, this implies that participants adopted a just deserts principle during allocation. The dangers of smoking have been highlighted by healthcare systems globally and strict smoking regulations have been established through strategies such as the Framework Convention on Tobacco Control (WHO, 2003). Hence, those who choose to smoke despite knowing that smoking is associated with negative medical outcomes are perceived as less deserving of medical treatment due to their irresponsible health choices (Hawn et al., 2011).

British and Singaporean participants gave lower priority to patients who were overweight, with moderate effect sizes. Earlier, Furnham et al. (2010) reported very large effect sizes, attributing discriminatory attitudes towards overweight patients to a lack of control over their weight and health. However, Nguyen Huynh et al. (2020) reported a smaller effect size, attributing it to an increase in awareness of weight stigma (Puhl & Suh, 2015). This study reported a moderate effect of weight on allocation decisions, implying a possible general consensus that weight is under an individual's control and they are accountable for maintaining their own weight and health (Furnham et al., 2010). This suggests that personal responsibility is considered when determining who is more deserving of receiving a scarce medical resource, in line with the just deserts theory (Pillutla et al., 2018).

British and Singaporean participants gave lower priority to patients who exercised less frequently in a week, with moderate effect sizes. This supports the study by Nguyen Huynh et al. (2020) which found that patients who exercised frequently were favoured over patients who were infrequent exercisers. Regular exercise is a preventive healthy habit known to reduce vulnerability to various illnesses as well as an effective post-treatment routine that helps in regulating hormonal changes and reducing muscle atrophy which contributes to improved post-transplant outcomes (Stefanovic & Milojkovic, 2005). Hence, physically active patients may be perceived as having positive health attitudes compared to non-active patients, and thus, lay individuals are inclined to allocate them a scarce medical resource.

The patient's diet, which has not been previously investigated, had a small and non-significant influence on the allocation decisions of British and Singaporean participants. A recent systematic review reported evidence that adopting plant-based diets are associated with positive health measures such as lower cholesterol and increased gut microbiota (Medawar et al., 2019). Hence, it was hypothesised that participants would prioritise patients on a vegan/vegetarian, but the results showed otherwise. A patient's diet did not have an effect on the participants' allocation decisions. As participants were not asked to explain their choices, it was beyond the scope of the present study to determine the reasons for the null effect of diet. Nonetheless, this is the first study that investigated diet, and in future studies, both quantitative and qualitative data on the effect of diet on allocation decisions could be collected.

The results indicated that a patient's gender has no effect on the allocation decisions of British and Singaporean participants. The results support some studies (Furnham et al., 2000; Furnham et al., 2007; Furnham, Thomas, & Petrides, 2002; Lenton et al., 2006; Wong, 2019) but not others (Furnham, 1996; Furnham & Briggs, 1993; Furnham et al., 1998; Furnham et al., 2011; Furnham, Hassomal & McClelland, 2002). The lack of a gender effect could be attributed to societal changes (Bornatici et al., 2020; Inglehart et al., 2017), with a larger proportion of people favouring gender equality, and rejecting the notion that females should be prioritised due to their positions as primary caregivers in the household (Donnelly et al., 2016).

Implications of allocation criteria results

Lifestyle factors, in particular, smoking frequency, alcohol intake, weight and exercise frequency, were significant predictors of participants' allocation decisions and they were also significantly correlated with each other. This indicates that when a patient's lifestyle behaviours are being considered, laypeople tend to adopt the just deserts principle during the decision-making process as it appeals to the sentiment that people should face any consequences of their behaviours. This strongly supports the earlier study that laypeople would prioritise non-smokers over smokers, light drinkers over heavy drinkers, normal weight over obese people, and frequent exercisers over infrequent exercisers for kidney dialysis (Nguyen

Huynh et al., 2020). Waldron (2011) also previously reported that lay participants were more likely to prioritise a patient who had suffered from a genetic liver condition than a patient with a history of alcohol abuse, implying that it is not uncommon that a patient's habits influence how deserving they are of being allocated a scarce resource.

Interestingly, these four patient factors were significant even though they are not typically the main causes of chronic kidney disease and failure (National Institute of Diabetes and Digestive and Kidney Diseases, 2016). The most common cause of chronic kidney disease and failure is diabetes of which the three main risk factors are higher weight, infrequent exercise and poor diet. However, lay participants may not be cognisant of these three factors in increasing the risk of kidney issues and possibly the need for kidney transplant .This suggests that lay participants may be using the lifestyle behaviours as a general reflection of the patient's level of responsibility towards their own health in, which in turn influences the patient's likelihood of being given priority for a scarce medical resource.

None of the comparisons between British and Singaporean citizens with respect to lifestyle factors were significant, suggesting some cross-cultural consensus regarding allocation decisions. Globally, people are increasingly aware of the negative consequences of unhealthy behaviours such as smoking and alcoholism as well as the benefits of engaging in physical activity and maintaining a healthy weight. The cross-cultural results from this study and Nguyen Huynh et al.'s (2020) indicate that the factors which the public perceive to be important for allocation are largely similar across the countries investigated. This knowledge could assist in the development of international guidelines on allocation decision-making for healthcare staff although further replications with other nationalities should be explored.

Implications of within-subject consistency results

The PRC and POC results indicated that participants only showed moderate internal consistency in their decisions, a finding similar to Wong (2019). This suggests the participants may lack insight into their decisions. Beckstead et al. (2014) found that doctors only demonstrated a modest level of self-insight and there were likely subliminal biases at play when doctors evaluated patient factors when deciding on treatment referrals. Another study with medical students found that the majority showed weight-related bias but were unaware of it, resulting in negative implications on the quality of patient care (Miller et al., 2013). This indicates that individuals do not typically display perfect self-insight or know exactly how they use information when making judgments. Harries et al (2000) suggested that this could be influenced by the individual's level of attention to information when making decisions.

Another noteworthy finding is the moderate correlation observed between the PRC and POC scores (i.e., the PPC result), which indicate that a sizeable proportion of participants may be unaware of the changes in the perceived importance of the factors brought about by engaging in the allocation task. The human mind is vulnerable to cognitive biases and individuals including medical staff are not always consciously aware of their decisions or do not actively examine biases that could influence their decision-making process, leading to suboptimal treatment (Saposnik et al., 2016). These results highlight the importance of educating allocation committees on the challenges when making allocation decisions.

Between-participant concordance

The Kendall's concordance test showed a moderate level of agreement across participants with respect to the ordering of the pre-rating and post-ranking of the factors used to make the allocation decisions, and weaker agreement for the coefficients derived from the model. The ordering of factors was very similar for both samples. However, some caution is advised when interpreting and applying results from studies of this nature to real life situations. In reality, medical conditions may often be a result of a combination of lifestyle behaviours and it is possible that the perceived importance of factors may differ in these circumstances.

Evaluation of the Bradley-Terry model

This study employed a different methodology from the traditional ranking method used in most studies by Furnham and colleagues. When the Bradley-Terry model was used to re-examine the lifestyle factors investigated by Nguyen Hyunh et al. (2020), the model produced consistent results, suggesting that the model performed as well as the ranking method. Moreover, this model has additional advantages. First, it is easy to conceptualise and efficient in computation, making it applicable to numerous decision-making studies. Second, a larger number of factors can be investigated, and they do not have to be categorical, which is especially relevant for variables that vary on a continuum. For instance, instead of comparing alcoholics versus non-alcoholics, alcohol consumption can be operationalised in terms of drinking frequency, which is more reflective of the general population's drinking habits, thus leading to greater ecological validity.

One limitation of the present study is that the study sample consisted only of lay participants without clinical training. However, allocation systems should be subject to public discussion and revision (Persad et al, 2009). Moreover, research into public beliefs highlight which ethical perspectives are popular or points of contention. This could help focus moral inquiry in future ethical research. Nonetheless, as real-life resource allocation decisions are often made after discussions by a multidisciplinary healthcare team of experienced clinicians, future research could recruit both clinicians and lay participants to determine if greater knowledge of the risk factors of chronic kidney disease and failure would influence kidney transplantation allocation. Participants should also be asked to explain their allocation decisions to improve interpretation of the results.

In conclusion, a Bradley Terry model was successfully employed in this cross-cultural study which contributes to our understanding of lay people's preferences when allocating scarce medical resources. There is substantial evidence that aspects of a patient's lifestyle such as smoking frequency, alcohol intake, exercise frequency, and weight shaped the allocation decisions of our British and Singaporean participants, whereas diet and gender did not affect allocation decisions. This study reflected the importance of the just deserts principle in medical allocation in both countries when lifestyle factors are concerned, an insight which should be considered when developing guidelines for the allocation of scarce medical resources.

Footnotes

[1] In 2017, the WHO age-standardized estimated prevalence of tobacco and cigarette smoking among those aged 15 years or more was 16.5% and 14.8% respectively in Singapore, compared to 19.8% and 17.5% respectively in the UK (WHO, 2019).

[2] In 2016, alcohol per capita consumption (of pure alcohol) was 2.0 litres in Singapore, compared to 11.4 litres in the UK. The prevalence of alcohol use disorders and alcohol dependence was 1.1% and 0.5% respectively in Singapore, compared to 8.7% and 1.4% respectively in the UK (WHO, 2018).

[3] Further participant demographic information collected is available from the first author on request.

[4] There was a high correlation between the Bradley-Terry model derived factor coefficient estimates and their *z*-values for each of the six factors across all participants. The correlations are shown in Appendix B.

[5] There are only 95 participants as four participants gave all six factors the same ratings and/or ranking and thus a Kendall's correlation coefficient could not be calculated.

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Table 1

Patient factors used to generate each hypothetical patient

Factor	Range	Remarks
Smoking Frequency	0 to 7 days a week	Approximately 3-4 patients per level
Alcohol Intake	Non-drinker; Occasional drinker; Excessive drinker	10 patients per level
Weight	Normal/Obese	15 patients per level
Exercise Frequency	0 to 7 days a week	Approximately 3-4 patients per level
Diet Type	Vegetarian/Vegan; Non-Vegetarian/Non-Vegan	15 patients per level
Gender	Male; Female	15 patients per level

Table 2

List of factors, the mean factor coefficients and standard deviations in the total (N = 99), British (*n* = 37) *and Singaporean* (*n* = 62) *samples.*

Factor	Sample	Mean Factor Score (*SD*)	Mean Pre-Experiment Ratings (*SD*)	Mean Post-Experiment Rankings (*SD*)
Alcohol				
	Total	-1.66 (2.00)	6.90 (2.53)	5.18 (0.92)
	British	-1.65 (2.07)	6.92 (2.62)	5.49 (0.73)
	Singaporean	-1.67 (1.97)	6.89 (2.50)	5.00 (0.98)
Smoking				
	Total	-1.59 (1.50)	6.26 (2.94)	4.84 (1.06)
	British	-1.50 (1.49)	6.14 (3.09)	4.68 (1.23)
	Singaporean	-1.64 (1.51)	6.34 (2.87)	4.94 (0.94)
Weight				
	Total	-0.98 (1.84)	5.33 (2.74)	3.59 (1.18)
	British	-1.16 (1.67)	5.32 (2.93)	3.81 (1.08)
	Singaporean	-0.87 (1.94)	5.34 (2.65)	3.45 (1.22)
Exercise				
	Total	0.77 (1.29)	4.94 (2.72)	3.54 (0.85)
	British	0.73 (1.13)	5.11 (2.83)	3.51 (0.84)
	Singaporean	0.80 (1.39)	4.84 (2.67)	3.55 (0.86)
Diet				
	Total	-0.04 (0.98)	3.37 (2.60)	1.86 (0.76)
	British	0.19 (1.00)	3.30 (2.79)	2.05 (0.85)
	Singaporean	-0.18 (0.94)	3.42 (2.50)	1.74 (0.68)

Gender				
	Total	-0.07 (0.98)	1.54 (1.34)	2.00 (1.84)
	British	0.004 (0.88)	1.35 (1.01)	1.46 (1.17)
	Singaporean	-0.12 (1.04)	1.65 (1.51)	2.32 (2.08)

Table 3

Correlation between patient factors

Factor	Alcohol	Smoking	Weight	Exercise	Diet	Gender
Alcohol	-	.775 **	.756 **	-.439 **	.094	-.082
Smoking	.720 **	-	.662 **	-.346 *	-.122	.042
Weight	.598 **	.527 **	-	-.564 **	.077	.070
Exercise	-.428 **	-.266 *	-.444 **	-	-.182	.020
Diet	-.290 *	-.332 **	-.220	.209	-	.098
Gender	-.010	-.200	.166	-.231	-.101	-

Note. Correlations for the British participants (*n* = 37) are above the diagonal and correlations for the Singaporean participants (*n* = 62) are below the diagonal.

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix A
List of the 30 hypothetical patients generated from the six factors

Patient Number	Gender	Smoking Frequency	Alcohol Intake	Weight	Exercise Frequency	Diet Type
1	Male	1	Non-drinker	Normal	7	Veg
2	Male	2	Occasional drinker	Normal	2	Veg
3	Male	4	Non-drinker	Normal	3	Veg
4	Male	0	Excessive drinker	Normal	0	Veg
5	Male	6	Excessive drinker	Normal	2	Non-Veg
6	Male	5	Occasional drinker	Normal	7	Non-Veg
7	Male	0	Non-drinker	Normal	6	Non-Veg
8	Male	1	Excessive drinker	Obese	5	Veg
9	Male	3	Excessive drinker	Obese	4	Veg
10	Male	4	Occasional drinker	Obese	1	Veg
11	Male	7	Non-drinker	Obese	3	Veg
12	Male	2	Occasional drinker	Obese	5	Non-Veg
13	Male	5	Occasional drinker	Obese	3	Non-Veg
14	Male	6	Non-drinker	Obese	1	Non-Veg
15	Male	4	Excessive drinker	Obese	1	Non-Veg
16	Female	1	Occasional drinker	Normal	6	Veg
17	Female	2	Non-drinker	Normal	5	Veg

18	Female	3	Excessive drinker	Normal	6	Veg
19	Female	7	Non-drinker	Normal	3	Veg
20	Female	6	Excessive drinker	Normal	0	Non-Veg
21	Female	3	Occasional drinker	Normal	4	Non-Veg
22	Female	5	Non-drinker	Normal	5	Non-Veg
23	Female	0	Occasional drinker	Normal	2	Non-Veg
24	Female	6	Excessive drinker	Obese	0	Veg
25	Female	3	Non-drinker	Obese	0	Veg
26	Female	4	Occasional drinker	Obese	4	Veg
27	Female	7	Excessive drinker	Obese	1	Non-Veg
28	Female	2	Non-drinker	Obese	6	Non-Veg
29	Female	5	Excessive drinker	Obese	2	Non-Veg
30	Female	0	Occasional drinker	Obese	7	Non-Veg

Appendix B

Pearson correlations between each factor coefficient estimate and their associated *z*-values obtained from the Bradley-Terry model across all participants (*N* = 99)

Factor	Correlation*
Alcohol	.806
Smoking	.669
Weight	.878
Exercise	.928
Diet	.933
Gender	.945

*All *p*'s < .001