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Assimilation of the Indicators Used in "Healthy Parents and Children 21 (Phase 1)" and an Analysis of the Indicator Framework

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Abstract : Healthy Parents and Children 21 (Phase 1), and also Healthy Japan 21 (Phase 1), are the first national health promotion campaigns in Japan to have concrete numerical targets ; however, the national review of these programs mainly considers changes in each numerical target. Care for infants & environmental preparation system for continuous maternal care are emphasized in the 2nd Healthy Parents and Children 21. Herein, two new investigations were performed mainly for the 1st. The index framework that contributed to the policy effect was investigated using ordered multivariate, multilevel and multinominal logistic regression analysis (mixed model). Considering the first basic task on adolescent healthcare, the contribution of the health standard index framework to the administrative effort index was very low (odds ratio＝0.041, 95％ CI : 0.002–0.703). In the third basic task on improving the environment for children, the framework of the citizen's behavioral index was negatively associated (i.e., disassociated) with the change in each indicator (parameter estimate＝－1.63, 95％ CI : －2.64–0.62). Promoting adolescent healthcare was selected as the 2018 task of the Japan Agency for Medical Research and Development. The assimilation points were also suggested under the forensic view, but not included in this health promotion effort. The degree to which the indicators accurately reflected reality is defined here as assimilation. Disassociation was also recognized among the indicators concerning child abuse, including the number of deaths caused by child abuse reported by Healthy Parents and Children 21 and by the National Police Agency, (Jonckheere-Terpstra test $P＝0.02$ in the contingency table). Further, the constitution of the subjective indicators concerning child abuse was confirmed to be different by cluster analysis, Mantel-Henzel χ^2 analysis $(P = 0.02)$, and logistic regression analysis (odds ratio＝1.44, 95％ CI : 1.02–2.50).

Key words : Healthy Parents and Children 21, National Health Promotion, indicator framework, assimilation, ordered multilevel multivariate multinominal logistic regression analysis, health policy

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Introduction

Healthy Parents and Children 21, and Health Japan 21 are the first national health promotion campaigns in Japan to set concrete numerical targets. Healthy Parents and Children 21 focused on parents and children (especially from infancy to childhood ; age : 0–14 years), while Health Japan 21 focused on adults. Both of these initiatives were formulated in 2000, and each further health promotion of "Healthy Parents & Children 21" (Phase 2) & "Healthy Japan 21" (Phase 2) program have been underway since 2015. The Ministry of Health, Labor and Welfare in Japan has reported on the impact and progress of Healthy Parents and Children 21 as follows[1] :

"Healthy Parents and Children 21", which started in 2001, is a national campaign promoted by all citizens to improve maternal and child health, as the starting point of a broader and long-term program to improve the healthy growth and development of children and therefore, our next generation. Current issues such as care for infants & the environmental preparation of system for continuous maternal care including prenatal period are emphasized in Healthy Parents and Children 21 (Phase 2). More concretely speaking, enforcement of adolescent health policy, enforcement of perinatal & pediatric emergency, pediatric home care, strengthening cooperation system among maternal and child health projects, preparing the regional support system for child healthy growing up and peace of mind for the child care could be shown. Healthy Parents and Children 21 (Phase 2) have prompted a re-launch of the program as Healthy Parents and Children 21 (Phase 2). In addition to its significance as a countermeasure against Japan's declining birth rate, this new national health promotion campaign aims to realize a society wherein individuals can all expect to live healthy lives (Health Japan 2l).

Japan is currently experiencing problems surrounding maternal and child health due to the following six points :
*Declining birth rate,
*Marriage at an older age,
*Declining marriage rate,
*Isolation of nuclear families and childcare,
*Health inequality due to child poverty,
*Health disparities in maternal and child health (proportion of obese children among elementary school children, youth dental care, etc.).

The following two indicators declined during the first campaign (2001–2014) :
1. Teen suicide rate,
2. Percentage of low-birth-weight infants among all births.
Tables 1 and 2[1] and Fig. 1[2] explain the basic tasks and priority issues of the Healthy Parents and Children 21 (1st).

Table 1. Consistency (the basic fundamental tasks and priority issues) of Healthy Parents and Children 21 (1st)

Basic Task A	Contents	In addition to working on improving maternal and child health measures during pregnancy, childbirth, and child-rearing, we will strengthen the collaboration structure among businesses and related organizations. By utilizing information effectively, we will also create a system for evaluating and analyzing maternal and child health projects, aiming for a system that can be seamlessly supported.
Health measures for healthy pregnant women and infants	Goal	Enhanced health care measures for healthy pregnant women and infants to ensure safe and secure pregnancy, childbirth, and child rearing.
Basic Task B	Contents	Various fields cooperate so that children and students are interested in mental and physical health themselves and can work on maintaining and improving health, aiming to promote health education and realize a society that supports the health of the next generation.
From school-age through adolescence to adult health care measures	Goal	Promotion of health such that the child acts on its own initiative and thus enhances health care in the next generation.
Basic Task C	Contents	To build a community that will support a child's healthy growth throughout life, support child care, and help parents not to be isolated. To promote collaboration not only with national and local public bodies for child rearing support measures, but also with various NPOs and private organizations in the area, child associations, and maternal and child health promotion officials.
Creating a community that watches and grows children's health	Goal	Watching the healthy growth of children in society as a whole, creating a community that supports child-rearing generation parents not to be isolated
Priority issue 1	Contents	A priority task is to stop receiving various signs of difficulty* in raising children. *difficulty as perceived by those involved in child rearing and those in the background. There are various elements to such difficulty attributable to the children, the parents, parental relationships, and environmental factors that might require support.
Support to cuddle with parents who feel difficulty raising children	Goal	Respect the diversity of parents and children, and build a supportive society.
Priority issue 2	Contents	To prevent the occurrence of child abuse, early prevention measures are important such as providing information for mothers during pregnancy. We will also strengthen cooperation between maternal and child health programs such as newborn visits and related organizations to discover and respond to a need as soon as possible.
Preventing child abuse from pregnancy	Goal	Construction of a society free from child abuse

Table 2. Indicators and Indices of Healthy Parents and Children 21 (1ˢᵗ)

	Task 1 : Enhancing adolescent health measures and promoting health education
Health standard indicators	Teen suicide rate/teenage abortion implementation rate/rate of anorexia nervosa in 15-year-old females (%) / percentage of obese children
Citizen behavioral index	Percentage of elementary/junior high and senior high school students aware of the precise harm possible from drug abuse/rate of teenage drinking and/or smoking/percentage of youths 18 years or older with exact knowledge of contraceptive methods/percentage of high school students with knowledge about physical influences on their health such as sexually transmitted diseases
Administrative index	Percentage of schools with established school health committees/percentage of junior high schools and high schools implementing drug abuse prevention education in collaboration with external organizations/percentage of junior high schools with school counselors/number of pubertal outpatient clinics (including counseling centers of mental health welfare centers) /percentage of local public governments engaged in adolescent health care measures/percentage of local public bodies promoting food education initiatives/rate of children missing breakfast

	Task 2 : Securing safety and comfort concerning pregnancy, childbirth, and infertility support
Health standard indicators	Rate of maternal mortality/proportion of those satisfied about pregnancy and childbirth/ rate of suspected postpartum depression (more than Edinburgh Postnatal Depression Scale (EPDS) 9 points)
Citizen behavioral index	Percentage of mothers who felt notification rate of pregnancy less than pregnancy 11weeks, the proportion of pregnant women who are working know the maternal health management guidance matters contact cards, the rate of positive effect to mothers by using the maternity mark
Administrative index	Improvement in perinatal medical care network/preparation of guidelines for response to normal labor emergency/number of midwives/maintenance of infertility specialist consultation center/preparation for infertility expert counseling/guidelines on adapting reproductive supplementary medical technology for infertility treatment/rate of breastfeeding at one month after childbirth resuscitation method

	Task 3 : Improving the environment for maintaining and developing health care standards for children
Health standard indicators	Perinatal mortality/percentage of very low birth weight infants in all births/neonatal, infant (1-4 years), and SIDS mortality rates/percentage of accidental deaths/percentage of non-3 year old children
Citizen behavioral index	Smoking rate during pregnancy/home smoking rate during parenting/rate of drinking during pregnancy/percentage of parents consulting a pediatrician/percentage of households with knowledge of nearest child emergency medical institutions/percentage of households with knowledge of accident prevention measures/percentage of families aware of infants not having access to bathroom doors/percentage of parents who know cardiopulmonary resuscitation/percentage of parents who lie babies on their backs to sleep/percentage of infants who have completed BCG intake by 6 months/percentage of infants completing diphtheria, tetanus, and pertussis (DPT) vaccines or prevention of measles by 1 to 6 months

Administrative index	Percentage of prefectures where early secondary and tertiary pediatric emergency medical systems are established/percentage of municipalities implementing accident prevention measures/numbers of paediatricians, neonatal physician, and pediatric psychiatrists per childhood populations/numbers of physicians working in neonatal departments/numbers of pediatricians working in the field of child psychiatry/percentage of pediatric wards with hospital classrooms/percentage of pediatric wards with support systems for home care of children with chronic disease etc./percentage of government ordinance cities, special wards, and municipalities maintaining respite care services and temporarily visiting nursing stations

Task 4：Achieving peace of mind in children and promoting development and reducing anxiety about childcare

Health standard indicators	Number of deaths due to child abuse/rate of child abuse reported to child guidance centers based on the law/percentage of mothers without confidence in child rearing/percentage of parents who think that they are aware of child abuse/percentage of mothers with time to relax with their children
Citizen behavioral index	Percentage of mothers with a child care counselor/percentage of fathers who attend child care/percentage of fathers playing with children/percentage of breastfeeding mothers at one month after childbirth
Administrative index	Percentage of public health centers established for follow-up to high-risk children discharged from perinatal care facilities/percentage of those centers satisfied with infant health checks/percentage of local governments using infant health checks as the target for child care support/percentage of municipalities that are engaged in grasping the situation of all infants by 4 months of age such as the percentage of municipalities that are focusing on cases without infant public health checks/percentage of local governments promoting food education initiatives/percentage of local governments and percentage of prefectures engaged in promoting networks related to organizations in food education/percentage of municipalities promoting efforts through cooperation among related organizations such as nurseries, schools, residents, etc./percentage of child consultation centers with medical expert doctors for child psychology/improvements in the number of short-term treatment facilities for emotionally impaired children/percentage of public health centers that support parent-group activities/number of pediatricians with technologies to deal with parent-child mental health problems

Based on the results obtained and the basic viewpoints in "Healthy Parents and Children 21（1st）", the committee prioritized the following four basic tasks to be addressed by the new program in the 21st century, with a report on the current status of and approach to each task as concretely as possible [3]：

Issue 1：Strengthening adolescent health care measures and promoting health education,

Issue 2：Securing safety and comfort concerning pregnancy and childbirth, and providing infertility support,

Issue 3：Improving the environment to maintain and enhance health care standards for children,

Issue 4：Promoting development of child mental health and planning for mitigation of childhood anxiety.

The following three groups of task indicators have been formulated：final health-level goals
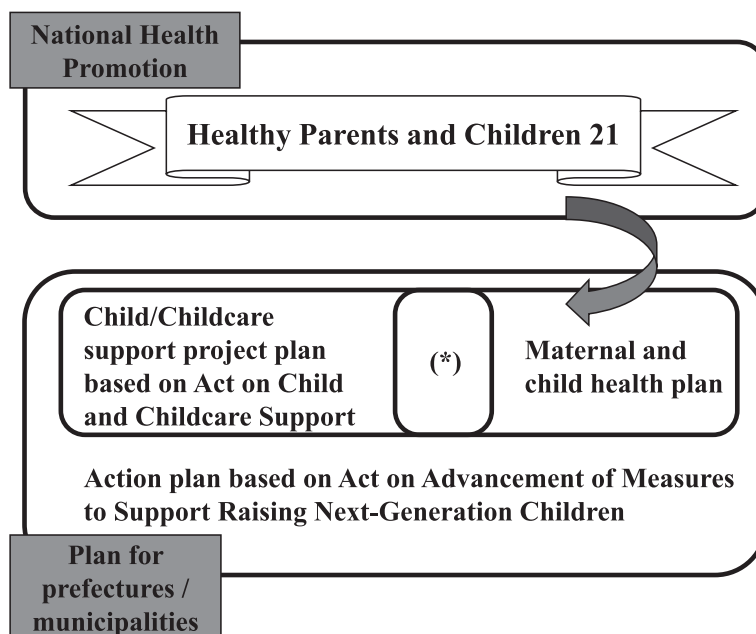
Fig. 1. Relationship among Healthy Parents and Children 21 (1st),
         National Maternal & Child Health Plan, Children Child Care
         Support Services plan, and Action Plan
         *It refers to health checkups for pregnant women, Infant
         home all houses visitation, Rearing support visit busitation.

[indicators of health and health measures in Healthy Parents and Children 21 (2nd)], indicators related to personal behavior (health behavior indicators), and those related to administrative and related organizations concerning improvements in the associated environments (indicators of environmental improvement). All such indicators are constituted at three levels of improvement designed to support behavioral transformation. For setting the target value, the target value of the country can be used as a reference. Because it is also important to set region-specific target values, regional diagnosis will be performed by using existing information such as demographics statistics and various health examinations, resident health surveys, etc.

The indicators developed for each issue are detailed below, with three groups of indicators. For these groups of indicators the following four issues have been identified with respect to their evaluation, and used to evaluate the four issues/tasks:

1. Improvement
   i) Achievement of the goal,
   ii) Status improved, and making progress towards achieving a set target,
2. No change,
3. Decreased status,
4. Impossible to estimate.

As a result of the final evaluation, the following reports (Tables 3, 4) were made.

Regarding Healthy Parents and Children 21, the Japan Society of Public Health and Japan Academy of Pediatrics have supported this national health promotion each year[4-6]. The neces-

Table 3. Achievement of issue-specific indicators in the final evaluation of Healthy Parents and Children 21 (1st)

Final evaluation		Basic Task 1	Basic Task 2	Basic Task 3	Basic Task 4	Item total	(%)
Improvement	Achievement of goal	4	7	8	1	20	27.1
	Not reached target, but improved	9	6	16	9	40	54.1
Unchanged		1	1	1	5	8	10.8
Poor		1	0	1	0	2	2.7
Unable to be evaluated		1	0	0	3	4	5.4
Total		16	14	26	18	74	100

Table 4. Achievement of indicators in the final evaluation of Healthy Parents and Children 21 (1st)

Final evaluation		Indicators of health level	Indicators of behavior	Indicators of efforts by administirative agencies and related organizations	Item total	(%)
Improvement	Achievement of goal	8	3	9	20	27
	Not reached target, but improved	6	18	16	40	54.1
Unchanged		3	2	3	8	10.8
Poor		2	0	0	2	2.7
Unable to be evaluated		1	0	3	4	5.4
Total		20	23	31	74	100

sity to strengthen support for child rearing was also pointed out, particularly with respect to fostering development of the next generation [7].

According to the final report of Healthy Parents and Children 21 (1st) in 2015, approximately 80% of the 74 items were improved. Meanwhile, it seems that the actual policy effect has been realized despite the many subjective indicators in this health promotion planning.

The committee found that the indicators in the re-launched Healthy Parents and Children 21 not only in Phase 2 but also in Phase 1 have the following three characteristics:
(1) both previously included indicators, that were newly investigated, are included,
(2) many subjective indicators are included,
(3) the indicators constitute multiple hierarchical frameworks (clusters).

The national review [7] was based mainly on the reported changes in each indicator. The present study therefore added two analytical approaches based on the original viewpoints. One is the integrated analysis of multiple indicators, with the new attempt to analyze the indicator framework itself. It is the first time that the Healthy Parents and Children 21 (1st) framework has been estimated to utilize 74 integrated indicators and, at the same time, it is the first time that the indicator framework was estimated. The other new approach is to investigate from the viewpoint of assimilation to reality (empirical observation). The

planners of Healthy Parents and Children 21 (1ˢᵗ) consisted of experts in the field of pediatrics, maternal and child health, and public health, yet no one was involved from the field of forensic or legal medicine. For the second version, the indicators for child abuse were enhanced by adding the forensic perspective, and that enhancement coincided with the indicator assimilation to actual child abuse. These two points were not recognized in other national reports on the analysis of the monitoring framework[9] ; they are also radical, original points with new aspects for Healthy Parents and Children 21 (2ⁿᵈ).

As mentioned above, this report also examined whether the indicators used accurately reflect the reality and it analyzes, using multivariate multilevel (ordered) logistic regression analysis, whether the index framework contributed to the policy effect for Healthy Parents and Children 21. "Multilevel" was defined here as ordered multi-categorical values constituting one independent variable, rather than multi-numerical values.

With respect to the health policy framework in Japan, reports entitled "Feasibility study of the monitoring framework for lifestyle-related diseases in developing countries" for the Research Program on the Challenges of Global Health Issues[9] and "Global strategy on human resources for health : Workforce 2030[10]" have been published. The analytical approach for the estimations in these reports involved monitoring the framework with validity and reliability, and the logistic regression approach for health policy framework has been published on Adverse Childhood Experiences Study (ACEs)[11] ; however, this logistic regression was not used for indicator framework analysis. In other words, in the field of life course epidemiology, logistic regression and a framework for examining predictors across the life course has been reported[12, 13]. This report therefore provides the first application of ordered multilevel multinominal & multivariate logistic regression analysis for the hierarchical indicator framework used in National Health Promotion.

Methods and materials

This study used the appendix of the estimation of Healthy Parents and Children 21[8] published in the final report on Healthy Parents and Children 21 (1ˢᵗ) by the Japanese Ministry of Health, Labour and Welfare in 2015 (published in March 2012 by the national estimation committee as the targets of health promotion in the near future). There were 38 observations in the first basic task, 10 in the second basic task, 42 in the third basic task, and 26 in the fourth basic task.

1) Analysis of the indicator framework

This analysis was planned 1) to estimate the contribution to policy effect by the actual framework of indicators, and 2) to reconsider the integrated nature of each indicator using ordered multivariate, multilevel & multinominal logistic regression analysis (mixed model).

In Healthy Parents and Children 21 (1ˢᵗ), point 3 of the framework was established and included the basic task, index level, indicators, and the final estimation (Fig. 2). Furthermore, the transition of the indicators was confirmed three times after the time of formulation (in 2000), at the first intermediate evaluation (in 2004), the second intermediate evaluation (in 2008), and the final evaluation (in 2012). Including the final estimation, these have consti-
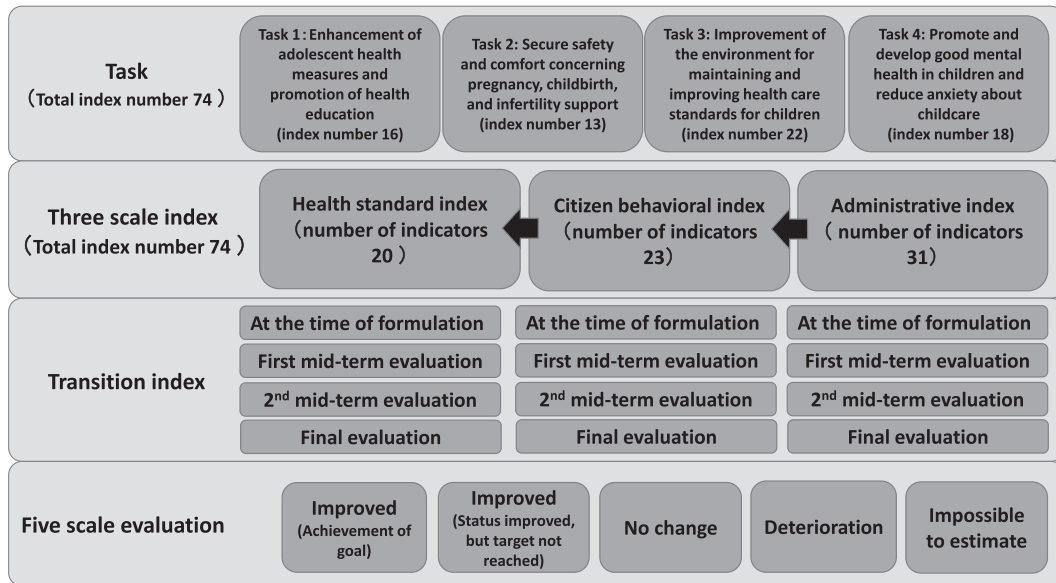
Fig. 2. Framework Structure of "Healthy Parents & Children 21 (Phase 1)"

tuted five categorical scales. In this study, only indicators with all of the first three measurements ─in 2000, 2004 and 2008─were used.

Four concrete scales could be found from Healthy Parents and Children 21 (1st), as follows:

(1) the final evaluation included five scales of indicators as the lowest layer in the hierarchy: improvement with achievement of goal, status improved (but target not reached), no change, deterioration, and impossible to estimate,

(2) three scales of indicators to measure the change in each indicator as the second lowest in the hierarchy: the value at the time of formulation in 2000, at the 1st mid-term evaluation in 2004, and at the 2nd interim evaluation in 2008,

(3) three scales of indexes as the second highest layer in the hierarchy: the index of health standards, the index of citizen behavioral efforts, and the index of administrative efforts,

(4) four scales of basic tasks as the highest in the hierarchy: the first task on adolescent healthcare, the second task on supporting pregnancy, childbirth, and infertility, the third task on the environment of healthcare for children, and the fourth task on caring for childhood mental health and anxiety.

Of the four above-mentioned scales, points (1), (2), (3), and (4) were used for ordered multivariate, multilevel & multinominal logistic regression analysis as four frameworks with scales.

For the ordered multivariate, multilevel & multinominal logistic regression analysis of the index framework, using the General Linear Model (GLM) in SAS 9.4 EG 7.1, five scales of the final evaluation were used as a categorical response variable, changes to indicator values in 2000, 2004, and 2008 with three scales used as quantitative explanatory variables, three types of indexes were used as a categorical classification variable, and four scales of basic tasks were used as a categorical group variable. The variable selection method was the variable increment

method, and the model used for optimization was Fisher Scoring, cumulative logit model. This type of multilevel logistic analysis seemed to be more ordered than multinomial analysis.

There were 38 observations (indicators) in the first basic task, 10 in the second, 42 in the third, and 26 in the fourth basic task. These 38 indicators were extracted from a total of 74 indicators from all measurements in 2000, 2004, and 2008.

The details of the 38 indicators are as follows :

(1) Basic Task 1 (adolescent health care)

Health Standard Index : teenage suicide rate (10–14 years, 15–19 years), teenage abortion rate, percentage of 15-year-old females with anorexia nervosa, and percentage of obese children,

Index of Effects by Administrative Organizations : the percentage of schools that have established school health committees, the percentage of junior high schools and high schools that are implementing drug abuse prevention education in collaboration with external organizations (junior high school, high school), the percentage of junior high schools with access to school counselors, number of local public governments engaged in adolescent health care measures,

(2) Basic Task 2 (supporting pregnancy, childbirth, and infertility)

Health Standard Index : maternal mortality (rate, number), proportion of those who are satisfied with pregnancy and childbirth, rate of suspected postpartum depression cases [more than 9 points on the Edinburgh Postnatal Depression Scale (EPDS)],

Citizen Behavior Index : the percentage of mothers who reported pregnancy within 11 weeks of conception, percentage of pregnant women who are working and who understand the maternal health management guidance to access for administrative services,

Index of Effects by Administrative Organizations : improvement of perinatal medical care network, preparation of guidelines for response to normal labor emergencies, number of midwives, maintenance of infertility specialist consultation centers,

(3) Basic Task 3 (environment of healthcare for children)

Health Standard Index : perinatal mortality, percentage of very low birth weight infants among all births, neonatal mortality, infant mortality rate, SIDS mortality rate,

Citizen Behavior Index : percentage of parents consulting a pediatrician, percentage of households implementing accident prevention measures,

percentage of families with infants who have taken preventive measures so that infants cannot open bathroom doors themselves, percentage of parents who know cardiopulmonary resuscitation, percentage of parents who lay their baby on its back to sleep,

Index of Effects by Administrative Organizations : numbers of pediatricians, neonatal physicians, and pediatric psychiatrists for childhood population, number of physicians working in the neonatal department, number of pediatricians working in the field of child psychiatry, percentage of pediatric wards with hospital classrooms, municipalities maintaining respite care services and temporary, visiting nurse stations,

(4) Basic Task 4 (development of childhood mental health care)

Index of Effects by Administrative Organizations : percentage of public health centers established for follow-up to high-risk children discharged from perinatal care facilities, percentage of local

governments with infant health checks as the target for child care support, percentage of child consultation centers with medical experts in childhood mental health problems, number of pediatricians with expertise in dealing with parental mental health problems.

Three transitional values in 2000, 2004, and 2008 for each indicator were measured, with a total sample size of 104.

We varied the sample sizes, sampling methods, and principal investigators of the survey for index for each subjective indicator. Some indicators were ratio/proportion, and some indicators were unadjusted numerical values of a real number.

2) An investigation of the degree to which the indicators accurately reflected reality (defined as assimilation)

For the Basic Task 4 of Healthy Parents and Children 21 (Phase 1) in this report, childhood mental indicators were set up for the promotion of safe development and mitigation of parenting anxiety, which can directly relate to child abuse. We examined whether the indicators being used are disassociated from the other published indicators, based on the premise that greater disassociation would result in less assimilation to reality.

In this report, two kinds of disassociation were investigated. One is the disassociation between the number of deaths due to child abuse reported in Healthy Parents and Children 21 and that reported by the National Police Agency[14]. The other is the disassociation of subjective indicators associated with child abuse between the values investigated by Prof. Z. Yamagata[15] and those investigated by Prof. T. Etoh[16, 17]. The former disassociation is between the indicator in Healthy Parents and Children 21 reported on in 2000, 2004, 2008, and 2012, and the other public official indicator constituted by a total of eight groups (four serial data sets per group in 2000, 2004, 2008, and 2012).

Regarding the survey by Prof. Z. Yamagata[15] and the survey by Prof. T. Etoh[16, 17], differences in methodology such as in the method for survey sampling, sampling number for each survey, and the questionnaire were investigated.

The total sample number that made this first association was 36. On the other hand, the latter disassociation is within the same indicator as in Healthy Parents and Children 21. To investigate this association, the following five indicators were used. The means of each value of two different surveys performed by two different investigators were calculated for each of the five indicators. Two means were calculated for each indicator, and the total sample size was 20. All values used for this calculation were proportions.

Fundamental tasks of Healthy Parents and Children 21. In promoting peaceful development of a child's mind and alleviating childcare anxiety, the following indicators reflect child abuse.

Indicators of Health Standards : the number of deaths due to child abuse, the number of abused children reported at the child consultation center based on mandatory reporting laws, the percentage of mothers who do not have confidence in parenting (as a subjective indicator), the decreased percentage of parents who think that they are abusing children (as a subjective indicator), the percentage of mothers who have time to spend with their children, and indicators of

their own actions (as subjective indicators) such as the proportion of mothers receiving counseling on parenting (as a subjective indicator), the proportion of fathers participating in childcare (as a subjective indicator), and the proportion of fathers playing with children (as a subjective indicator). It has been hypothesized without scientific confirmation that these above subjective indicators seemed to reflect abuse in the first iteration of Healthy Parents and Children 21.

All of these values were measured in 2000, 2004, and 2008. The disassociations were confirmed using contingency table analysis, one-way analysis of variance, cluster analysis, and logistic regression analysis. The latter three analyses were only applied to the above-mentioned latter disassociations. Hierarchical cluster analysis with the standard root mean square method was performed under the group average method to determine the indicator constitution by each of the two investigators.

Logistic regression analysis was performed using each of the two investigators as the two-scale categorical response variable and three two-scale subjective variables as the quantitative explanatory variables. We used the binary logit model and the Newton-Raphson method for optimization.

Results

1) Analysis of the indicator framework

The results of the logistic regression analysis are shown in Table 5.
The model of the second basic task on supporting pregnancy, childbirth, and infertility and the model of the fourth basic task on childhood mental health care were models constituted only by intercepts. The optimized logistic regression model comprised only the first basic task on adolescent healthcare (adjusted $R^2 = 0.38$) and the third basic task on the healthcare environment for children (adjusted $R^2 = 0.35$). As for the basic task analyzed using the optimized logistic regression model in this study, the number of observations exceeded the necessary number of observations, which is ten times the number of independent variables.

Using parameter estimations and odds ratio, the results discussed below are shown in Table 5 (Table 5-1, 2, 3, 4).

As for Basic Task 1 on adolescent healthcare, the parameter estimation of the citizen behavioral efforts index was negative, while other parameter estimations of the indices of health standards and administrative efforts were positive. The odds ratio of the index of health standards to the index of administrative efforts was 0.041 (95% CI: 0.002-0.524).

As for Basic Task 3 on the healthcare environment for children, the parameter estimations were negative for the index of health standards and positive for the index of citizen behavior. The odds ratio of the index of health standards to the index of administrative efforts was 0.193 (0.032-0.984).

There are two possible reasons for producing multiple intercepts. One explanation is that the random plural intercepts derived from the random effects from the mixed effects model including both fixed effects and random effects. The other possibility involved the ordered multivariate logistic model, wherein the left side of the logistic regression formula is linear (logit) and the right side is the linear combination of parameters, and both are associated linearly. The regres-

Table 5. Estimation of Indicator Frameworks by Ordered Multivariate Multilevel Multinominal Logistic Analysis in Healthy Parents and Children 21 (1st)

Basic Task 1

adjusted R2	0.384		
score test	$P < 0.0001$		

parameter	parameter estimation	95% CI (Wald)	
intercept	−4.237	−6.219	−2.256
intercept	−3.743	−5.44	−2.046
intercept	1.412	0.206	2.617
health standard index (H)	0.002	−0.013	0.006
citizen behavioral index (CB)	−2.121	−3.518	−0.724
administrative index (A)	1.05	−0.179	2.278

proportion of contribution	odds ratio estimation	95% CI (Wald)	
(H) vs. (CB)	1.002	0.999	1.005
(H) vs. (A)	0.041	0.002	0.703
(CB) vs. (A)	0.978	0.073	13.116

Basic Task 3

adjusted R2	0.35		
score test	P < 0.0001		

parameter	parameter estimation	95% CI (Wald)	
intercept	−3.852	−5.535	−2.169
intercept	−3.104	−4.443	−1.766
intercept	0.811	0.014	1.607
citizen behavioral index (CB)	−1.631	−2.64	−0.622
administrative index (A)	1.615	0.48	2.75

proportion of contribution	odds ratio estimation	95% CI (Wald)	
(H) vs. (A)	0.193	0.037	1.01
(CB) vs. (A)	4.949	0.752	32.592

Basic Task 2

parameter	parameter estimation	95% CI (Wald)	
intercept	−2.2	−4.263	−0.131
intercept	1.386	−0.163	2.936

Basic Task 4

parameter	parameter estimation	95% CI (Wald)	
intercept	−0.31	−1.088	0.468
intercept	2.037	0.834	3.24
intercept	2.485	1.042	3.927
intercept	3.218	1.22	5.217

Basic Task 1 : Adolescent health care, Basic Task 2 : Supporting pregnancy, childbirth, and infertility, Basic Task 3 : Environment of health care for children, Basic Task 4 : Development of mind and child care anxiety
For the multivariate, multilevel logistic regression analysis of the index framework, using the General Linear Model for linear model in SAS 9.4 EG 7.1, five scales of the the final evaluation were used as a categorical response variable, changes to indicator values in 2000, 2004, and 2008 with three scales were used as quantitative explanatory variables, three types of indexes were used as a categorical classification variable, and four scales of basic tasks were used as a categorical group variable. The variable selection method was the variable increment method, and the model used for optimization was Fisher Scoring, cumulative logit model. This type of multilevel logistic analysis is ordered.

sion coefficient on the other hand is the increase of a logit when one unit of a parameter increases. In the ordered logistic regression model, multiple intercepts were observed for one beta coefficient. This could be explained if all gradients of all linear regressions are the same, but with different intercepts.

The suitability report of this logistic regression procedure [18] was as follows :

⑴ Aim of this logistic model: to explain the association between the response variable and explanatory variable with and without adjusted effects of other variables in this study.

⑵ Odds ratio & 95 % CI: all calculated odds ratios at 95 % CI were reported, but not the calculated odds ratios at 95% CI of all explanatory variables from the limit of the number of observations.

⑶ Variable method: the variable increase method was used.

⑷ Coding of explanatory variable numbers: increments of explanatory variables were described in Table 5.

⑸ Interaction: the products of each explanatory variable did not test the interactions by investing in the predictive formula, although some odds ratios were reported.

⑹ Multicollinearity: the variance of inflation factors of multiple regression analysis using explanatory variables was less than 3.

⑺ Overfitting: in Basic Tasks 1 and 3, the number of observations was more than ten times the number of explanatory variables.

⑻ Linearity: this was not tested by a plot figure with categorization for Basic Tasks 1 and 3.

⑼ Rationality of variable : depended on the single regression analysis.

2) An investigation of the degree to which the indicators accurately reflected reality ⟨defined as assimilation⟩

In the final evaluation in April 2014 of Healthy Parents and Children 21, the number of deaths due to child abuse was included among 8 items whose evaluation did not change, and the lack of policy effect was one of the main topics discussed. Among those evaluated, the following were included as unchanged : the number of deaths due to child abuse, the proportion of mothers who lack confidence in child-rearing, the proportion of mothers who have time to spend with their children in a relaxed mood, the proportion of mothers with help by a special supporter for child-rearing, and the proportion of mothers given the psychological support by a special counselor. Of note, it might not be possible to evaluate the number of abused children from the reports made by child guidance centers based on the mandatory reporting laws. The actual number of counselings for correspondence to child abse cases in child consultation center eported by Healthy Parents and Children 21 was 17,725 at the time of formulation, 33,408 at the 1st interim evaluation, 40,639 at the 2nd interim evaluation, and 59,919 at the final evaluation, and these numerical values have been adopted by social welfare administrative work reports.

Regarding the number of deaths due to child abuse, the numerical value reported by the final evaluation/analysis sheet for the target of Healthy Parents and Children 21 and that reported by the National Police Agency based on the mandatory reporting laws are different. The National Police Agency reported that the difference is due to their subtraction of the number of

infanticides. He rein, a value different from the published value of the National Police Agency is adopted as the value indicating the total number of victimized children in child abuse cases. The actual number of deaths due to child abuse reported by Healthy Parents and Children 21 was 44 at the time of formulation, and according to the official values from the statistics of the National Police Agency[14], 51 at the first interim evaluation, 45 at the second interim evaluation, and 32 at the final evaluation.

Next, the details of five subjective indicators on child abuse were described. Regarding the proportion of mothers who lack confidence in raising children, the results of two other studies have been adopted. Those results were derived from Prof. Zentaro Yamagata et al[15] in their "Study on Final Evaluation and Problem Analysis of Healthy Parents and Children 21 and Promotion of the Next National Health Movement" and the values of Prof. Takaji Etoh et al[16] in their infant health survey, which involved continuous comparison of infant health levels by the Japan Children's Health Association. In the former, changes in the measured values were negligible, but in the latter case, improvement is suggested at a rate of 23.0% in the final evaluation at the time of formulation, and disassociation among the indicators was found. Ultimately, the national committees concluded that the values did not change at the time of the final evaluation, even after considering the measurements of the Prof. Yamagata's group in 2004, 2008, and 2012.

Regarding the proportion of mothers who have time to spend with their children in a relaxed mood, the same two surveys were adopted[17]. In the former, changes in measured values were negligible, but in the latter case, the value of 68.0% at the time of formulation was suggested to be improved to 75.8% in the final evaluation, and disassociation among the indicators was found. As above, the national committees concluded that the values did not change at the time of final evaluation.

Regarding childcare and the proportion of mothers who are receiving counseling for mothers and fathers the measured value in the first cited survey[18] improved in the 3-to-4-month-old infants, but deteriorated in the 6-month-old and 1-year-old children. In the latter case, disassociation within the indicator was not observed as a significant difference between the two reported percentage values at the time of formulation (99.2%) and in the final evaluation (99.3%). Ultimately, the national committees concluded that the values did not change at the time of final evaluation.

For the two above-mentioned indicators, improvements were observed only by the survey by Prof. Eto's group, but the national committee concluded that the results of Healthy Parents and Children 21 associated with child abuse did not improve and remained unchanged after Prof. Yamagata's group's survey (Table 6).

In summary, there was a statistically significant disassociation among the indicators concerning child abuse, specifically in the number of deaths caused by child abuse between Healthy Parents and Children 21 and the National Police Agency (Jonckheere-Terpstra test $P = 0.02$ in contingency table). The constitution of the subjective indicators concerning child abuse was confirmed to be different by cluster analysis (Figures 3-A, B), Mantel-Henzel χ^2 analysis ($P = 0.02$), and logistic regression analysis (odds ratio = 1.44, 95% CI : 1.02−2.50).

Table 6.   Assimilation of indicators associated with child abuse in Healthy Parents & Japan 21 (1st)

Index	Adopted value	Announce-ment value	Result	Cause of dissociation
The number of deaths due to child abuse	Announcement value of The National Police Agency	The National Police Agency	Disasociation	Subtracting the number of forced double suicides and neonate deaths just after birth
The proportion of mothers who cannot possess themselves in child rearing	○ Prof. Z. Yamagata's Study Group of the Ministry of Health, Labor and Welfare → No change ○ The value of infant health survey by continuous comparison study on infant health level by the Japan Children's Health Association and Prof. T. Eto's Study Group of Ministry of Health, Labor and Welfare → Improved		Disasociation inside the indicator	
The proportion of mothers who have time to spend with their children in a relaxed mood	○ Prof. Z. Yamagata's Study Group of the Ministry of Health, Labor and Welfare → No change ○ The value of infant health survey by continuous comparison study on infant health level by the Japan Children's Health Association and Prof. T. Eto's Study Group of Ministry of Health, Labor and Welfare → Improved		Disasociation inside the indicator	
The proportion of mothers seeking counseling for child rearing	○ Prof. Z. Yamagata's Study Group of the Ministry of Health, Labor and Welfare → 18 months : Deterioration ○ The value of infant health survey by continuous comparison study on infant health level by the Japan Children's Health Association and Prof. T. Eto's Study Group of Ministry of Health, Labor and Welfare → No change		Disasociation inside the indicator	

Discussion

The initial part of our discussion is based on the indicator framework analysis. According to Table 5, the logistic regression models were optimized for Basic Task 1 on adolescent healthcare and for Basic Task 3 on the health care environment for children. Therefore, as for Basic Task 1 and for Basic Task 3, this study attempted to explain the association between the response variable and explanatory variables with and without adjusted effects of other variables.

First, we suggest the following explanation based on the parameter estimates of each of the
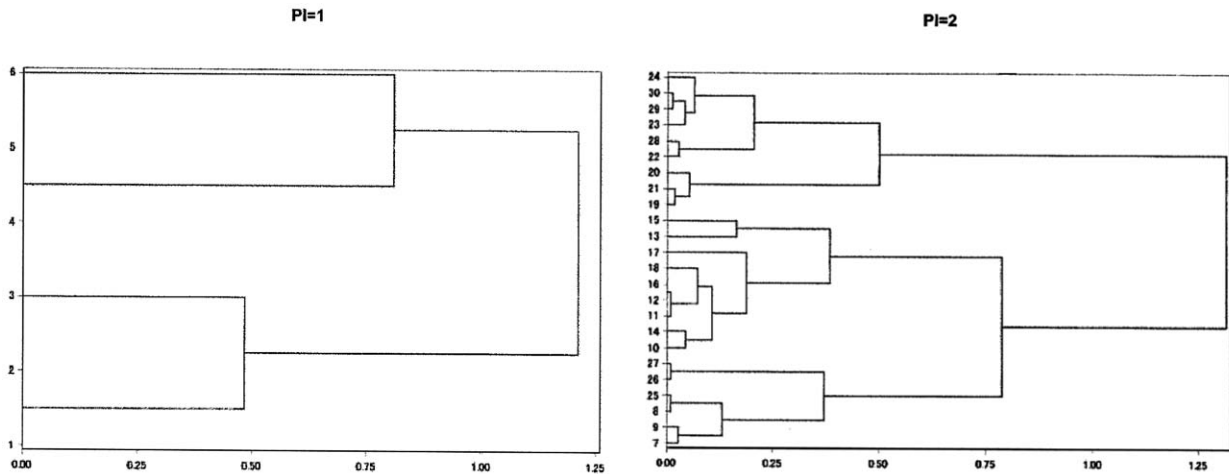
Fig. 3. Difference in constitution of subjective indicators on child abuse at different surveys by each of two different investigators in Healthy Parents and Children 21 (1st) by Hierarchial Cluster Analysis using the standard root mean square method with group average using SAS9.4EG7.2

three indexes. For Basic Task 1 on adolescent healthcare, the index of citizen behavioral efforts has less than the index of health standards and the index of administrative efforts, while for Basic Task 3 on the health care environment for children, the index of health standards has less probability than the index of citizen behavioral efforts.

Second, based on the odds ratio results for each of the three indexes, we suggest that because the odds ratio of the health standards index to the administrative efforts index was less than 1.00 for both Basic Task 1 and Basic Task 3, the index of health standards contributes only negatively to the index of administrative efforts.

As for the review of the indicators of the "Healthy Parents and Children 21" opened in December 2006[7], the study group on indicators etc of the "Healthy Parents and Children 21" performed the examination (for review of the "Healthy Parents 21" indicators etc[8]). The indicators revealed as concrete at this workshop are as follows:
*Three ratios such as the ratio of 18-year-olds who accurately know the contraception law for birth control, the "ratio of high school students who know exactly about sexually transmitted diseases" and the "ratio of high school students with knowledge of physical influences such as sexually transmitted diseases caused by behavior etc can be summarized as one indicator." Based on this finding, we will conduct a survey of high school students regarding knowledge and consciousness concerning the physical consequences etc. of sexual behavior.
*As for "Issue 3" on the "ratio of families implementing accident prevention measures", as a monitoring method, a survey was conducted for parents with 18-month-old children and 3-year-old children. The questions were narrowed down from the current 20 items to 10 items, and the average value of the household implementing the accident prevention countermeasure was set as the evaluation value.
*"Ratio of child guidance centers where full-time child psychiatrists are located" shall be the

"ratio of child guidance centers where doctors who can conduct professional medical treatment of children's hearts".

*"Ratio of pediatricians with technologies capable of responding to parent-childmind problems" is "the number of pediatricians with technologies that can respond to parent-childmind problems" and sets the goal of "100% 'To' increasing tendency".

*The most recent value of 42.4% (infant nutrition survey in 2005) was obtained as the "ratio of breastfeeding at one month after birth", and there was no increase in the trend from the baseline value of 44.8%. Further evaluations are required for further efforts. In order to increase the breastfeeding ratio, it is also necessary to provide support at obstetric medical facilities, so it is also an indicator of Issue 2 "Assistance for safety and comfort concerning pregnancy, childbirth, and infertility support".

In addition, detailed changes have been made and published. Changes are made for each indicator by consultation, and a common filter for the entire indicator has not been established. Even when there are already existing values, depending on the indicators, they are re-measured by the Yamagata team, there are multiple measured values and existing values for one index, and a divergence may be observed between the different values. Regarding setting of the target value, there are four kinds of countermeasures such as decreasing/increasing or defining the target value, and measures such as the prediction formula are not necessarily used in formulating the target value.

Data assimilation is mainly done to increase the reproducibility of numerical models in the field of earth science. Simply put, it refers to inputting actual observation values into the model so that results closer to reality are obtained. The concept of data assimilation is also used in epidemiology or public health, and one point is how to filter the observation value to construct a model close to reality[19–22].

Although the indicators discussed here have both data values and properties as models, limitations are also pointed out in medical health policy with time-dependent changes.

The use of evaluation indicators in health policy is a global practice, including in the United States and the WHO ; however, it remains true that the effect of health policy development cannot be obtained as desired when the accuracy of the evaluation index is not appropriate, as has already been pointed out. It is thus desirable to improve the accuracy of the indicators and to optimize them, preferably at the time of planning the original national health movement so that the most appropriate effect will be obtained. Also, it is desirable not only to set target values for the individual indicators that compose the national health promotion, but also to have a viewpoint on how to construct a model that closely matches reality. The concept of social simulation already exists, but the Japanese national health promotion currently underway is not necessarily built using the social simulation method. At the same time, it is impossible to simulate all infinite variables in today's society, and reproducibility is not necessarily guaranteed for simulation. A national health promotion strategy based on based on highly repeatable simulations will be expected in the future.

We have already examined Healthy Parents 21 with parents as the main focus and Healthy

Japan 21 with adults and lifestyle diseases as the main targets as the first full-scale national health movement in Japan. From now on, it will be necessary to develop corresponding programs for lifestyle-related diseases, such as dementia, as a national health movement that is applicable across an individual's lifetime, based on a highly reproducible simulation.

Among the deaths concerning child abuse raised in this report, Healthy Parents and Children 21 adopted values excluding forced double suicides and neonatal deaths just after birth from the statistics of the National Police Agency. It could be assumed that the latter value includes infanticide. With regards to forced double suicides and infanticide, it has been pointed out that those cases were extreme types of child abuse[22]. Child abuse control measures in Japan are strongly led by pediatricians, which is similar to that proposed in Healthy Parents and Children 21. Those familiar with normalcy are not familiar with paying attention to abnormalities, and thus separately taking up the double forced suicide and neonates' deaths just after birth as the highest risk index is also effective in reflecting mental health issues in our society. The phenomenon of "what is excluded is actually necessary" as the subject of health care management is actually found everywhere in public health.

Healthy Parents and Children 21, together with Healthy Japan 21, is a national health movement in Japan, a country with a health index. Together, a large number of indicators are formulated into multiple hierarchical frameworks, and using this framework structure, this paper has tried to construct a logistic model for Healthy Parents and Children 21. As already mentioned in the results, the conclusions can be summarized as follows :

(1) Health levels depend upon each resident, and the health effects of administrative policies are determined by confirming with the residents.

(2) Regarding pregnancy and childbirth, health care cannot be adequately provided for children by each resident of a household on his or her own, and, therefore, it is necessary for administrative agencies to use their power to improve that care.

(3) In promoting mental health and mitigating childcare anxiety, it is important to confirm that all three of the health levels, residents' participation, and administrative efforts have a positive impact. Achieving this is possible. In particular, (3) shows that the most important assertion of Healthy Parents and Children 21 is certainly fulfilled, indicating the success of Healthy Parents and Children 21. In this way, it was possible to evaluate the national health movement by understanding the direction for the future by utilizing indicators and a unified model.

Conflict of interest disclosure

The authors declare no conflict of interest associated with this manuscript.

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