特集：行動科学研究の発展と展望－理論から実践へ

Perspectives on Behavioral Sciences Research for Disease Prevention and Control in Populations

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Abstract

Background: Changing behavior is integral to population-health approaches to disease prevention, particularly for addressing the metabolic syndrome (*metabo*) and HIV/AIDS in Japan. For *metabo*, the most relevant behavioral changes are improving diet and increasing physical activity. For HIV/AIDS, changes in behaviors that promote transmission of the HIV virus are required. Using the most suitable health behavior theories to understand how to change the relevant behaviors in populations and high risk-groups is a key to effective public health action.

Methods: We describe and analyze important contributions that health-behavior theories and research can make in addressing the prevention and control of *metabo* and HIV/AIDS. Theory and application are presented in relation to individual health behaviors; in the context of interpersonal relationships, environment, community, and organizational factors; and in relation to the translation of theory into research and practice.

Results: Addressing complexly-determined behavioral health problems such as *metabo* and HIV/AIDS requires more than the application of a single theoretical model. Determinants of health risk behaviors act at multiple levels and occur in the context of economic, social, and cultural changes in Japan. Thus, they can be difficult to change, particularly through public health strategies that might focus only on informing, educating, and motivating individuals. Broad-reach, comprehensive programs and public health policy initiatives should be targeted at multiple levels. Examples from research in Japan and selected examples from Western countries demonstrate the unique contributions of health behavior theories.

Conclusions: Familiarity with the relevant theories of health behavior change is an important ingredient for developing successful public health programs – the challenge is to use the most relevant elements of the most-suitable theories to comprehensively address multiple levels of influence on complex health behaviors. We hope that readers will take the perspectives described in this article and use them as they work to address public health challenges in local communities, workplaces, and other organizations, and at the broad national level to improve those behaviors that are significant determinants of major health outcomes in Japan.

Keywords: health behavior, behavior theory, prevention, metabolic syndrome, HIV/AIDS

Ⅰ. Introduction

Understanding and influencing behavior is a central element of population-health strategies for disease prevention and health promotion. Changing the relevant behaviors is fundamental to the prevention of chronic diseases such as type 2 diabetes, cardiovascular disease, and the most common types of cancer (most notably, lung, breast, and colon cancer). Behavior change is also fundamental to reducing the risk of some of the major infectious diseases in populations, particularly HIV/AIDS.

To address the challenges of behavior change for disease prevention and control, evidence-based approaches are needed. In this context, the behavioral sciences are crucial and relevant to key public health challenges in Japan. We propose that the most important contribution of the behavioral sciences is in providing ways of thinking that help to understand the determinants of key health-related

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behaviors, and to develop and evaluate broad-based programs and policies based on this understanding.

For the most widespread chronic diseases, the relevant behavioral changes are avoiding tobacco or quitting smoking, reducing high levels of alcohol intake, increasing physical activity, and improving diet. One of the central goals of behavioral changes in relation to physical activity and encouraging healthy eating patterns is to prevent weight gain in whole populations and to encourage weight reduction among those who are already overweight. For infectious diseases such as HIV/AIDS, safe sexual practices such as condom use, or avoiding needle sharing among injecting drug users are the most common targets.

In this paper, our main aim is to provide a broad perspective and examples of how behavioral science theories and research can assist in developing more effective public health approaches to the prevention of chronic and infectious diseases. These issues will be considered within the context of Japanese culture, changing social environments and norms, and variation across subpopulations within Japan. For our examples, we will focus mainly on two issues of current public health importance for Japan: reducing the prevalence of overweight and obesity [i.e., the metabolic syndrome or *metabo*]; and reducing the transmission of the HIV/AIDS virus.

II. How Health Behavior Theories Can Inform Public Health Strategies for Disease Prevention

Theories of health behavior have a key role in informing practical approaches to health promotion and disease prevention by focusing the thinking of researchers, practitioners, and policy-makers on three key questions about behavior change: 1) What dimensions of the behavior are most important, for which health outcomes? 2) What are the modifiable determinants of these dimensions of behavior, in which settings? 3) What interventions to change the relevant behavior (including personal, social, environmental, and policy initiatives) are necessary and most likely to be effective?

Thus, population-based approaches to disease prevention and health promotion require understanding specifically which behaviors should be addressed, identifying the factors that can influence those behaviors, and knowing what interventions are likely to be most effective. So, is the best scientific guidance for behavior-change approaches in public health simply a matter of choosing a good theory and then systematically applying that theory to the problem at hand? Our answer to this question is 'no'.

In explaining the relevance of health behavior theories to major population health problems for Japan, our goal is to avoid over-simplification, and to convey an integrated perspective. Our aim is to show how, in a complex public health context where it is necessary to think about many behaviors, for many different individuals and social groups, in many different settings, it is possible to adopt a coherent and helpful perspective by using theories of health behavior. Furthermore, these theories must be considered *within the cultural dynamics of a population* – an overarching theme we will return to in the next section.

Preventing major chronic and infectious diseases is inherently complex. Any population-based endeavour with these aims typically will include some or all of the following elements:

- health practitioners and others communicating directly with individuals, with the aim of assisting and persuading them to change their behavior;
- organizational and social strategies through workplaces, schools, the consumer marketplace, and other settings, that use rules, regulations, programs, and incentives for the purpose of health promotion;
- public communication strategies using mass media campaigns that aim to increase knowledge, change social norms, and set the agenda for behavioral change; and,
- changes to social policy including, for example, initiatives in health care systems or modifications to the built environment, that are designed to promote some behaviors and to discourage other behaviors.

Health promotion and disease prevention initiatives for the Japanese population will involve many different elements, with choices to be made about which elements should be emphasized, for which intervention strategies, and in which organizational, social or environmental contexts. The use of well-chosen theoretical models of health behavior is essential for these purposes.

The central challenge is to identify which of the many available health behavior theories and models are most appropriate for which purposes, and how best to apply them. Glanz, Rimer and Viswanath[1)] provide a framework to guide the complex endeavor of promoting health behavior change in populations. They group theoretical models and their application into four categories: 1) models of individual health behavior; 2) models of interpersonal health behavior; 3) community and group models of health behavior change; and 4) models to guide the translation of theory into research and practice.

Models of individual health behavior provide systematic accounts of why individuals behave as they do, and how they go about changing their behavior: this includes how

they perceive their own behavior, evaluate the risks and benefits of different behavioral choices, absorb new information, and initiate and maintain the relevant changes. *Models of interpersonal health behavior* aim to account for how personal, family, and professional interactions can promote certain behaviors and discourage others. *Community and group models of health behavior change* focus on the dissemination and diffusion of new ideas about health behavior through populations, including organizational structures and policies, and how mass media and other forms of mass communication (including newer information technologies) may be used to influence populations. *Translation of theories in research and practice* requires taking into account how the determinants of behavior at multiple levels (individual, interpersonal, social, community, environmental, and policy), and interventions targeted at those multiple levels, may be organized in a systematic fashion for improved population health.

Ⅲ. Health Behavior Theory and Public Health in Japan's Cultural Milieu

It is important to recognize that while health behavior theories are designed to provide general explanations of why people do and do not engage in certain health-related actions, their relevance -- how they might or might not apply -- varies significantly from country to country and culture to culture. Thus, there are cultural factors to be taken into account in translating for Japan what is known from research that has been mainly carried out in Western populations. Throughout this paper, we will touch upon what we see as relevant "translational nuances" for the uses of health behavior theories in the context of public health interventions in Japan. Our sources are limited to English-language publications, discussions with Japanese colleagues and Westerners who have lived in Japan, and from our own few visits to Japan. Therefore, please excuse us for any inaccuracies or misunderstandings that we might convey, as we try to take into account what we have learned about Japanese cultural patterns and trends.

Several key issues are potentially relevant to translating health behavior theories into action strategies in Japan. Traditionally, Japanese society is considered to have a highly collectivistic orientation that emphasizes interdependence in human relationships, conformity, compliance, and striving for harmony[2]. This orientation contrasts with the individualistic orientation of many Westernized societies that often emphasize individual achievement over social relationships. Family, neighborhood, and group activities are central to Japanese children's socialization. *Hierarchical relationships* traditionally begin with parent-child ties and respect for elders, and extend to doctor-patient relationships and cooperative group efforts in the workplace. Avoidance of conflict, deference to authority, and a non-confrontational style are long-honored norms in Japan[3].

However, economic, social, and cultural transitions in Japan over the past century have brought change in families and other social relationships – some of which bear directly on health behaviors. *Gender roles* as they are experienced by Japanese men and women have evolved across recent generations from the mid-twentieth century to the present, with succeeding generations bringing greater equality to women by Japanese standards[3]. Further, in more recent generations, Japanese women are more likely to work outside the home, and this can contribute to changes in family eating routines. *Relationships to work* have changed with industrialization and concentrations of population in large cities, which has been associated with a decrease in the numbers of extended multigenerational families living together[2]. *Urban and rural lifestyles* have diverged so that rural populations are more automobile-dependent and thus less physically active in their daily lives than are city-dwellers, many of whom walk or use bicycles to get to and from public transit. This may be contributing to higher rates of childhood obesity in rural areas[4]. Increasingly, such *interactions with the built and natural environment* may influence health behavior and individuals' *interactions with their communities* may make certain behavioral choices easier, or more difficult.

We now turn to examples of how behavioral science theory, research, and practice can be informative in addressing two issues of current public health importance in Japan: reducing the prevalence of overweight and obesity (*metabo*) in the Japanese population, and preventing the transmission of the HIV/AIDS virus among susceptible population groups.

Ⅳ. Metabolic Syndrome (*Metabo*): Healthy Diet, Physical Activity and Too Much Sitting

In the past fifty years, a period of rapid economic and industrial development in Japan has brought major changes in lifestyle, including work, transportation patterns, the food supply, and physical activity. The combined influence of these changes is believed to have led to increases in obesity in both Japanese children and adults. An estimated 23 million of Japan's 128 million inhabitants are obese[5]. Public health concern has recently become focused on overweight and obesity under the description of metabolic syndrome or "metabo", because of its role as a major risk

factor for type 2 diabetes, cardiovascular disease, and some cancers[4, 5] – all diseases being addressed by current health policy initiatives in Japan. The ethnic-specific definition of obesity in Japan is a body mass index (BMI) of 25 or higher, based on the level of excess weight associated with increased prevalence of obesity-related diseases[6, 7]. Key behavioral contributors to *metabo* include eating too much of the wrong type of food (foods higher in fat than the traditional diet that is centered on rice and fish), lack of physical activity (not taking regular exercise and doing very little walking as an integral part of daily routines or in recreational time), and also the amount of time that people spend sitting[5].

The increases in metabo in Japan are seen in the young and the old, and in men and women, though the prevalence of *metabo* is more pronounced in middle-aged and older men, and among children living in rural areas[4, 5]. Interesting insights on the effects of industrialization and Westernization can be seen in Okinawa, where a paradox can be seen: increasing socioeconomic status (SES) is becoming associated with shorter life expectancy. Researchers hypothesize that traditional diet, daily active lifestyles, and high levels of social support account for greater longevity of traditional-living but lower SES Okinawan adults[8]. One study found dramatic changes over a 15-year period in which the prevalence of diabetes in a small town in Okinawa correlated with use of motorized transportation and shopping in supermarkets (rather than small shops)[9]. Supermarkets provide a wide range of more Western-style foods, whereas smaller local stores may be more likely to provide traditional Japanese foods. Also, supermarkets are typically farther away from people's homes. Recent research in Australia has shown that where destinations are more distant from people's houses, they are less likely to walk as part of their daily routines[10].

Physical activity is fundamental to public health strategies for the prevention of most of the common chronic diseases. A public health focus on physical activity[11] is fundamental to current concerns in Japan about the prevention of *metabo*. Successful initiatives require identifying the types of physical activity that are most relevant to contemporary public health concerns. Early approaches to physical activity and health emphasized *aerobic fitness training* through vigorous exercise at least three times per week for more than 20 minutes. Now, public health recommendations on physical activity for the USA propose *moderate-intensity activity* (typically brisk walking) on at least 5 days per week, for at least 30 minutes (which may be accumulated in the shorter bouts). Importantly, in relation to the prevention and control of *metabo*, 60-90 minutes per day is proposed as being optimal to maintaining a significant weight loss (e.g., 13 to 23 kg) and preventing repeated weight gain in adults[12].

New evidence on an important aspect of physical activity with major relevance to the prevention of *metabo* is emerging from health-behavior studies on the high volumes of time that adults spend *sitting* in most aspects of their daily lives. It now appears that contemporary changes in transport, occupations, domestic tasks, and leisure activities have had negative effects on daily energy expenditure[13]. Sedentary behavior (from the Latin *sedere* - 'to sit') is the term now used to characterize those behaviors for which energy expenditure is extremely low, such as prolonged periods of sitting time in transit or driving, sitting at a desk and working at a computer in the workplace, watching television at home, and so on.

For example, a prospective study in Australia showed that self-reported sitting time was a predictor of weight gain in women, *even after* adjustment for energy intake and leisure time activity[14]. Observational studies show that prolonged television-viewing time is associated with an increased risk of having *metabo*[15-16], and that taking more breaks from sitting time is associated with reduced likelihood of having metabo[17]. Recent findings also suggest that leisure-time physical activity, in the context of otherwise sedentary lifestyles involving higher volumes of sitting, is unlikely to be sufficient to prevent *metabo*, and its associated risks of major chronic diseases[13, 18]. Too much sitting (as opposed to too little exercise) may have deleterious physiological effects on the metabolism of blood fats in ways that increase the risk of developing *metabo*[19].

These new perspectives on the role of a lack of physical activity and the unique influences of sedentary behavior (too much sitting) on the risk of developing *metabo* have important implications for the major health initiatives in Japan. Public health officials have recently updated and re-focused government-sponsored efforts to address metabolic syndrome following the Healthy Japan 21 interim assessment which found increases in sedentary lifestyles, diabetes, and overweight and obesity – especially among middle-aged and older men (Yuriko Doi, personal communication). The government mandate requires medical insurance providers to screen insured individuals with metabolic syndrome and provide them with weight management programs for at least three months (Yuriko Doi, personal communication). Companies and local governments are required to measure the waistlines of adults aged 40 to 74 and to provide dietary guidance to help them lose weight, and they face financial penalties if they

fail to meet specific targets[20]. While these initiatives will be important in drawing attention to the changes that individuals need to make, and which have a strong and entirely appropriate emphasis on dietary improvement, it will also be important to take into account the changes that have occurred in people's environments which result in too little exercise and too much sitting.

We will next examine how the population health campaign uses available information about the individual level, interpersonal level, organization/community level, and translation issues that might inform successful *metabo* prevention in Japan's population.

Table 1. Influences on Metabolic Syndrome and Prevention/Control Strategies

Issue or Level of Analysis	Key Factors	Implications for Population Health Interventions
Epidemiology and trends	Increasing rates of obesity Westernization of Japanese diet Reduced daily physical activity Increases in prolonged sitting time	Increasing public's perceptions of relevant risks Broad-based advocacy for traditional cuisine Promoting physically active transport Innovative workplace regulations
Individual level	Knowledge of *metabo* risk Attitudes to eating and activity Motivation to change	Informative mass media communications School-based and family-oriented education Promoting short and long-term benefits of healthy weight
Interpersonal level	Family beliefs and practices Behaviors of friends, co-workers Social support of family and others	Initiatives through schools and community groups Mass-media messages emphasizing social norms Encouraging family and collective social responsibilities
Community models	Mass-media communications Prompts from health care system Workplace policies and programs	Using prominent role models Health care provider assessment and feedback Education of managers and workers
Translating theory into research and practice	Availability of healthier options Interventions on multiple levels Broad-based public policies	Engaging the food industry and urban planners Applying an ecological perspective to health planning Engaging all relevant government sectors

V. *Metabo*: Application of Individual-Level Health Behavior Theories

The dietary education, physical activity, and healthy weight management components of the *metabo*-prevention strategy of Japan can be directly informed by *models of individual health behavior* that address why individuals behave as they do and in turn, how their behavior can be changed. Behavioral determinants of *metabo* that are in the realm of discretionary personal choices are likely to include lack of knowledge about healthy food choices. Such choices must, however, be seen in the context of broader cultural changes in general eating patterns. The traditional Japanese adage of "Hara hachi bunme" or "stop eating when you're 80% full"[21] seems less resonant in modern Japan. Several studies have found that eating quickly and eating until full are associated with getting fatter, independent of total energy intake[22-24]. *Models of individual health behavior* suggest that in this context, there is the need for particular approaches that focus on how individuals perceive their own behavior, evaluate the risks and benefits of these different behavioral choices, how they absorb new information, and how they go about initiating and maintaining the relevant changes. In this context, the Theory of Planned Behavior (TPB) is an individual-level health behavior theory that emphasises the importance of people's *attitudes* to the particular food choices that they may or may not make. People's confidence about making behavioral changes (*perceived behavioral control* or *self efficacy*) when their attitudes are positive towards doing so, act together as major determinants of *intention*, which precedes the initiation of any relevant behavioral change. TPB also highlights the important role played by what people observe in the expressed beliefs and behavior patterns of others (*social norms*).

Lower levels of physical activity, and too much sitting, increasingly accompany the focus on academic achievement (for children and youth) and long work days (for adults, especially men), as well as children's increased use of video games and television-watching[25]. Shorter sleep duration has also been associated with increasing

obesity[23]. Within the framework of the Theory of Planned Behavior or TPB, these factors would be identified as *barriers*, which intervene between people's intentions and their actual behavior. While how much time is devoted to study, to the recreational use of video games or television watching, or to how long a child or adult spends sleeping, may be seen as matters of personal choice and within the control of individuals, these behaviors are also socially determined.

Thus, educational programs alone – without the strong support of others who are able to be influential – will probably be insufficient to achieve health-promoting changes. It is therefore important to also take into account interpersonal factors that can influence health-related behavioral choices.

Ⅵ. *Metabo*: Applications of Interpersonal Health Behavior Theories

Models of interpersonal health behavior account for how interpersonal and family relationships, social relationships in the workplace setting, and broader social networks can act to promote certain health-related behavioral choices and may strongly discourage others. Social Cognitive Theory[26] which emphasizes the reciprocal relationships between people and their social environments, and theories of social networks[27] are other useful frameworks for thinking about these influences. Social networks provide practical, or instrumental, sources of social support as well as emotional support and structured expectations and rules[27] that can influence eating and activity patterns.

Changes in family relationships and broader social networks may be contributing to the increasing rates of *metabo* in Japan. Japan's falling birth rate, increasing indulgence of children, increased consumerism, and a cultural shift away from families spending time together[5] interfere with structured routines for healthful eating and activity. The time pressures of modern life find fewer families eating together regularly, more families eating meals out at restaurants, and people more often turning to convenience foods that are higher in calories and fat[5, 25].

Interpersonal factors act particularly through the influence of families. The increase in two-parent working families, where children spend a considerable amount of time outside of their immediate family environment attending nursery school or other forms of outside care, has been argued to be associated with higher levels of childhood obesity[28]. And in the workplace, obesity was found to be associated with job stress (higher demands, low decision latitude) among Japanese males in factory jobs, and with eating fast and eating until full[24].

Ⅶ. *Metabo*: Application of Community and Group Models of Health Behavior Change

Community and group models of health behavior change focus on organizational, institutional, and built environment factors. For understanding how the social and built environment attributes of communities may act to influence health-related behavioral choices, *ecological models of health behavior* highlight the interplay in community settings between environmental, policy, interpersonal, and individual level factors[29]. Four core principles of *ecological models of health behavior* have been proposed: 1) that multiple influences at the intrapersonal, interpersonal, organizational, community, and public policy levels affect health behavior; 2) influences on behaviors interact across these different levels; 3) ecological models should be behavior-specific; and 4) multi-level interventions should be most effective in changing behavior.

Ecological models emphasize the role of *behavior settings*, the physical and social aspects of situations in which people spend their time that act to promote and encourage certain behaviors, and to restrict or prohibit other behaviors. For example, college students in Japan have been found to eat more often in response to environmental cues[30]; this may be related to the increased availability of convenience foods and fast food. Also, in modern Japan, the behavior settings that traditionally have provided frequent opportunities for physical activity as part of daily life have changed dramatically, both in large cities and in rural areas. For example, childhood obesity appears to be a greater concern in rural areas than in urban areas, as those living in rural locations are becoming increasingly automobile-dependent and lacking in walkable destinations[4]. Adults living in rural locations in Japan are known to be less physically active nowadays: the nature of work in rural areas has shifted from more active occupations such as farming and construction work to service industries with much lower levels of occupational physical activity[5].

These observations are consistent with evidence from studies in the USA and Australia, and show the importance of certain aspects of the built environment as influences on how much physical activity people get, and how much time they spend sitting. We now know that communities where people are largely dependent on using automobiles for their transport will significantly reduce their physical activity and increase their risk of being overweight or obese[31, 32]. For people who live in such communities, the built environment offers too few opportunities for walking, few useful destinations (such as shops, public transport stops, or

recreational facilities) in the local area, and streets that are not well connected to each other so that routes for walking and cycling are limited. Adults living in low-walkable communities are less physically active and walk less often for transport than do those who live in communities that are supportive of physical activity[32-34]. Another study in Australia found that women in low-walkable communities also spent more time watching television than those in high-walkable communities[35].

Ⅷ. *Metabo*: Translating Theory into Research and Practice

These examples indicate the need for comprehensive public health initiatives to address how influences acting at several levels may work together, and how they may be most effectively changed. In particular, there is a need to focus on how changes to the physical and social arrangements where people spend their time (*behavior settings*) make health-promoting choices more likely. There is also a need to focus on multiple levels of influence, addressing the many factors that work together to influence how individuals in different populations and different places make choices about food and physical activity.

Ⅸ. HIV/AIDS Prevention, Testing, and Control

The number of reported cases of HIV/AIDS in Japan is relatively low compared to other developed countries and neighboring Asian countries[36], but the number of cases continues to increase and reached record high levels with over 1,300 cases in 2005 and 2006[37]. The most often affected individuals are men in the 20-30 year age range, predominantly in large cities, and the most common route of transmission is sexual transmission, especially by homosexual contact between men[37]. Policies for HIV/AIDS surveillance and prevention were enacted in 1999[36] but were substantially updated in 2006[38].

The three pillars of the revised AIDS Prevention Guideline include the redefinition of HIV/AIDS from "an incurable special disease" to a "controllable general disease"; clarification of responsibilities so that the national government provides support and local governments (especially in the 47 prefectures) implement prevention and control systems; and prioritization and planning of policies to target higher-risk populations including homosexual men and youth[38]. The national government intends to place higher priority on the 16 local governments with more than 70% of HIV/AIDS cases in Japan, mainly in large population centers[38]. Specific prevention and control measures to be undertaken under the revised Guideline include: 1) providing the right message and information; 2) enhancing voluntary HIV counseling and testing systems; and 3) rebuilding the medical care system.

We next examine how the pillars and specific measures relate to individual level, interpersonal level, organization/community level, and translation issues that might inform successful prevention and control initiatives in the coming years.

Table 2. Key Factors in HIV/AIDS Prevention and Control

Issue or Level of Analysis	Key Factors	Implications for Population Health Interventions
Epidemiology and trends	Increasing rates of HIV/AIDS High-risk groups Geographic distribution	Redefinition of HIV/AIDS as a controllable disease Targeting homosexuals, young adults Focus more efforts in and near large cities
Individual level	Knowledge of HIV/AIDS Beliefs about risks/protection Misconceptions and prejudice	Clear, widely accessible information (mass media, web) Increase awareness, skills, access (e.g. testing, condoms) Building understanding and compassion for people with AIDS
Interpersonal level	Relationships, social networks Observational learning Acceptance of counseling/testing	Use social events to get out prevention messages Celebrities providing prevention messages Link social events to voluntary HIV counseling/testing
Community models	Mass media + testing systems Healthcare system change	HIV Testing Promotion Week activities and structures Establishing specialized HIV/AIDS hospitals with inpatient and outpatient services
Translating theory into research and practice	Understanding complex causes Disenfranchised groups Stigmatized groups Cultural attitudes to sexuality	Systematic planning of prevention/control activities Working with organized NGO's and local groups Address discrimination against homosexual men, increase women's safe sex negotiating skills

X. HIV/AIDS: Application of Individual-Level Health Behavior Theories

The measure of "providing the right message and information" can be best informed by *models of individual health behavior* that address why individuals behave as they do and how they go about changing their behavior. This includes how they perceive their own behavior, evaluate the risks and benefits of different behavioral choices, absorb new information, and initiate and maintain the relevant changes. A study of female college students in Nagasaki found that they had fairly high levels of knowledge about AIDS, and used the mass media as their main source of information, but also had common misconceptions and prejudices about people with HIV/AIDS[39]. The plans to provide accurate messages through a combination of mass media (on the national level), and local events and publicity in targeted areas[38] , use several individual-level theories such as the Health Belief Model, Theory of Planned Behavior, and value-expectancy theories to underpin assumptions about media effects and strategies for social marketing[40, 41].

XI. HIV/AIDS: Application of Interpersonal Health Behavior Theories

The prevention messages developed for public health approaches to HIV/AIDS also draw on *models of interpersonal health behavior* by highlighting how interpersonal relationships and broader social networks can act to promote certain behaviors and discourage others. This is an especially promising approach with young people, who are more attentive to the behaviors of their peers, and thus can be influenced through 'observational learning,' a key construct of Social Cognitive Theory[26]. Events like "Red Ribbon Live 2006" bring together large groups of people, involve celebrities conveying prevention messages, and may link with voluntary HIV counselling and testing events[38], thus applying ideas from interpersonal level theories.

XII. HIV/AIDS: Application of Community and Group Models of Health Behavior Change

Initiatives that focus on disseminating new ideas about health behavior through populations require guidance from *community models of health behavior change*. For HIV/AIDS, such initiatives include working within community organizational structures and their policies, and the use of mass media, cut across all three specific measures of the current policies for HIV/AIDS prevention and control. The mass efforts for HIV Testing Promotion Week blend communication and systems development and have nearly doubled the number of persons tested from one year to the next[38]. Increased attention to building a combined inpatient and outpatient specialized care system for HIV/AIDS in the prefectural hospitals is an important undertaking in treating this infectious yet controllable condition in a compassionate manner.

XIII. HIV/AIDS: Translating Theory into Research and Practice

For HIV/AIDS prevention in Japan, translating theory into research and practice in a comprehensive fashion is an important and significant challenge. It requires drawing on an understanding of the many and complex determinants of behavior (individual, interpersonal, social, community, environmental, and policy). *Ecological models of health behavior* suggest that HIV/AIDS prevention and control measures targeted at multiple levels are likely to be most successful[29]. These comprehensive strategies need to be organized in a systematic fashion for improved population health. Some key aspects of this challenge are unique to Japan and both traditional and changing cultural norms for behavior. Among the issues that have been raised are the lack of personal identifiers in case reporting for HIV/AIDS[42]; the challenge of testing and educating sex workers[36, 42]; the difficulty of reaching disenfranchised and stigmatized populations with public health measures[36]; and the need to reduce discrimination against gay men, and increase heterosexual women's ability to negotiate for safe sex[36, 42].

Both research and coordinated planning can reveal solutions for these important and difficult challenges. As international HIV/AIDS prevention experts have pointed out, a comprehensive national prevention program requires addressing environmental and cultural factors in vulnerability, linking prevention and treatment, delivering high-quality interventions on a large scale, and ensuring accountability in evaluating the success of individual and combined initiatives[43].

XIV. Final Thoughts on Using Behavioral Science to Inform Disease Prevention and Control

It will be clear from the examples we have described above that addressing complex health problems like *metabo* and HIV/AIDS requires more than the application of one particular theory of health behavior. The determinants of the behaviors that increase people's risk of developing *metabo* or contracting HIV/AIDS act at multiple levels (individual, interpersonal, social, community, environmental, and policy), and are part of circumstances

that have evolved over time through economic, social, and cultural changes. Thus, they will be difficult to change, particularly through strategies that might focus only on informing, educating, and motivating individuals. Comprehensive interventions that are targeted at multiple levels are needed, and they must be organized in a systematic fashion for improved population health.

For example, if the cornerstone of new public health strategies for metabo only involve measuring workers' waist circumferences and exhorting them to eat less and exercise more, this will probably not be sufficient to produce successful health outcomes. Even widespread measurement and advice on personal behavior change will not 'roll back' the economic, social, and cultural changes that have resulted in more and more Japanese people being affected by *metabo*. However, it may be feasible to mitigate the effects of these influences by new, multi-level health-promoting policies guided by ecological models of health behavior[29]. These could include, for example, incentives for people to make changes to their diet; innovations in transportation and urban planning to make walking a more viable option; ensuring that food and agriculture policies support healthier eating; providing information on caloric and fat content for prepared foods at the point of purchase; and so on.

Much research has revealed that individual-level psychological factors are not sufficient to explain entrenched diet and physical activity behaviors[44]. Also, there is little evidence that public education alone will result in significant weight loss in adult populations, so combination strategies that focus on the social and built environments are likely to be necessary. Another perspective suggests that focusing on prevention of childhood obesity may be more promising as adults may be able to "re-engineer" children's food and activity patterns and environments[5].

Familiarity with the relevant theories of health behavior change is an important step toward developing successful programs – the next challenge is to use then within a comprehensive planning process. Other key elements of effective programs for population health are accessible and practical information, active learning and involvement, a good program-to-audience match, and reinforcement of desirable behaviors[45]. Health education materials should be appropriate for, and ideally matched to, the educational and reading levels of particular target audiences, and be compatible with their ethnic and cultural backgrounds[46].

In addressing significant public health problems, there is no substitute for "knowing the audience." This applies to the conduct of fundamental research to understand determinants of health behavior as much as it applies to developing health promotion programs for specific individuals, groups, and communities. Participatory research and program design improve the odds of success[45].

We hope that readers will take the perspectives described in this article and use them as they work to address local and national public health challenges. Our hope is that these ways of approaching behavior change in public health will help in asking critical questions, thinking conceptually about the determinants of behavior and how to approach them, and reaching beyond the temptation to use less complex, single-focus, and formulaic strategies to address important population health problems[1].

Acknowledgments

Dr. Karen Glanz's effort was supported in part by a Distinguished Scholar Award from the Georgia Cancer Coalition. Dr. Neville Owen's work on this article is partially supported by a Program Grant (# 301200) from the National Health and Medical Research Council of Australia, and by a Research Infrastructure Grant from Queensland Health. The authors have no conflicts of interest to declare.

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