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Strategy and Practice of Support for Families with Multiple Births Children: Combination of Evidence-Based Public Health (EBPH) and Community-Based Participatory Research (CBPR) Approach

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1. Introduction

Since the early 1980s the number of multiple births has rapidly increased in all developed countries largely due to the widespread use of inadequately monitored ovulation induction and multiple embryo transfer (Bryan, 2006). Currently, around 3-4% of live births in Western developed countries are multiple births. Increasing multiple births rates have also been observed in Japan. More than 1% of all maternities (2% of all births) are multiples (Ooki, 2010).

Although there are similarities to singleton pregnancy and parenthood, the experience of expecting and parenting multiples is undeniably very different. The birth and parenting of multiples always present unique challenges for both families and health professionals. Multiple births are associated with substantial medical, health care, socio-emotional, developmental, educational and economic consequences for both families and society (Denton, 2005b; Leonard & Denton, 2006).

Addressing the causes of the high numbers of iatrogenic multiple births continues to be an urgent challenge. Meanwhile, those caring for multiple-birth children and their families need a fuller understanding of their special problems and needs (Bryan, 2006).

In this chapter the author introduces a current public health research and practice integration project for supporting multiple-birth families in Japan, where such support has not yet reached the level of many Western countries. Some important topics related to multiple births are concisely described below.

2. Current support for families with multiples in Japan

Before starting the present project in 2003, we performed a comprehensive book/journal review and information gathering related to the subjects of multiple births and parenting

multiples, and we performed key informant interviews to grasp the real situation in Japan. We found very little academic research related to multiples in Japan compared to that in Western countries. Most scientific reports were limited mainly to clinical obstetric researches or twin studies in the field of human genetics. And, few, if any, reports or books related to support for families with multiples were governmental reports or experience-based descriptions or case reports.

2.1 Iatrogenic multiple pregnancy

Multiple pregnancy is the most serious complication of assisted reproductive technology (ART) because of its well established medical risks (Derom et al., 1993; Ooki, 2011c) and social and economic consequences. Many fertile couples in Japan, with or without their knowledge of the health risks and family impact of a multiple birth, are said to regard a twin pregnancy as the ideal outcome of ART. Before any treatment for infertility is performed, the prospective parents need to be fully informed about the risks associated with multiple pregnancy as well as the practical, emotional and financial impact of parenting multiples (Leonard & Denton, 2006).

2.2 Pregnancy and parenting problems related to multiple births

Parents often describe multiple pregnancy as physically and emotionally difficult (Bryan, 2003). The diagnosis of multiple pregnancy frequently comes with a shock as well as happiness. Parents should be given written information about multiple births including details regarding local and national support organizations (Denton, 2005a). The goal of multiple birth education classes for expectant parents is to educate parents and other family members about the unique aspects of multiple pregnancy and parenthood (Leonard & Denton, 2006).

Mothers of multiples have been shown to suffer more from lack of sleep and fatigue than mothers of single-born children. Furthermore, depression is more common well beyond the infancy period, probably due at least to social isolation and fatigue (Bryan, 2003). Child abuse is more common in multiple birth families (Tanimura et al., 1990). The rates of divorce are higher in parents of multiples than of singletons (Jena et al., 2011). The development of most multiple birth children will be within the normal range. However, they will face a higher risk of certain longer-term problems including cerebral palsy, learning difficulties and, in particular, language delay (Bryan, 2003; Denton, 2005b). Multiple birth families have unique needs, which are still not widely understood or sufficiently addressed by health care and other professionals. A well-trained multidisciplinary team, which provides specific care, parent education and support, is the basis for improving health outcomes for multiple birth family members (Leonard & Denton, 2006).

2.3 Financial implications for families

The financial impact of having multiples on families is considerable, with most experiencing a substantial loss in income and an enormous increase in expenditure, especially if the infants are preterm or have complex health needs. Most women leave the work force on reduced or no salary; many do not return to outside employment for months or even years (Hall & Callahan, 2005; Leonard & Denton, 2006). Moreover, extra daily life expenditures

are required of multiple birth families compared to families with single-born children. The majority of multiple birth families, despite finding their income greatly diminished, do not qualify for subsidized child care or extra financial support. Early in pregnancy, parents should be encouraged to explore maternal support resources in their families and communities and to seek advice from other multiple birth parents.

2.4 The Declaration of Rights and Statement of Needs of Twins and Higher Order Multiples of ICOMBO

The International Council of Multiple Birth Organizations (ICOMBO ; <http://icombo.org/>) was formed at the 1980 Congress of International Society for Twin Studies. The mission of the ICOMBO is to promote awareness of the unique needs of multiple-birth infants, children, and adults. The multi-national membership of ICOMBO has developed this Declaration of Rights and Statement of Needs of Twins and Higher Order Multiples as benchmarks by which to evaluate and stimulate the development of resources to meet their unique needs. This statement is a very informative and revealing overview of a variety of socio-psychological and bio-medical aspects of the problems of multiple birth families or multiples themselves. These rights and statements were useful milestones in the development of research and support systems of families with multiples in Japan (Ooki, 2009).

The following statements were adopted in the latest version of the declaration in 2010:

1. Multiples and their families, as any other individuals, have a right to full protection, under the law, and freedom from discrimination of any kind.
2. A. Individuals or couples planning their families and/or seeking infertility treatment have a right to be fully informed about:
 1. factors which influence the conception of multiples;
 2. the associated pregnancy risks and treatments;
 3. the associated risks to one, more or all of the fetuses/infants;
 4. facts regarding parenting multiples; and
 5. the option of multifetal pregnancy reduction along with its associated risks and profound emotional consequences.
- B. Infertility treatment should intend to prevent multiple pregnancies, in particular high order multiples.
- C. Fertility services should disclose their number of multiple pregnancies, both intentional and unintentional.
3. A. Parents have a right to expect accurate recording of placentation, determination of chorionicity and amnionicity via ultrasound, and the diagnosis of zygosity of same sex multiples at birth.
- B. Older, same sex multiples of undetermined zygosity have a right to testing to ascertain their zygosity. Furthermore, involvement in registries of multiple-birth individuals should be absolutely voluntary on the part of the multiples.
- C. Zygosity should be respected as any other human trait and deserves the same privacy rules.
4. Any research incorporating multiples must be subordinated to the informed consent of the multiples and/or their parents and must comply with international codes of ethics governing human experimentation and other types of research.

5. A. Pregnant women, parents and their multiples have a right to care by professionals who are knowledgeable regarding the management of multiple gestation and/or the lifelong unique needs of multiples; and
 B. Multiple births, perinatal and infant deaths, and singleton births that started out as a multiple gestation, must be accurately recorded.
6. Co-multiples have the right to be placed together in foster care, adoptive families, custody agreements, and educational settings.
7. Multiples, as any other human being, have the right to be respected and treated as individuals with their own needs, preferences and dislikes.

The summary of the 'Statement of Needs' is as follows: twins, and higher order multiples have unique conception, gestation and birth processes; health risks; impacts on the family system; developmental environments; and individuation processes. Therefore, in order to insure their optimal development, multiples and their families need access to health care, social services, and education which respect and address their differences from single born children.

2.5 Three aspects of studies on multiples

There are three main independent fields of research regarding multiples, especially twins (Ooki, 2009). Twins are generally recognized as being a valuable resource not only for research on twin births themselves (the study 'of' twins in the field of obstetrics or biology), but also for research clarifying the relative contributions of genetic and environmental factors on human phenotypes (the study 'by' twins in the field of human genetics). It is only more recently that the special problems and needs of twins and higher-order multiple birth children themselves and of their families, and the need for special research (the study 'for' twins in the field of maternal and child care in public health) have begun to be recognized, although the number of reports is still very small compared to the other two research fields.

"Scientists must be encouraged to investigate norms for developmental processes which are affected by multiple births, benchmarks of healthy psychological development, and strategies and interventions that are effective in promoting the health of multiple birth families during the parenting period" (ICOMBO).

These three types of studies on twins and multiples are essentially strongly related to one another. The family support practices of families with multiples will become more fruitful if the findings of scientific research concerning twins and multiples in biology, obstetrics, psychology and human genetics are taken into account, in addition to the research on maternal and child care. The present project put strong emphasis on this point.

2.6 Support for families with multiples in Japan

The Japanese Association of Twins' Mothers (JATM) was established in 1967. Although JATM has the longest history of activity and the largest number of members throughout Japan, a nationwide systematic support system for families with multiples has not yet been achieved. There are many small local twins' mothers' clubs (so-called Mutual-Aid Self-Help groups) throughout Japan, although the exact number of such groups is unknown. The reason for this is that they come into existence and disappear in a relatively short time. Most of these small clubs do not have a stable foundation in terms of both financial and human resources. Many clubs have had common problems, for example the lack of successors to a

club leadership, relatively short periods of enrollment of the members, etc. There are no organizations connecting these small clubs (Ooki, 2009).

Many Western countries have nationwide organizations to support multiple birth families (Denton, 2005a). Support from local governments, public health centers and municipal maternal and child health care centers are not sufficient in Japan (Ooki, 2009). The history of such support is very short; e.g., the first multiple birth families-focused child care class was held in 1991. Very little information, advice and support is provided by medical institutions. Even if a maternity class regarding multiple pregnancy is held, most of these activities are not followed up with other similar programs in the communities where families live once the mothers deliver the multiples and leave the hospital. Multiples-focused pregnancy and parent education resources include leaflets, books and other printed materials, videos and DVDs, prenatal childbirth education classes, and online or telephone information and support networks. Valuable peer and professional support may come from local multiples' support groups or health care centers (Leonard & Denton, 2006). Although the situation has gradually improved, there remain very few such resources in Japan.

3. Public health challenges related to multiple births in Japan

All of the problems related to multiple pregnancy cannot be resolved if they are discussed merely in the context of certain families having problems at the moment or as problems in the narrow sense of clinical obstetrics. It is very difficult for public health professionals to recognize that families with multiples need special support, since multiple births themselves are not a disease or impairment. The main public health challenges related to multiple-births families in Japan can be summarized as follows (Ooki, 2009).

3.1 Lack, division, disparity and inequality of information

All kinds of information regarding multiple births is lacking, including evidence-based objective data on, for example, fertility treatment and short- and long-term prognosis of multiples. Qualitative data, for example, tips on the child-rearing of multiples, are also lacking and not fully described and organized. Therefore, health professionals do not know what the problems are. Moreover, there is very little cooperation and collaboration between families with multiples, medical institutions, administrative agencies, educational institutions and research institutions. This situation leads to division and inequality of information between parties and within each party.

3.2 Delay of institution of laws and guidelines

Governments and academic societies have very few guidelines or policies regarding multiple births, including fertility treatment, compared to Western countries or national or international academic societies. Therefore, the future directions of support for multiple birth families are vague and unclear.

3.3 Lack of specialists in multiple births

In general, few professional advisors in the fields of pregnancy and the growth and development of children have all kinds of adequate information to answer parents' questions concerning parenting multiple birth children.

3.4 Shortage of infrastructure and social resources

Social supports for families with multiples are very limited, and not necessarily convenient to use. Moreover, these social resources are very different among municipalities in both quantity and quality.

3.5 Lack of mental support for multiple families

Since multiple pregnancy has high risks, the priority is put on the safety of the delivery, and as a consequence mental care for mothers is overlooked. It is also important to improve family competency, including the capacity to make informed decisions, and to empower families.

4. Conceptual model of the present project

These problems surrounding multiple birth families are never resolved by the efforts of families with multiples alone, even if they create local twins' clubs or groups. A more multidisciplinary collaboration including specialists from each domain involved is essential. Moreover, population-based or at least large-scale epidemiologic studies to assess the long-term health and the social and psychological impact of multiple births on family, children and society are crucial to provide a scientific basis and to persuade policymakers of the importance of supporting families with multiples. The key concept of present practice is outlined in Figure 1. We are trying to combine research and practice by applying the EBPH (Evidence-Based Public Health) method (Gray, 2008), the CBPR (Community-Based Participatory Research) approach (Israel et al., 2008) and a population approach (Rose, 1994). Our emphasis is on determining the real needs of community members.

4.1 Needs of a population approach and a high-risk approach

The level of the health conditions of multiple birth families is lower than that of families with single-born children. There is no maternal and child health policy focused on multiple birth families in Japan. These disadvantages and this inequality of information start during pregnancy, or even during fertility treatment. This situation raises the risks of anxiety, experiencing difficulty and of failure in the child care or parenting of multiples. It is obvious that ad hoc individual support without a clear purpose, as is presently available, is insufficient, and a population approach focusing on all multiple birth families would be more effective, as shown in Figure 2. Merely waiting for families to ask for help or to take part in the child care classes is less effective than providing information actively and positively to all multiple birth families. It is important to target families without information, families who have information but cannot utilize it, as well as families who have information and can use it, as shown in Figure 3.

On the other hand, multiple birth families are obviously a high-risk group in terms of maternal and child health. Moreover, many future risks are predictable during pregnancy or fertility treatment. Appropriate early intervention as a 'high-risk approach' would also be effective. Community networks for multiple birth families would make both the population approach and the high-risk approach possible.

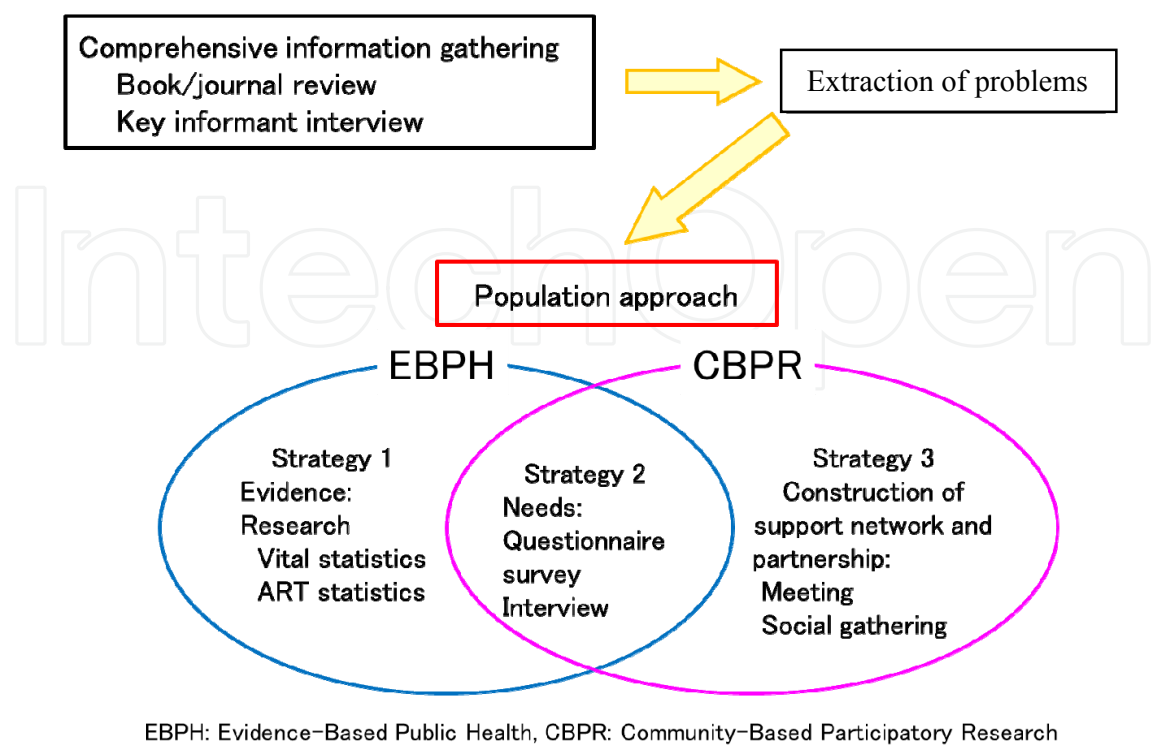


Fig. 1. Conceptual framework of the project.

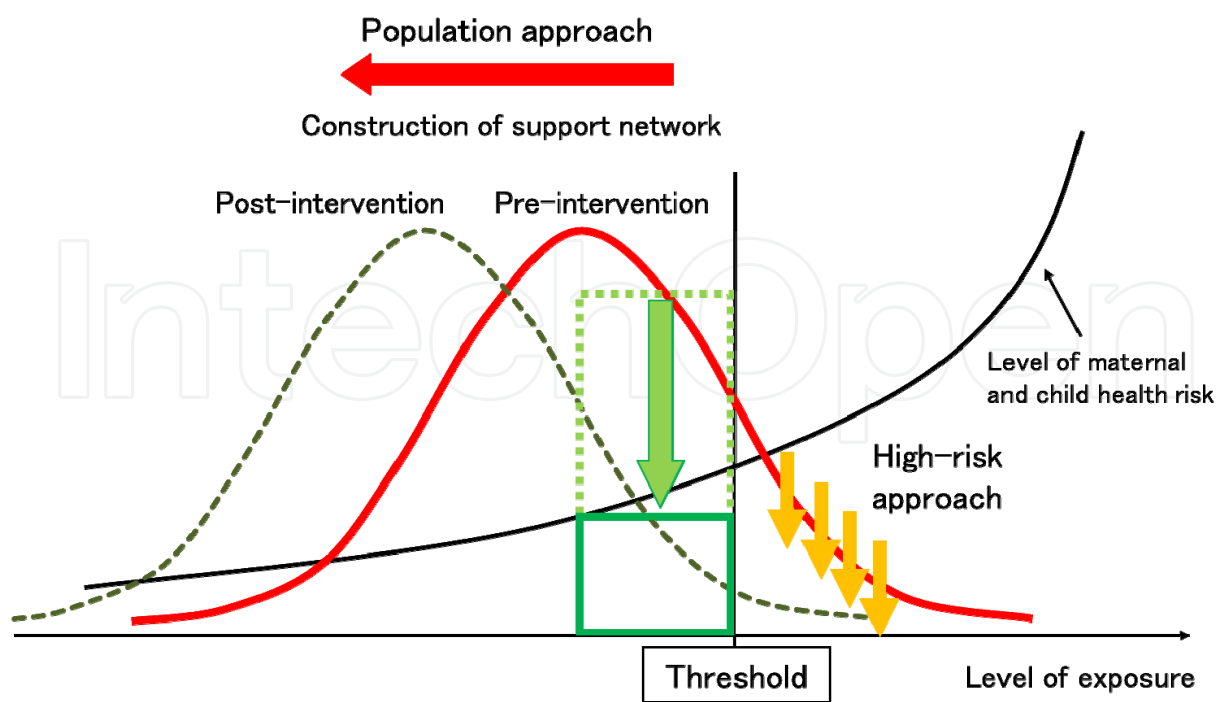


Fig. 2. Construction of support network for families with multiples as a population approach.

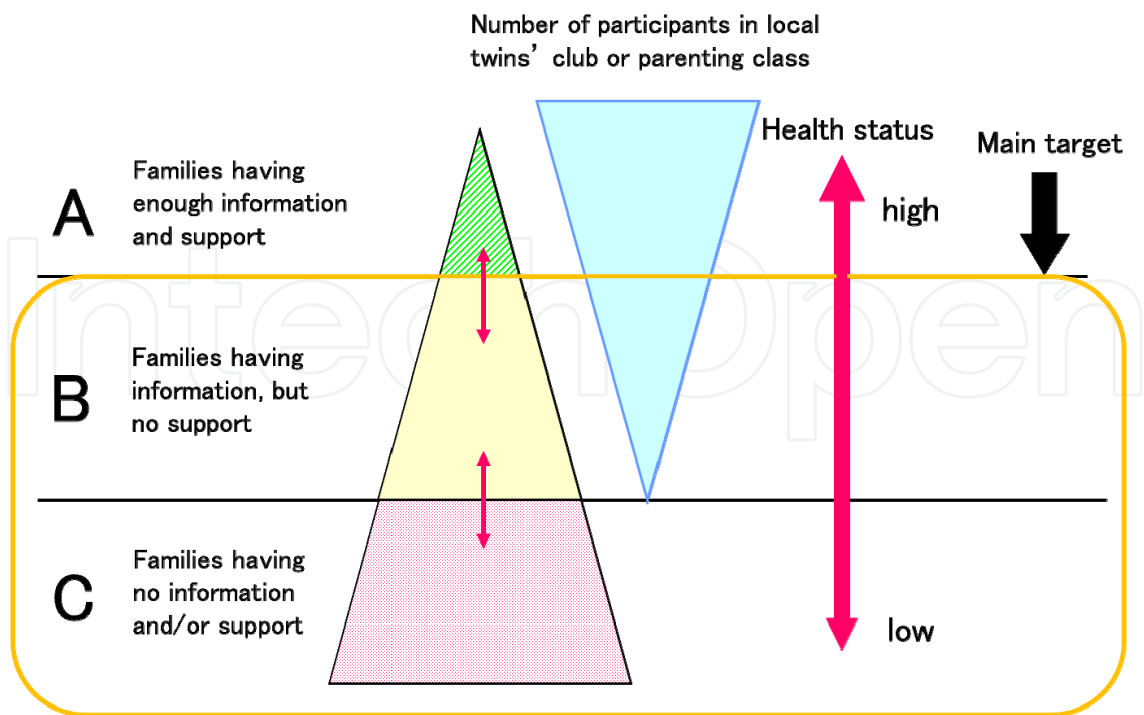


Fig. 3. Health status of families with multiples in the community.

4.2 Evidence-Based Public Health (EBPH)

As shown in Figure 4, the three main components of Evidence-Based Public Health (EBPH) are evidence, value and local needs and resources (Gray, 2008). EBPH requires that decisions about public health practice are based on the best available, current, valid and relevant evidence. These decisions should be made by those receiving care, informed by the tacit and explicit knowledge of those providing care, within the context of available resources. EBPH can also be defined in population health terms, e.g., "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of communities and populations in the domain of health protection, disease prevention, health maintenance and improvement (health promotion)". Evidence can come from a range of sources including scientific journals and other publications, population health statistics, epidemiologic data and locally collected data.

4.3 Community-Based Participatory Research (CBPR)

CBPR is an action research approach that emphasizes collaborative partnerships between community members, community organizations, health care providers, and researchers to generate knowledge and solve local problems (Israel et al., 2008). Hierarchical differences that typically arise between providers and patients are flattened through this partnership and all participants work together to co-create knowledge and effect change throughout all aspects of the research process. Each partner contributes unique strengths and knowledge to improve the health and well-being of community members. CBPR has gained increased credibility in healthcare and public health since the early 1990s because of its potential to inform understanding of individuals' health related experiences and inform the creation of workable and appropriate services. As shown in Figure 5, first, the researchers must know

what issues the community members are willing to work on, and they must understand the related attitudes, values, beliefs and customs ('Felt needs').

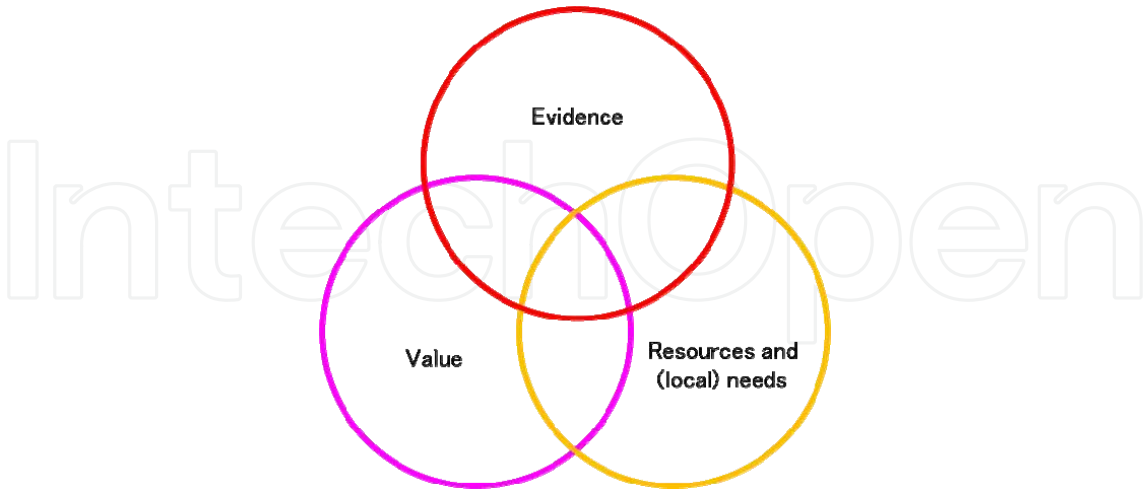


Fig. 4. Three main components of EBPH (Evidence-Based Public Health).

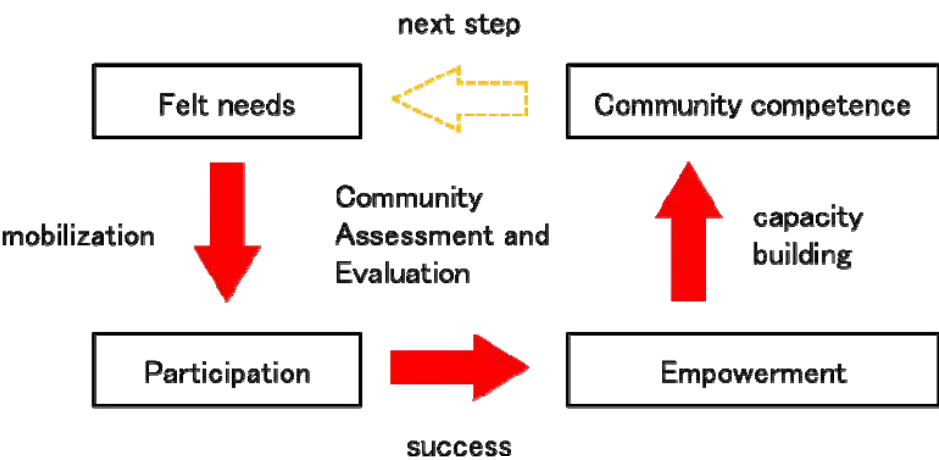


Fig. 5. Community partnership: Interlocking Dynamics model in the CBPR (Community-Based Participatory Research) approach. (Permission from Noel J Chrisman (1997). UW, personal communication)

The following nine principles seek to capture key elements of the CBPR approach (Israel et al., 2008). 1. CBPR recognizes community as a unit of identity. 2. CBPR builds on strengths and resources within the community. 3. CBPR facilitates collaborative, equitable partnership in all research phases and involves an empowering and power-sharing process that attends to social inequalities. 4. CBPR promotes co-learning and capacity building among all partners. 5. CBPR integrates and achieves a balance between research and action for the mutual benefit of all partners. 6. CBPR emphasizes public health problems of local relevance and also ecological perspectives that recognize and attend to the multiple determinants of health and disease. 7. CBPR involves systems development through a cyclical and iterative process. 8. CBPR disseminates findings and knowledge gained to all partners and involves all partners in the dissemination process. 9. CBPR requires a long-term process and commitment to sustainability.

4.4 Three strategies in the present project

The first strategy is to monitor secular trends of vital statistics and ART statistics concerning multiple births, although the latter are very limited in Japan. Monitoring and reanalyzing these statistics provide an important objective macroscopic view of the public health problems related to multiple births.

The second strategy is to provide evidence-based information to health professionals and policymakers as well as multiple birth families. A large-scale database of multiples, mainly twins, was begun in 1987 (Ooki & Asaka, 2005, 2006). The primary purpose of this database was genetic epidemiologic twin research. However, it turned out that the data, including both quantitative and qualitative, were also a useful resource for the provision of information on many features specific to twins, for example their growth and development, to families with multiples and health professionals. There are many tips for parenting multiples which are derived mainly from experience and intuition. Scientific data will add correct evidence-based information to these experience-based tips.

The third and most important strategy is to construct a human network and family support systems at the prefectural level by the CBPR approach, as shown in Figure 6. It would be very difficult to construct a nationwide family support network quickly. Therefore, prefectural level support networks should be constructed initially. Although the author may focus mainly on twin pregnancy and parenthood in the following description, the demands associated with higher-order multiples are of course similar but usually greater.

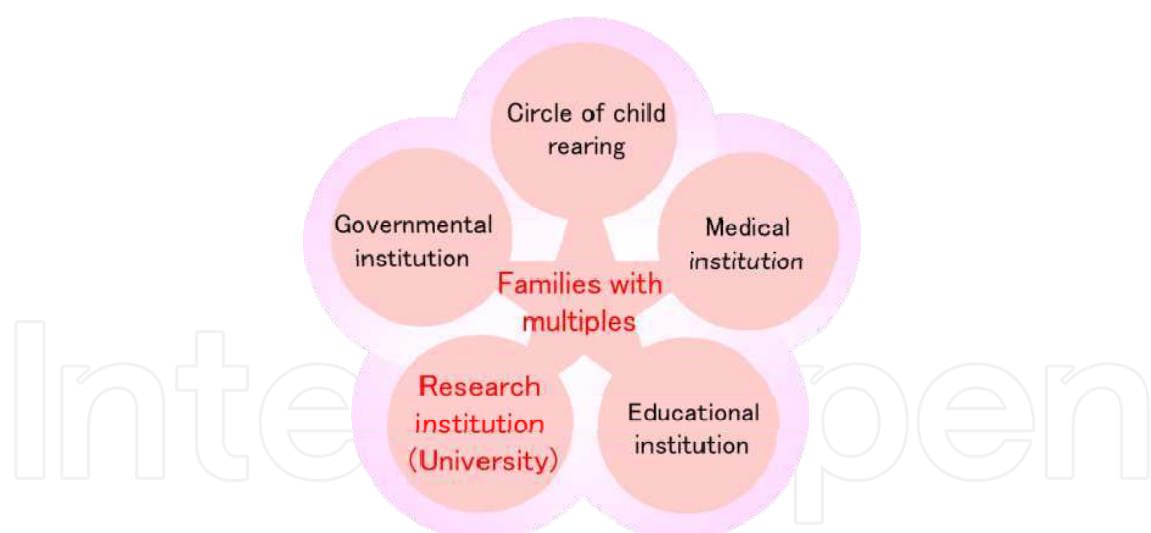


Fig. 6. Continuous and comprehensive support through pregnancy, child births and child rearing in a community support network.

5. First strategy: Making good use of vital statistics and ART statistics

All available vital statistics on multiple births within the entire Japanese population since 1974, originally collected by the Ministry of Health, Labor and Welfare (MHLW), were gathered, combined and reanalyzed. The vital statistics are based on birth records, which is published as an annual report of aggregate, not individual, data.

5.1 Secular trends of multiple births rates

Recent multiple births rates have been affected mainly by fertility treatments and maternal age (Derom et al., 1993). Secular trends of multiple births rates increased twice during the past two decades, and about 2% of all neonates are now multiples (Ooki, 2010). About 20 thousands live births are multiples, as shown in Figure 7.

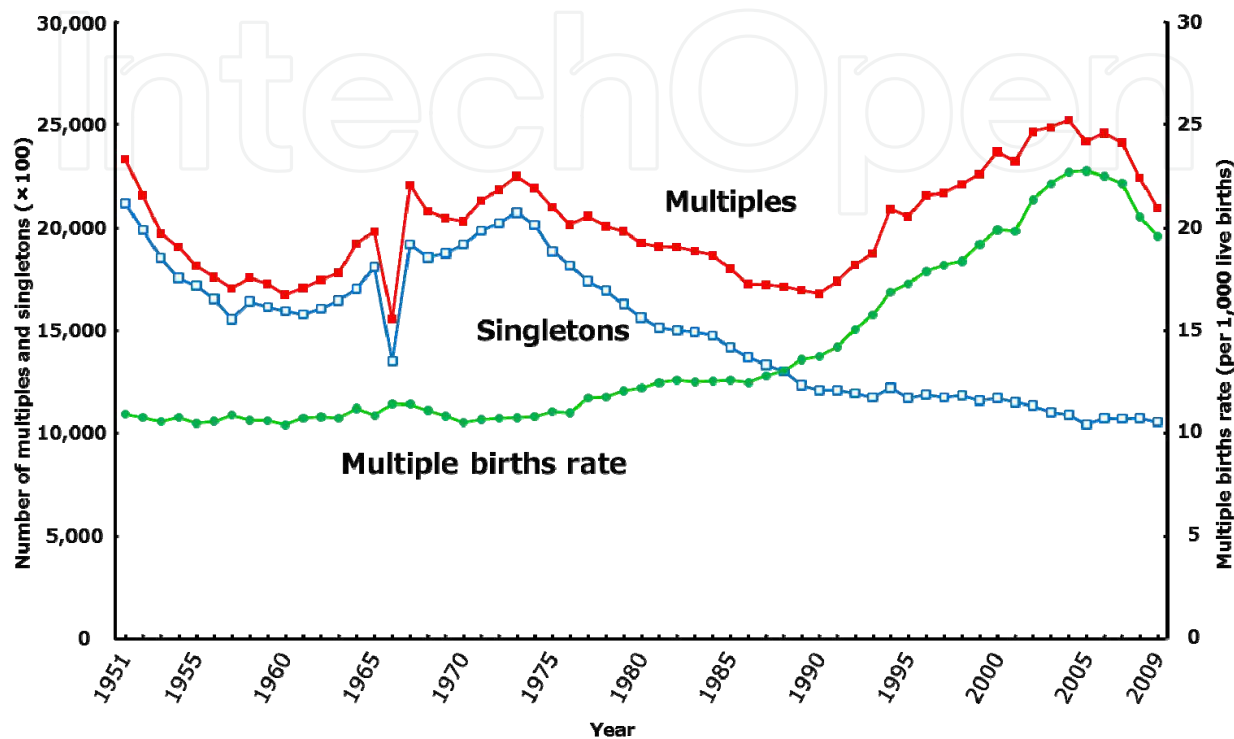


Fig. 7. Secular trend in the number of live birth singletons and multiples and the multiple births rates.

5.2 Low birthweight and preterm delivery

The population attributable risk percent was a useful indicator for clarifying the public health impact of certain risk factors. The population attributable risk percent of both low birthweight and preterm delivery tended to increase as a whole during the last thirty years, and recently reached around 20%. This is in relatively good accordance with several international studies (Blondel et al., 2002, 2006). The risks of very preterm delivery (<32 weeks) and extremely low birthweight (<1,000g) attributable to multiples are much higher than the risks of overall preterm delivery (<37 weeks) or low birthweight (<2,500g). Very preterm delivery or low birthweight require intensive care in neonatal units, and are at high risk for neonatal morbidity and developmental problems. Therefore, the rising number of multiples will increase the burden on neonatal services and health services in general, as well as resulting in higher numbers of children surviving with impairment.

5.3 Stillbirths rates, perinatal and infant mortality

Inasmuch as all these indicators were markedly improved both singletons and multiples, multiples were still 2-5 times higher compared with singleton (Ooki, 2009). The main reason

for this elevated perinatal mortality is preterm and very preterm birth, resulting in low and very low birthweight children. But, it is worth noting that prognosis is rather good as to multiples than singletons, if certain period of gestational weeks or birthweight is obtained. According to vital statistics, the infant mortality rate is lower in multiples compared to singletons, if birthweight or gestational age is near the cut-off point of LBW (2,500g) or preterm delivery (37 weeks).

5.4 Composition of maternal age

Maternal age class of multiple births is higher than that of singletons (Ooki, 2011a). About 60% of mothers were estimated to have given birth to their multiples in the first delivery between 1999 and 2009. It seems that mothers of higher age have many physical and mental burdens for parenting multiples. Moreover, if mothers take fertility treatment, economic burden would be also added. This may be still the case as to fathers.

5.5 The impact of maternal age and fertility treatment

During the 25-year period, multiple-birth rates according to maternal age class increased after the late 1980s. This tendency was obvious in women aged 35 to 39 years (Ooki, 2011a). The estimated numbers of iatrogenic multiple births greatly increased in women aged 30 to 34 and 35 to 39 years. The rate (per 1,000 live births) of iatrogenic multiple births gradually increased from 0.7 (1977) to 1.3 (1986), then rapidly and markedly increased from 1.3 (1986) to 11.4 (2005), and finally decreased to 8.1 (2009). The estimated maximum percentage of iatrogenic multiple births was 50.0%, in 2004 and 2005. The rapid increases in Japan in the number and rate of multiples born to women older than 30 years are likely due to iatrogenic rather than spontaneous multiple births, as shown in Figure 8.

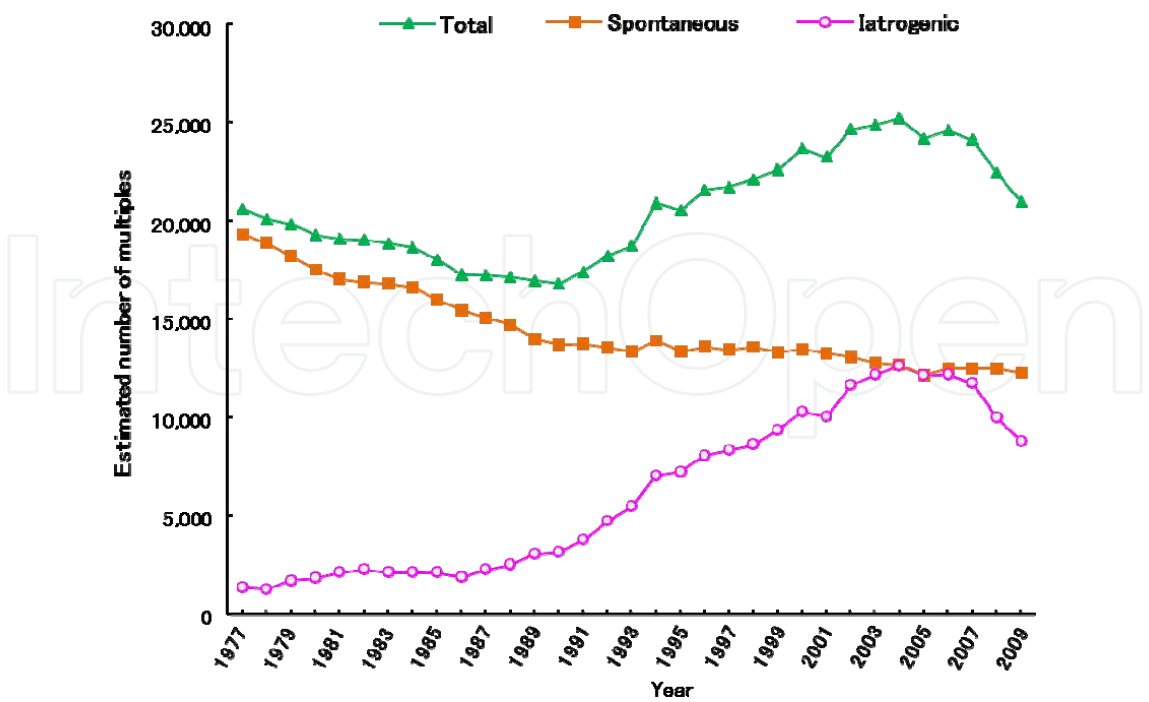


Fig. 8. Secular trends in the sum of the age-specific estimated number of spontaneous and iatrogenic multiple births, 1977-2009.

The effect of ART and non-ART ovulation stimulation fertility treatment on the number and rate of multiple live births from 1979-2008 was estimated using two independent data sources, ART statistics presented by the Japan Society of Obstetrics and Gynecology between 1989 and 2008 and vital statistics (Ooki, 2011b). The number of non-ART iatrogenic multiple births was estimated by subtracting the ART multiples from the total iatrogenic multiples. There was an overall increase in the non-ART multiple births during the thirty year period, whereas ART multiples tended to increase from 1983 to 2005, and then rapidly decreased thereafter, suggesting the effect of the single embryo transfer policy for ART. The number or percentage of ART multiples was almost consistently lower than that of non-ART multiples.

5.6 Summary

The present results offer clear evidence of the public health impact caused by the rapid increase of multiple births in Japan. Caution is recommended when considering these results, however, because these indicators were counted by the number of children (multiples), not by the number of mothers (families). According to the vital statistics in Japan, the mean number of children under 6 years old in one family was larger in families with multiples compared to families with singletons. Therefore, the risk of having stillbirth and/or child death in at least one baby in one family may be even higher in families with multiples than in families with singletons. Moreover, these impact can be presented by medical economics (Hall & Callahan, 2005), laws and guidelines on fertility treatment or multiple births (Bryan et al., 1997; Denton, 2005b; Leonard & Denton, 2006), the real situation of families with multiples (Thorpe et al., 1991), and social family support system or maternal and child health policies (Ooki, 2006b).

6. Second strategy: Construction of large-scale twin database and provision of evidence-based information

Many countries including some Asian countries are constructing or have constructed large population-based twin registries, mainly for genetic research (Ooki, 2009). No systematic twin registry exists in Japan, however. Since the frequency of families with multiples is not so high (1% at most), a strategic method is crucial, if researchers hope to gather a large amount of high-quality unbiased data.

6.1 Strategies for the collection of data on multiples in Japan

There are four main types of data included in studies on multiples (Ooki, 2006b). First, vital statistics can be obtained (Kato, 2004), but it is almost impossible to obtain access to personal information concerning individuals. Second, data from large hospitals have been used in the field of obstetrics. The collection of obstetric data on multiples is relatively easy with the trade-off of selection bias in favor of high-risk infants. Third, the Basic Resident Registration of municipalities can be used. But, cost-effectiveness is extremely low in the case of multiple birth families. Fourth, there is a volunteer-based database of multiples, which includes data from mothers belonging to associations for parents of multiples. It contains more detailed information on the condition of multiples after birth compared to the vital statistics and hospital data. Although volunteer-based databases may have some selection biases, cost-effectiveness is very high.

A volunteer-based twin database has been organized from 1987 (Ooki & Asaka, 2005, 2006) that is larger and less biased than hospital data and contains more detailed information after birth. Collaborative research with multiple-births families using the CBPR approach could increase the number of participants, improve the response rate for the questionnaire survey and validity of the data, provide researchers with information about the real needs of families and assist researchers in creating health needs-oriented research questions. In the CBPR approach, researchers become participant observers, as shown in Figure 9.

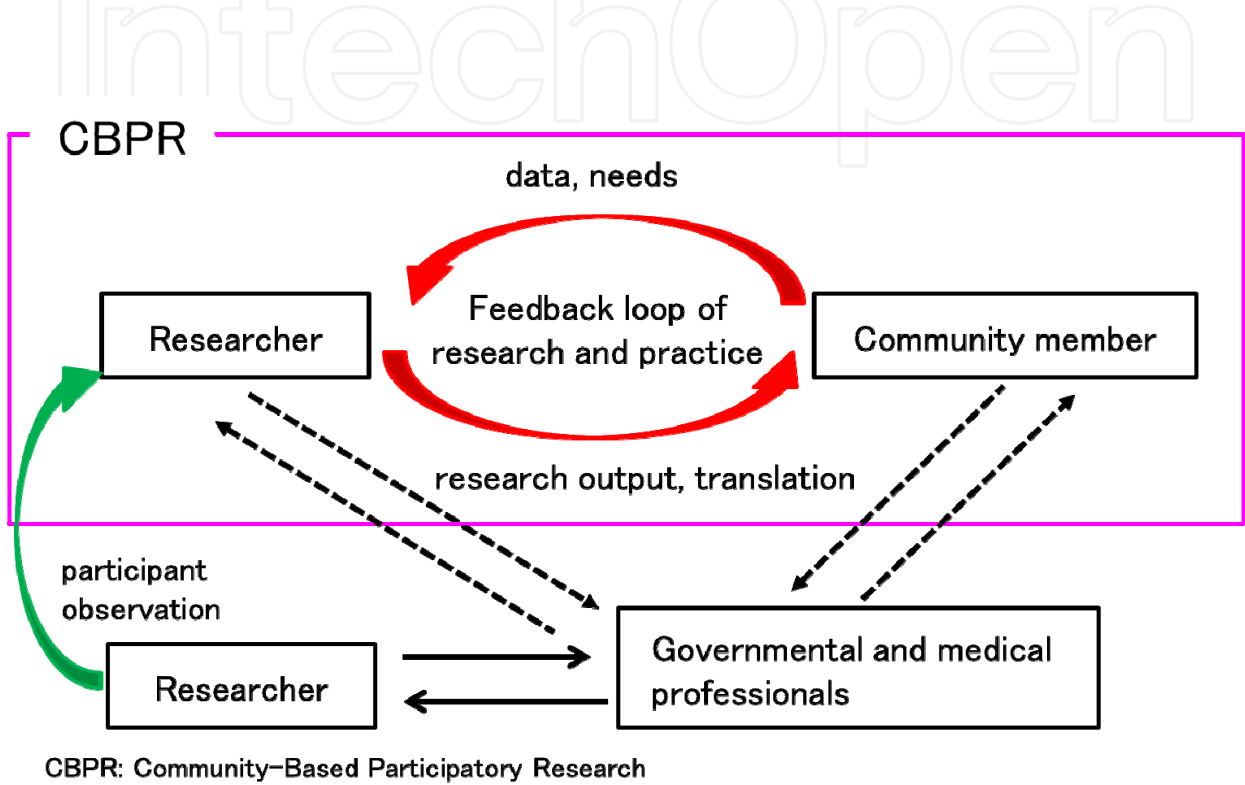


Fig. 9. Collaborative research with community members based on partnership.

6.2 Outline of Japanese Database of Multiples in Childhood (JDMC)

The database consisted mainly of three independent groups. The first group -school applicants group- included 1,205 mothers and their twin children, who had applied between 1981 and 2011 to the secondary school attached to the Faculty of Education at the University of Tokyo (Ooki & Asaka, 2005, 2006). The second group - the maternal associations group - consisted of 951 mothers from several associations for parents of multiples throughout Japan. Continuous data have been gathered from 2001(Ooki & Asaka, 2005). The third and most recently formed group consisted of 956 mothers who were recruited during collaborative research with multiple-births families throughout Japan starting in 2011, based on the present CBPR approach. Mailed or hand-delivered questionnaires were used to collect the basic data. Most medical findings of all databases were obtained from *The Maternal and Child Health Handbook*, which is presented by the MHLW to all pregnant women. This handbook serves as a valuable source of health information for mothers and children up to 6 years old. These questionnaire surveys are now in progress.

6.3 Ethical issues

As to school applicants group, the statistical analysis of the data was clearly written in the application document, and the detailed explanations concerning data collection by questionnaire and interview, and blood sampling for zygosity examination and health check were added as another paper from 1999. Moreover, informed consent was obtained from each twin and his or her parents in writing from 2001 on. The data analysis was also permitted by the ethical committee of this school. Zygosity diagnosis using DNA sample was permitted through the ethical committee of the Graduate School of Medicine, University of Tokyo. All the mothers in the maternal associations group cooperated voluntarily in this research, mainly through the presidents of their associations.

6.4 Zygosity diagnosis

6.4.1 Method of zygosity determination

There are two types of twins. Monozygotic (MZ) twins derive from the division of a single zygote, whereas dizygotic (DZ) twins derive from the independent release and subsequent fertilization of two ova (Machin, 1994). Zygosity determination is the process of determining whether same-sex twin pairs are MZ or DZ. The three reasons for determining zygosity at birth are (1) medical, (2) scientific and (3) personal (Derom et al., 2001). Zygosity is particular importance in questions of organ transplantation and inheritance of specific diseases (medical). To determine the relative contribution of genetic and environmental factors to the human traits, comparison of similarity between MZ and DZ pairs is made in the field of human genetics (scientific). The question of zygosity has a special importance to the multiples and their families (personal). The needs for an appropriate method of determining zygosity for use by twins' parents or health professionals have increased. Although the accuracy was lower concerning questionnaire method compared to DNA markers, cost performance is high and less invasive.

6.4.2 Development of zygosity questionnaire for Japanese twins

The determination of zygosity in twins based on questionnaires can be done with considerable accuracy, showing that the accuracy of the questionnaires employed is around 95% (Rietveld et al., 2000). The zygosity questionnaire for twins' mothers by Ooki et al. (1993), consisting of five simple questions regarding twins' similarity, was upgraded and achieved a total accuracy of 94.6% (212/224 pairs) (Ooki & Asaka, 2004). If zygosity determination by DNA/genetic markers was regarded as the gold standard, the accuracy of the zygosity questionnaire was 97.5%, leaving around 10% of pairs unclassified. The effectiveness of this simple method in practical use, especially when this questionnaire is used for the purpose of offering zygosity information to twins' mothers and health professionals more easily.

6.5 Representativeness of the subjects of JDMC

Most of the present subjects were normally developed twins. Therefore, birthweight seemed to be larger than the general twin population. Compared with hospital data, however, the present data more closely reflects real birthweight of the general twin population. It was ascertained that there was no fatal selection bias of severely discordant twin pairs. But some unexpected selection biases may exist (Ooki & Asaka, 2005).

6.6 Main evidences obtained from the JDMC

Main evidence produced by the present database (Ooki, 2009), which was provided to the multiple birth families and health professionals is described in brief.

6.6.1 Zygosity misclassification of twins at birth

By analyzing four independent samples, we found that at a constant rate about 25%-30% of MZ twins were misclassified as DZ twins at birth (Ooki et al., 2004). This percentage is in very good accordance with that of MZ twins having dizygous placenta. About 70% of mothers showed their interest in their children's zygosity for many reasons. One of the main reasons was their doubt about the zygosity they were told at birth. Considering all of these issues, medical specialists should be careful what advice they give parents about zygosity, placenta and related information.

6.6.2 Growth and development of twins

In Japan, the developmental norms have been examined every ten years and have been presented in *The Maternal and Child Health Handbook* by the MHLW. The physical growth after birth, motor and language development of twins in childhood must be evaluated using the standards for the general population, that is, essentially the standards for singletons. According to these measurements, many twins are regarded as having poor growth and development, especially when they are very young, and this causes both the twins and their parents much embarrassment and concern. Appropriate data should be provided to families and health professionals.

6.6.2.1 Intrauterine growth of twins

Because birthweight is the strongest indicator of the risk of perinatal death, birthweight norms are important both for clinical practices and for epidemiologic studies. Numerous birth weight standards by gestational age for twins have been reported in Western countries (Glinianaia et al., 2000), whereas little is in Japan (Kato, 2004). Other body size parameters at birth, such as birth length, chest circumference, and head circumference (Ooki & Asaka, 1993) have not been reported as consistently as birthweight. Selected percentiles by gestational age were calculated and smoothed (Ooki & Yokoyama, 2003). Compared with singletons, birth weight difference in twins was marked and slight difference was observed as to length, whereas no difference was observed as to chest and head circumference. It is very important for both multiple birth families and health professionals to recognize that the intrauterine growth of twins is amazingly different from that of singletons.

6.6.2.2 Physical growth of twins in childhood

There have been many studies on the physical growth of twins in childhood in Western countries (Akerman & Fischbein, 1992; Wilson, 1986). Most studies reported so far regarding the physical growth of twins after birth in Japan had very small samples and only roughly classified age after birth. Using 2,029 pairs of normally developed Japanese twins, Ooki and Yokoyama (2004) analyzed the characteristics of twins' physical growth from birth to 6 years and presented growth charts based on the analysis. The size deficit of the twins compared to the standards for the general population of Japan was largest at birth: more than 20% for

weight and approximately 6% for length. These deficits decreased rapidly in the first 6 to 12 months, and were found to be as low as 0-2% at 4 to 6 years of age. Growth charts specifically for twins are needed, at least for the first 1 to 3 years of age but not beyond the age of 6 years.

6.6.2.3 Longitudinal similarity of body weight from birth to 3 years

To clarify longitudinal similarity of body weight, 648 pairs of same-sex twin pairs were analyzed (Ooki, 2009). More than 90% of MZ pairs were similar, whereas 65% as to DZ. About half of MZ pairs were constantly similar after birth. Even if individual twin baby are born small, they rapidly catch up with singletons until one year of age. MZ pairs become more and more similar by one year of age irrespective of birthweight difference, whereas DZ pairs become more and more dissimilar. This tendency becomes marked with age. This is because MZ twin pairs, who have identical genetic composition, reach to the genetically determined their body weight. On the contrary, DZ twin pairs, whose genetic similarity is only 50%, equal to siblings in general, show variety of similarity.

6.6.2.4 Motor development of twins

Many studies have shown that twins tend to lag behind singletons in terms of motor development (Chaudhari et al., 1997; Peter et al., 1999), although the causes of this delay are not explained simply by the earlier gestational age at birth or the lighter birthweight of twins compared to singletons. Relative to general population norms in Japan, twins tended to be delayed in reaching several motor development milestones (Ooki, 2006a). Nevertheless, as twins mature, their development tends to catch up with that of singletons. Stepwise regression analysis showed that gestational age was the most influential on all six milestones. Motor development within pairs was more similar in monozygotic pairs compared with dizygotic pairs regarding each item, suggesting genetic contributions. More than half of the DZ pairs showed differences of one month or more in attaining walking without support.

6.6.2.5 Language development: Age at first spoken word

It has become a well-known fact that twins tend to lag behind singletons in terms of language development (Rutter et al., 2003; Thorpe et al., 2003), although the causes of this delay are unknown and appear to be complex. The subjects were 937 (maternal associations group) and 1,092 (school applicants group) twin mothers and their twin children (Ooki, 2005). Relative to general population norms, twins in the maternal associations group were about one to two months delayed in terms of age at first spoken word. Nevertheless, about 95% of twins have started speaking at least one word at 18 to 19 months, as singletons do. According to maternal reports, MZ males, compared with singletons, showed the largest delay throughout childhood; this delay was partly attributed to the effect of 'twin language'. Language development was more similar in MZ pairs than that of DZ pairs. The language development of twins partly differs from that of singletons and that estimation of language development specifically for twins are needed.

6.6.2.6 Breast-feeding of twins

Although an adequate quantity and quality of milk production has been documented even for high multiples, it seems difficult for mothers rearing multiples to breast-feed for many

reasons. Many studies deal with the introduction of the skills or techniques for breast-feeding multiples (Flidel-Rimon & Shinwell, 2006; Gromada & Spangler, 1998), and practical recommendations or guidelines (Leonard, 2003). Breastfeeding rates from 0 to 6 full months were analyzed using 4,023 Japanese twins (Ooki, 2008). Full breastfeeding of twins has risen recently in Japan, although the rates are still lower than those of the general population. But, the combined rates of full and partial breastfeeding were close to those of general population. The most influential factor that interfered with breastfeeding from 0-6 months was gestational weeks. The percentage of concordance pairs were around 95% for all months.

6.7 Some practical guidelines

The results of scientific research should be offered not only to researchers and professionals of maternal and child health, but also to families who offered valuable data (participants). The reliance between researchers and research participants or collaborators (families with multiples) is crucial, as shown in Figure 9. Research results must be translated into information that is useful for family support activity. There are two essentially important and often confused dimensions to estimating the growth and development of twins: comparing individual twins versus singletons, and comparing the similarity of the twins within a pair.

6.7.1 Physical growth and motor and language development

Twins showed a tendency to lag behind singletons in terms of physical growth and motor and language development in the present successive studies, as many studies have already pointed out. Nevertheless, as twins mature, their development tends to catch up with that of singletons. According to the interviews with mothers, the following advice was frequently given upon health examinations by health professionals without decisive evidence. *‘Because your children are twins, delay of the growth and development compared with singletons, is a natural event’*, or *‘Your children will catch up with singletons sooner or later. Therefore, do not worry’*. Surely this advice offers temporary comfort to mothers, but provides no essential solution. Concern about growth and development, especially language development, is one of the most common and most serious questions about their children that parents, especially those of twins, bring to their pediatricians or public health nurses. Although a substantial proportion of delays in twins seemed to resolve themselves in the preschool or early school years. Moreover, MZ pairs are in general more similar than DZ pairs, with variety of degrees, concerning almost all traits of growth, development and habitual behaviors. In other words, DZ pairs show considerable within-pair differences or discordance. Therefore, it is of little meaning when estimating or advising the similarity of twin pairs without considering their zygosity (Ooki, 2009).

Since about two-thirds of all twin pairs in Japan are DZ pairs due to widespread fertility treatments, dissimilarity within pairs is usually seen. The professional caregiver should abandon the stereotypical notion that all twins share similar characteristics, which is one of the most popular and erroneous ideas about twins in Japan. Similarity of twins were strongly influenced by zygosity. Zygosity is one of the key concepts connecting genetic studies with the maternal and child health care of twins. In the situation of a medical

examination of twins, health professionals should be aware that even within twin pairs, growth and development can differ considerably, and the existence of difference or discordance within a pair is usually in itself of little consequence. Moreover, total estimation of growth and development as twin children is essential, which should be take resemblance and difference of twins from singletons into consideration.

6.7.2 Breast-feeding multiples

Combined rates of full and partial breast-feeding were close to those of the general population. It was desirable to raise the full breast-feeding rates of multiples while maintaining the total (full and partial) breast-feeding rates. Antenatal counseling, hospital practice, the attitude of the medical team towards breast-feeding, the expertise of the public health nurse, and national policies on maternal and child health could change the current situation. However, when breast-feeding is not possible, the health professionals must carefully avoid judgmental approaches that may induce guilt, and mothers should not be given the impression that they have to breast-feed exclusively in order to breast-feed successfully (Leonard, 2003).

7. Third strategy: Human network construction in Ishikawa Prefecture

7.1 Background

The majority of twin registries throughout the world have been constructed primarily for genetic studies. It appears to be very difficult to achieve a high participation rate from families with very young children in Japan, particularly if researchers perform only a genetic twin study with no feedback for the participants. The nurturing of multiples entails a higher burden physically, mentally and economically than that of singletons, and participants surely expect appropriate information from researchers to facilitate the healthy growth of their twins. Offering information useful for the parenting multiples would be a strong incentive for the parents to participate in such studies, as shown in Figure 9.

Given this background, the construction of a population-based database of multiples in childhood at the prefectural level began in 2004 (Ooki, 2006b). The basic idea is a population approach to reduce health risks of multiple birth families. The goals of the registry are to contribute to the development of welfare programs for multiple birth families as well as to co-ordinate research useful for both human genetics and maternal and child health. The well established and sophisticated strategies and methods to recruit twin families into the registry were very useful for the construction of human network and information distribution in this program.

7.2 Maternal and Child Health Administration in Japan

Japan consists of 47 prefectures, the basic unit of local government, and about 1800 (1719 as of 2011) municipalities. National government policies for the health of mothers and children are planned and administered by the MHLW. Public Health Centers (PHCs) were operating in approximately 517 locations in 2008 (495 as of 2011); additionally, the government offices of cities, towns and villages operate other municipal PHCs. These health centers administer independent policies together with the policies and administrative functions delegated or

transferred by the MHLW. At present, most of the functions of Maternal and Child Health administration have been transferred from the prefectural level to the municipal level. Typically, a single prefecture has several PHCs, which serve several municipalities within their catchment area. PHCs establish communication and coordination between municipalities with respect to maternal and child health projects in cities, towns and villages, give guidance and advice to municipalities on technical matters, and provide expert maternal and child health services. In other cases, the city defined by law as the 'core city' of the prefecture has its own PHC.

7.3 Ishikawa Prefecture

This Prefecture is located in the middle of the Hokuriku region of Honshu Island. The former feudalism may be reflected in attitudes toward patriarchy, sterility, child nurturing and multiple births in some districts. Kanazawa city, the prefectural capital, is now the center of the Hokuriku area. When this project was initiated in 2004, the total number of municipalities was 39 (19 as of 2011). The birthrates of this prefecture over the past 10 years have been nearly the same as those of Japan as a whole. Ishikawa Prefecture has four prefectural PHCs, each with a branch office, and Kanazawa City, the core city, has three PHCs.

7.3.1 Vital statistics about the multiple birth rates

To obtain an initial outline of total multiple births, secular trends of multiple births in Ishikawa Prefecture were analyzed based on the Japanese vital statistics. The twin birthrate of this prefecture is higher than that of Japan as a whole. The number of multiple births is between about 100 and 160 deliveries each year between 1995 and 2008 (91 as of 2009). This number makes exhaustive identification of newborn multiples and a construction of the population-based approach possible.

7.3.2 Social support by governmental and medical institutions

Sources of support for multiple birth families and information provided as support by governmental and medical institutions were compiled exhaustively from a mailed questionnaire in June 2004 (Ooki, 2006b). Recipients were all PHCs in the prefecture, a municipal PHC, and obstetric and pediatric medical institutions. The number of surveyed institutions totaled 417. The number of support associations available to the parents of multiples was ascertained through governmental and medical institutions as well as through personally obtained information, and their activity was investigated. The three most important problem areas according to governmental and medical professionals in supporting multiple birth families were the following: 1. the lack of knowledge on multiples among the health professionals themselves, 2. the lack of information on the multiple birth families or on the multiple birth itself, and 3. insufficient social resources available to multiple birth families. Multiple births deliveries were highly concentrated in the district at several higher-level medical institutions with neonatal intensive care unit. There are 11 associations for parents of multiples, six in Kanazawa. The present findings and outline of social support organizations available to families with multiples were important in the

development of a closely focused case report and in the construction of an effective human network.

7.4 Construction of the human network

A human network to support multiple birth families was organized alongside the demographic research and questionnaire survey using the CBPR approach. This network was constructed with the help of the relationships between families with multiples, support groups for child rearing, governmental and medical institutions, and university. The Health and Welfare Bureau of Ishikawa Prefecture provided assistance in a positive way: several intensive meetings were held for the purpose of exchanging information between members of associations for the parents of multiples, the medical staff, public health nurses, midwives and twin researchers. Workshops, round-table discussion and other events were also held periodically, about two or three times per year, in both the local and central districts. The workshop program included professional lectures on multiples and meetings where the parents of multiples could meet with each other and exchange experiences. Information of this network was vigorously presented to the mass media, including television stations, newspaper publishing companies, and local bulletins and newsletters. The local mass media was found to be quite effective in advertising this program. Moreover, past research results (described in section 6.6 in this chapter) on multiples were rewritten with advice for mothers of multiples so the results could be easily understood, and these results were provided in a fact sheet, brochure and leaflet presented to participants in workshops, family support events and similar settings. Finally, the *'Ishikawa Support Network for Multiple Birth Families'* was founded in July, 2005.

The current work was the first attempt in Japan to construct a support network system focused on the multiple birth families at the prefectural level. This network comprises a wide range of core members, including leaders of the twin mothers' clubs, maternal and child health professionals of governmental and medical institutions as well as from the private sector, and researchers. Its aims are to hold workshops, family support events and parenting classes specialized for families with multiples, to facilitate the exchange of information, skills and discussion on maternal and child health policies, and to promote total research on multiple births. The leaflet produced by this network is available in every PHC, municipal PHC and obstetric and pediatric institution, as well as in other places where it would come to the attention of expectant mothers or parents of multiples. It is important to introduce the network to the families of multiples. Public health nurses, who introduce the network during their home visits, accomplish this effectively, especially in rural areas. In some cases, mothers with experience in parenting multiples also visit maternity hospitals.

7.5 Peer support program in *'Ishikawa Support Network for Multiple Birth Families'*

A peer support program was started in 2007. This is a home-visit program involving well-trained peer supporters, namely the mothers of multiples. Its main differences with the previous family support provided by local twin mothers' clubs are as follows. First, the roles of coordinator (well-trained mothers) and peer supporter were clearly divided. Coordinators arrange requests from clients (mothers or expectant mothers of multiples), make support plans, and allot proper peer supporters according to the chief complaints of

clients. They usually go along with peer supporter while home-visit, sometimes connect clients to social resources or health professionals of governmental and medical institutions. They also follow up the client and provide mental support for the peer supporter. The main role of the peer supporter is attentive listening to the client, and she also makes an activity log for case conferences. The peer supporter may advise the client, but does not impress her own opinion. Second, an education program by professionals is provided for the coordinator and peer supporter. This education program involves training in basic knowledge on multiple pregnancy and births, parenting multiples, and social resources and training in attentive listening. Third, since this program is considered one of the activities of the support network, it also incorporates training in systems dealing with clients who are having difficulty or who have emergency needs. Periodical meetings for the discussion of anecdotal reports or case conferences are held. Although it is very difficult to improve the statistical indicators of maternal and child health quickly, the questionnaire survey showed that the empowerment effect was observed not only for clients but also for peer supporters and coordinators. Moreover, the network itself was empowered by this activity.

7.6 Multiplied effect of this support network

By constructing a support network at the prefectural level, continuous support, an expansion of cooperation, a wide range of information exchange, support that is carefully crafted according to the characteristics of the region, a reduction of the overburden for specific key persons and expansible support became possible. By belonging to this network, local twin mothers' clubs gain avenues of communication with governmental or medical institutions. Moreover, the methodologies of social support networks in other fields with more members and longer histories, for example, patients' associations, are applicable.

Other prefectures have constructed or have been constructing and appear to be considering this kind of support network. The Ishikawa support network provides a good model. Although the method varies according to the real situation in a given prefecture, such as human resources or collaboration with governmental/medical institutions, the idea of a population approach is constant. The experience of the success or failure of the process of constructing a support network will be useful directly or indirectly to other prefectures. This strategy is welcomed by the many participants and other involved parties. Finally, the Japan Multiple Births Association (JAMBA) was established on February 22, 2010 (2/22/Heisei 22 in a Japanese era), in celebration of families with multiples. This association became a member of ICOMBO on June 2010.

8. Conclusion

Previous support systems were mainly focused on the individual or on small numbers of families with urgent needs or those willing to participate in child care classes. This is an approach to resolving problems downstream. However, many problems surrounding multiple birth families are wider social concerns. These problems have more essential background factors such as societal perspectives on fertility treatment, medical economics, perinatal medical systems, the institution of laws and guidelines, and human and social resources.

It is necessary to take an approach that is focused on the background factors and wider context to resolve these problems. Most data on multiples after birth can only be obtained by volunteer families with multiples. Epidemiologic studies should be performed based on community networks of multiple families and should reflect their real needs and unknown social concerns with appropriate and useful feedback based on scientific evidence, as shown in Figure 9. If research which actively involves the multiple birth families concerned and other community members is performed with CBPR approach, both families and researchers can benefit, and good relationships will be developed. The concept of the community support network seems to be one effective means of providing support for the multiple birth families. Evidence-based support for multiple birth families (EBPH in a broad sense) should be performed. Public health initiatives to resolve the many problems related to the rapid increase of multiple births are expected to be proposed and implemented.

In conclusion, the present approach of connecting research and practice can become an effective method applicable to other public health problems related to health inequality.

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Human behavior accounts for the majority of morbidity and premature mortality throughout the world. This book explores several areas of human behavior including physical activity, nutrition and food, addictive substances, gun violence, sexual transmitted diseases and more. Several cutting edge methods are also examined including empowering nurses, community based participatory research and nature therapy. Less well known public health topics including human trafficking, tuberculosis control in prisons and public health issues in the deaf community are also covered. The authors come from around the world to describe issues that are both of local and worldwide importance to protect and preserve the health of populations. This book demonstrates the scope and some of the solutions to addressing today's most pressing public health issues.

How to reference

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