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研究課題名（和文）妊娠中の母親の体重増加に関する意識が出生体重に与える影響

研究課題名（英文）Effect of maternal awareness of weight gain during pregnancy on birth weight

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研究成果の概要（和文）：本研究執筆にかかる情報収集、環境整備が十分に整い、順調に執筆作業を行うことができた。情報収集については、本課題に関連のある論文を基に新たな統計手法を加え論文を完成させ、エコチル調査の調査実施機関である、コアセンターへの事前審査、環境省の承認の上、国際誌への投稿を行った。本課題は、エコチル調査の成果発表のルール上、論文がアクセプトされてから、学会発表等が可能となるために、発表可能となった段階で積極的に世間に向けて情報発信を行っていききたい。

研究成果の学術的意義や社会的意義

質問表が自己記述式、未検証であり、質問への回答を得た妊婦のみを対象としており、妊娠前の質問については過小、過大評価が生じた可能性などいくつかの限界はあるが、日本人の大規模コホートにおいて、体型や健康に対する意識が低いグループと、それらに対応する特徴、および妊娠中の体重増加、胎児の成長に関連するリスクを明らかにした初めての研究である。本研究において、妊娠中の適切な体重増加と胎児の成長に影響を与える要因として、妊娠中の体重増加に関する意識について考慮し、根本的な要因を特定することの重要性を示唆している。

研究成果の概要（英文）：The information collection and environmental preparation for writing this research were sufficiently prepared, and we were able to conduct the writing work smoothly. For information collection, we completed the article by adding new statistical methods based on papers related to this project. We submitted the article to an international journal after prior review by the the Japan Environment and Children's Study (JECS) Core Center, the organization that conducts the JECS Survey, and approval by the Ministry of the Environment. In this project, we will actively disseminate the information to the public as soon as the paper is accepted for publication.

研究分野：環境医学

キーワード：SGA FFQ JECS

## 様式 C - 19、F - 19 - 1、Z - 19 (共通)

### 1. 研究開始当初の背景

我が国の出生体重は減少から横ばいに転じているものの、低出生体重の割合は依然として高い。低出生体重児出生には喫煙や母親の疾患、児の疾患等様々な要因がリスクとなるが、その一つに低栄養があげられる。近年瘦身願望の強い若い女性が増加しており、これらの女性は妊娠適応年齢に当たる。母親の妊娠中のエネルギー摂取が少ないと、自ずと児の出生体重に影響が及ぶ。

妊娠中の食事摂取には、体重増加に関する意識が影響すると考える。そこで本研究では、妊娠中の母親の体重増加に関する意識を他の要因と共に全国規模で調査することにより、その母親の意識が妊娠中の低栄養に至る要因となり、出生体重に影響しているか明らかにする。

### 2. 研究の目的

妊娠中の体重増加を抑制する理由にもとづいてグループの特定を行い、これらのグループが妊娠中の体重増加と胎児の成長にどのように関連しているかを検討した。

### 3. 研究の方法

JECSの全国データに登録された104,065人から、選別された92,539組の妊婦とその子どもを対象とした。自己記述式の質問紙の回答から得られた、体重増加を抑制する理由にもとづいて、latent class analysis (潜在クラス分析) を用いて、グループの特定を行った。加えて多項ロジスティック解析を用い、グループ間での妊娠中の体重増加及び胎児成長のリスクを推定した。

### 4. 研究成果

(結果)

グループ2は、グループ1と比較して、若く、妊娠前に低体重、未婚、初産、妊娠前に減量した経験があり、慢性疾患がない傾向があった。グループ3は、低学歴、未婚、経産、喫煙者、妊娠前の低体重と帝王切開の経験が多いという傾向を示した。グループ1と比較して、グループ2では、妊娠中の体重増加の不足およびLGA (large-for-gestational-age) のリスクが低く、グループ3では、妊娠中の過剰な体重増加とSGA (small-for-gestational-age) の調整前リスクが高い。

(考察)

質問表が自己記述式、未検証であり、質問への回答を得た妊婦のみを対象としており、妊娠前の質問については過小、過大評価が生じた可能性などいくつかの限界はあるが、日本人の大規模コホートにおいて、体型や健康に対する意識が低いグループと、それらに対応する特徴、および妊娠中の体重増加、胎児の成長に関連するリスクを明らかにした初めての研究である。

(結論)

本研究において、妊娠中の適切な体重増加と胎児の成長に影響を与える要因として、妊娠中の体重増加に関する意識について考慮し、根本的な要因を特定することの重要性を示唆している。

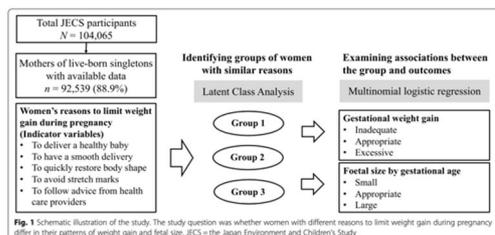


Fig. 1 Schematic illustration of the study. The study question was whether women with different reasons to limit weight gain during pregnancy differ in their patterns of weight gain and fetal size. JECS = the Japan Environment and Children's Study.

Table 1 Proportion of women reporting each reason (N = 92,539)

Reasons to limit gestational weight gain	n (%)
To have a smooth delivery	67,303 (72.7)
To deliver a healthy baby	63,798 (68.9)
To quickly restore body shape	43,191 (46.7)
To avoid stretch marks	14,255 (15.4)
To avoid lifestyle diseases later in life	27,081 (29.3)
To follow advice from health care providers	26,451 (28.6)
To follow advice from family and friends	7819 (8.5)
No particular reason	619 (0.7)
Other reasons	4643 (5.0)

\*No particular reason\* and \*Other reasons\* were omitted from the analyses because of the low response (0.7%) and inability to generate a meaningful item, respectively

Table 2 Probability of giving each reason by group (N = 92,539)

Reasons to limit gestational weight gain	Group 1	Group 2	Group 3
	71,002 (76.7%)	13,406 (14.5%)	8131 (8.8%)
	Probability (95% CI)		
To deliver a healthy baby	0.72 (0.71–0.72)	0.80 (0.79–0.81)	0.27 (0.24–0.30)
To have a smooth delivery	0.79 (0.78–0.79)	0.88 (0.87–0.89)	–
To quickly restore body shape	0.42 (0.41–0.44)	0.90 (0.88–0.93)	0.08 (0.06–0.10)
To avoid stretch marks	0.03 (0.02–0.04)	0.83 (0.69–0.91)	–
To follow advice from health care providers	0.29 (0.28–0.29)	0.38 (0.37–0.39)	0.13 (0.11–0.14)

Groups were defined on the basis of the distribution of reasons to limit gestational weight gain: Group 1 = more likely to cite smooth delivery and child health (health conscious); Group 2 = more likely to cite body shape, smooth delivery, and child health (body-shape and health conscious); Group 3 = less likely to cite any strong reason (not body-shape or health conscious)  
Women in Group 3 had a very low probability of citing "to have a smooth delivery" and "to avoid stretch marks"; therefore, we constrained those two items in the model for Group 3

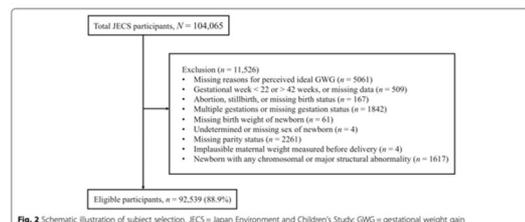


Fig. 2 Schematic illustration of subject selection. JECS = Japan Environment and Children's Study; GWG = gestational weight gain

**Table 3** Maternal characteristics determining membership in a particular group, relative to Group 1

Maternal factors	Group 2				Group 3			
	RRR	95% CI	aRRR	95% CI	RRR	95% CI	aRRR	95% CI
Maternal age, y								
≤ 19 (teenage mother)	1.47	1.26-1.73	1.06	0.89-1.27	1.90	1.58-2.28	1.51	1.22-1.86
20-34	Ref.		Ref.		Ref.		Ref.	
≥ 35	0.59	0.56-0.62	0.69	0.65-0.72	0.87	0.82-0.92	0.87	0.82-0.92
BMI categories, kg/m <sup>2</sup>								
< 18.5 (underweight)	1.17	1.12-1.23	1.23	1.17-1.30	1.33	1.26-1.42	1.22	1.14-1.30
18.5-24.9 (normal weight)	Ref.		Ref.		Ref.		Ref.	
≥ 25 (overweight)	0.41	0.38-0.44	0.41	0.37-0.44	1.06	0.99-1.14	0.95	0.88-1.03
Marital status								
Married	Ref.		Ref.		Ref.		Ref.	
Single mother	1.48	1.36-1.60	1.10	1.01-1.21	1.58	1.43-1.75	1.30	1.15-1.45
Educational level								
High school or less	Ref.		Ref.		Ref.		Ref.	
Vocational school/College	1.01	0.97-1.05	1.04	0.99-1.09	0.64	0.61-0.68	0.75	0.70-0.79
University or higher	0.88	0.84-0.93	0.91	0.86-0.96	0.57	0.54-0.61	0.73	0.68-0.78
Weight loss methods <sup>a</sup>								
None	Ref.		Ref.		Ref.		Ref.	
Healthy method	1.36	1.31-1.41	1.38	1.33-1.45	0.67	0.64-0.70	0.71	0.67-0.75
Unhealthy method	2.19	2.05-2.33	2.09	1.94-2.25	1.05	0.96-1.15	0.83	0.75-0.91
Total energy intake, kcal/d								
1st (lowest tertile)	1.04	1.00-1.09	0.98	0.94-1.03	1.18	1.12-1.25	1.07	1.01-1.14
2nd	Ref.		Ref.		Ref.		Ref.	
3rd	1.02	0.98-1.07	1.03	0.99-1.08	1.17	1.11-1.24	1.15	1.08-1.22
Physical activity, MET-min/d								
1st (lowest tertile)	0.97	0.92-1.01	0.98	0.93-1.03	1.07	1.01-1.13	1.01	0.95-1.08
2nd	Ref.		Ref.		Ref.		Ref.	
3rd	1.14	1.09-1.20	1.06	1.01-1.12	1.18	1.12-1.26	1.10	1.04-1.17
Smoking								
Never smoke	Ref.		Ref.		Ref.		Ref.	
Quit	1.12	1.08-1.17	1.03	0.99-1.08	1.59	1.42-1.57	1.38	1.31-1.46
Currently smoke	1.22	1.11-1.33	1.10	0.99-1.22	2.77	2.54-3.02	2.15	1.95-2.38
Alcohol								
Never drink	Ref.		Ref.		Ref.		Ref.	
Quit	1.20	1.15-1.25	1.12	1.08-1.17	1.04	0.99-1.10	0.99	0.94-1.05
Currently drink	1.06	0.99-1.13	1.12	1.04-1.20	0.97	0.89-1.06	0.97	0.88-1.06
Parity								
0	Ref.		Ref.		Ref.		Ref.	
1	0.68	0.66-0.71	0.76	0.73-0.80	1.20	1.14-1.27	1.16	1.09-1.23
2 or more	0.53	0.50-0.56	0.60	0.57-0.64	1.34	1.26-1.42	1.21	1.13-1.30
Past medical history								
Anaemia	1.04	0.99-1.09	-	-	1.03	0.97-1.09	-	-
Hypertension	0.46	0.39-0.54	0.67	0.56-0.79	1.23	1.08-1.40	1.13	0.98-1.30
Diabetes	0.57	0.45-0.73	0.87	0.68-1.11	1.11	0.89-1.39	1.04	0.82-1.33

**Table 3** Maternal characteristics determining membership in a particular group, relative to Group 1 (Continued)

Maternal factors	Group 2				Group 3			
	RRR	95% CI	aRRR	95% CI	RRR	95% CI	aRRR	95% CI
Previous caesarean delivery	0.70	0.65-0.76	0.97	0.92-1.06	1.51	1.41-1.63	1.44	1.32-1.56
Nausea and vomiting	0.99	0.94-1.04	1.05	1.00-1.11	0.89	0.84-0.95	0.93	0.87-0.99
Health guidance	0.89	0.83-0.94	0.92	0.86-0.98	1.01	0.94-1.08	0.99	0.91-1.07

BMI body mass index, CI confidence interval, RRR crude relative risk ratio, aRRR adjusted relative risk ratio, MET metabolic equivalent  
 Group 1 = health conscious; Group 2 = body-shape and health conscious; Group 3 = not body-shape or health conscious  
<sup>a</sup> Healthy method = eating less or reducing snacks, dieting, or exercising to lose weight; Unhealthy method = using medication, purging after meals, or smoking to lose weight  
 Adjusted model included age, pre-pregnancy body mass index, marital status, parity, educational level, weight loss methods, total energy intake, physical activity, smoking and alcohol consumption habit, past medical history (hypertension, diabetes), previous caesarean delivery, pregnancy-related nausea and vomiting, and receipt of health guidance

**Table 5** Average gestational weight gain (GWG) and new-born birth weight by maternal characteristics

Maternal factors	GWG, kg		P <sup>a</sup>	Birth weight, g		P <sup>a</sup>
	Mean (SD)	95% CI		Mean (SD)	95% CI	
Overall participants	10.3 (4.0)			3030.8 (408.2)		
Maternal age, y			< 0.001			< 0.001
≤ 19 (teenage mother)	11.9 (4.5)***	2994.3 (377.7)**		3034.1 (401.0)		
20-34 (Reference)	10.5 (4.0)			3021.8 (431.6)***		
≥ 35	9.6 (3.9)***					
BMI categories, kg/m <sup>2</sup>			< 0.001			< 0.001
< 18.5	10.9 (3.5)***	2930.7 (386.5)***		3015.4 (408.7)***		
18.5-24.9 (Reference)	10.6 (3.7)			3038.9 (400.2)		
≥ 25	7.7 (5.3)***	3125.2 (461.7)***				
GWG categories			< 0.001			< 0.001
Inadequate	4.8 (2.9)	2858.1 (445.2)***		3154.7 (387.9)***		
Appropriate (Reference)	9.6 (1.5)			3029.4 (375.6)		
Excessive	16.1 (2.9)					
Marital status			< 0.001			< 0.001
Married	10.2 (4.0)			3032.7 (408.1)		
Single mother	11.6 (4.5)	2997.0 (410.9)				
Parity			< 0.001			< 0.001
0 (Reference)	10.7 (4.1)			2999.0 (409.2)		
1	10.0 (3.9)***	3044.4 (397.6)***		3066.9 (421.4)***		
2 or more	10.0 (4.0)***					
Educational level			< 0.001			0.158
High school or less (Reference)	10.7 (4.4)			3030.0 (413.5)		
Vocational school/College	10.2 (3.8)***	3029.3 (408.5)				
University or higher	9.8 (3.5)***	3035.8 (397.3)				
Weight loss methods <sup>b</sup>			< 0.001			< 0.001
None (Reference)	10.2 (3.7)			3018.8 (405.9)		
Healthy method	10.2 (4.1)***	3041.5 (409.1)***				
Unhealthy method	11.5 (4.8)***	3026.1 (413.5)				
Total energy intake, kcal/d			< 0.001			< 0.001
1st (lowest tertile)	10.0 (4.1)***	3015.4 (408.7)***				
2nd (Reference)	10.3 (3.9)			3032.2 (407.5)		
3rd	10.6 (4.0)***	3044.8 (408.0)***				
Physical activity, MET-min/d			< 0.001			0.004
1st (lowest tertile)	10.2 (4.0)***	3026.1 (407.9)***				
2nd (Reference)	10.1 (3.9)			3037.2 (408.2)		
3rd	10.6 (4.1)***	3031.3 (407.0)				
Smoking			< 0.001			< 0.001
Never smoke (Reference)	9.8 (3.7)			3030.3 (404.0)		
Quit	10.9 (4.3)***	3046.6 (411.3)***				
Currently smoke	11.1 (4.7)***	2922.0 (420.3)***				
Alcohol			< 0.001			< 0.001
Never drink (Reference)	10.1 (4.0)			3024.0 (408.7)		
Quit	10.5 (4.0)***	3034.4 (407.6)***				

**Table 5** Average gestational weight gain (GWG) and new-born birth weight by maternal characteristics (Continued)

Maternal factors	GWG, kg		P <sup>a</sup>	Birth weight, g		P <sup>a</sup>
	Mean (SD)	95% CI		Mean (SD)	95% CI	
Currently drink	9.9 (3.9)***			3017.0 (410.7)*		
Anaemia			0.015			< 0.001
No	10.3 (4.0)			3028.2 (408.4)		
Yes	10.4 (3.9)	3042.4 (408.0)				
Hypertension			< 0.001			< 0.001
No	10.3 (4.0)			3034.0 (404.9)		
Yes	9.2 (4.7)	2909.3 (511.6)				
Diabetes			< 0.001			0.089
No	10.3 (4.0)			3030.7 (407.5)		
Yes	7.4 (5.5)	3054.3 (488.8)				
Previous caesarean delivery			< 0.001			< 0.001
No	10.4 (4.0)			3043.1 (409.0)		
Yes	9.6 (4.1)	2893.5 (372.9)				
Nausea and vomiting			< 0.001			< 0.001
No	10.8 (3.9)			3007.0 (426.0)		
Yes	10.2 (4.0)			3035.7 (404.0)		
Health guidance			0.613			< 0.001
No	10.3 (3.9)			3027.6 (404.4)		
Yes	10.3 (4.0)			3067.5 (425.3)		

BMI body mass index, GWG gestational weight gain  
<sup>a</sup> P-values are from one-way ANOVA or Student's t-test  
<sup>b</sup> Healthy method = eating less or reducing snacks, dieting, or exercising to lose weight; Unhealthy method = using medication, purging after meals, or smoking to lose weight  
 Bonferroni multiple comparisons (compared to reference category): \* < 0.05, \*\* < 0.01, \*\*\* < 0.001

**Table 4** Maternal characteristics and study outcomes, overall and by group

	All	Group 1	Group 2	Group 3	P <sup>a</sup>
	n (%)	71,002 (76.7)	13,406 (14.5)	8131 (8.8)	
Age, y, mean (SD)	30.7 (5.0)	31.0 (5.0)	29.4 (5.0)***	30.2 (5.3)***	< 0.001
Age categories, y					< 0.001
≤ 19 (teenage mother)	998 (1.1)	651 (0.9)	202 (1.5)	145 (1.8)	
20-34	67,786 (73.2)	51,051 (71.9)	10,744 (80.1)	5991 (73.7)	
≥ 35	21,943 (23.7)	17,889 (25.2)	2,231 (16.6)	1,823 (22.4)	
Missing	1812 (2.0)				
BMI, kg/m <sup>2</sup> , mean (SD)	21.2 (3.0)	21.4 (3.4)	20.5 (2.5)***	21.2 (3.5)***	< 0.001
BMI categories, kg/m <sup>2</sup>					< 0.001
< 18.5 (underweight)	14,867 (16.1)	10,805 (15.2)	2,502 (18.7)	1,560 (19.2)	
18.5-24.9 (normal weight)	67,712 (73.2)	51,871 (73.1)	10,229 (76.3)	5,612 (69.0)	
≥ 25 (overweight)	9,914 (10.7)	8,290 (11.7)	671 (5.0)	953 (11.7)	
Missing	46 (0.05)				
Educational level					< 0.001
High school or less	33,571 (36.3)	25,019 (35.2)	4,835 (36.1)	3,717 (45.7)	
Vocational school/College	38,695 (41.8)	29,989 (42.2)	5,838 (43.5)	2,868 (35.3)	
University or higher	19,735 (21.3)	15,709 (22.1)	2,686 (20.0)	1,340 (16.5)	
Missing	538 (0.6)				
Weight loss methods <sup>b</sup>					< 0.001
None	39,072 (42.2)	30,360 (42.8)	4,550 (33.9)	4,162 (51.2)	
Healthy method	46,612 (50.4)	35,985 (50.7)	7,330 (54.7)	3,297 (40.5)	
Unhealthy method	6,855 (7.4)	4,657 (6.6)	1,526 (11.4)	672 (8.3)	
Total energy intake, kcal/d					< 0.001
1st (lowest tertile)	30,925 (33.4)	23,538 (33.1)	4,536 (33.8)	2,851 (35.1)	
2nd	30,807 (33.3)	23,929 (33.7)	4,425 (33.0)	2,453 (30.2)	
3rd	30,794 (33.3)	23,523 (33.1)	4,444 (33.1)	2,827 (34.8)	
Missing	13 (0.01)				
Physical activity, MET-min/d					< 0.001
1st (lowest tertile)	31,986 (34.6)	24,853 (35.0)	4,390 (32.7)	2,743 (33.7)	
2nd	28,475 (30.8)	22,149 (31.2)	4,040 (30.1)	2,286 (28.1)	
3rd	29,901 (32.3)	22,463 (31.6)	4,692 (35.0)	2,746 (33.8)	
Missing	2177 (2.3)				
Smoking					< 0.001
Never smoke	53,212 (57.5)	41,910 (59.0)	7,503 (56.0)	3,799 (46.7)	

**Table 6** Relative risk ratio for inappropriate GWG, relative to Group 1

	Group 1	Group 2					Group 3				
	(n = 71,002)	(n = 13,406)	RRR	95% CI	aRRR	95% CI	(n = 8131)	RRR	95% CI	aRRR	95% CI
	Cases, n (%)	Cases, n (%)					Cases, n (%)				
<b>GWG</b>											
Inadequate	12,872 (18.1)	2126 (15.9)	0.86	0.81–0.90	0.93	0.88–0.98	1407 (17.3)	1.08	1.01–1.15	1.07	0.99–1.15
Appropriate	33,210 (46.8)	6410 (47.8)	Ref.		Ref.		3356 (41.3)	Ref.		Ref.	
Excessive	23,550 (33.2)	4574 (34.1)	1.01	0.96–1.05	0.98	0.94–1.03	3238 (39.8)	1.36	1.29–1.43	1.28	1.21–1.35

CI confidence interval, RRR crude relative risk ratio, aRRR adjusted relative risk ratio, GWG gestational weight gain

Group 1 = health conscious; Group 2 = body-shape and health conscious; Group 3 = not body-shape or health conscious

Adjusted maternal characteristics include age, pre-pregnancy body mass index, marital status, parity, educational level, weight loss methods, total energy intake, physical activity, smoking and alcohol consumption habit, past medical history (anaemia, hypertension, diabetes), previous caesarean delivery, pregnancy-related nausea and vomiting, and receipt of health guidance

**Table 7** Relative risk ratio for adverse foetal size, relative to Group 1

	Group 1	Group 2					Group 3								
	(n = 71,002)	(n = 13,406)	RRR	95% CI	aRRR <sup>1</sup>	95% CI	aRRR <sup>2</sup>	95% CI	Cases, n (%)	RRR	95% CI	aRRR <sup>1</sup>	95% CI	aRRR <sup>2</sup>	95% CI
	Cases, n (%)	Cases, n (%)							Cases, n (%)						
<b>Foetal size</b>															
SGA	5250 (7.4)	1043 (7.8)	1.05	0.98–1.12	1.03	0.96–1.11	1.04	0.97–1.12	680 (8.4)	1.15	1.05–1.25	1.08	0.99–1.19	1.11	1.01–1.22
AGA	58,533 (82.4)	11,110 (82.9)	Ref.		Ref.		Ref.		6618 (81.4)	Ref.		Ref.		Ref.	
LGA	7219 (10.2)	1253 (9.3)	0.91	0.86–0.97	0.97	0.91–1.04	0.96	0.90–1.03	833 (10.2)	1.02	0.95–1.10	1.07	0.98–1.16	1.02	0.94–1.11

CI confidence interval, RRR crude relative risk ratio, aRRR adjusted relative risk ratio, AGA appropriate for gestational age, LGA large for gestational age, SGA small for gestational age

Group 1 = health conscious; Group 2 = body-shape and health conscious; Group 3 = not body-shape or health conscious

aRRR<sup>1</sup>: Adjusted maternal characteristics included age, pre-pregnancy body mass index, marital status, parity, educational level, weight loss methods, total energy intake, physical activity, smoking and alcohol consumption habit, past medical history (anaemia, hypertension, diabetes), previous caesarean delivery, pregnancy-related nausea and vomiting, and receipt of health guidance

aRRR<sup>2</sup>: Adjusted for gestational weight gain in addition to maternal characteristics adjusted in aRRR<sup>1</sup>

5. 主な発表論文等

〔雑誌論文〕 計1件（うち査読付論文 1件/うち国際共著 0件/うちオープンアクセス 1件）

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オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 -

〔学会発表〕 計0件

〔図書〕 計0件

〔産業財産権〕

〔その他〕

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6. 研究組織

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7. 科研費を使用して開催した国際研究集会

〔国際研究集会〕 計0件

8 . 本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関
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