



Review article

An overview of health fitness studies of Hong Kong residents from 2005 to 2011

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Abstract

The purpose of the present paper was to provide a review of the health fitness studies conducted among Hong Kong residents for the past 7 years (2005–2011) and a better understanding of the historical developments, future trends, and research studies on this topic conducted during the past 27 years. In the 164 articles reviewed, the present paper covers six major areas: obesity, physical fitness, cardiovascular risk factors, physical activity, lifestyle, and growth and development. It was found that the quality of life of the local residents and the physical fitness levels of cohorts of all ages were declining—more than 60% of the population did not exercise even for 30 minute/week or walk 8000 steps a day. Various interventions had been conducted, but their findings were not encouraging. In 2011, the prevalence of obesity reached 20% for the youth and 22% for the entire population. A review of the studies on lifestyle revealed that some researchers were adopting a multifactorial and multibehavioral approach to better understand and modify the lifestyle management. It is encouraging to note the increase in both the quantity and the quality of researches conducted during the past 27 years in Hong Kong, as reflected by over 270 international refereed publications. Copyright © 2012, The Society of Chinese Scholars on Exercise Physiology and Fitness. Published by Elsevier (Singapore) Pte Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Cardiovascular risk factors; Growth and development; Lifestyle; Obesity; Physical activity; Physical fitness

Introduction

In 2004, two articles were published on the overview of the health fitness of children and adults in Hong Kong from 1984 to 2004, based on the findings of 117 research papers.^{1,2} With more and more research being conducted among the local population, it was felt that it would be timely to provide another review article on this topic, for providing updates on the current research and knowledge in this area. Health-related fitness is widely accepted to be associated with the quality of life. A review of research findings in this area during the past 7 years (2005–2011) would add to the findings from the 1984–2004 review and contribute to the strategic planning for

the attainment of wellness and quality of life for the local residents in the years ahead. The findings might also have implications on the promotion, design, and delivery of sports and physical activities for all health-related fitness programs in the region.

Methodology

The present paper covers six major areas, namely obesity, physical fitness, cardiovascular risk factors, physical activity (PA), lifestyle, and growth and development, based on the findings of 164 peer-reviewed articles. Relevant peer-reviewed articles were identified by searching the PubMed (National Center for Biotechnology Information, US National Library of Medicine), PubMed Central databases, SPORTDiscus, Google Scholar of articles, and publications by local universities between January 1, 2005 and December 31, 2011. Articles that were published in the 21st century but not included in the two earlier papers^{1,2} were also included. Despite making every

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effort to include all publications on the Hong Kong population, it is possible that some articles have been omitted.

Results

The following paragraphs represent the summaries of the findings of the 164 articles reviewed. The interest of the researchers has increased in the six areas identified; however, much work still needs to be done in Hong Kong to fight the battle of being overweight and obese, help people lead a sedentary lifestyle, improve the level of physical fitness, and lower the prevalence of cardiovascular risk factors in the years ahead.

Obesity

Children

Definition of overweight and obesity. The commonly used diagnostic criteria of overweight and obesity for children and adolescents are given in Table 1.^{3–18}

There were also other criteria, such as people with a BMI of over 90th percentile for age and sex was estimated to be overweight or obese¹⁹ and a waist-to-stature ratio of ≥ 0.46 to be overweight.²⁰

Ko et al²¹ investigated the prevalence of overweight and obesity among children and adolescents in Hong Kong using the current four criteria—the Group of China Obesity Task Force (overweight: BMI for age ≥ 24 kg/m²; obesity: BMI for age ≥ 28 kg/m²) and the Centers for Disease Control 2000 Growth Charts for the USA¹⁶ (overweight: BMI for age ≥ 85 th percentile; obesity: BMI for age ≥ 95 th percentile). Data on 2098 school students, aged 11–18 years, were collected from 14 volunteer schools. The results suggested that the prevalence of obesity in Hong Kong adolescents determined using various diagnostic criteria was similar (2.8–4.8%; 3.9–6.0% in boys and 2.4–3.7% in girls, with a particularly high rate in young boys) except for the 1993 HKGS criteria, which gave an exceedingly high figure (boys: 18.1%; girls: 13.9%). The World Health Organization (WHO) updated the criteria of BMI for age,²² and Lin et al⁹ in their study adopted the latest criteria as well as Criterion 2 to compare with other studies.

Prevalence of obesity. Childhood obesity was known in Hong Kong for more than three decades and, despite joint efforts of professionals and stakeholders, it still remains an important public health issue.²³ From 1998 to 2001, the obesity rates

(defined by the HKGS criteria) among Hong Kong primary and secondary school students increased from 12.7% to 14.7% for boys and 10.4% to 12.4% for girls.²¹ Another government survey conducted in 2003–2004 showed that the incidence of obesity in children and adolescents increased to 18.7%,³ which was consistent with the study of Ko et al²¹ in 2003 (18.2% among those aged 14–17 years), but Wing et al¹⁷ reported a relatively lower prevalence (14.8%) in the younger cohort (5–15 years old). So et al²⁴ investigated 14,842 Hong Kong children and adolescents (7472 boys and 7370 girls; aged 6–18 years) during the 2005–2006 school year and found an annual increase of 0.5 percentage in the prevalence of overweight and obesity, compared to the 1993 government data.

In the Hong Kong Student Obesity Surveillance (HKSOS) project in 2006–2007, a total of 22,612 school students, aged 11–18 years, were recruited to provide self-reported data, and the prevalence rate of overweight/obesity was found to be 12.4% (16.1% for boys and 9.7% for girls).²⁵ In another study with 3204 school students aged 12–18 years (50.7% boys) from four schools, it was found that boys were more likely to be overweight/obese than girls (18.0% vs. 8.7%).¹⁰ Although there might be some differences in the incidence of overweight and obesity due to the use of different diagnostic criteria, the trend was on the increase. Tin et al¹⁴ suggested that, in Hong Kong, the percentage of overweight primary school children increased to 21.3% in 2007/2008. In a study conducted in 2008–2009, which targeted the Hong Kong children of 1997 birth cohort, Lin et al⁹ reported that the incidence of obesity was 4.9% (age- and gender-specific BMI ≥ 30 kg/m²) in 6783 individuals.

Risks of overweight and obesity and predisposing factors. Childhood obesity is a global epidemic and is more critical than obesity in adults. It is associated with a lot of medical consequences and cardiovascular risk factors, notably impaired glucose tolerance, hypertension, atherogenic dyslipidemia, microinflammation, and morbidity including nonalcoholic fatty liver disease, sleep apnea, and early atherosclerosis.²⁶

In Chinese adolescents, overweight/obesity is independently associated with systolic blood pressure, insulin resistance, high-sensitivity C-reactive protein, and low high-density lipoprotein cholesterol (HDL-C) (Table 2)^{3,33–44}; early intervention in overweight and obese adolescents may potentially retard the development of these cardiovascular risk factors.²⁷ Leung et al²⁸ indicated that a high waist circumference is a predictor of hypertension in adolescents, whereas increased PA is a protective factor.

Table 1
Criteria of overweight and obesity applied to Hong Kong children.

Criteria
1 HKGS (obesity or overweight was greater than 120% median weight for height on local growth chart in 1993; no definition for childhood overweight was set) ^{3–6}
2 IOTF 2000 criteria (age- and gender-specific BMI corresponding to cutoff points of 25 and 30 kg/m ² at the age of 18) ^{7–14}
3 Overweight and obesity—defined as BMI greater than local age- and gender-specific 85th percentile (or 25 kg/m ² whenever smaller) and 95th percentile (or 30 kg/m ² whenever smaller), respectively ^{15–18}

BMI = body mass index; HKGS = Hong Kong Growth Survey; IOTF = International Obesity Task Force.

Table 2
Criteria of general and central obesity applied to Hong Kong adults.

Criteria	
General obesity	WHO classification for Asian populations: overweight and obesity defined by a BMI of 23.0–24.9 and 25 kg/m ² , respectively. ^{3,33–42}
Central obesity	WHO (2004): a waist circumference of ≥80 cm or more in women and ≥90 cm or more in men. ^{33–37,43,44}

WHO = World Health Organization.

For Hong Kong Chinese children, increased variety of snack consumption²⁹ and breakfast skipping³⁰ were found to be associated with an increased risk of being overweight (BMI ≥23 kg/m²). Compensation for short weekday sleep duration by sleeping longer on weekends or holidays could lower the risk of overweight and obesity.¹⁷ It was suggested that, in order to combat childhood obesity, care should be taken to improve the following conditions: the lack of coordinated professional input to the needs of children at risk of obesity, absence of nursing input,³¹ and lack of an effective healthy school model to improve healthy eating and PAs.³² There was no consistent association between socioeconomic characteristics and childhood BMI.¹¹ Lin et al⁹ found that, in Hong Kong, informal child care at 5 and 11 years was associated with a higher BMI Z-score and the presence of overweight/obesity, which suggested that parents/grandparents or others providing child care might be a potential target for education and intervention to counter the emerging epidemic of childhood obesity.

Adults

Definition of overweight and obesity. The current diagnostic criteria of overweight, general obesity, and central obesity for adults are shown in Table 2.

There were some other criteria: overweight was defined as a BMI of ≥23–26.9 kg/m², obesity as a BMI of ≥27 kg/m²,⁴⁵ obesity as a BMI of ≥27.5 kg/m²,³³ central obesity as a waist-to-hip ratio of >0.95 in men and >0.85 in women, and central obesity as a waist-to-height ratio (WHtR) of >0.5.⁴⁶

Chen et al⁴⁷ conducted a study to examine the validity of BMI and waist circumference (WC) obesity cutoffs, recommended by the Working Group on Obesity in China (WGOC) (BMI cutoffs: 24.1–27.9 kg/m² for overweight and ≥28.0 kg/m² for obesity; WC cutoffs: ≥85 cm in men and ≥80 cm in women for abdominal obesity), among Hong Kong Chinese people. A total of 1122 Hong Kong women, aged 41–63 years, were enrolled, and a percentage dual X-ray densitometer was used to measure their body fat. Regression analyses showed that the BMI cutoffs (kg/m²) of 23, 24, 25, and 28 corresponded to the percent body fat (%BF) of 34.8, 35.9, 36.9, and 39.5, and the 80-cm WC corresponded to 34% trunk fat. Compared with the %BF cutoff (≥40%) for obesity, the WHO/IOTF BMI-obesity criterion (≥25 kg/m²) showed better sensitivity (75%) and specificity (71%), and the WGOC criterion (BMI ≥28 kg/m²) showed low sensitivity (41%) but excellent specificity (93%). It was concluded that the WGOC's BMI cutoffs were appropriate, but the 80-cm WC might be too high for this population.

Ko and Tang⁴⁸ analyzed the data on a total of 17,242 Chinese individuals (4822 men and 12,420 women), aged 15 years or above, from the Hong Kong community, collected in 1997/1998. After categorizing, the age-standardized prevalence of BMI ≥23, ≥25, ≥28, and ≥30 kg/m² corresponded to 40.9%, 23.4%, 7.9%, and 3.2%, respectively. A BMI of 23.0 kg/m² was suggested as the cutoff point for overweight or preobese, 25–27.5 kg/m² for “early” obese, and ≥30 kg/m² for the severe obese states.

Ko et al,⁴⁹ in a study conducted among Chinese population, demonstrated that a WC of 84.6 cm in men and 75.7 cm in women were the optimal cutoff values for central obesity based on mesenteric fat thickness. Meanwhile, the study also suggested that people with central obesity and preobesity had higher mesenteric fat thickness and cardiovascular disease (CVD) risk than those with normal waist, using WC cutoff values to define central preobesity (≥85–90 cm in men and ≥75–80 cm in women) and obesity (≥90 cm in men ≥80 cm in women). However, Auyeung et al⁴¹ found that slight overweight and central obesity might increase survival in older men.

Prevalence of obesity. In the United Christian Nethersole Community Health Service (UCNCH) primary health-care program 1996–1997, a cohort of 17,242 individuals from Hong Kong (4822 men and 12,420 women), aged 15 years or above, was assessed, and the age-standardized prevalence of obesity was found to be 29% in men and 21% in women.⁴⁸ Schooling et al,⁵⁰ in a study of 54,088 individuals aged 65 years or older conducted in 1998–2000, found that the prevalence of overweight and obesity among elderly people was 40.4% and 22.5%, respectively.

In 2000, the “Better Health for Better Hong Kong” (BHBHK) health promotion campaign was instituted, and a total of 4793 individuals (over 4000 from the working class), aged 17–83 years, were randomly selected. The overall obesity was found to be 37.5% (42.5% in men and 32.6% in women).^{34,35} Compared to the data of a survey (conducted in 1990) on coronary artery disease risk factors among Hong Kong Chinese working population (1513 participants), the percentage of central obesity doubled in men (12.2% vs. 26.7%) but remained almost similar in women (28.5% vs. 26.7%) over the decade.³⁶

In the Population Health Survey 2003/2004,³ overweight and obesity generally increased with age, with 38.9% of the population, aged 15 years and above, being overweight and 21.1% obese; overweight (42.3% vs. 35.9%) and obesity (22.3% vs. 20.0%) were more common among males than among females. In 2004–2005, the prevalence of overweight, obesity, BMI ≥27.5 kg/m², and central obesity was 58.7%,

32.4%, 11.8%, and 29.3% in men and 38.9%, 21.4%, 8.4%, and 31.2% in women, respectively.³⁷ In our recent study,⁴⁶ a total of 3080 participants, aged 5–75 years, were randomly selected and interviewed over telephone; the incidences of general obesity (BMI ≥ 25 kg/m²) and central obesity, based on WHtR (>0.5), were found to be 17.5% and 19.9%, respectively.

Ko et al³⁷ compared the data collected from the investigations of UCNCH in 1996–1997 ($n = 17,119$), 2001–2002 ($n = 1,697$), and 2004–2005 ($n = 50,260$). It was found that the prevalence of general obesity stabilized in men and declined in women compared to that 10 years ago, and WC increased by 1 cm in men (with a consequent increase in prevalence of central obesity from 23% in 2001 to 26.5% in 2005) and 2 cm in women (central obesity from 27.5% in 2001 to 26.6% in 2005) from 2001 to 2005. A more recent study showed that central obesity was 28.7% in men and 28.0% in women.⁴⁴

The Department of Health reported that, in 2010, 48.5% and 27.5% males and 31.4% and 15.5% females were overweight and obese, respectively. The prevalence of overweight and obesity increased significantly from 2005 to 2010 among the Hong Kong population, aged 18–64 years, and it was worse in males than in females.

Risks of overweight and obesity and predisposing factors. In Hong Kong adults, central obesity appeared to have a stronger association with hypertension.⁵¹ Thomas et al⁴³ reported that hip circumference contributed independently and inversely to cardiovascular risk in women but not in men. Ko et al⁴⁹ suggested that individuals with central obesity harbored high CVD risks, fatty liver, and excess visceral fat in both genders. While bioparameters⁵² and socioeconomic parameters¹¹ were associated with a higher prevalence of overweight and obesity, health-related lifestyle factors were the direct contributors.

In Hong Kong Chinese working population, obesity (BMI and WC) was associated with reduced sleeping hours and long working hours in men.³³ It was independently associated with several unhealthy dietary habits, including irregular meals, frequent consumption of sugary drinks, and frequent dining out.³⁴ To learn more about the relationship between dietary habits, PAs, and obesity among Hong Kong residents, Chow⁵³ analyzed the data obtained from the Hong Kong Population Health Survey 2003–2004. He found that similar to many industrialized societies, positive energy balance as a consequence of excess energy intake and a sedentary life were the main culprits. Ko et al⁴⁴ investigated the associations between obesity and sugar-sweetened beverages and lifestyle factors in the Chinese population. They identified that consumption of sugar-sweetened beverages in women and physical inactivity, smoking, and high meat intake in men were associated with obesity.

Focusing on age group studies, Schooling et al⁵⁰ found that the relationship between obesity and mortality varied according to the underlying health status. Among those with a poor health status, obesity was associated with higher outcome, whereas in those with a good health status, obesity was associated with lower outcome. These findings were supported by Auyeung

et al,⁴¹ who speculated that mild-grade overweight, obesity, and even central obesity might have a protective function. Ho et al⁴⁵ found that menopausal status was a significant and independent predictor of the decrease in lean mass and increase in the percentage of body fat in women. Increased dietary soy protein intake had a mild favorable effect on the body composition of postmenopausal women.⁵⁴

Weight control

It was found that preadolescent overweight children perceived themselves to have significantly more body fat than normal-weight children.¹² For children, it appeared that an accurate perception of weight and knowledge of health fitness could help them evaluate their weight status and choose an appropriate weight control approach. Another study reported that female adolescents in Hong Kong were motivated to adopt a variety of weight control behaviors on the basis of their perception of their body weight, rather than their actual (estimated) BMI.¹⁹ Females who perceived themselves to be overweight were more likely to exercise, restrict caloric intake, self-medicate, or purge.

In the management of obesity, usually pharmacological and lifestyle modification strategies are used in combination. A dietary control approach was found to be effective in maintaining weight loss and improving the metabolic and cardiovascular risk factor profile after cessation of pharmacological treatment, which indicates that a lifestyle modification may produce health benefits equivalent to pharmacological methods.³⁹ Yu et al⁶ conducted a study on the effects of diet and strength training on obese children's physical self-concept, and found that a 6-week program of both diet only and diet and strength training could significantly decrease the BMI, but the increase in lean mass was significantly more in the diet and strength training group (+0.8 vs. +0.3 kg, $p < 0.05$). Both groups developed greater confidence in strength, and those in the diet and strength training group also improved their endurance self-concept. In a qualitative study, Chan et al⁵⁵ examined the clients' (overweight/obesity) experience of a community-based lifestyle modification program (LMP) on lifestyle and behavior change. The results suggested that participants perceived that the program had positive impacts on their health and nutrition knowledge. Psychological (frustration, negative emotion, lack of motivation, and pressure from others during the program) and environmental (working environment and lack of healthy food choices in restaurants) barriers for lifestyle and behavior impacted the implementation of the LMP. Lok et al⁵⁶ investigated the variations in counseling style of nutritionists and their effects on patients' weight change during a 12-week community-based LMP using a semistructured interview. They found that the patients' weight change after adjustment for age and baseline weight varied significantly depending on the counseling style ($p < 0.001$).

Summary

From the literature review, the following observations are made:

1. There is no universal consensus on the definition of overweight and obesity in BMI. The commonly used criteria are as follows:
 - (a) Overweight and obesity for individuals aged 18 years or below—age- and gender-specific BMI of 25 and 30 kg/m², respectively
 - (b) Overweight for adults—BMI of 23.0–24.9 kg/m²
 - (c) Obesity for adults—BMI of ≥ 25 kg/m²
 - (d) Central obesity for adults—a waist circumference of 80 cm or more in women and 90 cm or more in men
2. The prevalence of obesity in Hong Kong is still severe and an incremental momentum remains in both children and adults.
3. The risk of obesity and its prevention are still hot research topics. In future studies, more evidence should be provided to confirm the BMI cutoffs of overweight and obesity for different age groups. Despite being aware of the high prevalence and serious negative effects of obesity, there are not many research studies on weight control for different cohorts—age, gender, and overweight levels.

Physical fitness

Children and adolescents

Sung et al¹² found that overweight children perceived themselves to have significantly more body fat than normal-weight children; as a consequence they have poorer appearance, sports competence, endurance, coordination, flexibility, overall physical self-concept, and self-esteem, despite not being less healthy, physically active, or strong. Overweight children had poorer endurance, coordination, and flexibility than normal-weight children, but better strength (bilateral hand grip).

Chow et al⁵⁷ found that male youths with intellectual disability (ID) performed better on the 6/9-minute running ($p = 0.03$) and sit-up ($p = 0.02$) tests, and had lower skin fold measures ($p = 0.01$) than females, while females performed better on the sit-and-reach test ($p = 0.01$) than males. The cardiovascular fitness level (6/9-minute running) of youths with ID was 30% lower than their peers without ID, while differences in other fitness variables were not consistent with variations in age and gender.

Deighan et al⁵⁸ found that knee peak torque was significantly greater in the athletic students [physical education (PE) major] than in the sedentary students (art major). Further analysis showed that peak torque was influenced more by stature than by body mass ($p < 0.01$). It was suggested that exercise could produce benefits in the growth of children.

Comparing with the mainland Chinese school children, Chung et al⁵⁹ suggested that the higher-quality but unhealthier lifestyle in Hong Kong caused poorer physical fitness in the younger generation there. Hong Kong children were heavier than their mainland China counterparts and had poorer results in standing long jump tests; also, 10- and 11-year-old individuals and 12-year-old male children in Hong Kong had poorer muscle flexibility than the Chinese children.

Mak et al¹⁰ studied health-related physical fitness among Hong Kong children and found that boys performed

significantly better in sit-up (38.8 vs. 31.6 times/minute) and 9-minute running (1632.1 vs. 1353.2 m) tests, but poorly in sit-and-reach (27.4 vs. 32.2 cm) tests than girls (all $p < 0.001$). Overweight/obese and underweight adolescents had poorer performance in push-up and sit-up tests than normal-weight adolescents. However, the relation between BMI and health-related physical fitness in adolescents was weak. In boys, BMI correlated only weakly with sit-up ($r = 0.05$, $p < 0.05$) and sit-and-reach ($r = 0.06$, $p < 0.05$) tests. In girls, no significant correlation between BMI and fitness test was found.

Interventions

McManus et al⁶⁰ investigated the effects of moderate-intensity continuous training (MIC) and high-intensity interval training (HII; short intervals, long recovery bouts) on aerobic power and related variables, while keeping the total cardiovascular work constant among Hong Kong Chinese primary school boys. The results showed that after the completion of the 8-week training, significant increases in peak oxygen uptake were noted for both groups. The HII group showed marked pre- to post-increases in both peak oxygen pulse and oxygen pulse at the ventilation threshold, whereas ventilation threshold did not change in the boys of the MIC group.

Hong et al⁶¹ evaluated the effects of prolonged walking with backpack loads on trunk muscle activity and fatigue in children. Fifteen Chinese male children aged 6 years performed 20-minute walking on a treadmill with different backpack loads (0%, 10%, 15%, and 20% of body weight). The results suggested that a load of up to 15% of body weight in a backpack was acceptable to children of the age cohort.

Methodology

A 6-minute walking test (6MWT) has frequently been used to measure outcomes prior to and after treatment in patients with moderate-to-severe heart and lung diseases. Li et al⁶² performed the 6MWT in a cohort of healthy Chinese children and established its reliability and validity over the treadmill exercise and pulmonary function tests. It was found that the 6MWT was reliable in healthy children, and the validity was identified by comparing the test results with a retest conducted 18 days later. In another study, a large sample (1445 participants, 7–16 years old) was measured and a standard curve of 6MWT for Hong Kong Chinese children was plotted. The results showed that male participants performed better than their counterparts.⁶³

Hui and Chan⁶⁴ assessed the relationship between heart rate reserve (HRR) and oxygen uptake reserve in Hong Kong Chinese children. It was found that 50–85% VO₂ peak was equivalent to 72–93% HR_{max} and 56–88% HRR, and 50–85% VO₂ reserve represented 60–89% HRR in children.

For the measurement of energy expenditure in healthy Chinese children, Mellecker and McManus⁶⁵ studied the energy expenditure and cardiovascular responses to seated and active gaming in children aged 6–12 years. The resting energy expenditure (REE) was found to be 1376 ± 267 kcal/day and

the resting heart rate 81 ± 12 beats/minute. Statistically significant mean differences of 0.35, 0.93, and 4.27 kcal/minute were found between the rest and seated, XaviX bowling, and XaviX J-Mat gaming formats (SSD company Ltd, Shiga, Japan), respectively (for all, $p < 0.001$), while heart rate during the XaviX J-Mat gaming was significantly higher than during the seated gaming ($p < 0.001$).

In another study, Mellecker and McManus⁶⁶ examined the effects of measurement time and measurement device (mask or mouthpiece) in 23 children aged 7–12 years. The results showed that there were no significant differences in the resting energy expenditure (REE) when measured after 10, 15, 20, or 25 minutes of rest compared to that measured after 30 minutes for either the mask or the mouthpiece/noseclip (REE range, 1371–1460 kcal/day). The lowest coefficient of variation percentage (%CV, 6%) for the device was obtained after 20 minutes of using the mask, which indicated that a 20-minute protocol using a mask might be a more practical protocol for measuring REE in children.

Chan et al⁷ used the REE values for obese Chinese children in the 13 existing prediction equations (MJ/day) and compared them with the direct measurement values (Deltatrac II MBM-200, Finland). It was found that, when applied to obese Chinese children, none of the existing prediction equations were accurate in their estimation of REE. They subsequently proposed a new formula for local obese children (10–15 years old):

$$\text{REE} = (17.4 \times \log \text{FFM}) + (11.4 \times \text{conicity index}) - (2.4 \times \text{centrality index}^a) - 31.3$$

The mean difference of new predicted and measured REES was -0.01 MJ/day (SD = 1.51) with an interclass correlation of 0.91.

Adults

In an evaluation of the lower body strength of the elderly people, Macfarlane et al⁶⁷ found that those with high levels of habitual PA (11.5 ± 4.1) and moderate activity (10.9 ± 3.9) performed more chair stands than those with low activity (9.7 ± 3.5 ; $p < 0.0001$ and $p = 0.0015$, respectively). There was a significant decrease in the 30-second chair stand test (30CST) results with increasing age (when grouped into 1960s, 1970s, 1980s, and 1990s decades, the means were 12.1, 10.3, 9.4, and 7.2, respectively). Compared with their US counterparts, the Hong Kong elderly people performed worse.

For Hong Kong Chinese elderly people (65 years or older), Woo et al³⁸ found that the percentage of individuals with an underweight BMI ($<18.5 \text{ kg/m}^2$) increased with age, whereas that of obese people decreased with age, in both men and women. Fat mass was similar for the three age groups in men but was lower in older women compared with younger ones. Grip strength and walking speed also declined with age in both men and women. Further analysis indicated that fat mass and BMI were the main factors contributing to the physical

performance, as measured by walking speed. Yu et al⁶⁸ found that fat mass was independently associated with cardiorespiratory function [$\text{VO}_{2\text{max}}$, odds ratio (OR) = -0.20 , $p < 0.001$] for Chinese women aged 55–94 years. The $\text{VO}_{2\text{max}}$ decreased with age (7.1% per decade), and the decline also depended on BMI (OR = -0.03 , $p < 0.001$) and the level of PA (OR = 0.02, $p < 0.001$). It was predicted that the normative values of $\text{VO}_{2\text{max}}$ in this age cohort was $20.3 \pm 4.1 \text{ mL/kg/minute}$.

Tse et al⁶⁹ examined an 8-week core endurance training program in college-age rowers and found that it improved selected core endurance parameters in healthy young men. Macfarlane et al⁷⁰ conducted two gender-balanced 8-week intervention programs: an exercise prescription model (EPM; 30-minute continuous activity, 3–4 days per week) and a lifestyle model (LIFE; 6-minute activity, 5 times per day, 4–5 days/week). For sedentary adults, both LIFE and EPM significantly improved $\text{VO}_{2\text{max}}$ [5.3%, s.e. = 0.24 and 7.4% (s.e. = 0.36), respectively ($F = 34.0$, $p < 0.0001$)], but there were no differences in additional energy expenditure between the groups.

Jones et al⁷¹ studied the effect of a 12-week community-based Tai Chi program (1.5 hours, 3 times weekly) on health-related outcomes. The results suggested that the novice group had increased handgrip strength, flexibility, and peak expiratory flow rate after the program; the experienced group had greater flexibility, lower resting heart rate, and higher diastolic blood pressure than the novice group. Xu et al⁷² reported that either Tai Chi practice or jogging exercise could improve the strength of keen extensors and flexors and the torque of ankle dorsiflexors in the long run (4 or more years). In addition, muscle endurance was more pronounced in Tai Chi practice. Hui et al⁷³ reported that a 12-week Tai Chi or walking exercise (5 days/week) could produce significant and similar beneficial effects on body composition, aerobic fitness, muscular fitness, fasting blood glucose, resting metabolic rate, and perceived health in middle-aged Chinese. Walking exercise elicited about 46% higher metabolic expenditure than Tai Chi exercise. Woo et al³⁸ conducted a 12-month intervention (3 times per week) of either a Tai Chi or a resistance exercise in community-living elderly people (65–74 years old), and found that, in women, both intervention groups had reduced loss of bone mineral density in the total hip compared with the control group. There were no differences in balance, flexibility, or the number of falls between intervention and control groups after 12 months. Although the benefits of Tai Chi practice varied due to different types of Tai Chi, the age extent of participants, and the intensity of practicing, Leung et al⁷⁴ recommended Tai Chi as an alternative treatment for improving balance so as to reduce falls. Despite low exercise intensity, Tai Chi is also effective for middle-aged people due to its unique features in movement breath and mediation. It was found that an 8-week Tai Chi intervention could significantly ($p < 0.05$) improve middle-aged people's (M age = 43.53 years) health parameters such as resting heart rate, body composition, flexibility, and balance with a large effect size.⁷⁵

For senior citizens, dancing is another recommended exercise and leisure activity. Hui et al⁷⁶ found a significant difference between the dancing group (lower-impact aerobic

^a Subscapular/triceps skinfold.

dance) and the control group in health statuses measured as resting heart rate, 6-minute walking, trunk flexibility, body composition, lower limb endurance, and the “general health” and “bodily pain” domains of SF-36 after 12 weeks. Thomas et al⁷⁷ reported that a 12-month buddy peer support group activity improved aerobic fitness significantly and reduced both body fat and time to complete the 2.5-m get-up-and-go test for the Chinese elderly population. However, no other improvements in the CVD risk factors (anthropometry and blood pressure) were observed.

Lower body strength is very important for the elderly population; the 30CST is a reliable and valid method for measuring their lower extremity strength. Macfarlane et al⁶⁷ examined the validity of the 30CST in a field setting and found it to be significantly correlated with individual values of hip flexion ($r = 0.42$, $p < 0.0001$) and knee extension ($r = 0.0004$); no improvement occurred when the hip flexion and knee extension scores were combined ($r = 0.39$, $p < 0.0001$).

Summary

From the published data, it was revealed that Hong Kong children’s physical fitness was not as good as their mainland counterparts. Physical fitness norms are affected by gender, prevalence of obesity, and disability. The elderly people are generally underweight, and their mobility and cardiovascular function decrease with age.

It has been identified that a 20-minute protocol using a mask might be a more practical protocol for measuring REE accurately in children. A prediction equation of REE was developed for obese children, and further studies would be desirable. In evaluating children’s cardiovascular fitness, the 6MWT was found to be a reliable and valid method, and a standard curve of 6MWT was developed for Hong Kong children. Existing evidence showed that Tai Chi is an activity that can improve the physical fitness and quality of life of elderly people.

Cardiovascular risk factors

CVDs are the number one cause of the death globally.⁷⁸ Behavioral risk factors include unhealthy diet, physical inactivity, tobacco use, and harmful use of alcohol. Metabolic risk factors include elevated blood pressure, elevated blood glucose, elevated blood lipids, and overweight and obesity. Other risk factors are globalization, urbanization, population aging, poverty, stress, and heredity.

Children and adolescents

Metabolic risk factors. Ozaki et al⁷⁹ investigated the prevalence of metabolic syndrome (MES) in 2115 Hong Kong adolescents aged 12–20 years. The results showed that the prevalence of MES was 2.4%, along with 32.2% for hypertension, 10.9% for increased triglyceride, 9.0% for central adiposity, 2.4% for low HDL-C, and 0.3% for impaired fasting glucose. In addition, overweight, a positive family history of

diabetes, and studying at schools of lower academic standing were found to be independent risk factors for MES.

Kong et al²⁷ conducted a study to find out the association between alanine aminotransferase and cardiovascular risk factors in the Hong Kong population (2012 individuals, aged 12–18 years). They found that, after adjusting for age and BMI, the highest alanine aminotransferase stratum remained independently associated with diastolic blood pressure and insulin resistance in boys ($p < 0.05$) and with serum triglyceride and Homeostasis Model Assessment (HOMA)-beta ($p < 0.05$) in girls. Kong et al⁸⁰ conducted an observational study of serum concentrations of insulin growth factor-I (IGF-I), insulin-like growth factor binding protein-3 (IGFBP-3), and cardiovascular risk factors in 1647 adolescents aged 12–19 years. The results showed that both IGF-I and IGFBP-3 concentrations were independently associated with waist circumference, fasting insulin, and hemoglobin concentrations in boys (all $p < 0.05$) and with systolic blood pressure, serum creatinine, fasting insulin, and hemoglobin concentrations in girls (all $p < 0.05$). It was suggested that dysregulation of the IGF system might play a linking role for the clustering of cardiovascular risk factors.

Sung et al⁸¹ found that oscillometrically measured blood pressure standards increased similarly with age, height, and weight, and was associated positively with a family history of high blood pressure and inversely with sleep duration among Hong Kong Chinese children aged 6–18 years. Leung et al²⁸ found that the prevalence of elevated blood pressure on the first, second, and third screenings (hypertension) was 9.54%, 2.77%, and 1.44%, respectively, in Hong Kong Chinese adolescents, and hypertension was more likely to be systolic. Meanwhile, a high waist circumference (≥ 85 th percentile) was independently associated with a higher risk of hypertension, while exercising twice or more per week was protective.

Behavioral risk factors. Kong et al⁸² examined the association between self-reported level of PA and cardiovascular risk in 2119 Hong Kong children, aged 6–20 years. The results showed that PA level, sex, and pubertal stage were independently associated with the cardiovascular risk score. In female children, a high PA level was negatively associated but puberty was positively associated with the cardiovascular risk score. Those with a high PA were more likely to be boys, who were less obese, had a lower Z score of total cholesterol (TC)/HDL-C ratio, and were less likely to be in the prepubertal stage.

So et al⁸³ conducted a study to determine the association between blood pressure and the frequency of structured physical training activities in Chinese adolescents. A total of 8981 students, aged 11–18 years, were assessed. A logistic regression, adjusted for age, family history of hypertension, BMI, and sleep duration, showed that exercising two times a week was negatively related to hypertension.

Exercise environment is another worthwhile research dimension, with increasing studies being conducted on the risk factors caused by air pollution.^{84–86} Indoor swimming is recommended as a desirable exercise for Hong Kong

adolescents in view of the health risk from increasing air pollution and the challenges in maintaining exercise adherence.⁸⁵

Adults

Metabolic risk factors. In a review study of the MES and type 2 diabetes from the Hong Kong perspective, Chan et al⁸⁷ reported that Chinese type 2 diabetic patients exhibited marked phenotypic heterogeneity in terms of risk profiles and complications. Apart from genetic differences, age- and stress-related neurohormonal dysregulation may also contribute to the increasing prevalence of obesity, type 2 diabetes, and MES in the Chinese population living in modern societies. Ko et al⁸⁸ found that the prevalence of MES among Hong Kong adults was high, using the current various definitions of MES (6.1–13.4), and that there was a male preponderance of the MES prior to the age of 50 years and a female preponderance after the age of 50 years.

Thomas et al⁴³ investigated the impact of sex-specific physiological parameters on cardiovascular risk factors and found that men had higher blood pressure, lipid profile, and glucose control, but better insulin resistance than women. The prevalence of glucose intolerance (13.8% vs. 15.4%) and type 2 diabetes mellitus (9.5% vs. 10.0%) in men and women was similar. Further analysis indicated that there was a clear positive relationship between increasing ORs and development of hypertension, glucose intolerance/diabetes, or dyslipidemia in both men and women. In examining the association between the increasing glycemia and cardiovascular risk factors, Thomas et al⁸⁹ found that glycemia and insulin resistance increased with fasting and postload glucose level ($p < 0.001$). In women, age, insulin, and waist circumference were associated with fasting glucose level, while BMI, age, and triglycerides were associated with postload glucose level. In men, age and insulin were associated with fasting glucose level, and WC, triglycerides, and insulin was associated with postload glucose level.

In a longitudinal study ($M = 8.45$ years) of Hong Kong people aged 25–74 years, Thomas et al⁹⁰ found that the overall proportion of individuals with MES was 17.6% (17.2% for males and 17.7% for females). The prevalence increased significantly with age, ranging from 8.0% for those aged 25–34 years to 39.8% for those aged 65–74 years. In 2008, Cheung et al⁹¹ investigated the association between elevated blood pressure and dysglycemia using the same sample cohort, and found that 58% of people with diabetes had elevated blood pressure and 56% of people with hypertension had dysglycemia. Both dysglycemia and elevated blood pressure were related to age, waist circumference, waist-to-hip ratio, systolic and diastolic blood pressure, fasting and 2-hour blood glucose, homeostasis model assessment estimate of insulin resistance, HDL-C, and triglycerides.

Simmons et al⁹² conducted a comparative study to investigate the glucose intolerance and cardiovascular risk factors of people in Hong Kong between 1990 and 2001–2003, and

found that their 2-hour plasma glucose values increased from 5.6 ± 2.1 mmol/L in 1990 to 6.5 ± 2.5 mmol/L in 2001–2003.

Behavioral risk factors. There exists an intricate relationship between physical health and psychological status. Cheung et al⁵¹ conducted a study on the relationship between hypertension and anxiety or depression among Hong Kong Chinese people, and found that hypertension was associated with anxiety but not with depression, and that individuals with hypertension were more anxious than the general population.

In the BHBHK campaign projects, Ko et al³⁴ examined the prevalence of cardiovascular risk factors in the Hong Kong population and their level of self-awareness of health. They showed a combination of a high prevalence of multiple cardiovascular risk factors and a low level of awareness of their suboptimal health status. Of the 4841 responders, 37.5% were obese, 22.3% had hypertension, 11.6% were smokers, 31.0% had hypercholesterolemia, 2.2% had diabetes, and 0.7% had a past history of CVD. A total of 1338 participants (27.7%) had two or more risk factors (men vs. women: 36.9% vs. 18.9%, $p < 0.001$).

Chiu et al⁹³ enrolled 68,000 outpatients, aged 45 years and older, from 44 countries to compare their cardiovascular risk profiles and the outcomes of Chinese living inside and outside China. They found that the prevalence of hypertension, hypercholesterolemia, diabetes, abdominal obesity, and $BMI \geq 25$ kg/m² was lowest in Chinese Mainland, higher in Hong Kong/Singapore/Taiwan, and highest in Western Europe and North America, which might be due to sociocultural differences.

Intervention strategies. Thomas et al⁹⁴ conducted a 12-month longitudinal study on the effects of Tai Chi and resistance training (3 sessions per week and 1 hour per session) on cardiovascular risk factors in elderly Chinese people (aged 65–74 years). They found that there was no significant changes in the Tai Chi group compared to the resistance training or control group (BMI, waist circumference, and dual X-ray densitometry percentage body fat, blood pressure, lipids, and insulin resistance), except for the improvement of insulin sensitivity index in the resistance training group. Ko et al⁹⁵ reported that a 10-week (2 sessions per week) Tai Chi intervention program in middle-aged women (range 30–50 years) improved their systolic blood pressure and lipid profiles [TC and low-density lipoprotein cholesterol levels (LDL-C)]. Woo et al³⁹ demonstrated that a nutritionist-led multicomponent group intervention was effective in improving the metabolic and cardiovascular risk factor profile, while the metabolic profile deteriorated in the nonintervention group, with increases in fasting glucose, triglycerides, TC, and LDL-C levels.

Summary

From the articles reviewed, it was found that the prevalence of cardiovascular risk factors was widely reported in children and adults. Increasing waist circumferences adjusted for age and BMI were significantly associated with cardiovascular risk factors in both children and adults. Monitoring and

modification of metabolic and behavioral risk factors are important for decreasing cardiovascular risk. Effective interventional programs along with educational programs and a long-term planning should be developed and implemented.

Physical activity

Children and adolescents

Participation of normal children in PA. Chow et al⁹⁶ observed the PAs of elementary school children during lesson time and analyzed the environmental influences. They found that the actual mean lesson time was 31.7 minutes compared to the scheduled mean time of 43.3 minutes, and children accrued an average total 4.6 minutes of vigorous PA and 15.8 minutes of moderate-to-vigorous PA (MVPA) during lessons (14.9% and 50.7% of lesson time, respectively). Standing accounted for 38% of their lesson time and walking for 36%. In a follow-up study, Chow et al⁹⁷ found that students of a secondary school engaged in MVPA for about 35% of lesson time (18.5–21.0 minute), which indicated that they were less active than students observed during the PE class in an elementary school. Temperature, teacher behavior, and two lesson characteristics (subject matter and mode of delivery) were significantly associated with the PA level.

Chow reported that, in a 2001 survey it was found that more than 80% of children watched TV at their leisure time and nearly half of the children (45%) watched TV for over 3 hours/day, while only 33% chose to exercise.⁵³ In a comparative study, Ha et al⁹⁸ found that boys and girls in Hong Kong spent significantly less time, outside of school hours, in PAs than their Australian contemporaries ($p < 0.05$). Mak and Day⁹⁹ found that the participation in sports (at least weekly) decreased significantly in boys, TV/video watching and homework for at least 2 hours/day increased significantly in both sexes, and being unfit/very unfit increased significantly in girls from 1995 to 2000.

In the 2005–2006 Hong Kong Growth Survey, So et al⁸³ found that 10.7% of the boys and 5.3% of the girls were physically active, but over half of the students did not do any exercise other than attending PE classes at school. In a cross-sectional study in 2007–2008, Kong et al⁸² found that 21.5% of children (aged 6–20 years) were reported to participate in high-level PAs, and boys were more active than girls (32.1% vs. 14.1%, $p < 0.001$). In a study of free-living activity patterns in lean and obese children, McManus et al¹⁰⁰ found that children's free-living activity is characterized by many short-duration and low-intensity bouts of movement. Obese children took longer rest intervals between bouts and engaged in fewer activity bouts, both at school and at home.

Participation of special children in PA. Sit et al¹⁰¹ investigated the PA levels in children (grades 4–6) with disabilities during PE classes and recess. They found that children accrued little MVPA during the PE classes (7.8 minutes) and recess (8.9 minutes), while activity levels varied across disability types, with differences being attributed to lesson context and

behavior of the teacher. Fong et al¹⁰² reported that children with developmental coordination disorder participated in fewer out of school activities and less frequently than their normal developing peers. To explore the determinants of activity and participation in preschoolers with developmental delay (DD), Leung et al¹⁰³ investigated 54 DD and 54 age-matched typically developing children, and found that children with DD had a significantly lower activity and participation ($p < 0.001$) than their counterparts. Further analysis revealed that deficits in social and motor functioning and attention-deficit hyperactivity disorder-related symptoms were important determinants of activity and participation in preschoolers with DD.

Factors and strategies in affecting PA. Lau et al¹³ found that parental influence, especially father's influence as a role model, was significantly related to attraction to PA in overweight Chinese children. Perceived physical competence was also an important factor in an overweight child's attraction to PA. Ha et al⁹⁸ found that parental support significantly correlated with self-reported activity in Australia, but not in Hong Kong. Children in Hong Kong received significantly less perceived support for activity from parents ($p < 0.001$), teachers ($p < 0.001$), and peers ($p < 0.001$) compared to their Australian counterparts. To understand the role of PA culture in the lives of Hong Kong Chinese children and their parents, Ha et al¹⁰⁴ interviewed 48 children, aged 9–16 years, and their parents, and found that parents valued PA as a factor that contributed to their children's well-being and provided balance to their life. Regarding the involvement of parents and children in PA, the barriers to the parents' involvement in their children's PAs included lack of time and a habitual sedentary lifestyle at home.

McManus et al¹⁰⁵ conducted a study on the use of heart rate feedback to increase PAs in children of 9–11 years. The findings showed that, in the short term, total daily PA increased by an average of 24% ($p < 0.001$) and vigorous PA by 0.6% ($p < 0.05$), but there was no change in moderate PA. Moreover, when the feedback was removed, the increases did not persist. Tse and Yuen¹⁰⁶ reported that a health education regarding the diet and PA was effective in encouraging the teenagers to eat more healthily and adopt an active lifestyle. Sit et al¹⁰⁷ found that, when given a free choice, children (9–12 years) spent more than half of their available time participating in interactive versions of games than in similarly themed computer screen games in recreation sessions. It could be speculated that access to new-generation interactive games, particularly those with adjustable intensity levels, might facilitate children's participation in PAs.

Methodology. Chu et al¹⁰⁸ conducted a study to calibrate the RT3 accelerometer for ambulation and nonambulation in children, and the results indicated that RT3 movement counts increased in a linear manner with scaled oxygen uptake from stationary to vigorous movement ($r^2 = 0.83$). The receiver-operating-characteristic-derived thresholds showed good ability to discriminate between nonambulatory and ambulatory

tasks, as well as to distinguish between low, moderate, and vigorous ambulation (sensitivity values of 87–100% and specificity values of 97–100%).

Capio et al¹⁰⁹ investigated the validity of an MTI accelerometer (Manufacturing Technologies Inc., Fort Walton Beach, FL, USA) as a PA measurement instrument among children with cerebral palsy, aged between 6 and 14 years. The MTI measured activity counts, a monitoring device measured the heart rate, and the System for Observing Fitness Instruction Time (SOFIT) was used for direct PA observation. The results showed that there were strong relationships between MTI and SOFIT data ($r = 0.75$; $R^2 = 0.56$; $p < 0.001$) and between heart rate monitor (HRM) and SOFIT data ($r = 0.65$; $R^2 = 0.43$; $p < 0.001$) in structured activities. In free play activities, the association between MTI and SOFIT data ($r = 0.67$; $R^2 = 0.45$; $p < 0.001$) was significantly stronger ($p = 0.01$) than that between heart rate and SOFIT data ($r = 0.14$; $R^2 = 0.02$; $p < 0.001$). These findings suggested that the MTI appears to be a valid instrument for measuring raw activity volume among children with cerebral palsy and is suitable for use in studies attempting to characterize the PA of this population.

Huang et al¹¹⁰ examined the reliability and validity of the modified Chinese version of the Children's Leisure Activities Study Survey questionnaire in assessing PA among Hong Kong children aged 9–12 years. Results showed that the questionnaire provided reliable and valid estimates in overall PA patterns, but substantial overestimation was observed in vigorous activity. In another study, Huang et al¹¹¹ assessed the reliability and validity of a questionnaire to measure child- and parent-reported psychological and environmental correlations of PA. A total of 303 schoolchildren, aged 9–14 years, and their parents volunteered to participate in this study, and 160 of them completed the questionnaire twice within an interval of 10 days. Reliability statistics for both child- and parent-reported continuous variables showed acceptable consistency for all the intraclass correlation coefficient (ICC) values greater than 0.70 and kappa statistics showed fair to perfect test–retest reliability for the categorical items. The criterion validity assessed by correlating psychosocial and environmental measures with child-reported PA found associations with PA in the self-efficacy scale ($r = 0.25$, $p < 0.05$), the peer support for PA scale ($r = 0.25$, $p < 0.05$), and the home PA environmental scale ($r = 0.14$, $p < 0.05$).

Adults

Participation in PA. Abdullah et al¹¹² found that one-third of the university students did not participate in PAs during the past month in a self-reported survey. Woo et al³⁸ found that the level of PA decreased by age and sex-specific difference was remarkable for older people (65+ years); females participated less in PAs than males.

Chow⁵³ reported that, in 2001, people in Hong Kong spent, on average, 2.4 hours daily watching television, and only 55% of local adults exercised in the previous month. Sit et al¹¹³ reported that over 70% of adults with physical disability in Hong Kong were not physically active enough to avail health benefits.

Under the Behavioral Risk Factor Surveillance System, the Department of Health of Hong Kong conducted annual telephone interviews on health-related lifestyle and behaviors with at least 2000 randomly selected land-based, noninstitutionalized persons aged 18–64 years. The 2005–2010 data showed that over half of Hong Kong adults had no moderate exercise during the last 7 days and about 20% of adults chose a low level of PA. Females participated in low and moderate PAs more often than males. In 2010, it was found that only 35.7% (41.6% for men and 30.8% for women) of Hong Kong people's self-reported PA met WHO's recommendation.

Benefits of participating in PA. Chan et al¹¹⁴ found that practicing mind–body (emphasizing the conscious control of each body movement) and cardiovascular (such as jogging and swimming) exercises had a similar effect on improving the level of memory function in elderly population. Individuals who participated in the training program demonstrated better learning ability and memory than those who did not exercise regularly. Individuals who practiced both types of exercises outperformed all other groups, even after including the corrections for the total hours of exercise.

Poon and Fung¹¹⁵ found a positive association between PA and related satisfaction in Chinese elderly adults. An interdependent self-construal moderated the relationship between physical exercise and related satisfaction, which suggested that PA might be psychologically beneficial to elderly adults across cultures but its benefits might depend on cultural emphasis and individual self-construal. Regular physical exercise was associated with better cognitive test performance, and the beneficial effects were more significant among the young population than among the elderly (aged 65–75 years).¹¹⁶ Kwok et al¹¹⁷ reported that a low-intensity mind–body exercise could be beneficial to the cognitive functioning (Chinese Dementia Rating scale, $p = 0.045$) of elderly adults.

Man et al¹¹⁸ compared the attention and memory function among elderly Tai Chi practitioners, and found that the Tai Chi group had demonstrated better performance in attention and memory tests than the exercise group and the health control group. Lam et al¹¹⁹ conducted a 1-year exercise intervention (24 forms of simplified Tai Chi or stretching and toning exercise) in Chinese elderly and found that the global cognitive function, delayed recall, and subjective cognitive complaints (paired t tests, $p < 0.05$) were improved in both groups at the 5th month. Improvements in visual spans and clinical dementia rating scores were observed only in the Tai Chi group (paired t tests, $p < 0.001$).

Tse et al¹²⁰ found that an 8-week supervised physical exercise program (1 hour per session and once a week) could significantly decrease elderly patients' pain intensity (score 4.89–2.89, $p < 0.01$) and increase the range of movement in the neck, shoulder, and back; increase hip and knee rotation; and improve flex and abduction ($p < 0.01$). Chan et al¹²¹ reported that an 8-week physiotherapy session with additional individually tailored aerobic exercises could reduce the pain in patients with chronic low back pain and improve their disability ($p < 0.001$) at 8 weeks and 12 months, but no extra

effect was observed compared to the physiotherapy group either at 8 weeks or at 12 months.

Predisposing factors for PA. Abdullah et al¹¹² investigated the factors related to nonparticipation in PAs among the college students in Hong Kong. They found that being female, not residing in a university residence, being in the faculty of arts, and rating current health status as poor or very poor were associated with physical inactivity, and “no time” (68.6%) and “no interest” (22.6%) were the most common reasons the students gave.

Sallis et al¹²² conducted a comparison study of neighborhood environments and PA among a combined sample of 11,541 adults (990 adults from Hong Kong) and found that low-cost recreational facilities, bicycle facilities, many shops nearby, transit stop in the neighborhood, and sidewalks were significantly related to the participation in PAs. They concluded that a neighborhood built to support PA could contribute to increased participation in PAs.

Seo et al¹²³ compared the factors associated with physical inactivity among five East Asian college students (in Taiwan, Hong Kong, South Korea, Singapore, and Malaysia), and found that fruit and vegetable consumptions were significantly correlated with physical inactivity when gender, age, and BMI were controlled. Those who engaged in binge drinking at least once during the past 2 weeks were less likely to be physically inactive than those who did not. In the multivariate model, only in Hong Kong the current tobacco users were more likely to be physically inactive.

Strategies in offering PA. Cheung et al¹²⁴ conducted a study on the use of environmental stimuli strategy to promote PA in school teachers. The intervention content included the following: (1) sending messages about exercise benefits; (2) distributing information leaflets; (3) putting up posters in the school; and (4) providing pedometers. The results demonstrated that the strategy was effective in assisting teachers to increase their PA levels at work following a 6-week intervention period.

Eves et al¹²⁵ reported that active transport interventions (targeting stair climbing) were unsuccessful in Hong Kong, and further studies showed that a small but significant increase in stair climbing on the mass transit system, but no significant changes in the shopping mall. Moreover, the active transport of walking reduced at higher humidity and temperature. These studies confirmed that lifestyle PA interventions did not have universal application. Li et al,¹²⁶ after conducting a 6-year follow-up, found that PA mediated the effects of health worry on walking difficulty among the elderly individuals; greater health worry predicted lower levels of participation in PA, which in turn predicted walking difficulty. Thomas et al⁷⁷ found that motivational interventions (pedometry or buddy peer support) increased PA levels among elderly Chinese people aged 60 years and more.

Assessment of PA. Macfarlane et al¹²⁷ examined the convergent validity of six methods, including four objective instruments [a one-dimensional (MTI) and a three-dimensional (Tritrac)

accelerometer, an HRM, and a pedometer] and two subjective instruments [a 7-day PA recall questionnaire and a daily PA logbook (PA-log)], to assess PA in daily life. A convenient sample of 57 individuals aged 15–55 years and of mixed gender (36 men and 21 women) was recruited. The PA-log and International Physical Activity Questionnaire—Chinese version (IPAQ-C) showed similar estimates (978 and 708 minutes, respectively), and neither differed significantly from the lower estimates by the Tritrac and MTI. These findings showed that there was generally a consistency in the times accrued at low, moderate, vigorous, and health-enhancing PA thresholds within similar types of activity monitors (questionnaire derived; accelerometer derived), but there was poor agreement (convergent validity) across the different types of monitors (i.e., PA-log, IPAQ-C, HRM, MTI, and Tritrac).

Macfarlane et al¹²⁸ examined the reliability and validity of the IPAQ-C (short, lasting for 7 days), while the concurrent validity used a PA-log and an MTI accelerometer over 7 consecutive days. The results showed that the IPAQ-C can be considered an adequately reliable instrument (ICC of 0.79 and %CV of 26%) to assess the total amount of PAs in the population, but the validity comparisons between the IPAQ-C and the two reference methods (PA-log and MTI accelerometer) were quite poor.

In another study, Macfarlane et al¹²⁹ examined the pedometer guidelines for free-living individuals using three objective criteria (HRM, MTI, and Tritrac) and found significant differences between them. Quartiles of pedometer-determined activity were predominantly seen in the accelerometer data, especially during moderate- and moderate-to-vigorous-intensity activity, but not in the HRM data. In both criterion accelerometer data sets, a threshold of 8000 steps per day accurately categorized approximately 90% and 80% of those who achieved and did not achieve the targets of 30 min/day, respectively.

Macfarlane et al¹³⁰ examined the validity and reliability of the IPAQ-C, long form (IPAQ-LC). A total of 83 Chinese adults (47 males and 36 females) were recruited, who wore an ActiTrainer accelerometer and completed the IPAQ-LC in an 11-day follow-up. The results showed that the IPAQ-LC had good test–retest reliability for grouped activities, with ICCs ranging from 0.74 to 0.97 for vigorous, moderate, walking, and total PAs, with between-test effect sizes that were small. The Spearman correlation coefficients were statistically significant for vigorous PA ($r = 0.28$), moderate + walking PA ($r = 0.27$), as well as overall PA ($r = 0.35$), when compared with the accelerometer-based criterion measures.

Cerin et al¹³¹ developed and validated a questionnaire of perceived neighborhood characteristics related to appropriate walking for Chinese seniors (Neighborhood Environment Walkability Scale for Chinese Seniors, NEWS-CS), based on the Neighborhood Environment Walkability Scale—abbreviated (NEWS-A). The final version of the NEWS-CS consisted of 14 subscales and four single items (76 items); its test–retest reliability was moderate to good (ICC >0.50 or % agreement >60), except for four items measuring distance to destinations. In a follow-up study, Cerin et al¹³² examined the

reliability and validity of the Neighborhood Physical Activity Questionnaire (NPAQ) in Chinese-speaking elders (NWQ-CS). The results showed that the NWQ-CS measures of walking has moderate to excellent reliability and the reliability was generally higher for estimates of weekly walking frequency than of minutes of walking. In another study, Cerin et al¹³² examined the reliability and validity of the IPAQ-LC in Chinese seniors, including moderating effects of neighborhood walkability and socioeconomic status (SES) on reliability and validity. Acceptable reliability was found for all measures of PA across different types of neighborhoods. Participants from low SES areas were less reliable at estimating leisure-time PA and sitting, but more reliable at estimating transport-related walking. Lee et al¹³³ expressed reservation in using the International Physical Activity Questionnaire—short form (IPAQ-SF) in assessing PA after reviewing the findings of 23 validation studies. They found that IPAQ-SF overestimated PA as measured by objective criteria by an average of 84%.

Ho et al¹³⁴ assessed the validity of the modified Chinese Baecke questionnaire using a 3-day activity diary as the reference method and 2-week test–retest reliability was also evaluated. The results showed good reliability (correlation coefficients ranging from 0.65 to 0.90), and a high correlation between the weighted total index computed from the questionnaire and daily energy expenditure obtained from the diaries ($r = 0.61$) was obtained.

Summary

It could be concluded from the review of literature that Hong Kong children's participation in MVPA in the PE class and out-of-school hours was unsatisfactory. Participation of obese and special children in PA was much less than that of normal children. Over half of the adults did not participate in moderate PA. Existing government policy and programs seemed to be ineffective in promoting participation in PAs during the past few years.

Aging in conjunction with decreasing PA is associated with a range of health problems.¹³⁵ In Hong Kong, the aging problem becomes more and more serious—over 1 million people will be older than 60 years in 2012. Thus, development of a more active family, community, and society is urgently needed. In a longitudinal study over a period of 8 years with 416,175 Taiwanese people, aged 20 years or more, Wen et al¹³⁶ found that 15 minutes a day or 90 minutes a week of moderate-intensity exercise reduced the risk of all-cause mortality by 14% and increased the life expectancy by 3 years.

Accelerometers were widely used in assessing the daily PA and had been successfully used in many field-based studies.^{137,138} In conducting studies involving a large population, questionnaires should be more practical. Scholars have examined and updated the reliability and validity of questionnaires used in Hong Kong community, such as the IPAQ-C (long and short forms), NEWS-CS, and modified Chinese Baecke questionnaire. They would continue to contribute to the development of norms and monitor PA patterns of the local population.

Lifestyle

Children

Lifestyle is a key factor and predictor of physical fitness for children. The education system, living environment, diet, and leisure pattern influence the health of children.⁵⁹

Eating habits and nutrition. Tse and Yuen¹⁰⁶ examined the effects of a nutrition education program on teenagers' dietary activity and PA. They found that there was a significant decrease in the consumption of fried food per day ($p < 0.01$), and a significant increase in the choice of healthier foods in terms of snack preference and expectation ($p < 0.05$). Moreover, daily PA increased significantly ($p < 0.01$), but the amount of exercise in previous 7 days did not increase significantly.

Chung et al¹³⁹ recorded a 2-day dietary and physical fitness pattern of children from three local primary schools to explore the integrated effect of nine nutrients on an individual's physical fitness level. The findings revealed that a balanced diet provides benefits, with physical fitness as the outcome measure.

So et al¹⁴⁰ assessed the relationship between breakfast frequency and measures of obesity in 11,570 Hong Kong Chinese children, aged 9–18 years. It was found that 8% (8.7% of boys and 6.9% of girls) of children in primary schools and 14% (14% of boys and 15% of girls) in secondary schools were breakfast skippers. The dose effects of breakfast frequency ($p < 0.001$) on BMI and PBF were -0.125 kg/m^2 and -0.219% for boys and -0.165 kg/m^2 and -0.353% for girls, respectively. In a 2-year follow-up study, Tin et al¹⁴ reported that a total of 5.3% boys and 5.2% girls skipped breakfast ($N = 113,457$ primary 4 students). In cross-sectional analyses, breakfast skippers had a higher mean BMI than eaters among both primary 4 ($p < 0.001$) and primary 6 ($p < 0.001$) children. Compared with eaters, baseline breakfast skippers experienced a greater increase in BMI in the subsequent 2 years ($p < 0.001$), and this association was stronger among lunch skippers than among eaters (p for interaction = 0.04). Tin et al³⁰ suggested that breakfast skipping was associated with being overweight (OR = 1.59, 95% CI) and obese (OR = 2.06), and significantly related to leading various lifestyles, skipping lunch, engaging in fewer extracurricular PAs, and watching more television.

Sleeping. Wing et al¹⁷ conducted a study in 5159 primary school students to investigate the effects of weekend and holiday sleep compensation on childhood obesity. The results revealed that children slept significantly longer during holidays (10.20 ± 0.92 hours) and weekends (10.07 ± 0.93 hours) than during school weekdays (9.18 ± 0.95 hours). Overweight/obese children tended to wake up earlier, had shorter sleep durations, and spent more time on academic activities ($p < 0.05$) and television viewing ($p < 0.01$). Further analysis demonstrated that short sleep duration was associated with a higher BMI, but compensation of sleep during weekends/

holidays might partly ameliorate the risk of childhood overweight/obesity.

Mak et al¹⁴¹ investigated the association between smoking and sleep disorders among adolescents. Compared with nonsmokers, the OR (95% CI) of insomnia was 1.39 for experimenters (smoked once or a few times) and 0.91 for smokers. Smoking was positively associated with difficulty in maintaining sleep ($p < 0.001$), but negatively with difficulty in initiating sleep ($p < 0.001$) and early morning awakening ($p = 0.003$).

Zhang et al¹⁴² conducted a 5-year prospective follow-up study to explore the longitudinal course, predictors, and impact of childhood insomnia in a community-based cohort. The results showed that the prevalence of chronic insomnia was 4.2% and 6.6% for baseline and follow-up, respectively, and the incidence and persistence rates of chronic insomnia were 6.2% and 14.9%, respectively. Further analysis suggested that hyperactivity and frequent temper outbursts were correlated with chronic insomnia at the baseline; the presence of frequent temper outbursts at the baseline could predict new incidence of insomnia. Moreover, enhanced alcohol use and smoking were also associated with new incidences of insomnia.

Social and family influences. Lam et al¹⁴³ investigated the relationship between sociocultural influence on body dissatisfaction and dieting in girls aged 12–19 years. The results showed that age, BMI, and peer, parental, and media pressures for thinness were associated with body dissatisfaction and dieting. Peer and media had direct relationships with dieting and the effect of BMI on dieting was mediated through body dissatisfaction.

In a cross-sectional comparative study, Lee and Loke¹⁴⁴ found that socioeconomic disparities, family composition, and age group were key factors associated with healthy lifestyle behaviors in adolescents. The findings showed that adolescents in Guangzhou, when compared with those in Hong Kong, obtained higher mean scores in “physical participation” ($p < 0.001$), “nutrition” ($p < 0.001$), “social support” ($p = 0.001$), “stress management” ($p = 0.022$), “identity awareness” ($p < 0.001$), “health practices awareness” ($p < 0.001$), and “safety” ($p < 0.001$).

Health promotion in school. Lee et al¹⁴⁵ assessed whether the health-promoting schools (HPSs) could contribute to the better health and well-being of Hong Kong children. Children from five primary schools and four secondary schools were surveyed in 2001 and 2004. Results showed the students attending HPS program had improved their lifestyle in various aspects, showed better life satisfaction and emotional status, and reported better health and academic performance.

In 2008, Lee et al¹⁴⁶ conducted a study to examine whether the concept of HPS helped in improving students’ health knowledge and practices to combat the challenge of communicable diseases. Results from the self-administered questionnaire revealed that the students of HPSs had a more positive health behavior profile (personal hygiene practice, knowledge on health and hygiene, as well as access to health

information) than those of non-HPSs. Lee¹⁴⁷ suggested that HPS was an effective, holistic, and whole-school approach in improving health, ranging from PAs and healthy eating to emotional health, and would help combat the global burden of childhood obesity. Lee et al¹⁴⁸ indicated that the findings of studies conducted in Hong Kong showed that school policies and environment changed from the time of adoption of the healthy school framework. Most Hong Kong primary school students reported that they were practicing positive lifestyle behaviors at a young age.³² Female primary school students were practicing more positive lifestyle behaviors and maintaining better psychosocial well-being than their male counterparts, including PAs. It was concluded that lifestyle choices were formed in early adolescence and health education should begin as early as possible to inculcate healthy behaviors among children.¹⁴⁸

Adults

Lee and Loke¹⁴⁹ investigated the health-promoting behaviors and psychosocial well-being of university students. The results revealed that relatively few university students had a sense of “health responsibility” (6.5–27.1%), engaged in any form of PA (31.2%), exercised regularly (13.8%), and ate fruits (35.2%) and vegetables (48.9%) every day. Positive personal growth was reported by 50.6% of the students, 42.5% used stress-management skills, and 74.1% rated their interpersonal relationships as meaningful and fulfilling.

In a cross-sectional representative study, Chou¹⁵⁰ investigated the prevalence and clustering of four major lifestyle risk factors in 4812 Hong Kong Chinese seniors. It was found that 14% smoked, 5% drank frequently for at least 4 days per week, 43% were physically inactive, and approximately one-third did not eat sufficient fruits and vegetables.

Ko et al⁴⁴ reported that in the Chinese workforce, men were more likely to smoke, drink alcohol, consume sugar-sweetened beverages, and eat more meat portions than women, but were physically more active (all items, $p < 0.001$). After adjusting for confounding factors, frequent intake of sugar-sweetened beverages remained independently associated with obesity in women, while physical inactivity, smoking, and high daily meat intake predicted obesity in men.

Twinn et al¹⁵¹ conducted a survey of lifestyle risk factors for cardiovascular health among young Hong Kong Chinese women, and found that 7% of the women surveyed smoked and an increasing trend of smoking existed among women in Hong Kong. Meanwhile, 21% of women reported that they consumed alcohol regularly, 10% of women described themselves as overweight or obese, 31% of women were underweight, and one-third of them exercised regularly. Moreover, 12% of women reported to have experienced mental problems, 37% described themselves as experiencing depression, 43% reported to cry easily, and 49% were feeling irritable, and 97% were experiencing stress in their everyday life in the last 3 months.

Eating habits and nutrition. Woo et al¹⁵² conducted a study on nutrient intake and psychological health in elderly

population, and found few associations between lifestyle factors. Dietary factors that were inversely associated with the Geriatric Depression Scale score included total fat intake; vitamins A, B₂, B₃, C; fibers; and vegetables. In terms of nutrient density, intake of iron and isoflavone was an additional factor.

Ko et al³⁶ demonstrated that in Hong Kong Chinese adults (aged 17–83 years), men had a worse cardiovascular risk profile and less desirable dietary habits than women, and those with more unhealthy dietary habits were more likely to be obese and smokers. There were close associations between dietary habits and risk factors for CVD in the Hong Kong population. Therefore, it is desirable to provide more effective community education on healthy lifestyle.

In a longitudinal study over 5–9 years, Woo et al²⁹ found that dietary pattern was a significant factor predisposing to the development of overweight and obesity in the Hong Kong Chinese population. After adjusting for confounding factors, increased snack consumption was found to be associated with an increased risk of developing overweight (BMI ≥ 23 kg/m²).

Tse and Benzie¹⁵³ conducted a cross-sectional qualitative descriptive study on dietary-related profile of older persons. The results showed that 40% of the elderly people who lived alone and ate alone consumed less fruits and vegetables, fluids, and dairy or bean curd products. The majority of them (61%) perceived their nutritional status to be satisfactory, and the perceived nutritional status was positively correlated with the perceived health status ($r = 0.794$, $p < 0.0001$).

Chan et al¹⁵⁴ examined the effects of dietary and other lifestyle factors on bone health in young women living in Hong Kong and Beijing. The findings suggested that great differences in lifestyle and dietary intake existed between the two cities. In Hong Kong, women have significantly lower bone mass density (BMD) and higher body-size-adjusted dietary intakes. Regression analysis revealed that BMI was the most important determinant that affected BMD. Additionally, the use of oral contraceptives and dietary intake of carbohydrates, fiber, and vitamin E were also associated with BMD.

Sleeping. Ko et al³³ investigated the sleeping and working hours in the Hong Kong workforce and found that the mean daily sleeping time was 7.06 ± 1.03 hours and working time 9.02 ± 2.02 hours. Men had less sleeping time (women vs. men: 7.14 ± 1.08 vs. 6.98 ± 0.96 hours, $p < 0.001$) and more working hours (women vs. men: 8.50 ± 2.19 vs. 9.42 ± 1.79 hours, $p < 0.001$) than women. Meanwhile, those with short sleeping hours (6 hours or less per day) and long working hours (49 hours per week) had the highest BMI and waist in both genders.

Wong and Fielding¹⁵⁵ conducted a population-based cross-sectional telephonic interview among Hong Kong adults and found that the weighted prevalence of insomnia was 39.4%, which was equivalent to 2.2 million affected adults in Hong Kong; women reported significantly poorer circumference sleep quality (all $p < 0.05$). It was also found that non-full-time employment status, existing long-term health problems, alcohol consumption four to seven times per week, higher

scores of Hospital Anxiety and Depression Score, poor mental health component of quality of life, and low self-perceived health status were significantly associated with insomnia (all $p < 0.05$).

Quality of life. Ko¹⁵⁶ investigated the relationship among obesity, PA, and quality of life in nonmanual workforce, and found that obese people had lower scores on some of the SF-36 subscales. As the level of PA decreased, mean scores on most SF-36 subscales also progressively decreased. Obese women with no regular PA had lower scores on some quality of life subscales than those with some regular PA.

In a longitudinal study (mean 4.1 years), Lam et al¹⁵⁷ found that in the elderly age cohort, smoking continued to be a major cause of death, and quitters had significantly lower risks of death than current smokers from all causes—lung cancer, other cancers, stroke, and all CVDs.

Woo et al¹³⁵ examined the relative contributions of geographic, socioeconomic, and lifestyle factors to quality of life, frailty, and mortality in the elderly. The results of a health survey of 4000 people aged 65 years and more suggested that district variations directly affected self-rated physical health and also exerted an effect through socioeconomic position as well as lifestyle factors. Lifestyle factors also directly affected physical and mental components of health, frailty, and mortality.

Predisposing factors in improving quality of life. Lau et al¹⁵⁸ reported that a 6-week exercise program did not improve health-related quality of life (SF-36) among patients recovering of severe acute respiration syndrome. Ko et al⁹⁵ found that a 10-week Tai Chi intervention program could improve some of the parameters of health-related quality of life in SF-36 questionnaire scores, namely vitality and mental health, in middle-aged healthy Chinese women. In a 23-month study, Lam et al¹⁵⁹ examined whether the baseline stage of change for general health promotion action predicted health-related lifestyle practices among Chinese adults. The results showed that 37% of the individuals remained in the same stage, 43% had progressed to later stages, and 20% had regressed to earlier stages of change at follow-up. Further analysis revealed that the predictive validity of stage of change for general health promotion action was supported from these longitudinal findings.

Woo et al³⁹ found that a nutritionist-led LPM consisting of components of dietary management, PA, and peer group support was effective in weight maintenance of obese individuals after medication treatment.

Leung et al¹⁰³ found that higher-level participation in intellectual activities was significantly associated with a lower incidence of global cognitive decline, as measured by both the total hours per week (multivariate-adjusted OR = 0.97, $p = 0.003$) and the total number of subtypes (multivariate-adjusted OR = 0.74, $p = 0.018$), for the elderly people.

Summary

The numbers of investigations conducted to gain an understanding of the lifestyle of Hong Kong residents have increased

in the past years, with the major objective of improving the quality of life. Most studies focused on interactive lifestyles, and some were longitudinal studies of relatively short periods (5–8 years). In a recent lifestyle survey of 3024 Hong Kong people aged 5–74 years, their lifestyle management practices were investigated.⁴⁶ The lifestyle management practices included PA and exercise habit, body weight control, eating habits, sleeping habits, drinking and smoking habits, and medical expenditure. The findings suggested that the population in the 25–39-year age group led an unhealthy lifestyle in comparison with other age cohorts—they exercised less, skipped breakfast more frequently, had more irregular meals, consumed more alcohol, and smoked more often. Elderly people need to pay more attention to weight control, especially to the reduction of abdominal obesity. Children and females should cut down on snacks and exercise more. Overall, it appeared that Hong Kong people relied on medication to stay healthy and did not acquire the habit of exercising. Findings related to sleeping and eating habits suggested that parents should pay more attention to these aspects in raising their children. The overall health status of the manual workforce was poorer compared to the office workers, which suggested that a new government policy would be desirable to enable this group to enjoy health, higher productivity, and better quality of life.

Growth and development of children

Morphological measurement

Cole et al¹⁶⁰ collected data from surveys of children in six high- and middle-income countries: Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States. The authors noted that two East Asian countries (Hong Kong and Singapore) have an appreciably higher prevalence of thinness than the other countries. In the HKSOS project 2006–2007, it was reported that the prevalence of underweight among children was 8.7% (8.6% for boys and 8.7% for girls).²⁵

To monitor secular changes in the growth of Hong Kong children aged 6–18 years and document the extent of the evolving obesity epidemic, So et al²⁴ investigated 14,842 school children and compared the data with the 1993 growth survey. The findings showed that for each age group and for both genders, height, weight, and BMI increased from 1963 to 1993 and again from 1993 to 2005–2006. As WC was not measured and included in the 1993 growth survey, Sung et al¹⁶¹ conducted a study of 14,842 ethnic Chinese children in 2005/2006. Reference values and percentile curves for sex- and age-specific WC and WHtR of Chinese children and adolescents were provided. WC was found to correlate more closely with BMI than WHtR ($r = 0.93, 0.91$; cf. 0.65 and 0.59 for boys and girls, respectively). It was suggested that the use of WHtR did not offer any advantage over WC for children.

Using the same data set collected in 2005–2006, So et al¹⁶² evaluated the implications of replacing Hong Kong's 1993 growth references with the WHO's 2007 reference (WHO2007) for children aged 6–18 years. The results showed that approximately 5% of children currently considered normal weight could be identified as underweight, and 1.4% of

children aged 6–10 years and 2.8% of those aged 11–18 years who are currently considered normal height would be classified as short. They cautioned that the use of WHO2007 in Hong Kong could increase clinical workload and patient and parent anxiety by identifying additional “underweight” and/or “short” children. Further study with clinical data was desired to determine the utility of HK1993, WHO2007, and HK2005/06 in assessing medically significant growth problems among Hong Kong children.

Instruments of pubertal development

Chan et al¹⁶³ examined the reliability of pubertal self-assessment (Tanner stages self-assessment questionnaire) using gender-specific line drawings with brief Chinese explanatory text in Hong Kong children. Participants were 172 boys and 182 girls, aged between 8 and 18 years, from one primary and two secondary schools. The results showed that most children were capable of identifying their own sexual maturation status accurately or close to the rater's assessments, but girls tended to overestimate their breast stages and boys tended to underestimate their genitalia development. Overall, this study confirmed that a Tanner pubertal self-assessment questionnaire with line drawings and explanatory Chinese text could reliably estimate sexual maturation status in Hong Kong Chinese children. Using the same database in a 2008 study, Chan et al¹⁶⁴ validated the reliability of a Chinese version of the self-reported Pubertal Development Scale against raters' sexual maturation status assessment of the Hong Kong children. The findings demonstrated that there were moderate to substantial correlations between raters' assessment and children's self-reported Pubertal Development Scale, and the agreements between raters' Tanner-derived composite stage and children's pubertal category score were moderately high.

Summary

Secular growth of Hong Kong children have been observed by several investigators over the past 15 years. Changes were noted between 1963–1993 and 1993–2005/2006. Norms for the WC and WHtR were developed. For adolescents, puberty is an important and critical change, and their awareness of puberty, and body and behavior changes should be closely monitored and investigated.

Summary of major findings

An earlier review of the health fitness studies conducted in Hong Kong residents during 1984–2004 presented findings from 117 articles. During the past 7 years, 164 articles were found, representing a fourfold increase in the rate of research output in this area. While the development of sports for the elite athletes, as reflected by the achievements of Hong Kong athletes in international competitions, was outstanding (such as winning a total of 14 gold, 27 silver, and 27 bronze medals in the 2006 and 2010 Asia Games), the development of sports for all, as indicated by various health fitness parameters of the local residents, continued to decline. For example, the physical fitness levels of all age cohorts were declining, and more than

60% of the population did not exercise even for 30 minutes per week or walk 8000 steps a day. Various interventions have been conducted, but their long-term results were not encouraging. The prevalence of obesity was also on the rise, reaching 20% for the youth and 22% for the entire population in 2011. It was observed that an increase in the prevalence of the cardiovascular risk factors among the Hong Kong residents was thus inevitable. Therefore, continuous monitoring and modification of metabolic and behavioral risk factors were recommended. The data on secular growth reinforced the effects of increased affluence and increased consumption of food as well as protein and fat in the diet. The review on the study of lifestyle revealed that some researchers were adopting a multifactorial and multibehavioral approach to better understand and modify the lifestyle management. Target populations and age cohorts were identified, and specific recommendations were made for them to acquire better lifestyle management practices. It is also encouraging to note the increase in the quantity and quality of research publications during the past 27 years in Hong Kong, as reflected by over 270 international refereed publications. Findings from local research can also contribute to the attainment of quality of life for residents in other international cities of developing countries. It would be desirable to conduct more comparative studies in this area so that we can learn and work with one another in the years ahead.

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