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

Satoshi Inoue, Mutsuhiro Nakao*, Kyoko Nomura, Eiji Yano

Abstract

Background: Judo therapy is a well established Japanese co-medical profession specializing in outpatient manual treatment of fractures and sprains. Recently, the number of judo therapists has been rapidly increasing as a result of proliferation judo therapy academies. This study examines whether such rapid increases have improved geographical distribution of judo therapy facilities in Japan.

Methods: The number of judo therapy facilities and the population in each municipality were obtained from the Web yellow pages and from Japanese census data for 2004, 2006, and 2008, respectively. Lorenz curves and Gini indices were calculated to demonstrate distributions of judo therapy facilities per 100,000 people. A bootstrapped method was used to identify statistical significances of differences in Gini indices.

Results: In all municipalities, the mean numbers of judo therapy facilities per 100,000 people were 15.3 in 2004, 15.8 in 2006, and 17.6 in 2008. The Gini indices for judo therapy facilities nationally were 0.273 in 2004, 0.264 in 2006, and 0.264 in 2008. The numbers of judo therapy facilities increased significantly between 2006 and 2008 ($p < 0.05$) but the indices did not change significantly in the same period. The Gini indices for local towns and villages remained unchanged and were consistently higher ($p < 0.05$) than those in urban areas throughout the study periods.

Conclusion: Our results suggest that recent increases in the number of judo therapy facilities have not necessarily led to greater equality in their geographic distribution in terms of Gini indices.

Background

Judo therapy, originating in the Japanese martial art of judo, represents one of Japan's most unique and traditional co-medical professions [1]. Primarily, judo therapists manually treat sprains, bruises, soft tissue damage, fractures, and dislocations in their own offices. Since 1920, judo therapists have required state licensing. Following the 1998 court decision that rejected regulations promulgated by the Japanese Ministry of Health, Labour and Welfare limiting the total number of judo therapists [2], the number of academies training judo therapists increased from 14 to 70. As a result of the increased number of academies, new graduates qualifying as judo therapists began to practice during the period from approximately 2004 to 2006. People have the right for free access to healthcare service under universal coverage of health insurance in Japan; it has been achieved with relatively low cost (340 billion dollars annually for national health expenditure, 9% of GDP). In general, under the Japanese Health Insurance System, judo therapists can operate their facilities independently, and total medical expenditures for judo therapy have been estimated at greater than 3 billion dollars annually [3]. Thus, the practice of judo therapy requires careful monitoring.

Judo therapists are expected to provide complementary and alternative medical treatments, particularly in areas with insufficient medical care services. In this sense, assessing the geographic distribution of judo therapists is important. If the increased number of judo therapists were concentrated primarily in urban areas, which also contain a relatively large number of

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orthopedists, the overlapping services provided by both professions might lead to conflicts between them. Some orthopedists have rumored that patients at their clinics are recruited by judo therapists. Clearly, for the current increased numbers of judo therapists to provide their services more equitably in terms of geographic distribution would be preferable, but no published studies have examined this possibility.

The Lorenz curve and Gini indices, originally used in economics research to assess income inequality [4,5], were chosen to describe geographic distribution in this study because they can be used to summarize resource distribution on a formal, standardized scale from "0" (even distribution) to "1' (greatest possible unevenness of distribution). Gini indices can provide a standardized basis on which to make judgments on the comparative degrees of geometric unevenness for different manpower resource pools at a point in time, or over a period of time [6,7]. The indices have frequently been used to study disproportionate distributions of health services, including those pertaining to the numbers of physicians and medical facilities [8-13]. For example, using Gini indices, Kobayashi studied the number of physicians in Japanese municipalities and reported the changes in geographical distribution before and after the increase in medical schools [10]. Several reports using Gini indices for the geographical density of physicians, especially practicing physicians and pediatricians, have been published since the mid-1990s [11-13]. To perform the same type of analysis to assess disproportionate distributions of judo therapy facilities, we developed our database of the number of judo therapy facilities in each Japanese municipality and have published two reports on the geographic density of judo therapists [14,15]. However, both studies were cross-sectional in study design and the geographic distribution of judo therapists was not examined over time.

Thus, the objective of this study involved examining recent changes in the geographic distribution of judo therapy facilities in relation to the increase in judo therapy academies in Japan. Assuming that the orthopedists have a primary right to be located where they are, and do not require redistribution themselves, we would like to determine if the expansion of judo therapy in Japan since 1998 has been equitable between urban and rural areas, rather than concentrating in the urban areas where orthopedists have already been established. The hypothesis of this study was that as the number of therapy facilities expanded, so a more equal pattern of provision would be observed. To test this hypothesis, the Gini index of the number of judo therapy facilities at each of the national and regional levels was used as the simple parameter for statistical analysis. Then the Gini indices and their 95% confidence intervals of the number of judo therapy facilities were estimated at two-year intervals during 2004 to 2008, when the number of judo therapy facilities rapidly increased, to compare between 2004 and 2006 and between 2006 and 2008.

Methods

Number of judo therapy facilities

The data set, developed from the NTT Internet Townpage Directory of Internet sites [16] in July 2004, 2006, and 2008, was composed of the number of judo therapy facilities in 3,218 municipalities throughout Japan. This method was validated in our previous studies [14,15]; the total number of judo therapy facilities obtained from the Townpage Directory (= 21,995) was close to the number of judo therapy facilities in all prefectures reporting health insurance payments (= 23,199) in 2002. The Internet search used "judo therapist" and the name of each municipality as keywords. Among the search results, only "Sekkotsu-in (facility for bone setting)" and "Seikotsu-in (osteopathy facility)" were selected because other facilities are prohibited from practicing by the Japanese Health Insurance System. This study uses the number of judo therapy facilities instead of the number of judo therapists because no information could be gathered about the latter.

Population by municipality

The population of each municipality was estimated from census data [17,18], as described in detail in our previous study [15]; the data set can be obtained from the corresponding author upon e-mail request. The incorporated population in July 2008 was used for the analysis of the municipalities consolidated after 2004. The populations of certain major cities were too large for direct comparisons; in these cases, Tokubetsu-ku (specific wards) were used for purposes of comparison. In total, 1,921 municipalities were defined for use in the analysis.

Analysis

All statistical analyses were performed using the STATA (Ver.9 for Windows) and two-tailed p values of less than 0.05 were regarded as statistically significant. Although there were several measurements to report the geographic distributions [10,19], this study used the mean numbers of judo therapy facilities per 100,000 people with their Gini indices according to our previous studies [14,15] and Japanese other studies [6,10]. The Gini indices were calculated based on Lorenz curve, and the procedure of the calculation was 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 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 45° diagonal line. 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; this 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).

The Gini idex is originally a single value reflecting unequal distributions, but the confidence intervals (C.I.s) of the Gini index can be obtained by a bootstrapping procedure [20]. The bootstrap 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 repeatedly drawn 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% C.I.s of the Gini index. A 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 created new dataset. 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 quantile functions of the simulated data so that the bands have 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].

Results

Table 1 shows the number of judo therapy facilities per 100,000 people and the estimated Gini index. Although the general population gradually decreased during the period studied, the number of judo therapy facilities consistently increased, resulting in an increase of the number of judo therapy facilities per 100,000 people. The number of judo therapy facilities in the entire country increased by 5.3% in 2006 and 8.3% in 2008 per 100,000 people compared to the values obtained in 2004 and 2006, respectively. This increase was significant only in 2008, which posted the same increase in urban areas. In contrast, no significant changes were found for towns/villages in both 2006 and 2008.

Compared to the values in the previous 2 years, the degrees by which the Gini index changed (95% C.I.) were -0.009 (-0.013, -0.006) in 2006 and 0.0005 (-0.006, 0.007) in 2008 in all areas; they were -0.010 (-0.013, -0.007) in 2006 and 0.0006 (-0.005, 0.006) in 2008 in urban areas, and -0.003 (-0.009, 0.003) in 2006

Table 1 The number of judo therapy (J.T.) facilities, their distribution per 100,000 people, and Gini indices in all areas, urban areas, and towns/villages in 2004, 2006, and 2008

	2004	2006	2008
Population (×1000)			
All areas (n = 1,921)	127,902	127,758	126,931
Urban areas (n = 919)	114,557	114,552	114,049
Town/villages (n = 1,002)	13,345	13,206	12,882
Number of J.T. facilities			
All areas	22,774	23,996	25,989
Urban areas	20,888	22,045	23,906
Towns/villages	1,886	1,951	2,083
J.T. facilities per 100,000 population*			
All areas	15.3 ± 11.8 (14.7-15.7)	15.8 ± 12.2 (15.3-16.4)	17.6 ± 14.0 (17.0-18.2)†
Urban areas	18.0 ± 9.8 (17.4-18.6)	19.0 ± 9.9 (18.3-19.6)	20.9 ± 12.1 (20.2-21.7)†
Towns/villages	12.8 ± 12.9 (12.0-13.6)	13.1 ± 13.3 (12.2-13.9)	14.8 ± 14.9 (13.6-15.4)
Mean Gini (95% C.I.)*			
All areas	0.273 (0.261-286)	0.264 0.253-0.276)†	0.264 (0.251-0.276)
Urban areas	0.258.248-0.267)	0.247 0.238-0.257)†	0.248 (0.239-0.257)
Towns/villages	0.407 (0.394-0.419)	0.404 (0.392-0.417)	0.400(0.388-0.413)

Mean values ± standard deviations (95% confidence intervals, C.I.s) of J.T. facilities per 100,000 people are presented; the mean Gini indices (95% C.I.s) of their distributions were estimated using the bootstrap method.

† The differences in values were significant ($p < 0.05$, two-tailed t-test) when compared to those in the previous 2 years.

and -0.004 (-0.011, 0.003) in 2008 in towns/villages. This indicates that the Gini index significantly decreased in 2006 but not in 2008 in all areas and in urban areas but that it did not decrease significantly in either 2006 or in 2008 in towns/villages The Gini index was statistically higher (all $p < 0.05$) in urban areas than in towns/villages in 2004, 2006, and 2008. The Lorenz curves of judo therapy facilities per 100,000 people in 2008 are presented for all, urban, and town/village areas in Figure 1.

Discussion

The present study demonstrates that the density of judo therapy facilities per population unit has increased, irrespective of area, from 2004 to 2008 along with the increase in the absolute number of judo therapy facilities. In particular, the extent to which judo therapy facilities per population unit increased in 2008 was statistically significant and higher than that in 2006 by a factor of more than 1.5. However, this increase in 2008 did not reflect equality in the geographic distribution of judo therapy facilities according to the Gini index. Rather, it reflects a trend toward increased geographical gaps between urban areas and the rest of Japan in 2008.

These findings are important because under the current laws and regulations governing medical delivery systems, the Japanese government cannot intervene in choices about where medical practitioners practice. For example, Japan's physician manpower policy during the 1970s involved increasing the number of medical students and medical schools from 65 to 79 to address the shortage and maldistribution of physicians resulting in communities without doctors. The number of newly certificated physicians increased from approximately 4,000 to 8,000 per year by the mid-1980s. However, 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 does not constitute an advisable health policy. Rather, a policy that alleviates the maldistribution of medical providers should be developed. In the present study, the Gini indices significantly decreased in all areas and in urban areas only in 2006, even though the extent to which judo therapy facilities per population unit increased during this year was lower than that during 2008. Because the number of judo therapy facilities per population unit has remained at greater than 20 per 100,000 in urban areas since 2008, it seems clear that the rapid and substantial growth in the number of qualified judo therapists might not naturally match the geographic distribution of the need for judo therapy facilities.

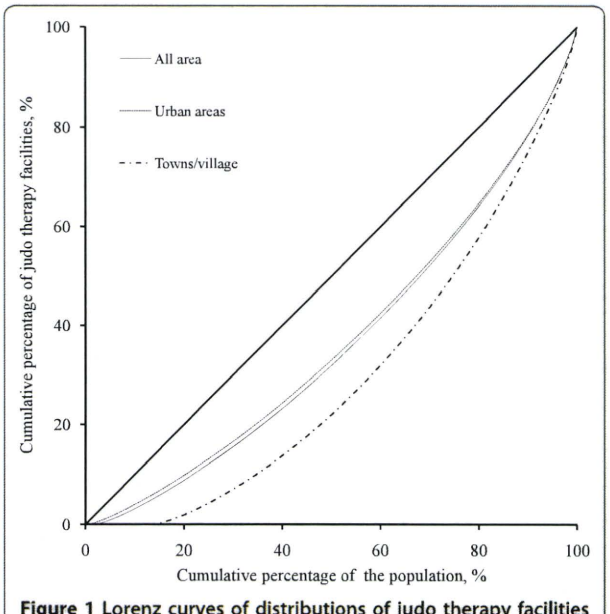

Figure 1 Lorenz curves of distributions of judo therapy facilities in all areas, urban areas, and towns/villages in 2008. The 45° diagonal line represents a completely even distribution. Unequal distributions produce cumulative curves below the 45° line.

In the present study, national data were not used for two reasons, even though all judo therapists are required to report to the designated public health center. First, the statistics on judo therapists are organized according to each public health center but not according to each municipality [24]. Second, these data were not completely accurate insofar as they might have included defunct businesses because reporting closures of these facilities is not required [14,15]. We finally decided to gather information about judo therapy facilities from the Townpage of each municipality, and the number obtained via this method was within 5% of the number of judo therapy facilities in all prefectures reporting health insurance payments. The number of facilities may represent a good surrogate for the number of therapists because in most cases, each facility contains only one practicing judo therapist. Using registration data obtained from the Japanese Judo Therapists' Association [25], we estimated that an average of 1.09 therapists worked in each facility during the period studied.

Before making remarks, several limitations should be noted. First of all, this study is not an analysis of the economics of service provision, but a use of a particular descriptive technology in assessing distributions of judo therapy facilities. Spatial inequality matters are largely due to the time price associated with any health facility, as well as other economic phenomenon including spatial access to health facilities [26,27]. Because geographical distribution of medical service provider directly relates to urgent need of human life in the community, distribution per se should be analyzed apart from economics. Financial aspects of Judo therapy facilities are important

but beyond our scope requiring totally different data set and method for analysis. Thus the results of time-changes in geographic distribution of judo therapy facilities were simply shown in this study. In the future a variety of economic factors need to be considered to interpret our results before approving or opposing health-care policy for the number of judo therapy facilities. Second, this study is limited by its use of a municipality-based method to determine the number of judo therapy facilities and residents; the scale and nature of the facilities could not be assessed. These were grouped data, and the possible effects of 'ecological fallacy' should also be firmly considered for the interpretation of the results [28]. Also, the number of judo therapy facilities was divided by 100,000 people as the only indicator of 'need'. This was because the national data of health-care facilities have usually been published as a unit of per 100,000 residences in Japan, but we should bear in mind that different 'needs' indicators normally produce different inequality estimates: all of which have implications for health policy and planning competing health priorities. Third, the effects of unions of municipalities on the Gini indices should be considered. The Gini index is itself affected by the number of subjects analyzed [17,18], and the indices for small towns and villages are smaller when such towns or villages are combined into larger cities. However, the number of united cities, towns, and villages was limited (= 27) from 2006 to 2008 and does not appear to account for changes in the geographical differences characterizing Japan in 2006. Fourth, four-year study period was relatively short to observe the change of distribution of judo therapy facilities. However, we were specifically interested in the change of distribution of judo therapy facilities from the start of drastic change of graduates qualifying as judo therapists (i.e., the years 2004 to 2006) in this study, and we recognize that the future study should be continued to observe the distribution of judo therapy facilities.

In spite of these limitations, we demonstrated that judo therapy facilities are widely but unevenly distributed. We suggest that recent increases in the number of judo therapy facilities do not necessarily lead to amelioration of inequalities in their geographic distribution. A large portion of elderly individuals live in nonurban areas, and this fact seems to reinforce the need for judo therapy in such areas [29]. Geographic distributions of health services are affected by forces of demand and supply, and in the future we would like to assess the needs for judo therapy and the number of qualified judo therapists comprehensively in all regions before considering intervention plans to motivate judo therapists to practice in the underserved local areas.

Conclusions

The numbers of judo therapy facilities increased significantly between 2006 and 2008 in Japan, but the Gini indices did not change significantly in the same period. The Gini indices for local towns and villages remained unchanged and were consistently higher than those in urban areas throughout the study periods. These results suggest that recent increases in the number of judo therapy facilities have not necessarily led to greater equality in their geographic distribution in terms of Gini indices.

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Authors' contributions

SI collected the data, performed statistical analysis, and wrote the manuscript. MN and EY have made substantial contributions to conception and design, and have been involved in drafting and revising the manuscript. KN made substantial contributions to analysis and interpretation of data. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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■原　著■

柔道整復師施術所と整形外科医師の地理的分布の経時的変化

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背景・目的：1998年より柔道整復師の養成施設が増加し始め，2008年の有資格者は43,000人を超えた。この増加が柔道整復施術所の地理的分布にどう影響したか，業務の関連がある整形外科医師数と対比させながら経時的に観察し，地域における偏在傾向を定量的に評価した。

対象・方法：2002，2004，2006，2008年の全市町村の柔道整復師施術所をNTTのインターネットサイトであるiタウンページにより調べた。整形外科医師は医師歯科医師薬剤師調査により調べた。各市町村の柔道整復師施術所と整形外科医師の数と人口比，およびGini係数を用いて地理的格差を調査した。

結果：柔道整復師施術所数は2002から2008年まで22,000から25,989施術所に，整形外科医師数は18,571から19,273人に増加した。各市町村の人口10万人あたりの柔道整復施術所数と整形外科医師数は，中央値でそれぞれ13.8から16.3施術所，9.1から9.5人と変化した。人口10万人あたりの柔道整復施術所数は2006-2008年の間で有意に増加したが，Gini係数は2004-2006年の間では0.273から0.264と有意に減少すなわち偏在が小さくなったものの2006-2008年の間では有意な変化はなかった。整形外科医師では2006-2008年でGini係数が大きくなったが有意な変化はなかった。

結論：2008年は全国の柔道整復師施術所数が有意に増加したが，施術所の地域偏在の解消へ向かわなかった。単に柔道整復師の有資格者が増えても施術所の総数が増えるだけで，必ずしもその地域格差を小さくしない事が示唆された。

キーワード：代替医療，地理的分布，柔道整復，ジニ係数，整形外科

はじめに

柔道整復師（以下柔整師）はあん摩，マッサージ，指圧師，はり師，きゅう師と同じく代替医療を実践し，国家資格となっている。2007年の国民生活基礎調査[1]によると，筋骨格系疾患の有訴者（肩こり，腰痛，手足の関節が痛むなど）のうち，病院，診療所への通院者が約36％，あんま，はり，きゅう，柔整師などへの通院者が約16％である。日本では代替医療の利用割合は高く，国民の医療全体を考えるとその影響を無視する事はできない。

柔整師の育成施設においては2000年までは14校の専門学校があるのみで，資格取得者は年間約1,000名であった。ところが1998年の裁判[2]により新設校ができ始め，特に2004-2006年頃から有資格者も増加して2000年ではのべ30,830人[3]であったのが2008年にのべ43,000人[4]を超えた。2010年には大学7校を含め約100校となり，資格取得者は年間5,000人と急増している。柔整師は骨折，脱臼に関しては医師の同意が必要であるが，それらを含め，捻挫，打撲，挫傷に対して施

（指導：矢野栄二教授，中尾睦宏教授）
学位申請論文

術を単独で行う事が出来る。その施術には健康保険を用いる事ができ，2007年には約3,400億円が使われている[5]。柔整師の業務範囲は整形外科医療の分野に近いが，整形外科医師（以下整形医師）の増加数は2000年から2008年で約1,300人であるのに対して柔整師はその間に約12,000人増加しており，柔整師と整形医師の間に業務上の軋轢があるという意見もある[6~8]。また柔道整復師施術所（以下柔整施術所）は過疎地にも多く存在し[6]，高齢者の需要も高い[9]ことが今までの研究から知られている。

わが国の医療資源の地理的分布における研究では県別人口あたりの平均分布数を求めたものが散見されるが，全国市町村別の調査は医師数の報告があるのみである[10]。柔整師に関しては，都道府県別の人数と施術所数を表す資料はあるが[7]，地理的分布の詳細を検討した研究論文は少ない[6]。医師の絶対数不足，過疎地における病院施設の閉鎖など医療を取り巻く環境は厳しさを増しており，今後は医療サービスと代替医療サービスのそれぞれの役割と相互関係を考えていく必要がある。そのためにも柔整施術所の地理的分布を知ることは重要と考えた。

所得格差をみるために経済学の領域でよく使用されるローレンツ曲線・Gini係数を使って，医療資源の不均衡な分布の研究が出されており[11,12]，医師や医療施設の地理的格差の研究にも使われている[10,13~18]。わが国では1992年にKobayashiら[10]が全国の市町村における医師の数を調べ，10年間に医師数が37％増加したにもかかわらず，医師の地理的偏在の改善は見られなかったこと報告した。1990年半ばより，国内外でローレンツ曲線・Gini係数により開業医や小児科医の地理的集中度を検討した報告が散見されるが，医療資源の地理的分布差を経時的に検討した報告は少ない[13~15,18~20]。

柔整師の地理的な適正配置を業務の重なる部分がある整形外科の配置と対比させながら検討する事は，医療費の適正な利用という点でも重要である。われわれは柔整師資格取得者が急増した2002年より全国すべての市区町村における柔整施術所の調査を行ってきた。そこで本研究では，柔整師が急増している状況下で柔整施術所の地理的分布がどのように変化してきたか経時的に観察し，地域における偏在傾向を定量的に明らかにした。そして参照データとして整形医師数の地理的分布を同時に調べた。

方　法

1．対象とデータソース

1）市町村別柔整施術所数：柔整師は開設のさいに保健所への報告義務があるが，報告されているのは県内の保健所単位の施術所数に限られている。よって市町村単位での公的データは入手が困難である。また廃業・休業をより正確に評価する必要性もあった。そこで本研究ではNTTのインターネットサイトを利用した。2002年，2004年，2006年，2008年における全国すべての市町村（含む特別区）の柔整施術所数をiタウンページのホームページ（URL：http://itp.ne.jp/servlet/jp.ne.itp.sear.SCMSVTop）を利用して調べた。キーワードを「柔道整復師」として，地域名をそれぞれの市町村名で入力した。柔整施術所数は，検索された施設より保険業務取り扱いの出来ることを表わす施術所名である「接骨院」，「整骨院」のみを抽出した。「接骨院」，「整骨院」以外の「治療院」などの名称で掲載されている場合は，保険業務取り扱いが出来ないとみなして除外した。

2）市町村別整形医師数：整形医師は医師・歯科医師・薬剤師調査の2002年，2004年，2006年と2008年より入手した。

3）市町村別人口：市町村別人口はiタウンページの調査期間と合わせるために，各都道府県の公式のホームページにおける統計資料より報告されているそれぞれの推計人口を入手した*。2002年度以降に新たに合併した市町村においては，2008年7月時の合併後市町村として人口を加算して調整後解析に用いた。政令指定都市においては，一市町村の人口が膨大となりGini係数の解釈にあたり他の市町村と同列の比較が困難となるため，一特別区を一市町村として扱い分析し合計1,921市区町村を対象とした。

* 各都道府県の推計人口を入手したURLをご希望の方はinos @ med.teikyo-u.ac.jpまで

2．解析方法

地理的分布を調べるため，各自治体の人口10万人あたりの柔整施術所数を算出した。また地域偏在の指標としてローレンツ曲線，Gini係数を算出した。ローレンツ曲線，Gini係数は以下の手順により算出した。

1）自治体を人口10万人あたりの柔整施術所比率の低い順に並びかえた。
2）1）の順でY軸を柔整施術所と整形医師の累積相対度数，X軸を人口累積相対度数としてプロットしローレンツ曲線を作成した。
3）ローレンツ曲線と対角線（Y=X）に囲まれた面積に対する対角線下面積の比率をGini係数として算出した（ローレンツ曲線が対角線に近いほど格差が少なく，Gini係数は小さい）。

ローレンツ曲線，Gini係数は2002，2004，2006，2008年の各年それぞれの年で全市区町村をまとめて全国の値を求めた後，市区部と町村部に分けてそれぞれの値を求めた。Gini係数の有意性を検定するためbootstrap法[21]を使い，その年と2年前のGini係数の差の検定を行った[22]。統計解析はすべてSTATA（Ver.11 for windows）により行った。

結　果

2002年から2008年までの全国・市区部・町村部別の人口，柔整施術所数，整形医師数，人口10万人あたりの柔整施術所数，人口10万人あたりの整形医師数を表に示す。全国ではこの期間に柔整施術所数は22,000から25,989，整形医師数は18,571から19,273人に増えた。また人口10万人あたりの柔整施術所数を中央値（25パーセンタイル-75パーセンタイル）で示すと，13.8（7.5-20.6）から16.3（9.4-23.7）に変化した。人口10万人あたりの整形医師数は9.1（0-15.0）から9.5（0-15.8）人に変化した。人口10万人あたりの柔整施術所数の全国での増加率（対2年前比）は2004年で3.6％，2006年で4.2％，2008年で9.4％となり，整形医師ではそれぞれ1.1％，2.1

表　全国ならびに市区部と町村部における柔整施術所と整形外科医師の数とその人口10万人あたりの数

	2002	2004	2006	2008
人口（×1,000）				
全国	127,440	127,902	127,758	126,931
市区部（n=919）	114,007	114,483	114,480	113,978
町村部（n=1,002）	13,432	13,490	13,279	12,954
柔整施術所数				
全国	22,000	22,774	23,996	25,989
市区部	20,129	20,888	22,045	23,893
町村部	1,871	1,886	1,951	2,091
整形医師数				
全国	18,571	18,771	18,866	19,273
市区部	17,342	17,500	17,604	18,012
町村部	1,229	1,271	1,262	1,261
人口あたり柔整施術所数[a]				
全国	13.8（7.5-20.6）	14.3（7.9-20.9）	14.9（8.6-21.9）	16.3（9.4-23.7）*
市区部	15.9（11.2-21.3）	16.0（11.8-22.0）	17.1（12.5-22.9）	18.6（13.6-24.6）*
町村部	10.9（0-19.3）	11.4（0-19.5）	11.6（0-20.4）	12.4（0-22.4）
人口あたり整形医師数[b]				
全国	9.1（0-15.0）	9.2（0-15.4）	9.4（0-15.3）	9.5（0-15.8）
市区部	12.7（9.2-17.7）	12.8（9.2-18.0）	12.8（9.4-17.8）	13.1（9.5-18.1）
町村部	0（0-9.9）	0（0-10.2）	0（0-9.9）	0（0-10.3）

[a]人口10万人あたりの柔整施術所数，中央値（25-75パーセンタイル）。
[b]人口10万人あたりの整形医師数，中央値（25-75パーセンタイル）。
*2006年と比べて$p<0.05$（95％信頼区間）。

%，1.1%であった。人口10万人あたりの柔整施術所数は全国，市区部とも2006年から2008年の間に有意に増加した。町村部での人口10万人あたりの柔整施術所数はすべての期間で増加していたが有意な変化はなかった。一方，人口10万人あたりの整形医師数は全国，市区部ともすべての期間で増加していたが有意な変化はなかった。町村部での整形医師数は2004年が最大で以降は減少傾向であったが，人口10万人あたりの中央値はすべての調査年で0人であった。表には示さなかったが，柔整施術所が存在しない町村部は2002年から2008年の間で1,002ある町村部で320から311に，整形医師は537から534に減少した。

地域偏在の指標であるGini係数の2002年から2008年までの変化を**図1**と**図2**に示す。**図1**は全国の結果で，**図2**は市区部・町村部別の結果である。柔整施術所では全国と市区部では2004年から2006年の間でGini係数が有意に減少，すなわち地域偏在が小さくなったが，2006年から2008年では有意な変化はなかった。町村部での柔整施術所は2002年よりGini係数は小さくなったが，有意な変化はなかった。整形医師では全国，市区部，町村部いずれもGini係数は2006年から2008年で大きくなったが，有意な変化はなかった。

考　察

人口10万人あたりの柔整施術所数が2004年から2006年の間では有意な差がなく，2006年から2008年の間で有意な増加がみられた理由の1つとしては柔整師の資格取得者の急増が考えられる。2002年までは資格取得者が約1,000名前後であったのが，養成校の急増により，2004年には約3倍の約3,000名となり2008年には約5,000名となっている[23]。柔整師は資格取得後から開設するまでに平均で5.5年との報告がある[24]。これは柔整師が急増する前のデータであり，急増により資格取得後の開設を各柔整師が早めた可能性も考えられるが，2002年前後の柔整師の急増により柔整施術所が2006年から2008年の間に急増したと考えられた。また資格取得者が2003年で約2,000名であり，2008年では約5,000名であることから今後さらに柔整施術所が急増する可能性がある。

Gini係数でみると全国と市区部で2004年から2006年の間では有意に減少，すなわち地域偏在が

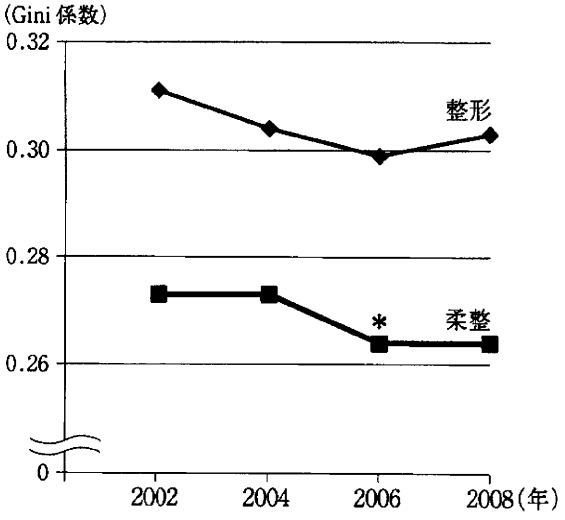

図1　全国の柔整施術所と整形医師のGini係数の推移（2002-2008年）
整形は整形外科医師Gini係数，柔整は柔整施術所Gini係数を示す。
＊2004年と比べて$p<0.05$（Bootstrap法）。

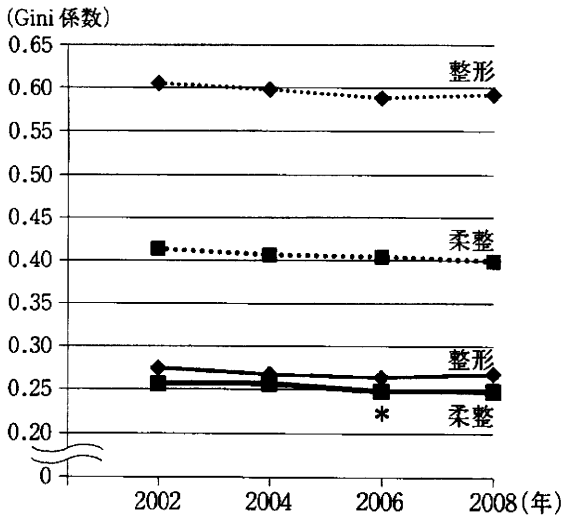

図2　市区部と町村部に分けた柔整施術所と整形医師のGini係数の推移（2002-2008年）
整形は整形外科医師Gini係数，柔整は柔整施術所Gini係数を示す。
直線は市区部，点線は町村部を示す。
＊2004年と比べて$p<0.05$（Bootstrap法）。

小さくなったが，人口10万人あたりの柔整施術所数が有意に増加した2006年から2008年では有意な変化がなかった。市区部と町村部での人口10万人あたりの柔整施術所数をみると，市区部においてのみ2006年から2008年の間で有意に増加している。町村部でも2002年の調査から町村部での柔整施術所は増加しているものの，急増した柔整師がより利益を求め，人口の多い市区部での開設が増えた可能性が考えられる。整形医師数を市区部，町村部でみると，2006年から2008年の間は町村部，市区部とも有意な変化はなかった。医師が飽和状態になると仕事と利益求めやすい地方へ移動すると言われているが[25]，日本では都会から地方への移動や地方での定着率は低くまだその現象が見られていないのかもしれない[19]。町村部では整形医師も柔整施術所も有意な変化はまだない。今後，柔整師増加の影響がさらに進む中で，整形医師と柔整師の分布の推移を見ていくことは，地域医療における柔整師の役割を考察する上での参考資料となると考える。

柔整施術所，整形医師の町村部でのGini係数が全国，市区部に比べ大きい，すなわち地域偏在が大きい理由としては，柔整施術所，整形医師が存在しない町村部の存在が挙げられる。Gini係数を算出する際に柔整施術所，整形医師が存在しない町村部が多いほどGini係数は大きくなる。また柔整施術所のGini係数が整形医師に比べ小さくなっているのは，柔整施術所がより多くの町村部に存在しているためと説明することもできる。町村部では柔整施術所の存在しない町村が減り，Gini係数ががが小さくなってきたが，統計学的に有意な変化はみられなかった。全国レベルでみると柔整師が急増しても地域偏在は解消されなかった。これは医師数が増加しても地理的格差が解消しなかった事[10]と同様に，医療サービスの数の増加が必ずしも地域格差の解消につながらない事を示している。

最後に本研究の限界について考察する。まずiタウンページによる柔整施術所数の調査の妥当性について考える。本調査での柔整施術所の総数は2002年においては22,000施術所であり，日本柔道整復師会による調査結果は23,199施術所であった。差は約5％であり本調査の信頼性はあると考えた[6]。次に柔道整復は施術所数で，整形外科は医師数で解析している点について考察する。これはデータ取得の方法論上やむをえない部分もあったが，日本柔道整復師会の調査では1柔整施術所の平均柔整師数は1.09人であり最大で東京の1.23人となっている。1施術所イコール1人と仮定すれば，整形医師数との対比は可能となる。ただし近年人口の多い市区部では1柔整施術所に複数の柔整師が勤務している可能性もある。その為人口の多い市区部のみ1施術所あたり1.5人とした解析を行ってみたが，主要な結果への影響はみられなかった。第3に人口の評価方法について述べる。本研究では市町村の人口は各都道府県が発表している推計人口を使用した。iタウンページの調査期間が2002-2008年と6年間におよび，人口あたりの柔整施術所を用いるためその期間の人口変動も重要である。国勢調査では5年に1度のために今回の調査では，2年毎の推計人口を用いた。最後に市町村合併の影響について考える。一般的にGini係数はその対象数にも影響され，人口の少ない町村が大きい市区部などに合併されることによりその偏在が小さくなる[15]。市区町村数は2006年（n=1,949）から2008年（n=1,921）となっており，人口10万人あたりの柔整施術所数が有意に増加した期間における市区町村の合併数は少なかった。さらに本研究では2008年の市区町村数を基に調整した解析がなされており，市区町村数の変化によるGini係数への影響はない。本研究は，柔整施術所と整形医師の数，ならびに帰属する住民人口を基に指標を作成した市町村毎のグループデータを解析している。調査の対象を柔整施術所と整形医師診療所として施設数の比較や，住民人口を柔整に通院する可能性の高い年齢に絞って調査解析を行うなど，今後さまざまな研究を重ねていきたい。

結　語

柔整師の急増とともに全国の柔整施術所数の急増がみられたが，施術所の地域偏在の解消へとは向かわなかった。単に柔整師の有資格者を増やしても施術所の総数が増えるだけで，必ずしもその地域格差を小さくせず，柔整師の有資格者の増加が地理的格差解消にならない事が示唆された。

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Chronological Numeral Changes of Judo Facilities and Orthopedic Physicians on Geographical Distribution in Japan

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Background : Judo therapy is a well established Japanese co-medical profession specializing in outpatient manual treatment of fractures and sprains. Recently, the number of judo therapists has been rapidly increasing as a result of proliferation judo therapy academies. This study examines whether such rapid increases have improved geographical distribution of judo therapy facilities in Japan, assessing the number of orthopedic physicians simultaneously as reference.

Methods : The number of judo therapy facilities, orthopedic physicians, and the population in each municipality were obtained from the Web yellow pages, national survey of physicians, dentists and pharmacist, and census data for 2002, 2004, 2006, and 2008, respectively. Lorenz curves and Gini indices were calculated to demonstrate distributions of judo therapy facilities and orthopedic physicians per 100,000 people. A bootstrapped method was used to identify statistical significances of differences in Gini indices.

Results : In all municipalities, the median numbers of judo therapy facilities per 100,000 people were 13.8 in 2002, 14.3 in 2004, 14.9 in 2006, and 16.3 in 2008 ; those of orthopedic physicians per 100,000 people were 9.1 in 2002, 9.2 in 2004, 9.4 in 2006, and 9.5 in 2008. The Gini indices for judo therapy facilities nationally were 0.273 in 2002, 0.273 in 2004, 0.264 in 2006, and 0.264 in 2008 ; those for orthopedic physicians nationally were 0.311 in 2002, 0.304 in 2004, 0.299 in 2006, and 0.303 in 2008. The numbers of judo therapy facilities increased significantly between 2006 and 2008 ($p<0.05$) but the indices did not change significantly in the same period. The Gini indices for local towns and villages remained unchanged and were consistently higher ($p<0.05$) than those in urban areas throughout the study periods. The numbers and Gini indices for orthopedic physicians did not significantly changed during the study period.

Conclusions : Our results suggest that recent increases in the number of judo therapy facilities have not necessarily led to greater equality in their geographic distribution in terms of Gini indices.

Key words : alternative medicine, geographic distribution, Gini index, judo therapy, orthopedics