

Case study for the People's Republic of China

Table 8 summarizes the health cost data used for the PRC, including prevalence rates (e.g., for overweight and obesity, hypertension, LBW, and stunting), and mortality rates from cancers, CVD, and stroke, as well as from all causes. Crude, rather than age-specific, mortality rates were used, because age-specific RR data have not been developed for Asia. However, some age-specific mortality data are available. The available projections for 2020 [47] are age-specific. Analyses are presented for 1995, and projections for 2025, when shifts in diet, obesity, and disease profiles will increase health costs considerably. The projections to 2025 were made because investments for the prevention of diet-related NCDs face a long interval before economic benefits are obtained. For example, an investment in reducing LBW might not affect adult hypertension or adult-onset diabetes for 20 to 50 years.

For the 2025 mortality rates predicted for the PRC, baseline predictions for 2020 [47] were used. These show very large increases in death rates for diet-related chronic diseases, consistent with the predictions made here for dietary patterns, obesity, and hypertension. Predictions relating hypertension and intake of saturated fats assume that rural areas will catch up with current rates of increase in urban areas, and that there will be modest increases in fat intake in urban areas. These trends are now being observed in developed countries.

It was assumed, based on consumption data from the PRC Health and Nutrition Surveys [32], that fruit and vegetable intake will not increase markedly by 2025. In the 1991 CHNS survey, which obtained 3-day sets of dietary data on 7,450 adults in eight provinces, only 20% of those sampled consumed the recommended amount of 500 to 700 g/day of fruits and vegetables. The Nutrition Society of China has established 500 to 700 g/day of fruits and vegetables as the level recommended as protective against chronic diseases [86].

Trends in overweight and projected proportions of overweight are important for economic analyses. Recent data for the PRC show a major shift in the

proportion of the population that is overweight. For example, a study in eight provinces [87] found that 6.2% of men and 11.2% of women had BMIs of 25 or above in 1989. By 1997 this had increased to 17.3% in men and to 20.7% in women. The results were almost identical when a cohort was followed for eight years. The sample sizes were 2,403 men and women in 1989 and 4,049 in 1997. This result is consistent with an acceleration in the level of consumption toward increased consumption of meat (mostly pork), edible oil, and other sources of fat in the diets of these same adults [31].

There is no simple way to use this information to predict obesity in the PRC in 2025, but there is no reason to believe that the 1989 to 1997 rate of increase will not be matched. However, a more conservative view was taken here. If this documented rate of increase were to continue, an additional 1.39 % of Chinese men would become overweight each year: a cumulative increase of 39% from 1997 to 2025. For women, the corresponding increases would be 1.35% and 38%. It was assumed, conservatively, that male and female overweight in the PRC would increase at only half this rate. This suggests that an additional 19.5% of men and 19.0% of women will be overweight in the PRC in 2025, i.e., totals of 36.8% of men and 39.7% of women.

Hospital costs in the PRC account for most health system costs, because most health care is provided through outpatients visits to doctors at hospitals, and through hospital stays as inpatients. Hospital doctors also prescribe the drugs required and these are sold at hospital pharmacies. No data are available for medical expenditures other than those for doctors and hospitals. In the 1980s, the pharmaceutical sector outside hospitals was small, but there is evidence that this has grown rapidly. According to a recent estimate (G. Henderson, personal communication, 2000) it accounts for as much as 15% of drug expenditures: more in large cities, less in rural areas.

Some of the costs of chronic diseases in the PRC are summarized in tables 9 and 10. The human costs

TABLE 8. Data and assumptions for calculating the costs of diet-related chronic diseases in the People's Republic of China in 1995, and projections for 2025

Data category	1995	2025
Nutrition and diet-related factors		
Overweight and obesity, men	8.1% ^a	36.8% ^a
Overweight and obesity, women	12.2% ^a	39.7% ^a
Saturated fat intake	7.0% ^b	12.7% ^b
Fruit and vegetable intake (g/day per capita)	235	232
Low birthweight (LBW)	27% ^c	9% ^d
Stunting	45% ^e	24% ^f
Morbidity by cause		
Hypertension, men	19.1% ^a	25% ^a
Hypertension, women	18.2% ^a	25% ^a
Diabetes	1.4% ^a	2.4% ^a
Mortality by cause (per 10,000; men and women combined)		
Ischemic heart disease (IHD)	29.61	93.4
Stroke	90.20	155.8
Diabetes	6.24	
Cancers	90.58	243.9
All causes	520.43	948.8
Other variables		
Total population (million)	1,188	1,547
Rural population	70% ^a	45% ^a

Sources: overweight and obesity [84]; diet and stunting, China Health and Nutrition Surveys, 1989–97 http://www.cpc.unc.edu/projects/china/china_home.html; LBW [85]; morbidity and mortality, Chinese Academy of Preventive Medicine. The cost of diet-related noncommunicable disease in China: Beijing (draft manuscript for the Asian Development Bank, Manila, 2000); population, gopher://gopher.undp.org:70/00/ungophers/popin/wdtrends/urban

a. Percentage of total adult population.

b. Percentage of diet, by weight.

c. Percentage of all births in 1965.

d. Percentage of all live births, 1995 actual figures.

e. Percentage of all live births.

f. Percentage of children 5 and under

Bases for predictions: overweight, projections using trend lines; saturated fat intake, current intake, supplemented by estimates of the authors that production will increase by 2.8% per year, assuming that fat intake in rural areas will rise to current urban levels, and that fat intake in urban areas will increase to the rates seen in the United States in the 1960s; fruit and vegetable intake, extrapolation from current trends, assuming that the current decline will stabilize; hypertension, assuming that rural rates will catch up with urban rates, but that urban rates will not rise further since Asian levels are already high relative to developed countries; mortality, [47], using 2020 baseline data; population, see above; LBW and stunting, levels 30 years previously (to estimate the childhood conditions of current adults), i.e., actual 1995 levels are used for 2025, and estimated 1965 levels are used for 1995.

are very large. Diet-related chronic diseases account for 2.57 million deaths annually, 41.6% of all deaths. Stroke causes one in five of these deaths. Hypertension rates are high and are not far behind US rates, whereas obesity and saturated fat consumption are lower. Deaths from diet-related chronic diseases in the PRC are predicted to rise dramatically to 7.63 million total deaths in 2025, 52.0% of all deaths. Cancers alone will account for more than a quarter of all deaths in that year.

The economic costs of diet-related chronic diseases are very large (tables 9–11). Total hospital spending in 1998 on diet-related chronic diseases was estimated as US\$11.74 billion. This represents 1.6% of GDP, and

22.6% of all hospital expenditures. Hospital expenditures include nearly all health system spending, as discussed above. Hospital stays for these chronic diseases are expensive. The average hospital stay in the PRC for all treatments, from combined data for urban and rural areas for 1998, cost US\$300 and lasted 16 days, compared to over US\$500 and 20 to 30 days for diet-related chronic diseases.

These diseases also have large economic costs in terms of lost productivity due to premature deaths. If each adult death from these diseases causes, on average, 10 years of lost productivity, then the GDP lost, in present value terms, is US\$2,210: assuming 1995 wages at US\$300 per year; real growth of wages at 3%

TABLE 9. Costs of diet-related chronic diseases in 1995, and projected adult deaths from these diseases in 2025, in the People's Republic of China

1995 estimates	
Number of adult deaths	2.57 million (41.6% of all deaths)
Hospital costs	US\$11.74 billion (22.6% of all hospital costs; 1.6% of GDP)
Productivity losses due to premature death	US\$3.41 billion (0.5% of GDP)
Total cost	US\$17.50 billion (about 2.1% of GDP)
2025 prediction	
Number of adult deaths	7.63 million (52.0% of all deaths)

Source: Authors' calculations, based on tables 8 and 10.
US\$1.00 = 8.09 yuan; GDP = gross domestic product.

TABLE 10. 1998 hospital costs and 1995 human costs, in terms of rural and urban mortality rates, for major diet-related chronic diseases (cancers, ischemic heart disease, hypertension, and stroke) in the People's Republic of China

Condition	1998 hospital costs (million yuan)	1995 mortality rates per 100,000 persons		
	Total	Rural	Urban	Total
Cancers	14,838	82.83	106.33	90.58
Diabetes	6,954	3.78	11.97	6.24
Ischemic heart disease	33,800	23.09	44.83	29.61
Hypertension	15,695	—	—	—
Stroke	23,699	87.03	106.33	90.20
Major diet-related	94,986	196.73	269.46	216.63
All causes	419,678	532.50	492.25	520.43

Source: 1998, Chinese Academy of Preventive Medicine. The cost of diet-related noncommunicable disease in China, Beijing (draft manuscript for the Asian Development Bank, Manila, 2000), using China National Health Services Survey (1998).

Notes: Costs for 1998 are based on the number of outpatient visits per 1,000 persons, multiplied by average cost per visit, plus number of inpatient admissions per 1,000 persons, multiplied by average cost per hospital stay. Cost data are presented by disease category, see table 11. US\$1.00 = 8.09 yuan.

per year, and a 12% discount rate. There is, of course, the issue of labor surplus. Underemployment and unemployment exist in many developing countries and are increasing in the PRC. However, the US\$300 per year figure assumed here for average wages is very modest for a country with a 1995 per capita income of more than twice that level. Therefore, the estimate here of productivity loss from these chronic diseases is conservative. Assuming that about 60% of those over 18 are active in the labor market, then annual losses from these chronic diseases are US\$3.41 billion due to premature deaths, i.e., about 0.5% of GDP. Diet-related chronic diseases in the PRC have total annual costs of about 2.1% of GDP, in terms of lost productivity due to premature deaths and to hospital costs. Hospital costs account for three quarters of this loss.

There are no data available for loss of work output for patients who survived or for lowered work rates in general from diet-related chronic diseases, including lost productivity from persons who are debilitated and

being treated as outpatients or not being treated at all. For Tianjin, the data available include lost wages, and the costs per patient hospitalized for stroke and heart attack.* These costs are about twice as high as the costs of hospitalization at city hospitals in table 11. This implies that the losses of work output due to morbidity are similar to those from mortality, and that the estimate here of 2.1% GDP loss is only about 60% of the total cost.

How much of the chronic disease in the PRC can be traced back to dietary causes? Detailed calculations in table 12 lay out population attributable risks (PARs) for adult diet and health factors, and five chronic conditions, based on the pathways identified in figures 25 to 28.

* Tian H. Chronic disease intervention project cost-effectiveness evaluation from 1991–96 in Tianjin city. Tianjin, PRC: Tianjin Municipal-Academic Station, September 1999 (mimeo.) (In Chinese).

TABLE 11. 1998 hospital costs and related data for chronic diseases in the People's Republic of China

Disease	Category	Prevalence ^a (1/1000)	Inpatient visits per 1,000 population per year	Out-patient visits during last two weeks prior to survey per 1,000 population	Average cost (yuan) for one out- patient visit	Average length of individual stay (days)	Average cost (yuan) per inpatient	Average cost (yuan) of outpatient per 1,000 population per year	Average cost (yuan) of inpatient stay per 1,000 population per year	Average cost (yuan) for outpatient visits and inpatient stays per 1,000 population per year
Cancers	All hospitals	1.2	0.8	0.8	326	31	8,172	6,361	6,129	12,490
	City hospital	2.3	1.5	1.4	376	39	11,894	13,288	17,841	31,129
	Rural hospitals	0.8	0.5	0.6	281	25	5,092	4,018	2,546	6,564
Diabetes	All hospitals	3.2	0.4	1.1	152	26	3,950	4,274	1,580	5,854
	City hospital	9.8	1.2	3.0	184	28	4,161	14,519	5,035	19,554
	Rural hospitals	0.9	0.1	1.4	71	17	3,213	2,629	321	2,950
Heart disease	All hospitals	14.2	2.3	6.6	117	21	3,626	20,112	8,340	28,451
	City hospital	34.5	5.0	11.4	175	26	5,214	51,767	26,070	77,837
	Rural hospitals	7.4	1.4	5.0	71	16	1,754	9,167	2,456	11,623
Hypertension	All hospitals	15.8	0.8	5.3	81	19	2,819	11,098	2,114	13,212
	City hospital	39.3	1.8	10.1	122	21	3,406	31,990	6,165	38,155
	Rural hospitals	7.9	0.4	3.6	42	15	1,933	3,914	773	4,687
Stroke	All hospitals	5.9	1.7	3.1	146	30	4,728	11,911	8,038	19,949
	City hospital	13.1	4.2	6.7	163	33	5,377	28,208	22,583	50,791
	Rural hospitals	3.4	0.9	2.0	123	25	3,715	6,278	3,158	9,436
All Diseases	All hospitals	157.5	35.4	163.9	63	16	2,384	268,894	84,370	353,264
	City hospital	273.3	48.3	161.9	119	23	4,037	499,235	194,947	694,181
	Rural hospitals	118.4	31.0	164.6	45	13	1,532	191,298	47,538	238,836

Source: Chinese Academy of Preventive Medicine. The cost of diet-related noncommunicable disease in China, Beijing (draft manuscript for the Asian Development Bank, Manila, 2000) using National Health Services Survey 1998.

a. Prevalence data are from self-reporting of particular chronic diseases. US\$1.00 = 8.09 yuan

TABLE 12. Pathways for calculation of population attributable risks (PARs) of dietary effects on chronic diseases for application to existing 1995 data (and projections, to 2025) in the People's Republic of China

Contribution of	To	PAR direct effect (%)	PAR indirect effect (%)	Pathways for indirect effects
Childhood dietary effects				
Stunting	Overweight	55.6 (41.9)	NA	NA
LBW	Hypertension	44.8 (10.5)	NA	NA
LBW	Diabetes	33.9 (14.6)	NA	NA
Effects on CVD				
Animal fat intake	CVD	14.9 (28.3)	NA	NA
Overweight	CVD	12.2 (32.2)	NA	NA
Hypertension	CVD	20.6 (24.5)	NA	NA
Diabetes	CVD	6.5 (10.7)	NA	NA
Stunting	CVD	N/A	6.8 (13.5)	Via overweight
LBW	CVD	N/A	9.2 (2.6)	Via hypertension
LBW	CVD	N/A	2.2 (0.3)	Via diabetes
Effects on stroke				
Hypertension	Stroke	25.2 (24.5)	—	—
Diabetes	Stroke	2.1 (10.7)	—	—
Overweight	Stroke	—	6.0 (13.1)	Via hypertension
Stunting	Stroke	—	3.4 (5.5)	Via overweight and hypertension
LBW	Stroke	—	11.3 (2.6)	Via hypertension
LBW	Stroke	—	0.7 (1.6)	Via diabetes
Effects on hypertension				
Overweight	Hypertension	24.0 (53.3)	—	—
LBW	Hypertension	44.8 (10.5)	—	—
Stunting	Hypertension	—	13.3 (22.3)	Via overweight
Effects on diabetes				
LBW	Diabetes	33.9 (14.6)	—	—
Overweight	Diabetes	22.7 (33.1)	—	—
Stunting	Diabetes	—	12.6 (22.0)	Via overweight
Effects on cancers ^a				
Fruit and vegetable intake	Cancers	22.7	—	—

Source: data from tables 1–11 and figures 1–9; calculations by the authors.

a. Relative risk data for cancers may not take into account fully the observed large fruit and vegetable deficiency, relative to recommended levels, in the People's Republic of China, and hence the PAR above is tentative. For comparison, the desired/recommended levels of nutrition-related variables are as follows: LBW, 0%; stunting 0%; hypertension 0%; fruit and vegetable intake, 700 g/day (recommended in the People's Republic of China; [86]). Animal intake, 8 to 10% of dietary calories; overweight, 0%; CVD = cardiovascular disease; LBW = low birthweight; NA = not applicable; PAR = population attributable risk.

These conditions are also traced back to childhood stunting and LBW as appropriate. The most important pathways are summarized in table 13 for 1995 and in table 14 for 2025. Because of concerns about overlaps between different pathways, the single most important pathway for each condition was chosen. Where the most important factor is hypertension, the PAR for overweight is also presented. Hence the results are a minimum estimate of the effects of diet. In the PRC in 1995, dietary factors accounted for between one-fifth and one-quarter of each of these chronic diseases.

If these adult conditions are traceable back to childhood factors, then the most important cause of diet-related chronic diseases in adults is currently LBW. However, there is a lack of good data for LBWs of the current adult population. A conservative estimate was

used, assuming that the incidence of LBW in 1965 was three times what it is now. It was also assumed, based on current trends in the PRC, that stunting has decreased more slowly than LBW, and has fallen from around 45% 30 years ago or earlier, to 24% currently. This is consistent with improvements in women's BMIs, which affect birthweights, and with slower improvements in the complementary feeding of infants, which affects stunting. In the PRC in 1995, LBW accounted for at least 10% of stroke and CVD, a third of diabetes, and almost half of hypertension, according to our calculations. One way to test this would be to examine location-specific patterns of diet-related chronic diseases and to compare these with what is known about variation in birthweight. Another way to test this would be to look at morbidity and

TABLE 13. Estimated contributions of diet-related and childhood factors to chronic diseases in the People's Republic of China in 1995

Diseases	Key factor	PAR (share of condition attributable to this diet factor)
Diet-related factors		
Cancers	Fruit and vegetable intake	22.7% ^a
CVD	Hypertension	20.6%
CVD	Overweight	12.2%
Diabetes	Overweight	22.7%
Stroke	Hypertension	25.2%
Stroke	Overweight	6.0%
Hypertension	Overweight	24.0%
Childhood factors		
CVD	LBW	9.2% (via hypertension)
Stroke	LBW	11.3% (via hypertension)
Diabetes	LBW	33.9% (direct effect)
Hypertension	LBW	44.8% (direct effect)

Source: based on table 12.

a. Estimates for cancers are from ref. 40 and represent the proportion of all cancers deaths preventable by changes in diet, exercise, and alcohol consumption. This represents an average from all cancers. Some cancers are more preventable by diet than others, especially by fruit and vegetable intake.

This table picks out the most important diet-related pathways for each of the outcomes. If overlap between different pathways is not 100%, then these are underestimates of dietary effects on chronic diseases.

CVD = cardiovascular disease; LBW = low birthweight; PAR = population attributable risk.

mortality due to diet-related chronic diseases in rural migrants to urban areas.

Significant changes in morbidity and mortality patterns are predicted for the PRC in 2025 (table 8). Hypertension rates will not increase much beyond the already very high rates in urban areas. LBW, an important source of higher risk of hypertension will decrease. Overweight and obesity, also associated with increased hypertension, will increase quite sharply. Overweight and obesity will become the main underlying factor for CVD, diabetes, and hypertension. Hypertension will remain the most important underlying factor for stroke. Overweight and obesity will account for a third of CVD and of diabetes, and more than half of all hypertension by 2025. In other words, the importance of diet in chronic diseases will intensify.

In early life, childhood stunting is predicted to become the main risk factor, accounting for between 5% and 22% of CVD, diabetes, hypertension, and stroke. Childhood factors have yet not been studied

TABLE 14. Projected contributions of diet-related and childhood factors to chronic diseases in the People's Republic of China in 2025

Diseases	Key factor	PAR (share of condition attributable to this diet factor)
Diet-related factors		
Cancers	Fruit and vegetable intake	22.7% ^a
CVD	Saturated fat	28.30%
CVD	Overweight	32.3%
Diabetes	Overweight	33.1%
Stroke	Hypertension	24.53%
Stroke	Overweight	13.1%
Hypertension	Overweight	53.3%
Childhood factors		
CVD	Stunting	13.5% (via overweight)
Stroke	Stunting	5.5% (via overweight)
Diabetes	Stunting	13.8% (via overweight)
Hypertension	Stunting	22.3% (via overweight)

Source: based on table 12.

a. Estimates for cancers are from ref. 40. They represent the proportion of all cancers deaths preventable by changes in diet, exercise and alcohol consumption. This represents an average from all cancers. Some cancers are more preventable by diet than others, especially by fruit and vegetable intake.

This table picks out the most important diet-related pathways for each of the outcomes. If overlap between different pathways is not 100%, then these are underestimates of dietary effects on chronic diseases.

CVD = cardiovascular disease; LBW = low birthweight; PAR = population attributable risk.

for cancers in later life. This importance of stunting is related to the much reduced level of incidence of LBW in 1995 as compared to 30 years earlier. Stunting also reduced over this period but its decline was smaller than that of LBW. Stunting in the PRC has proved more resistant to improvement than LBW, possibly because of inadequacies in infant feeding patterns.

The differences between the major pathways are shown in figure 29 for 1995, and in figure 30 for 2025. It is striking to note how the priority pathways shift from LBW-hypertension, to stunting-overweight. This change in pathways has cost implications. It is not possible to predict hospital expenditures in 2025, but it is clear from the 1995 data that CVD costs about four times as much as stroke, in relation to the number of deaths caused.

When total expenditure on CVD is divided by the number of deaths from CVD, and compared with total expenditure on stroke divided by the number of deaths from stroke, CVD expenses are three times higher per

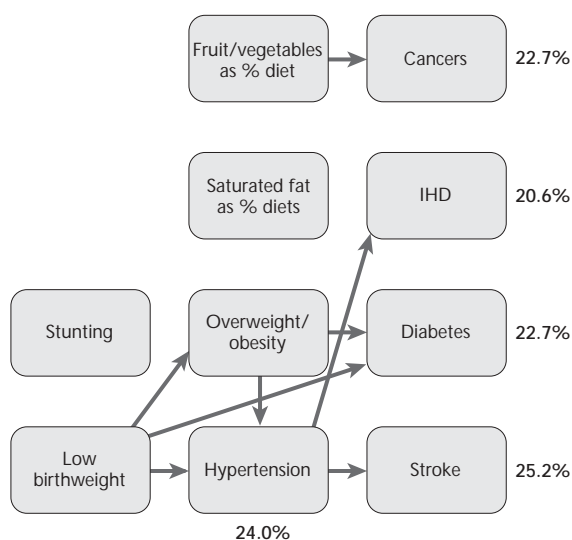


FIG. 29. Main pathways for dietary effects on chronic diseases in the People's Republic of China, 1995. Notes: Percentages next to boxes indicate the estimated minimum contribution of key dietary factors to each disease condition; IHD = ischemic heart disease

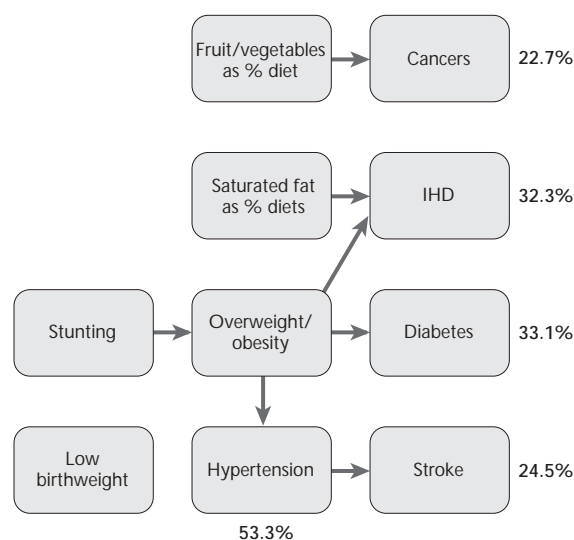


FIG. 30. Main pathways for dietary effects on chronic diseases, in the People's Republic of China, projected for 2025. Notes: Percentages next to boxes indicate the estimated minimum contribution of key diet factors to each disease condition; IHD = ischemic heart disease

death, even if hypertension expenditures are added to stroke expenditures. Thus the large predicted increase in CVD is going to increase health costs seriously. Improvements in patterns of care for CVD and stroke, decreasing the length of hospital stays, would moderate this increase in costs. Moreover, as these diseases and related patterns of care become more common, improved technology and disease management might reduce costs per person. On the other hand, the PRC to date imports very little technology. A push to open its markets to new medical technology could drastically increase the costs of medical care.

It is more difficult to predict the effect of increased cancers on hospital costs in 2025. Cancer expenditures are currently the lowest per death of the three major conditions. However, cancer treatment is still relatively new in the PRC. Many cancers are diagnosed there relatively late in relation to possibilities of treatment. It is quite likely that cancer care will become increasingly resource-intensive by 2025. Estimates by the World Cancer Research Fund (WCRF) researchers [88] are that cancer treatment expenditures will increase by a factor of 25 in developing countries by 2025.

It is typically more expensive and more difficult to intervene to reduce overweight than to reduce hypertension. Although medical 'quick fixes' are not necessarily desirable, there are modestly priced drugs, such as diuretics, for controlling hypertension. Drugs to treat CVD are also available, but are more expensive. There are, however, few proven, cost-effective interventions to reduce overweight.

In order to reduce mortality and morbidity from diet-related chronic diseases, and to reduce associated costs, it is important that the PRC begins to invest in policies to avert the above predictions for 2025. Findings here suggest three priorities. First, (as a 'quick fix') it is important to monitor the population for hypertension, particularly in urban areas and particularly for those aged 40 and above, i.e., the age groups when mortality from CVD and stroke become significant. Those identified with hypertension are candidates for treatment, usually through drugs (the 'quick fix' mentioned above) but also through modifications to behavior and diet. Second, there is a good case for the continuation of efforts to reduce stunting. Stunting has potentially deadly consequences, when combined with more affluent diets in later life. Third, it will be important to devote more resources to those age groups for whom diet modification and establishing healthy exercise patterns are possible. Current evidence suggests that the right time to intervene is in early life, before poor diet and activity patterns become habitual. To wait until chronic diseases become clinically evident, at late stages in the disease process, is cost-ineffective and very expensive in terms of treatment options.

Physical exercise is currently given much lower priority than academic studies in schools in the PRC, because of strong academic competition. Schoolchildren spend increasing proportions of their time on extra lessons outside school. This reduces the time available for physical activity.

The data presented in this review underscore the public health importance of diet-related chronic diseases in the PRC. It is suggested that diet currently is responsible for about 20% of diet-related chronic diseases and that this figure which will rise to between 25% and 45% by 2025, varying among different diseases. The 1995 costs of this problem are estimated conservatively as 2.4% of GDP, a figure which is expected to climb substantially by 2025.