Author's response to reviews

Title: Increased number of Judo therapy facilities in Japan and changes in their geographical distribution

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Author's response to reviews: see over
Dear Dr. Marshall,

We received your letter of December 17, 2010 regarding the publication of the above manuscript in *BMC Health Service and Research*. We have revised the manuscript in accordance with the reviewer’s recommendations. Details are described on a separate page as “Response to the Reviewer’s Comments.” Additionally, we noted “competing interests,” “author contributions,” and “acknowledgements” in the revised manuscript.

We re-submit our paper and hope that our revised paper is now acceptable. We look forward to hearing from you.

Yours sincerely,

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Response to the Reviewer’s Comments

1. The raison-d’être of this study appears to be the desire to determine if the expansion of Judo Therapy (JT) in Japan since 1998 has been equitable between urban and rural areas, rather than concentrating in the urban areas where orthopaedists are already established (p3). (This assumes the orthopaedists have a primary right to be located where they are, and do not require redistribution themselves). Consequently an appropriate hypothesis for the study would have been that as the number of therapists expanded, so a more equal pattern of provision would have been observed.

Answer. In response to the reviewer’s suggestion, we added a new sentence to clarify our hypothesis; “The study hypothesis was that as the number of therapy facilities expanded, a more equal pattern of provision would be observed (Page (P) 4 Lines (L) 16-18”).

2. The work of Kobayashi and others have suggested that saturation of local markets for health professionals may result in geographical redistribution, producing a more equal pattern of provision across the national space.

Answer. According to the paper by Kobayashi, the number of practising physicians and the ratio of physicians per 100,000 population increased between 1980 and 1990. However, analyses using Lorenz curves and Gini indices indicated that the inequality in physician distribution did not improve. These results were consistent with our findings, and have already been noted on P8L16-18 in the Discussion as, “the inequality in physician distribution did not improve between 1980 and 1990 according to a previous Japanese study [10], suggesting that simply increasing the supply of medical providers is not an advisable health policy.”

3. The authors adopt a descriptive technique commonly used in economics to describe income inequality, the Lorenz Curve, and associated Gini coefficient. This approach has also recently been introduced into epidemiological studies to
investigate the geographic variation in disease etiology. It appears that some such studies use aggregate data for this purpose, for example by estimating inequity of death rates over regions.

**Answer.** We agree and have addressed this point in the Introduction; “Lorenz curve and Gini indices, originally used in economics research to assess income inequality [4,5], were chosen to describe geographic distributions in this study because they can be used to summarize resource distribution on a formal, standardised scale from “0” (even distribution) to “1” (greatest possible unevenness of distribution). Gini indices can provide a standardized basis by which to judge the comparative degree of geometric unevenness for different manpower resource pools at a point in time, or over a period of time [6,7]. The indices have been used frequently to study disproportionate distributions of health services, including those pertaining to the numbers of physicians and medical facilities [8–13] (P3L23-P4L6).”

4. One reviewer has raised issues about the approach, which is recognised appropriate, to be but for which certain assumptions and implication need to be explained (e.g. the use with group data), and a clear explanation given.

While the Gini index is explained, there is no indication of how to interpret the coefficient of variation.

**Answer.** To clarify (and simplify) the logic behind this study, we decided to delete the description of the coefficient of variation because the parameter was not essential to this study. Instead, we added an explanation for the principle of the Gini index in the Materials and Methods section; “this study used the mean number of judo therapy facilities per 100,000 people with their Gini indices, as in our previous studies [14,15] and other Japanese studies [6,10]. Gini indices were calculated based on Lorenz curves, as follows. Municipalities were sorted by the number of judo therapy facilities per 100,000 people. Beginning with the municipality with the fewest judo therapy facilities, the x axis of the Lorenz curve represents the cumulative percentage of the population; the y axis represents the cumulative percentages of judo therapy facilities. Under conditions of complete equality, the cumulative curve would coincide with the
Unequal distributions produce cumulative curves below the 45° line. The Gini index is defined as the proportion of the area surrounded by the 45° line and the Lorenz curve in relation to the area below the 45° line; the index ranges from 0 to 1, with higher values indicating larger geographical gaps. In the same way, the Gini indices per 100,000 people were calculated individually for urban areas (= 919) and towns/villages (= 1,002) (P6L3-P6L13).

5. Likewise, and as raised by the reviewer, a more detailed explanation of bootstrapping would be valuable, particularly as readers, will largely be unfamiliar with the whole approach. These are all perfectly valid comments. The reviewer also raises issues about the choice of the inequality indices, given other also available. This is also a valid comment, and would appropriately be raised in the discussion.

Answer. In the original version, we had added an explanation of bootstrapping in response to the suggestion of another reviewer. In this revised paper, we added several sentences to explain bootstrapping. “Originally, the Gini index was a single value reflecting unequal distributions, but the confidence intervals (CIs) of the Gini index can be obtained using a bootstrapping procedure [20]. This procedure is a computer-intensive method that draws independent samples from the data and calculates the target statistic on each draw. The bootstrap procedure uses the observed data to estimate the theoretical and usually unknown distribution from which the data came [20, 21]. Bootstrap samples of the same size as the original sample are drawn repeatedly by sampling with replacement from the observed data. Based on previous studies [22, 23] a bootstrap method with 1,000-time randomizations was used to estimate 95% CIs of the Gini index. Replacement random sampling was performed 1,921 times from the original database of judo therapy facilities per 100,000 people, and the Gini index was estimated using the newly created data set. This procedure was repeated 1,000 times, and the confidence bands of the Gini index were constructed by multiplicatively expanding the 2.5% and 97.5% points of the quantile functions of the simulated data so that the bands had 95% simultaneous coverage over the range of the Gini index. The estimated Gini indices were compared between urban areas and
towns/villages for each year. Annual differences in the Gini indices were calculated and the bootstrap method was applied to determine statistical significance [22, 23] (P6L14-P7L5).

6. The reviewer also makes several points in relation to the economic theory behind the approach, the necessity for a full understanding on the theories and their implications, and the work upon which the authors are building. The fundamental issue with respect to these comments is the context within which the paper is presented. Is the paper an analysis of the economics of service provision, in which case all the comments would be relevant? Or is the paper a use of a particular descriptive technology in a different setting? If the latter, this is much like statistical analyses where it is not necessary to understand the detailed mathematical basis of, for example, maximum likelihood, in order to appropriately and correctly use a procedure which is based upon that likelihood.

**Answer.** The answer is definitely the latter. This paper is about the use of a particular descriptive technology in a medical setting, and the Gini index was simply used as a statistical parameter for assessing the inequality of distribution.

7. It would appear that the emerging use of this technology in health service distribution and epidemiology focuses on the latter, which is quite acceptable if the method is appropriate, the assumptions have been met (and tested where appropriate), the technique correctly applied, and any limitations discussed.

**Answer.** In response to the reviewer’s suggestion, we addressed the method (P6L3-P6L13, answer #4), assumptions (P4L16-18, answer #1), application of the technique (P6L14-P7L5, answer #5), and limitations. Limitations in the use of the technique are noted at the beginning of the Limitations section; “First, this study is not an analysis of the economics of service provision, but the use of a particular descriptive technique for assessing the distribution of judo therapy facilities. Spatial inequality matters are largely due to the time-price associated with any health facility, as well as other
economic phenomena, including spatial access to health facilities [26, 27]. Because the geographical distribution of medical service providers is related directly to urgent human needs in a community, the distribution per se should be analyzed apart from the economics. The financial aspects of judo therapy facilities are important, but beyond the scope of our study and require a totally different data set and method of analysis. Thus, this study shows simply the results of temporal changes in the geographic distribution of judo therapy facilities. In future, a variety of economic factors need to be considered to interpret our results before approving or opposing health-care policy on the number of judo therapy facilities (P9L15-P10L1)“.

8. Economists working in the field of health service provision may well wish to present the results within the context of economic theory, and thus may have a different perspective, but given the method is applied correctly, the underlying results will be the same.

Answer. As mentioned in the responses to comments #6 and 7, our position is the latter, and we agree with the reviewer’s idea.

9. Consequently the matter resolves to whether or not it is possible to apply and interpret the results of these indices outside of the framework of economic theory. As the technique is essentially similar to an Area Under the Curve (AUC) analysis, developed by electrical engineers and radar engineers during World War II for detecting enemy objects in battlefields (Wikipedia), and now widely applied in health research, I would argue that it is possible to understand, apply and interpret the results as with any other statistical procedure, and do not support the argument that a full understanding of the economic theory and antecedents is a requirement for their use. This position is consistent with the authors’ most recent re-submission letter.

Answer. We are glad to hear that our position, stated in the previous re-submission letter, was understood; we have further revised the manuscript in accordance with the
reviewer’s suggestions (answers #1–7). The revised points are summarized in the next answer (#10).

10. In summary the authors must take into account the fact that most readers will be unfamiliar with the approach. As there is generally no restriction on word count in BMC publications (and supplementary data can be presented where appropriate), and consistent with some of the reviewers comments, the paper should be expanded to include clear explanatory text so that the approach is clearly defined, the assumptions clearly stated and tested, and the limitations, and issues, clearly discussed.

Answer. We understand that most readers of the journal are unfamiliar with the application of the Gini index, and decided to expand the descriptions, including those of the Gini index and bootstrap method with appropriate references, as previously noted (answers # 3 and 4). As the reviewer suggested, the study assumption is now noted in the Introduction (answer #1), and tested statistically using the bootstrap method (answer #4). The limitations and issues relating to the application of an economic indicator (i.e., the Gini index) to medicine are discussed in detail (answer #7).

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