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Correlation between the ratio of physician consultation fees to hourly minimum wage and consultation length: a cross-sectional study of nine countries

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ABSTRACT

Objectives Current healthcare reimbursement system is criticised for not adequately compensating physicians' cognitive services. This study was performed to examine primary care physicians' consultation fees in nine countries, relative to the national hourly minimum wage and to examine the correlations of the physician consultation fee with consultation length and other healthcare indices.

Design and outcome measures Nine reference countries for which healthcare statistics are publicly available and outpatient consultation is compensated by fee-for-service payment were selected. A representative consultation fee was chosen to calculate the ratio of the consultation fee to the hourly minimum wage. The primary outcome was the correlation between the consultation fee/hourly minimum wage ratio and consultation length. In addition, the consultation fees were compared with fees for haemoglobin A1c tests and brain imaging. Pearson's method was primarily used for correlation analysis.

Results The mean representative consultation fee/hourly minimum wage ratio was 4.02 (median, 2.7; range, 0.80–10.36). The mean consultation length was 12.9 min (median, 14.7 min; range, 5–21.1 min). A significant correlation (r=0.79) was found between consultation length and the consultation fee/hourly minimum wage ratio. The ratio of consultation fee to hourly minimum wage was moderately negatively correlated with the annual number of physician visits, number of consultations per doctor and length of hospital stay. The brain CT fee/consultation fee ratio was moderately positively correlated with the number of CT units per 1 million population. In Japan and Korea, where the brain CT/consultation fee ratio was highest, the number of CT examinations per population was also highest.

Conclusions The relationship of consultation fees to each country's hourly minimum wage varied in nine reference countries; however, it was strongly correlated with consultation length. The imbalance in compensation for cognitive services might drive increased use of imaging tests in some countries.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ National data of each country that are publicly available were used.
⇒ However, only correlation was examined due to the limitation of the sample number.
⇒ Cross-sectional nature of this study does not signify cause-and-effect relationship.
⇒ The selection of nine reference countries was arbitrary.

INTRODUCTION

Physicians' cognitive services constitute the foundation of healthcare; these services involve such skills as clinical data collection and analysis, judgement and planning related to the diagnosis and treatment of health problems based on pertinent expertise, as well as the communication of such information to the patient. A major criticism of the current healthcare reimbursement system, including fee-for-service payment, is that it does not adequately compensate cognitive services; thus, it penalises primary care physicians and others who principally provide cognitive services.[1] For example, Medicare reimburses physicians 3–5 times more for procedural care than for cognitive care, with the result that a specialty procedure (eg, cataract extraction) generates more revenue in 1–2 hours of work than a primary care physician receives for an entire day's work.[2] This imbalanced compensation has a large impact on the healthcare system, as evidenced by the persistent decline in the number of primary care physicians and the overzealous pursuit of procedural care or expensive laboratory and imaging tests. In addition, the undercompensation of physicians for their evaluation and management services has resulted in the reduction of physician service time per patient and pursuit of high-volume clinical care in certain healthcare settings.[3] Such changes contribute to inadequate time spent with patients and an inability to maintain ongoing relationships with them; these factors are significantly associated with dissatisfaction among physicians

and patients.[4] According to a recent study, a large proportion of the global population have only a few minutes with their primary care physicians; importantly, a short consultation time is likely to adversely affect patient healthcare and physician workload.[5]

Despite its difficulty, there is a need to achieve social agreement regarding an appropriate level of compensation for professionals (eg, physicians) who provide services essential to public welfare. One method to address this issue would be to align physician compensation with the national minimum wage as a reference, because it provides a basis for the social contract in terms of wages and work compensation. On the other hand, comparing physician fees to fees for laboratory and imaging tests would provide an alternative perspective concerning the utilisation of healthcare resources.

This study was performed to examine primary care physician consultation fees in relation to the national hourly minimum wage in various countries. In addition, the physician fees were compared with fees for a reference laboratory test (haemoglobin A1c (HbA1c)) and brain imaging (brain CT and MRI). The correlations of the physician consultation fee adjusted by the minimum wage with the fee for HbA1c tests, brain imaging, consultation length and other healthcare indices (eg, number of physician visits and length of hospital stay) were examined.

METHODS

Data source

Eight reference countries were initially selected: Australia, Belgium, Canada (British Columbia, Manitoba, Ontario, Quebec), France, Germany, Japan, South Korea and the USA. Selection criteria were as follows: Organisation for Economic Co-operation and Development (OECD) member country with relevant healthcare statistics publicly available; data concerning public healthcare fee system accessible online; and outpatient consultation fee designated based on a fee-for-service system. In addition, to represent more Asian countries, Taiwan was included because most of the pertinent data were available. In the UK, physicians are mainly paid by salary and not by fee-for-service, and public healthcare fee data were not accessible for analysis; thus, the UK was excluded from the study. Data concerning reference fees for each country were obtained from the following database sites (Online supplemental methods 1 and 2).[6–32]

Australia : https://www.ausdoc.com.au/sites/default/files/mbs_quick_guide_jan2021.pdf, http://www9.health.gov.au/mbs/search.cfm

Belgium : https://www.riziv.fgov.be/fr/themes/cout-remboursement/par-mutualite/prestations-individuelles/prix/Pages/medecin-partie01.aspx

Canada (British Columbia) : https://www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/msp/physicians/payment-schedules/msc-payment-schedule, http://www.bccss.org/bcaplm-site/Documents/Programs/laboratory_services_schedule_of_fees.pdf

Canada (Manitoba) : https://www.gov.mb.ca/health/documents/physmanual.pdf

Canada (Ontario) : https://www.health.gov.on.ca/en/pro/programs/ohip/sob/, https://www.health.gov.on.ca/en/pro/programs/ohip/sob/lab/lab_mn2020.pdf

Canada (Quebec) : https://www.ramq.gouv.qc.ca/en

France : https://www.ameli.fr/medecin/exercice-liberal/remuneration/tarifs-generalistes/tarifs-metropole, https://www.15-20.fr/wp-content/uploads/2020/07/labo-tarifs-A3-2020.pdf, https://www.ameli.fr/accueil-de-la-ccam/index.php, http://www.ameli.fr/fileadmin/user_upload/documents/Nouveaux_tarifs_forfaits_techniques.pdf

Germany : http://www.e-bis.de/goae/defaultFrame.htm

Japan : http://2020.mfeesw.net/x15/x23/

South Korea : https://repository.hira.or.kr/handle/2019.oak/2540

Taiwan : https://www.nhi.gov.tw/Content_List.aspx?n=58ED9C8D8417D00B

The US : at https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PhysicianFeeSched, https://www.cms.gov/Medicare/Medicare-Fee-for-Service-payment/ClinicalLabFeeSched/Clinical-Laboratory-Fee-Schedule-Files, https://www.medicare.gov/procedure-price-lookup/

For information regarding the healthcare index and minimum wage, the OECD report was used: https://stats.oecd.org/ (last access, 10 July 2021).

Fees for consultation, HbA1c tests and brain imaging

Although we aimed to focus on primary care consultation, the definition of primary care was often ambiguous and included services provided by various physicians. In many countries, the consultation fee for a physician working in a different setting was not explicitly differentiated. Some countries (Australia, Canada and the USA) adjusted fees for differences in consultation time or level of consultation, whereas others used fixed rates regardless of such differences. To simplify the analysis, a representative consultation fee was selected to calculate the ratio of consultation fee and hourly minimum wage when different fees were used according to time spent. These were level 2 for Australia and part 2 level B for the USA (online supplemental methods 1). Where consultation fees for new patients differed from consultation fees for established patients (Korea and Japan), fees for established patients were used. For the three countries where different consultation fees were applied based on time spent (Australia, Canada and the USA), the ratio of an hourly consultation fee to the hourly minimum wage was calculated as minimum, maximum and mean (ie, consultation length was presumed to be the maximum, minimum and mean of the maximum and minimum possible time spent for the selected fee scheme). For example, for an Australian level 3 routine consultation (item number 36),

where a consultation length of 20–40 min is specified, the minimum, maximum and mean time spent were calculated as 20, 40 and 30 min (20+40/2), respectively.

HbA1c was chosen as a reference laboratory test because of its relative simplicity in fee schedule compared with other lab tests, and its importance. Compared with blood battery or liver function test, hemoglobin (HgB) A1C has a single fee schedule in most countries. Likewise, brain imaging was chosen as a reference imaging test because it has simpler fee schedule in most countries studied. In addition, brain CT/MRI is typical high cost tests that are often the culprit of abuse. Fees for brain CT and brain MR with contrast were used. In Canada, only professional fees were listed for CT and MRI. Thus, to calculate the total fee of Canada, the mean fees of commercial imaging labs were referenced (online supplemental methods 2).

Physician consultation length

A recent report regarding consultation length among primary physicians was used as the primary reference for each country; additional references were included where available. If multiple reports of consultation length were available from a single country, data from the most recent and highest quality report were used.[33–35]

Statistical analysis

Pearson's method was mainly used for correlation analysis; the Spearman correlation coefficient was also employed depending on the number of samples used in the analysis. Slopes and intercepts were estimated by simple linear regression. The primary outcome was the correlation between the representative consultation fee/hourly minimum wage ratio and the consultation length for each country. Correlations between the consultation fee/hourly minimum wage ratio and other healthcare indices (eg, number of physician visits and length of hospital stay) were also examined.

In addition, consultation fees were compared with the fees for HbA1c and brain imaging; fee ratios were calculated. The correlations of the consultation fee/HbA1c ratio with consultation fee/brain imaging ratio and consultation fee/brain imaging ratio with healthcare utilisation indices (eg, numbers of CT/MR machines per population and CT/MR examination per population) were examined. Pearson's coefficients of $r \geq 0.7$ or ≤ -0.7 were considered to indicate strong correlations.

Patient and public involvement

Patients and/or the public were not involved in the research.

RESULTS

Consultation fees are compared with hourly minimum wages and some key indices of healthcare in each country in table 1. The mean ratio of representative consultation fees to each country's hourly minimum wage was 4.02 (median, 2.7; range, 0.80–10.36). The mean consultation length was 12.9 min (median, 14.7 min; range, 5–21.1 min). For three countries where consultation fees were adjusted based on time spent (Australia, Canada and the USA), consultation fees were used to gain a more accurate perspective relative to the hourly minimum wage. Minimum, maximum and mean consultation lengths were presumed to represent the maximum, minimum and mean values of the maximum and minimum possible time designated for the selected fee schemes, as described in the Methods section (online supplemental table S1). The ratio of the hourly consultation fee to the hourly minimum wage differed widely among these three countries, with the lowest ratio found for Australia (5.67–11.35), middle ratio for Canada (8.13–13.6) and highest ratio for the USA (18.2–31.07). Next, the relationships of the consultation fee to the fees for the reference laboratory test (HbA1c) and reference imaging test (brain CT and brain MR) were examined (table 2). The difference between laboratory and imaging fees relative to consultation fees also varied widely, with mean compensation ratios for HbA1c, brain CT and brain MR to consultation fees of 0.46, 9.75 and 17.89, respectively (median and range for HbA1c, 0.37, 0.09–1.24; for brain CT, 6.2, 2.1–27.36; and for brain MR, 10.41, 4.27–49.15, respectively). A number of CT and MR units per 1 million population were highest in Japan, which had the highest and second-highest compensation ratios for brain CT/consultation fee and brain MR/consultation fee, respectively. In contrast, Taiwan had the second-lowest numbers of CT and MR units per 1 million population, despite the comparatively high ratios of fees for these brain imaging tests to fees for consultation. The number of CT examinations per 1000 population was highest in South Korea, followed by Japan; the number of MR examinations was highest in Germany, followed by France. Next, the correlations between consultation length and the ratio of representative consultation fee/hourly national minimum wage were examined in reference countries. Regarding Canada, where data for the compensation ratio were publicly available in four provinces and consultation length data were available only at the country level, the mean ratios for the four provinces were used. A significantly strong correlation was observed ($r=0.79$; $p=0.0109$); the estimated slope was 1.43, indicating that the mean consultation length tended to rapidly increase with increasing representative consultation fee ratio. Non-parametric analysis using the Spearman coefficient ($\rho = 0.83$; $p=0.0083$) also supported a strong correlation (figure 1).

Excluding Canada and the USA, which had the highest consultation fee/minimum wage ratio, two groups of countries were distinguished: one had the lowest consultation fee and short consultation times (Japan, Korea, Taiwan and Germany) and the other had a lower consultation fee and long consultation times (Australia, Belgium and France). Notably, despite the similar tendency towards short consultation length in Japan and Korea, only 42.1% of patients in Japan indicated that doctors spent sufficient time with

Table 1 Consultation fees and some key indices of healthcare

	Australia	Belgium	Canada (British Columbia)	Canada (Manitoba)	Canada (Ontario)	Canada (Quebec)	France	Germany	Japan	Korea	Taiwan	USA
Consultation fee differs according to time spent	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Consultation fee*	17.50–111.05	22.61–27.06	31.61–77.15	26.99–86.15	45.9–217.15	49.15–99.4	23–25	4.66–15.15	720–2880	11 780–16 480	234–322.2	75.08–208.45
Consultation length†	14.7	15	15.8	15.8	15.8	15.8	16.0	7.6	6.1	6.3	5	21.07
Hourly minimum wage	20	9.67	14.6	11.9	14.25	13.1	10.15	9.35	901	8590	158	7.25
Ratio of representative consultation fee per hourly minimum wage‡	1.94	2.80	5.28	7.24	5.93	7.59	2.46	0.99	0.80	1.37	1.48	10.34
Average salary of GP/average general salary	1.9	2.5	2.9	2.9	2.9	2.9	2.9	4.4	NA	NA	NA	3.19
Physicians, density per 1000 population	4.67	6.11	2.97	2.97	2.97	2.97	3.2	6.43	2.4	2.95	2.1	2.6
Remuneration of primary care physicians§	FFS+other	FFS+Cap	FFS+Cap+Salary +Other	FFS+Cap+Salary +Other	FFS+Cap+Salary +Other	FFS+Cap+Salary +Other	FFS +Other	FFS	NA	FFS	FFS	FFS+Cap+Salary +Other
Remuneration of provider setting§	FFS+P4P	FFS+Cap	FFS+Cap	FFS+Cap	FFS+Cap	FFS+Cap	FFS+P4p +Other	FFS	FFS	FFS+P4P	FFS	FFS+Cap+P4p +other
Predominant mode of primary care§	private group	private solo	private group	private group	private group	private group	private solo	private solo	group	private solo	NA	private group
Average annual no of physician visits per capita	7.3	7.3	6.6	6.6	6.6	6.6	5.9	9.8	12.5	17.2	12.3	4.0
No of consultation per doctor	2095	2271	2568	2568	2568	2568	1944	2330	5191	7080	6150	1624
Doctor spending enough time (%)	91.6	97.5	79.9	79.9	79.9	79.9	83.7	85.8	42.1	80.8	NA	81.5
Doctor providing easy to understand explanation (%)	93.5	97.7	89.1	89.1	89.1	89.1	NA	84.3	94.2	82.9	NA	89.8
Doctor involving patient in decision (%)	87.8	95.2	84.8	84.8	84.8	84.8	NA	87.2	NA	82.4	NA	85.2
Ambulatory sensitive condition admission rate per 100 000												
Asthma	63.1	21.3	13.7	13.7	13.7	13.7	29.6	31.5	34.7	65	NA	37.1
Diabetes	153.2	154.8	96	96	96	96	150.6	206.1	162.3	224.4	NA	226
Hypertension	39.2	14.1	13.9	13.9	13.9	13.9	33	254.5	22.5	73.9	NA	57.5
Average length of stay in hospital (days)	5.2	6	8.2	8.2	8.2	8.2	8.8	8.9	16.2	17.9	8.4	4.8

Continued

Table 1 Continued

	Australia	Belgium	Canada (British Columbia)	Canada (Manitoba)	Canada (Ontario)	Canada (Quebec)	France	Germany	Japan	Korea	Taiwan	USA

*Currencies are Australian dollar for Australia, Euro for Belgium, France and Germany, Canadian dollar for Canada, Japanese Yen for Japan, Korean Won for Korea, New Taiwanese dollar for Taiwan and US dollar for the USA.
†Adapted from Irving G, Neves AL, Dambha-Miller H, *et al*. International variations in primary care physician consultation time: a systematic review of 67 countries. BMJ Open 2017;7:e017902 except for Korea and Taiwan. For Korea, 의과 의원의 외래 진료 질 담보 및 비용 관리를 위한 진찰료 수가모형 at https://repository.hira.or.kr/handle/2019.oak/2429 (last access, 31st March, 2021). For Taiwan, 健保給付中逐年下降的醫師費，會帶來什麼影響？ at https://www.twreporter.org/a/health-insurance-system-diagnostic-fee (last access, 31st March, 2021).
‡Representative consultation fees were chosen as follows. Australia : item number 23, level B, Belgium : item number 101076, Consultation au cabinet par un médecin généraliste accrédité, Canada : Item number 00100, Consultation - in office: (age 2–49), Item number 8540, Complete History and Physical Examination, Item number A005, Consultation and Item number 15801 Clientèle inscrite de 500 patients ou plus, En cabinet ou à domicile en lien avec les activités du médecin en cabinet for British Columbia, Manitona, Ontario and Quebec, respectively. France : G : consultation au cabinet majorée de la majoration pour le médecin généraliste, Germany : Item number 7 Vollständige körperliche Untersuchung mindestens eines der folgenden Organsysteme, Japan : Item number A 0 0 1再診料, Korea : Item number AA254 재진 진찰료, Taiwan : Item number 00101B, 00102B, 00105B, 00106B, 00107B, 00108B. 一般門診診察費－醫院門診診察費, USA : Item number 99202, level2.
§Adapted from Payment primary care at .https://www.oecd.org › els › Payment-Primary-CareXLS.
Cap, capitation; FFS, fee-for-service; GP, general practitioner; NA, not available; P4P, pay for performance.

Table 2 Ratio of consultation fee compared with haemoglobin A1c and brain imaging fee

	Australia	Belgium	Canada (British Columbia)	Canada (Manitoba)	Canada (Ontario)	France	Germany	Japan	Korea	Taiwan	USA
hemoglobin (HgB) A1C/ consultation fee	0.43	0.30	0.07		0.09	0.27	1.25	0.68	0.58	0.86	0.09
Brain CT/consultation fee	6.61	NA	4.2	3.77	3.85	5.80	15.62	27.36	8.68	19.49	2.14
Brain MR/consultation fee	10.41	6.48	11.0	9.85	10.04	9.46	33.74	24.72	27.74	49.15	4.17
No of CT unit* per million population	70.25	24	14.82	14.82	14.82	18.24	35.1	111.5	40	17.92	42
No of MR unit per* million population	14.8	11.5	10.1	10.1	10.1	15.4	34.5	55.2	32	10.6	34.5
No of CT exam/1000* population	140.9	205	144	144	144	199	145	230.8	249	111.6	220
No of MR exam/1000* population	51	98	62	62	62	123	145	112	74	38.8	82

*For Canada, country level data are shown for each province.
NA, not available.

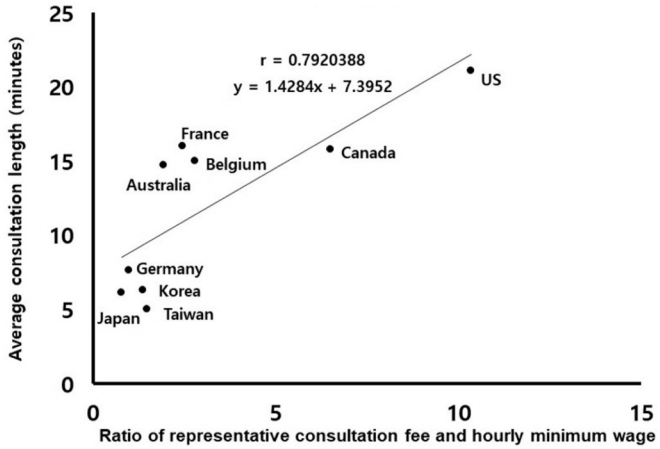

Figure 1 The correlation between consultation length and compensation ratio of representative consultation fee/hourly national minimal wage of nine reference countries.

patients, while 80.8% of patients in Korea had this perception (table 1). The correlation between consultation length and patient perception that doctors spent sufficient time with patients was moderate (Pearson's r=0.48and Spearman's $\rho = 0.24$; online supplemental figure S1A).

As expected, consultation length was strongly negatively correlated with annual number of physician visits and number of consultations per doctor (online supplemental figure S1B,C). Consultation length was also strongly negatively correlated with the length of hospital stay and moderately negatively correlated with the hypertension admission rate (online supplemental figure S1D, E). The ratio of consultation fee to hourly minimum wage was moderately negatively correlated with the annual number of physician visits, number of consultations per doctor and length of hospital stay (online supplemental figure S2A–C).

Countries with low ratio of consultation fee to minimum wage tended to have higher HbA1c brain CT and brain MR fee compared with consultation fee (figure 2A–C).

In addition, countries with higher HbA1c/consultation fee ratio tended to have higher imaging/consultation fee ratios, suggesting systematic overcompensation for lab tests and imaging tests in countries with low compensation for consultation (online supplemental figure S3A,B). Finally, the relationships of the brain imaging/consultation fee ratio with the numbers of CT and MR units per 1 million

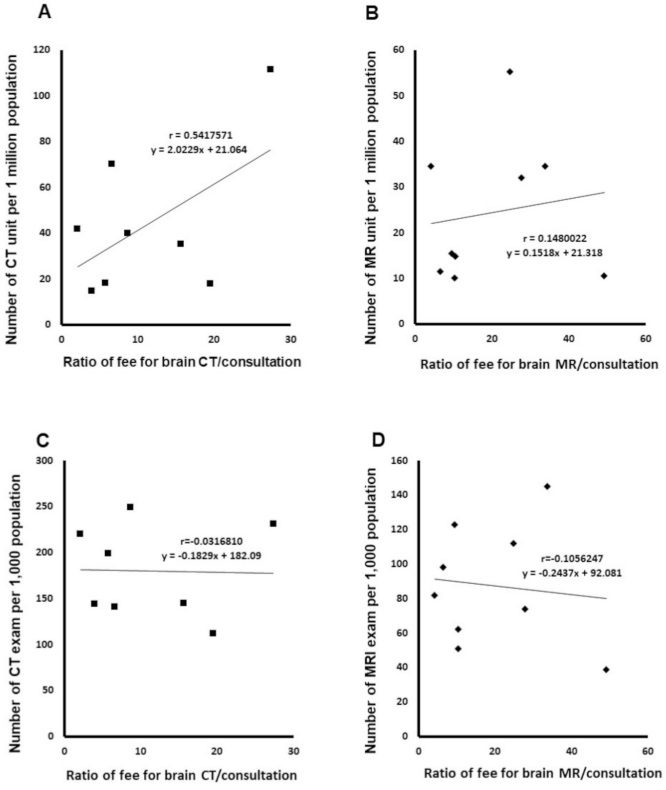

Figure 3 (A–D) shows the correlation between the compensation ratio of brain imaging/consultation fee and the number of CT unit per 1 million population. (A) the number of MR unit per 1 million population, (B) the number of CT exam per 1000, (C) and the number of MR exam per 1000 (D).

population were examined. The brain CT/consultation fee ratio was moderately positively correlated with the number of CT units per 1 million population but was not correlated with the number of CT examinations per 1000 population (figure 3A–D). The brain MR/consultation fee ratio was not correlated with the number of MR units per 1 million population or the number of MR examinations.

DISCUSSION

In this study, we aimed to compare physicians' consultation fees (the prototypical fee for physician cognition and evaluation and management services) with the national hourly minimum wage (a socially agreed on wage floor

Figure 2 (A–C) shows the correlation between the compensation ratio of consultation/minimum wage and hemoglobin (HgB) A1C/consultation fee (A), brain CT/consultation fee (B) and brain MR/consultation fee (C).

legally paid to employees) in nine reference countries. We found that the rate of compensation for consultation varied widely: some countries had consultation fees less than or similar to the hourly minimum wage, whereas other countries (eg, the USA) had consultation fees up to 10.4-fold higher. As expected, the level of compensation for consultation was strongly correlated with consultation length. In addition, compensation for consultation was strongly negatively correlated with the compensation level for HbA1c tests and moderately negatively with compensation levels for brain CT and brain MR.

The problem of inequity in reimbursement for cognitive services compared with technical procedures has been raised for some time. A 1981 American Society of Internal Medicine White Paper explained that health insurance was originally created to protect patients from the high costs of surgical procedures; the expansion of health insurance benefits led to increased coverage for procedural services but did not include coverage for cognitive services.[36] However, it is difficult to determine the appropriate compensation level for physicians' thought processes in today's world of ever-increasing demand for social justice and resolution of inequality. In our study, we noted that the three Asian countries had lower levels of compensation, compared with Western countries; they also had shorter consultation length, higher mean annual number of physician visits per capita and higher number of consultations per doctor. Compared with the USA and Canada, the level of compensation tended to be lower in Australia and European countries, while the consultation length was similar overall. These long consultations despite lower compensation levels may be largely explained by difference in how physicians are paid (eg, salaried or fee-for-service) and whether the healthcare system involves two tiers of payment (eg, public vs private). For example, in countries such as South Korea, where physician fees are determined only by the government, and physicians are paid on a fee-for-service basis, physician income is dependent directly on the volume of service. In such instances, physicians are strongly motivated to increase patient volume instead of providing longer consultation time, particularly if the compensation level is low. In contrast, countries where physicians are salaried independent of the number of patients they serve and where a private healthcare system allows physicians to compensate for low service fees, physicians' approaches are less driven by the volume of patients. Although the optimal length of a physician consultation is controversial, a consultation that is excessively short (ie, 5–6 min) is an obvious cause for concern. In a recent study from Japan, one of the countries with a short consultation time, a sufficiently long consultation (more than 7.6 min) was an important factor in the subjective satisfaction of patients with chronic low back pain, particularly among patients with psychological problems.[37] Of interest, despite similar culture and short consultation time, much higher percentage of Korean patients indicated that doctors spend sufficient time than Japanese patients. Compared with Japan, South Korea was still in the process of economic growth in year 2010s, thus, patients may still have been used to the short consultation and low-quality care of previous decades, which led to less dissatisfaction from short consultation.

The level of compensation for HbA1c and brain imaging, relative to consultation fees, also considerably varied among the reference countries. Because consultation fee was negatively correlated with HbA1c or brain imaging fees, systematic overcompensation for lab and imaging tests compared with consultation may be present in countries with low compensation for consultation. Although a number of CT and of MR examinations were not significantly correlated with the imaging fee/consultation fee ratio, the decision to use expensive imaging depends heavily on the health insurance system and coverage plans; national databases (eg, OECD Stat) cannot capture all of these services in countries where they are not covered by public insurance, thus resulting in inaccuracies. Notably, a number of CT examinations per 1000 population were highest and second highest in South Korea and Japan, respectively, which had the third highest and the highest brain CT/consultation fee ratios. These results suggest that the imbalance in compensation between cognitive services and imaging tests might drive the increased use of imaging in these countries.

Because of limitations concerning publicly available datasets for healthcare service fees in many countries and differences in healthcare systems among countries, our study had many limitations. First, the selection of nine reference countries was arbitrary. Second, although we used consultation length data from the most recent and highest quality studies, such studies are inherently illustrative. The minimum wage is determined by various factors, including each countries' attitudes towards the labour market and social inequality. There is no consensus regarding what constitutes the optimal consultation time; the implications of short consultations and their negative influences on health or overuse of medical resources is an emerging area of investigation. However, our results showed that consultation duration was strongly negatively correlated with the length of hospital stay and moderately negatively correlated with hypertension admission rate, an ambulatory sensitive care condition, suggesting that short consultations have negative influences on some healthcare indices. In countries where no universal payment system is in place, multiple fee systems may exist, resulting in inaccurate brain imaging fees. Although we suggested that an increased number of brain imaging tests is correlated with low compensation for physician cognitive service, it is also influenced by a number of variables such as the prevalence of hypertensive diseases, cerebrovascular diseases or the proportion of elderly people. Because national data that do not reflect such variables were used, this is another limitation of this study. Finally, since correlation does not mean cause and effect, more valid conclusion may be obtained from a prospective policy study, which examines the effect of change

in compensation for cognitive service on consultation length as well as other healthcare indices.

In conclusion, we showed that the ratio of consultation fees to hourly minimum wage varied among countries and was strongly correlated with consultation length in nine reference countries. The brain CT/consultation fee ratio was moderately positively correlated with the number of CT units per 1 million population, suggesting that the imbalance in compensation for cognitive services might drive increased use of imaging tests.

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