

NATIONAL NUTRITION STRATEGY

**Strategic Study
2014 – 2050**

**Department of Nutrition
Ministry of Health
Sultanate of Oman**

**Prepared by:
Dr. Samia Al-Ghannami
Dr. Stephen J. Atwood
May 2014**

National Nutrition Strategy

Strategic Study 2014 – 2050

Table of Contents

Glossary	4
Executive Summary	6
Background:	9
Oman in the Region	9
Public Nutrition and the multisectoral model.....	12
Global changes in understanding of the importance of public nutrition	13
Pre-pregnancy Origins: the importance of women's health and the life-cycle.....	15
Post-natal causes: the role of food and health	15
Situation analysis	16
Status of women's nutrition.....	16
Women's health and undernutrition – anemia, BMI.....	16
Women's over-nutrition – metabolic syndrome, overweight and obesity	16
Status of children's nutrition	18
Child undernutrition – underweight, wasting, stunting.....	18
Children's undernutrition: low birth weight	20
Children's over-nutrition	22
Status of factors affecting nutrition specific causes (direct)	22
Infant and Young Child feeding	22
Dietary quality and diversity.....	23
Adolescent nutrition and adolescent pregnancies.....	24
Status of factors affecting nutrition sensitive causes (indirect)	25
Fertility rates and birth spacing.....	25
The urban environment.....	26
Educational completion rates	26
Water quality and quantity	27
Food security and food self-sufficiency	27
Physical activity and active living.....	28
On-going programs and interventions.....	30
Supplementation and Fortification Programs	30
Supplementation programs	30

Food fortification programs.....	30
Baby Friendly Hospital Initiative.....	31
Infant and Young Child Nutrition.....	32
Programs for women	32
Focus on women: pregnant and non-pregnant	32
Reaching Women: The rationale for multi-sectoral involvement.....	33
SWOT analysis of Oman nutrition program	33
The Vision for 2050	34
Main Goals for 2050 and Strategies	34
Implementation arrangements and the way forward	36
Development of a multisectoral approach	37
Establishment of a public nutrition knowledge base.....	37
Improving public nutrition capacity:	38
Conclusion.....	39
Annex 1: Output from <i>Partners for Public Nutrition</i>: opportunities for multi-sectorality	40
Partners for Public Nutrition: Education	40
Partners for Public Nutrition: Commerce & Industry.....	42
Partners for Public Nutrition: Social Development.....	43
Partners for Public Nutrition: Regional Municipalities and Water Resources	44
Partners for Public Nutrition: Agriculture	45
Partners for Public Nutrition: Consumer Protection Authority.....	46
Partners for Public Nutrition: Supreme Council for Planning	47
Partners for Public Nutrition: Academia.....	48
Partnership for Public Nutrition: Health	49
References	50

Glossary

The definitions below are derived from *Repositioning Nutrition as Central to Development* (World Bank 2006). The definitions of BMI are taken from the CDC¹.

Malnutrition: A term that includes all forms of “bad” nutrition, including underweight, stunting, overweight and obesity. The term *undernutrition* is therefore increasingly used to designate malnutrition that is due to a lack of food or nutrients. (Sometimes the term *malnutrition* is still used as an equivalent of *undernutrition*.) There are several forms of malnutrition:

Chronic undernutrition (or stunting): Failure to reach linear growth potential because of inadequate prenatal and postnatal nutrition or poor health. Chronic undernutrition implies long-term undernutrition and poor health and is measured as height-for-age that is two z-scores below the international reference. For children under 12 months, recumbent length is used instead of height.

Acute malnutrition (or wasting): Weight (in B) divided by height (in meters squared) that is two z-scores below the international reference. Acute malnutrition describes a recent or current severe process leading to significant weight loss, usually a consequence of acute starvation or severe disease. It is commonly used as an indicator of undernutrition among children and is especially useful in emergency situations where food supplies are compromised.

Underweight: Low weight for age, i.e., two z-scores below the international reference for weight for age. Underweight implies stunting or wasting and is an indicator of undernutrition.

Overweight: Excess weight relative to height. Overweight is commonly measured by body mass index (BMI) among adults. A BMI > 25 indicates overweight, BMI > 30 indicates obesity

Body Mass Index: defined as a person’s body mass (in Kg) divided by the square of their height (in meters.) The formula used for BMI = Mass (kg)/ (Height (m))² Although an indirect measure, BMI is used to measure body fat. As such it can be used to measure underweight as well as overweight; BMI < 18.5 indicates underweight. These values are for adults. There are charts that indicate different cut-off points for over and underweight for children and growing adolescents.

¹ See http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html#Definition accessed 12 May 2013

Nutrition Specific interventions are those that lead directly to an improvement in nutritional status (e.g., breastfeeding, vitamin and mineral supplements, reduction of diseases, etc.).

Nutrition Sensitive interventions are those that had indirect effect on nutritional status by impacting on underlying and basic causes of undernutrition (e.g., keeping girls in school through secondary years to avoid adolescent pregnancies, improvements in personal and environmental hygiene through water and sanitation initiatives, etc.).

Clinical Nutrition and Dietetics is the branch of nutrition associated with health care services of individuals; usually conducted in an institution; includes food science and research. Is to public health nutrition as clinical medicine is to public health.

Public Health Nutrition administers the nutrition component of public health services focusing on population health; usually conducted within the health service as well as within the community

Public Nutrition has a remit broader than health; tends to deal with upstream multi-sectoral influences on nutritional status; usually more involved with nutrition sensitive interventions than public health nutrition, which would be more involved with nutrition specific interventions.

Executive Summary

Oman has experienced remarkable development over the past 35 years. Between 1970 and 2005, Oman's per-capita GDP rose 30-fold, the population surged from 732,000 in 1970 to 3.8 million in 2013, the Total Fertility Rate (by UN Estimates) dropped from 7.41 to 3.7, and life expectancy at birth rose from 51 years to 76.2 years in 2011. The increase in life expectancy and drop in fertility were both cause and effect of a drop in under five year old children (U5MR) from 35 deaths of under-five year olds per 1000 live births in 1990, to 21.7 in 2000, and 11.9 in 2011. Indicators of undernutrition also improved with reduction in underweight, and stunting. Food fortification programs (most notably iodine fortified salt) have significantly improved micronutrient status in the population. Not all of these benefits have been equitably distributed. There remain areas in the country where stunting remains a problem (e.g., stunting rates in Wusta are 21%) and in pregnant and non-pregnant women where anemia is still a concern.

All of these remarkable advances have not been without their price. New affluence throughout the country has contributed to a more sedentary life style; water scarcity has prevented the full development of food sovereignty and led to importation of the 85% of foods, rendering the country vulnerable to fluctuations in food prices, and to the often poor quality of commercially processed, energy dense high calorie foods. The result of this and a history of low birth weight has been a rapidly increasing problem of overweight and obesity in adults, and a growing epidemic of non-communicable diseases, particularly Type 2 diabetes, kidney and heart diseases: 38.2% of adults are overweight, 33.5% obese in a 2012 study, 62.5% had an elevated waist circumference as evidence of the metabolic syndrome with 40 % having hypercholesterolemia. Exercise is minimal; the environment does not support active living.

The development of these problems is traced back to pre-natal and post-natal periods. Prenatal origins implicate the first half (particularly the first trimester) of pregnancy during the fetal growth spurt; a period of time where brain development is also vulnerable. Postnatal causes are identified as excessive diets of calorie-dense foods rich with fats and carbohydrates and low physical activity beyond the age of two years in children, adolescents, and adults.

Considerable attention is spent in examining both factors, and on solving problems of reaching women before they become pregnant, supporting them nutritionally throughout pregnancy and lactation, and in modifying behavior and diet in children, adolescents and adults, particularly activities that improve physical fitness and exercise. In each of these instances, it is obvious that one sector alone will not be able to correct the problem. This is truly a multi-sectoral issue that will require coordination and cooperation between many sectors.

An area of concern is food self-sufficiency and the availability of locally grown, non-processed foods, particularly as these relate to dietary diversity that is so important for reducing the saturated fat and refined sugars that are a part of most food imports. It is a difficult problem as most freshwater in the country is already being used for agriculture

and there is little room for expansion. Yet models now exist of rural and urban home gardens based on new water and nutrient efficient systems that are capable of delivering inexpensive organically grown vegetables at the local level that have the potential to improve dietary diversity¹².

A situational analysis of the status of women and children's under and overnutrition is presented, followed by an status of factors affecting nutrition specific and nutrition sensitive causes of malnutrition. There is an update of significant on-going programs including food supplementation and fortification programs, the Baby Friendly Hospital initiative and its impact on exclusive breastfeeding, other interventions associated with infant and young child feeding, and programs with major impact on women's nutrition before, during and after pregnancy. This analytical section finishes with a SWOT analysis of the national nutrition program.

In looking ahead to 2050, a vision is presented of *An equitable, environmentally sustainable and increasingly self-sufficient Oman, with a population physically fit and well-nourished at all ages committed to an active life style and balanced diet that secures women's nutrition throughout the life-cycle, making it a regional model of health and well being.*

The Goals that must be achieved to realize this vision are spelled out for three domains (i.e., health and nutrition, food security and quality, and physical fitness through active living) each representing a different causal pathway to the major nutritional problems of the country: stunting, anemia, overweight and obesity. Each Goal is followed by a strategic approach.

Health and Nutrition:

1. Reduce the prevalence of overweight and obesity to < 5% of the population through exercise and a balanced diet of fresh vegetables and fruits.
2. Reduce levels of stunting and low birth weight to < 3% of the population through improvement of all women's health and nutrition before, during and after pregnancy, and emphasis on .
3. Raise exclusive breastfeeding rates at 6 months to >90% to improve nutritional and cognitive potential of children.
4. Reduce anemia and all micronutrient deficiencies through consumption of appropriate micronutrient rich foods.

Food security and quality:

1. Increase diet of non-obesogenic fresh fruits and vegetables by reducing importation of cardiotoxic processed, high-density foods to <30% of all intake through cooperative agreements with regional suppliers, and increased regulation and import tariffs on non-healthy foods.
2. Increase local food self-sufficiency and dietary diversity through organically grown vegetables and fruits by introducing high-tech (i.e., nutrient and water efficient) rural and urban gardens in 80% of all households.

Physical fitness through active living:

1. Improve physical fitness of the population at all ages through measures to increase active living to 1 hour / day of aerobic heart-friendly exercise (i.e., walking, jogging, bicycling, gardening).
2. Create urban green-spaces and pedestrian transport routes (e.g., biking, walking, jogging paths) in all cities that are pedestrian friendly and open for safe exercise and intra-city travel throughout the day and night.

The Goals tell *what* needs to be achieved to realize the Vision; the following section gives three broadly defined Implementation Arrangements for *how* to set the process in motion; each an essential step that ultimately lead to the goals, and from there to the Vision. The Arrangements are not in a specific order since they must be done simultaneously: (i) developing a multisectoral approach, (ii) establishing an enhanced public nutrition knowledge base, and (iii) improving national and local capacity in public nutrition. While not being prescriptive, these indicate the direction the government should take for the way forward.

The Annex has the multi-sectoral output from a recent workshop on multisectoral planning for a nutrition strategy: *Partners for Public Nutrition* held on 5-6 March 2014 in Muscat, under the auspices of the Department of Nutrition, Ministry of Health.

Background:

Oman in the Region

Between 1970 and 2005, Oman's per-capita GDP rose 30-fold from 158 Omani Rials (OMR) to 8,289 OMR bringing with it all the promises of modern civilizations. That 35-year span marked a period of remarkable growth and changes in Omani society accompanied by transitions in demography, epidemiology, and nutrition.

Demographically, the population grew from 732,000 in 1970 to 3.8 million in 2013. Over the same period, the Total Fertility Rate (by UN Estimates) dropped from 7.41 to 3.7, and life expectancy at birth rose from 51 years in 1970 to 76.2 years in 2011. The increase in life expectancy and the drop in fertility were in large part the result of significant reductions in mortality rates of under five year old children (U5MR) from 35 deaths of under-five year olds per 1000 live births in 1990, to 21.7 in 2000, and 11.9 in 2011. The demographic profile of the country changed as well with the change in life expectancy. In 1970, 46.4% of the population was under the age of 15 years; in 2010 only 34.3% was in this young age group, and in 2012 it was 33.7%.

Oman has undergone remarkable improvements in its health and nutrition indicators for women and children, enough so that WHO ranked it one of the top 10 member countries in its 2000 World Health Report, *Health Systems: Improving performance*.¹³ UNICEF marks the country's rate of progress as significant, moving from a U5MR of 48 in 1990, to 22 in 2000, and 9 in 2011 – a rate of reduction of 82% since 1990, and 60% since 2000. These indicators are matched by a life expectancy at birth that has risen from 51 years in 1970, to 76 years in 2012; a figure that reflects the improvements of IMR to 9.5 deaths / 1000 live births, down from 103 deaths / 1000 live births in 1975¹⁴.

Moderate and severe underweight is only 9%, wasting is 7% (see below), and stunting (moderate and severe) is approximately 10%. This remarkable achievement is contextualized in a document from WHO, referred to below¹⁵. Low birth weight is 9.49%,⁶ slightly improved from levels in 2010. Anemia remains a problem, although reportedly only in a mild form (rarely falling below 10 g/100ml¹⁵): 42.7% in pregnant women and 34% in non-pregnant women,¹⁶ 50.5% pre-school age children are anemic.¹⁶

Some of these latter data are surprising, juxtaposed as they are against the significant improvements in other areas of health and nutrition in Oman, the recognition of Oman's double burden of malnutrition is another sobering reality. While underweight rates may be decreasing, the overweight and obesity rates are on the increase. In 2000 the National Health Survey found only 7.9% underweight, but 28.9% were overweight, 17.3% obese and 1.8% severely obese.¹⁷ The report from the National Nutrition Surveillance 2010 estimated 48% obese (which combines overweight, obese and morbidly obese), with significant regional differences (Grade II obesity 6% in Musandum vs ~34% in Dhofar). Furthermore, the problem was marginally greater in

women than in men². And the results of the latest national NCD screening program show 38.2% overweight.¹⁸

Typical of the interrelationship between epidemiologic and demographic transitions, the increasing age of the population has led to the emergence of a double burden of disease. While problems of diarrheal disease, maternal complications, and several communicable diseases are still of concern, cardiovascular disease, hypertension, diabetes, cancers and chronic kidney disease are on the rise. The burden of NCDs has now become substantial as shown in the figure below (Figure 1): of the more affluent Arab Countries, Oman has the second highest disease burden and a significant problem with diabetes. Infectious diseases are no longer dominant; increasingly, chronic non-communicable diseases characterize Oman's major health problems as the population now lives long enough to contract them. The double burden of disease that characterizes the epidemiological transition is reflected in the double burden of malnutrition that is key to the nutrition transition: that period of development where evidence of both undernutrition in the form of stunting, underweight, wasting or micronutrient deficiency coexists with over-nutrition in the form of overweight or obesity.

The problem is leading to an increase in the metabolic syndrome, as indicated by growing percentage of Omanis with an increased Waist/Hip ratio (i.e., 42% in 1992, 48% in 2000), an indicator of the metabolic syndrome considered a risk factor for cardiovascular disease. A different study done in 2001 identified the prevalence of the metabolic syndrome as 21.0%.¹⁹ These problems have yet to be as severe in adolescents and children, though UNICEF notes that it is emerging as a serious problem in adolescents in Oman². A 2011 survey of overweight and obesity in the Eastern Mediterranean Region, showed a rate of 1.9% of preschoolers in Oman as being overweight, 27.2% of adult women overweight and 22.3% of adult women as obese.²⁰ Figures for overweight and obesity in Omani school children were not presented.

The same conditions of improved socio-economic status, changes in lifestyle to a more sedentary existence, importation of high caloric density processed foods, an urbanized environment with poor access to parks or areas for exercise contributing to lack of physical activity, and so on are found in many of the Arab countries, particularly those members of the Gulf Cooperation Council (GCC)³ The recent *Lancet* series on the health of the Arab countries places Oman as second only to United Arab Emirates in deaths from non-communicable diseases.

Evidence produced by the planning section of the Ministry of Health in late January 2014²¹, shows that Oman now has one of the highest rates of death from cardiovascular disease among the more affluent Middle East countries, and indeed in the world. This problem is currently predicted to escalate together with an increase in diabetes and other co-morbidities of the metabolic syndrome. Cancer rates will also increase as highlighted by the International Agency in their report on cancer for World Cancer Day⁴. In addition, the societal burden of non–

² An earlier publication (2003) used data from a 2000 study that showed a prevalence of Obesity of 46.2% in females and 46% in males The authors found the prevalence less in younger age groups. This was data from 13 years ago measuring a problem that has increased in the past decade .

³ GCC members: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates

⁴ WHO IARC, World Cancer Day report, IARC 2-14 available at

<http://apps.who.int/bookorders/anglais/detart1.jsp?codlan=1&codcol=76&codcch=31>

communicable disease (NCD) will grow as the demographic transition continues and as life expectancy increases. In other countries facing similar trends, work efficiency declines as absenteeism due to disease, and premature deaths from coronary artery disease and diabetes contribute to greater DALYs. The costs to society in lost human as well as financial capital and to the health system becomes unsustainable, both on a financial and societal basis, even in the most affluent societies. Population growth (with an expressed desire by many Omanis to sustain the TFR at >3) will place added burdens to the society with commensurate increases in demand for water, food, and energy.

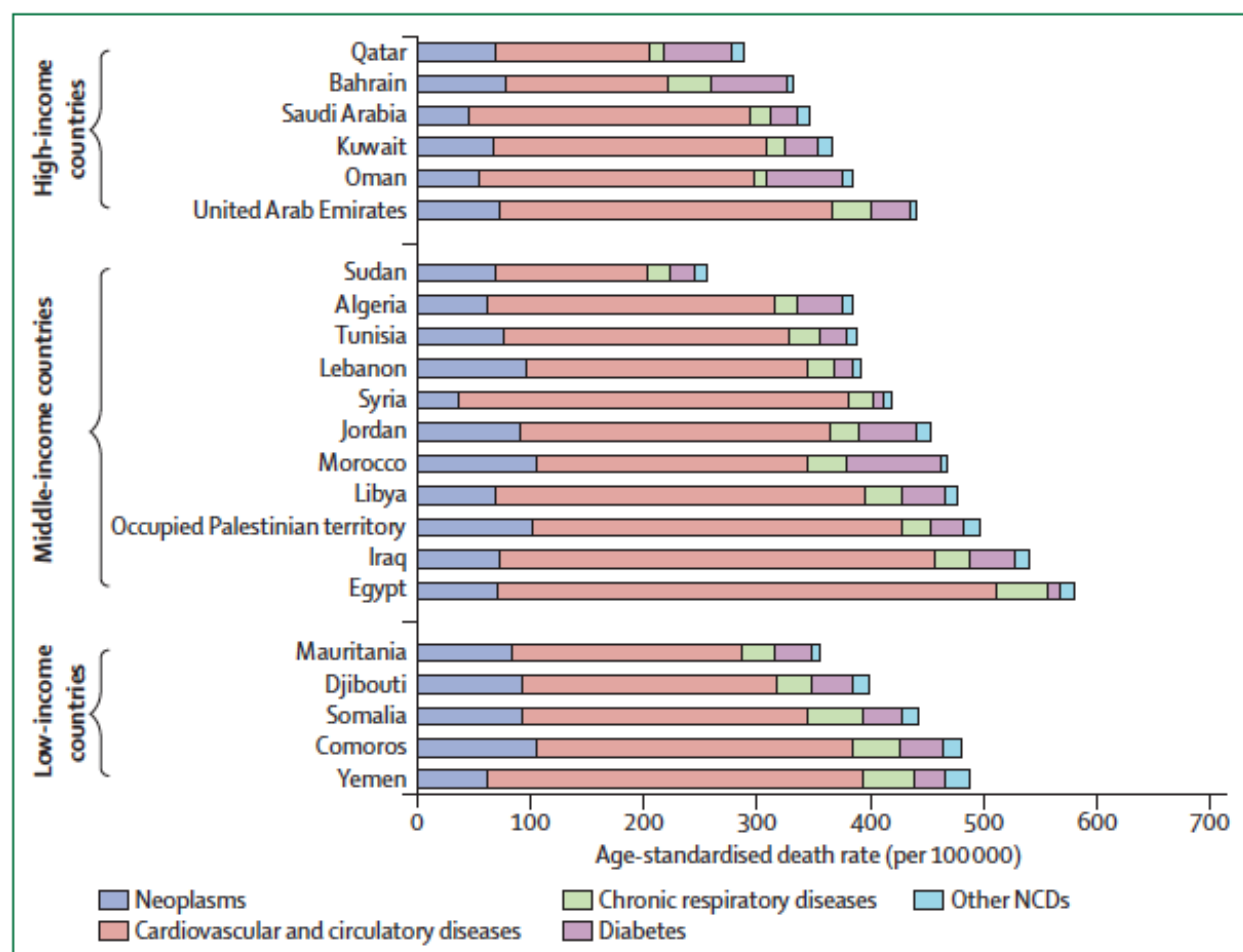


Figure 1: Death rates from Non-communicable diseases in Arab Countries source²²

The similarities and potential for learning from other regional countries was the motivation behind the *Technical consultation on scaling up nutrition in the Eastern Mediterranean Region*, held in Amman, Jordan 2-3 November 2011.²³ Fifteen countries made presentations at the meeting, reiterating their common problems within the nutrition transition of their growing double burden of malnutrition. Some countries had more persistent problems with infectious diseases but still were seeing the emergence of non-communicable diseases as their epidemiological transition entered this difficult and expensive phase.

A common recommendation for each country was to tackle the multiple determinants of malnutrition through multisectoral programs.²³ In addition, almost all noted the need for

‘strengthening political commitment, legislation and multisectoral approaches’. In some ways, Oman already has this commitment, as the Sultan is an advocate for improved nutrition. But leashing that political power and directing it for multisectoral cooperation and convergence may still be a challenge.

Public Nutrition and the multisectoral model

A multisectoral approach has been accepted by the Sultanate as a necessary way to approach the complex problem of public nutrition in Oman. The rationale for the multisectoral approach with coordination and collaboration between different stakeholders is represented in the attached figure (Figure 2) from the recent *Lancet Nutrition Series*⁸. In the figure, the areas in blue are

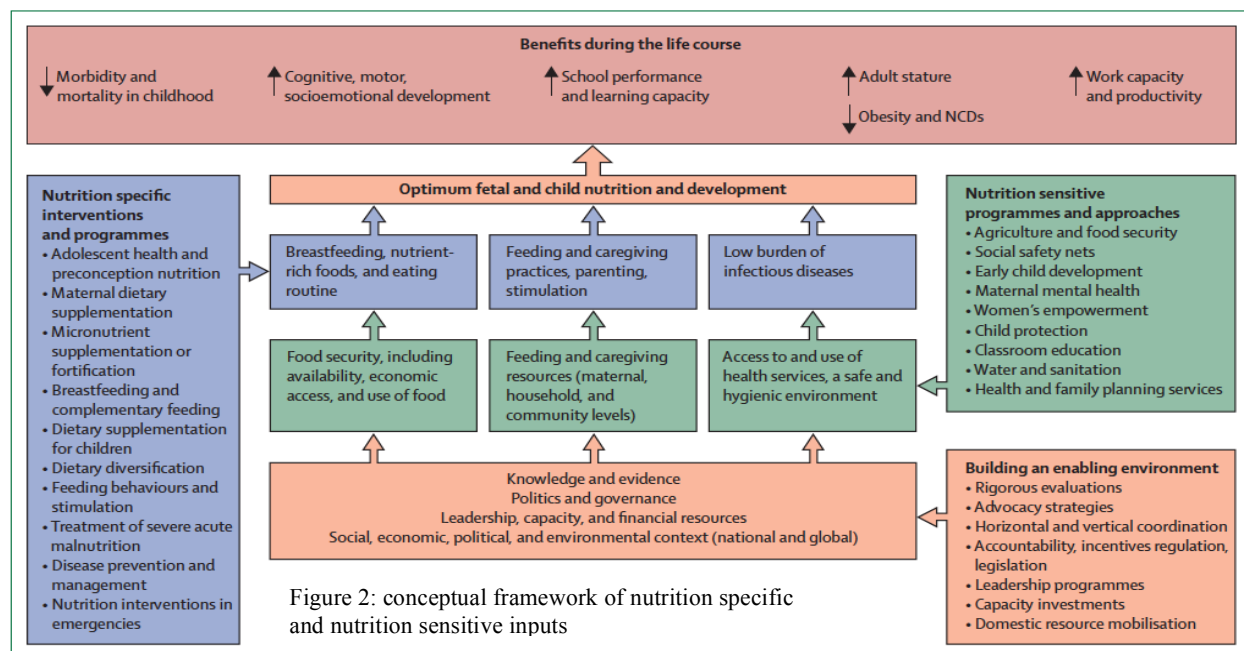


Figure 2: conceptual framework of nutrition specific and nutrition sensitive inputs

Figure 2: Conceptual framework of nutrition specific and nutrition sensitive inputs source ⁸

those interventions (termed “nutrition specific”) that are usually implemented through the Ministry of Health. They have a direct effect on nutrition outcomes (e.g., giving iron supplements to correct iron deficiency anemia). The interventions in green are less direct, and represent those that address basic or underlying causes of malnutrition; usually implemented by partners and other stakeholders who are members of the multisectoral coalition with a goal of improving nutrition in the nation. The orange colored areas are related to governance, leadership, control of resources, etc.

Administratively, the intersectoral approach means involving ministries of agriculture, education, social affairs, commerce, and water resources. Previous consultations to the Government of Oman have recommended the creation of an intersectoral body dealing with nutrition. Using the experience of other countries, this would work best if under the direction of a highly ranked body with close connections to the nation’s leadership.^{24,23}

Global changes in understanding of the importance of public nutrition

Nutrition has traditionally been a subject of food, agriculture, and health. It has dealt largely with clinical topics focused on balanced diets and nutrients tailored to the individual. It dealt with the dyad of mother and infant, with good breastfeeding practices and introduction of appropriate complementary foods. Good nutrition protected a child's normal growth and aided in the return to health of the sick patient. If it went beyond the individual, it was in planning relief efforts after natural disasters or complex emergencies. Nutritional indicators were divided into acute

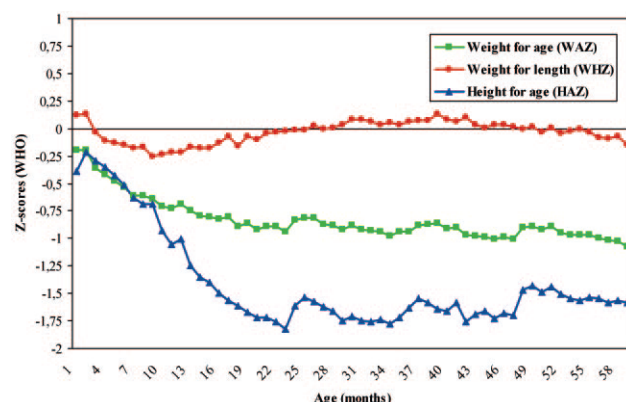


Figure 3: Worldwide timing of growth faltering *source*⁷

overweight was not really a problem in the developing world, nor to any great extent in the developed world.

These views have changed over the past 35 years as globalization has spread, changes in lifestyle and diet have also spread. And as different elements of 'malnutrition' have become evident, the need to understand them has increased. It was not enough to advise the individual as a separate case, entire populations were showing changes in rates of obesity or overweight, stunting, micronutrient deficiencies, etc., and these seemed to be impacting and being impacted by education, and the environment, as well as food.

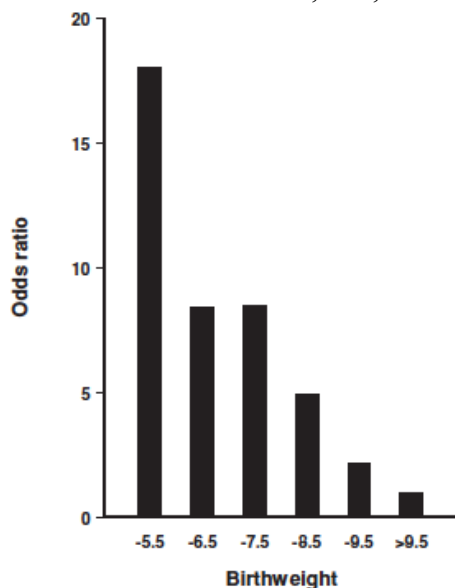


Figure 4: Odds ratio for development of metabolic syndrome according to birth weight in men *Source*:⁹

(wasting) and chronic (stunting) with underweight a composite of both. The causes were poor diet or disease, largely if not entirely starting after birth. If there was a focus on woman's nutrition, it started with her first encounter with the health system and concerned iron and folate supplements, usually in the second trimester of pregnancy and extended through the period of lactation. Food science and research focused on the immediate factors that affected the nutrition of individuals. Malnutrition was undernutrition; both were considered synonymous as

A major change in the global nutrition community's understanding of the causes of stunting changed in 2001²⁵ and were reinforced in 2010⁷ by the findings that stunting, rather than following a period of chronic underweight in a child, was actually present at birth. This suggested that stunting had a different etiology or cause from underweight and wasting; the focus changed from post-natal conditions only to studying the prenatal component to stunting (see Figure 3).

The new data expanded the idea that prenatal and postnatal nutrition were integral to each other and that the contributions of the intrauterine and early postnatal period (first two years of life) to normal

adult stature were equally important²⁶. Put simply, if

the nutrition and health of the mother in early pregnancy established the potential for her child's ultimate adult stature, her child's health and nutrition in the first two years of its life determined whether that potential would be reached.

This time period, from conception until 24 months of age, was later referred to as the 1000-day window of opportunity during which interventions directed at improving the long-term nutrition of the child would be most effective. Stunting was found to be largely irreversible after two years of life and thus, beyond that age, there is little that can be done nutritionally to correct a child's short stature.

It was also clear that children who were malnourished *in utero* and born with low birth weight were predisposed to develop adult onset diseases, including metabolic syndrome (a combination of risk factors for heart disease, diabetes and cerebrovascular diseases) (Figure 4). Research by

Hales and Barker showed that the likelihood of development of metabolic syndrome increased as birth weight decreased⁹. This contributed to the double burden of malnutrition: the presence in the same community and even in the same household of under-nutrition and over-nutrition. The double burden put a drain on government resources, as the resulting diseases among adults are chronic, expensive to treat and affect the country's workforce.

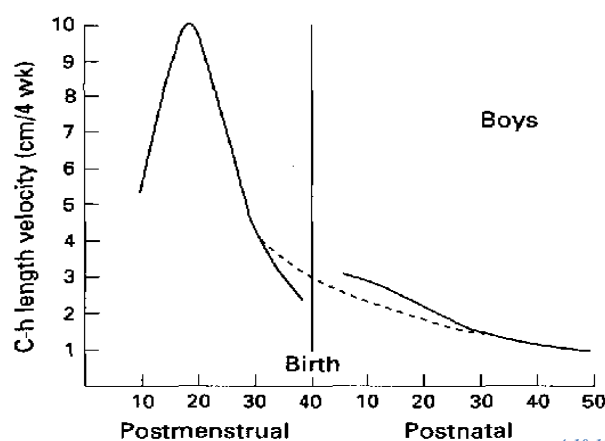


Figure 5: Growth velocity in length in boys Source:^{4, 10, 11}

the first 14-16 weeks of gestation when length and neural cell division are occurring at their greatest rate. When researchers started looking for clues in the relationship between fetal development and maternal nutrition, and the association between stunting and cognitive development they went back to previous research that described the growth spurt in brain cell development occurring at the same time as the spurt in linear growth (that is, from conception to 14-16 weeks of gestation). (Figure 5)^{11, 27}.

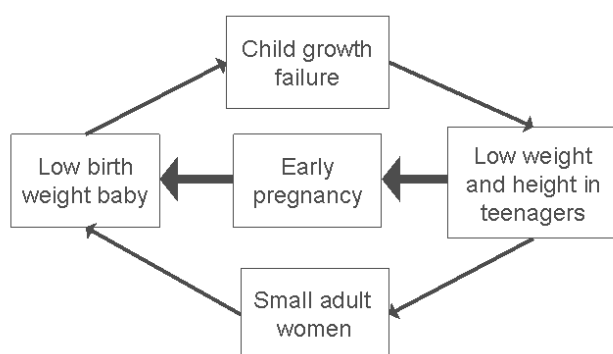


Figure 6: Importance of teen age pregnancy in the intergenerational cycle of growth failure Source:⁵

Since a third of Omani women don't register for ANC until the second trimester, and few women in any country come for ANC in the first month after conception, this means that in order to protect the nutrition and health of women in that critical period, they must be reached before they are pregnant. Normal nutrition and absence of disease (i.e., through nutrition specific interventions) during this period will mitigate the effects of poor nutrition *in utero* that can have an impact on birth

weight, stunting, and on adult onset diseases, including obesity, cardiovascular disease, stroke, and diabetes mellitus type II. Since women in this period are not always known seen by the Ministry of Health, other ministries can be key in reaching them through programs with an indirect effect on their nutrition (i.e., through nutrition sensitive intervention): agriculture, education, regional municipalities and water resources, and so on. But the responsibility falls on the society in general to be sure that all women enter pregnancy well nourished and disease free.

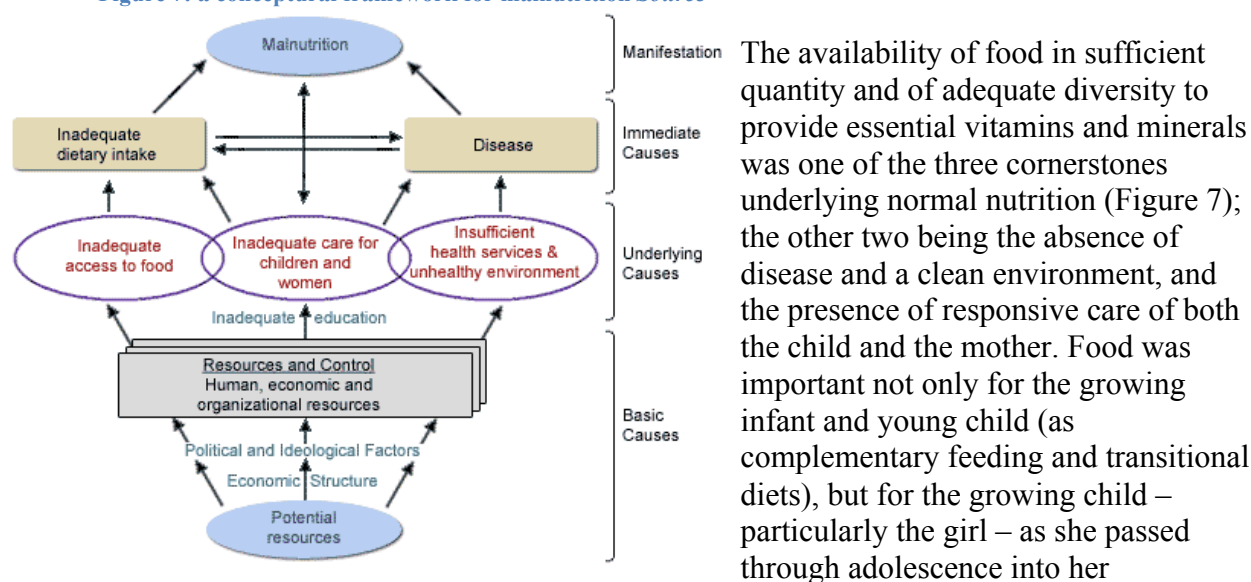
Pre-pregnancy Origins: the importance of women's health and the life-cycle

This concept was introduced at a time when the life cycle approach to nutrition was also defined, since, in order to reach the mother at conception, it was necessary to reach her *before* she became pregnant. It also became evident that the birth weight and stature of the mother was a factor in determining the birth weight and stature of her offspring, leading to the intergenerational transmission of poor nutrition. This became particularly important in the case of adolescent pregnancies (Figure 6), where both mother and child suffered: the mother by having her own linear growth velocity stunted while her weight gain continued, and the fetus by having its necessary nutrition diverted to the mother's own growth in weight.

Post-natal causes: the role of food and health

As mentioned above, the quality of intra-uterine nutrition and a mother's health set the child on a course for development and established the potential for ultimate growth in cognition and stature. Once the child is born, the quality of post natal nutrition and health particularly in the child's first two years of life, determined if the child would live up to that potential.

Figure 7: a conceptual framework for malnutrition Source²⁸



reproductive life, fully prepared nutritionally for her first pregnancy.

The life-cycle approach led to a change in emphasis. When considering only the nutrition of the young child, frequency and quality of food rather than quantity were always considered more important, so food security was less of an issue. An infant's caloric needs (1000 to 1500 calories per day) could usually be supplied with little effort by household food, supplemented by mother's breast milk. But with the adoption of the life-cycle approach came a greater emphasis on food – the nutrition of the older child, the adolescent and the young woman before pregnancy becomes key, if she is to be well-nourished at conception and into the first trimester of

pregnancy. It also leads logically to food fortification approaches that can guarantee some degree of micronutrients to the overall population of all ages, particularly to the pre-pregnant woman.

Situation analysis

Status of women's nutrition

Women's health and undernutrition – anemia, BMI

Approximately two thirds of women are registered for ANC in their first trimester, though data was not found regarding the average week of gestation for the first trimester visit. In 2012, 23% of women had a birth interval of less than 2 years, a figure unchanged from 2000. An additional 43% had a birth interval of 2-3 years.⁶

26.75% of pregnant women are anemic (with a regional variation from 33% in Musandum to 11% in Al Wusta).⁶ An earlier study from South Sharqiyah indicated that 43.6% of 852 pregnant females were anemic²⁹, a figure that has dropped to 19% in 2012. Significant risk factors in the South Sharqiyah study were mother's age and weight.²⁹ The rates according to earlier national surveys went down from 55% in 1992 to 30% in 2000 and climbed again in 2004 to 38.8%.

The rate of women's anemia outside of pregnancy, although less than in pregnant women, remains a problem. A technical report responding to a UNICEF global report on micronutrients gives rates of 42.7% in pregnant women and 34% in non-pregnant women.¹⁶ Another report (Oman World Health Survey) registers non-pregnant women as having a prevalence of anemia of 32.2%; of pregnant women the proportion was 60.5% (although based on a small sample). Of interest, however, in this study was that rates seemed unaffected by place of residence (rates in urban population 29%, rural 24%), unimproved by increasing education level (rates among non-educated 32%, Secondary 80%, University 32%), or economic quintile (rates in poorest quintile 27%, richest 32%).³⁰ There is a difference between men and women, however: Anemia in non-pregnant women was 39%, compared to men where it was 12%. The difference is more than could be explained on a physiological basis, thus reflecting a gender difference rather than a sexual difference.

The most recent underweight data (reflected in low BMI for women and men) is from a 2000 survey and shows an improvement from 1992: 10% of women are underweight, 6% of men, whereas in 1992 the figure was 12.5% for women (men were not recorded). Age distribution is U shaped: the age groups most affected for both women and men is the 20-34 year olds, and over 65 years.³¹

Women's over-nutrition – metabolic syndrome, overweight and obesity

The metabolic syndrome encompasses five components: (i) abdominal obesity (large waistline represented by a high waist/hip ratio), (ii) high triglycerides, (iii) low HDL cholesterol, (iv) hypertension, (v) high fasting blood sugar.

The growing problem of obesity in Oman is leading to an increase in the metabolic syndrome as indicated by an increased percentage of Omanis with an increased Waist/Hip ratio⁵ (i.e., 42% in 1992, 48% in 2000). A different study done in 2001 identified the prevalence of the metabolic syndrome as 21.0%.¹⁹ These problems have yet to be as severe in adolescents and children, though UNICEF notes it as emerging as a serious problem in adolescents in Oman. An earlier publication (2003) used data from a 2000 study that showed a prevalence of Obesity of 46.2% in females and 46% in males. The authors found the prevalence less in younger age groups. This was data from 13 years ago measuring a problem that has increased in the past decade.³² A 2011 survey of overweight and obesity in countries in the Eastern Mediterranean Region, showed a rate of 1.9% of preschoolers in Oman as being overweight, 27.2% of adult women overweight and 22.3% of adult women as obese.²⁰ Figures for overweight and obesity in Omani school children were not presented.

Obesity rates among adult males and females in child-bearing age sum up to about 48% in 2000 without a significant increase from 1992. According to the technical report on the Omani Food Based Dietary Guidelines (OFBDG), in 2000 the waist-hip ration, an NCD risk indicator, increased to 49.1% compared with 42.6% in 1992. For the same year, the percentage of high blood pressure for Omani adults males and females was 21.5%, 25.2% and 15.2% for systolic, diastolic and both respectively. The national average of Hypercholesterolemia, a risk factor for atherosclerosis that is highly determined by diet, was 40% in 2000.³³

The increasing prevalence of the metabolic syndrome is reflected in the growing problem of Type 2 Diabetes Mellitus. The 2012 Annual Health Report notes the increasing prevalence of this disorder: the prevalence in 1991 was 9.75%, the National Health Survey in 2000 showed an increase to 11.6% in adults more than 20 years. The 2008 Health Survey showed the prevalence of 12.3%⁶, an increase of more than 20% over 17 years.

In a study of family clustering of Type 2 DM⁶, only 16% of Omanis interviewed had no diabetes and no family history of diabetes; the other subjects were either diabetic or had a family history of diabetes.³⁴ The prevalence of diabetes in Oman in 2011 was estimated to be 10.8% with a further 9.7% of the population at high risk with an impaired glucose tolerance test.³⁵ The issue being that with this family predisposition, and the changes in lifestyle and diet prevalent in Oman today, type 2 DM will become an epidemic in the country, at great expense to the national economy. In the same article referenced above, WHO estimated a projected increase of 190% in the number of subjects living with diabetes in Oman over the next 20 years.³⁵

Non-communicable diseases (NCD)

MoH has embarked on a special initiative concerning NCD prevention and control designed to fight current and potential future problems such as obesity, cardiovascular disorders, diabetes, cancer and kidney diseases. Part of the prevention is early detection of people at risk and/or having abnormalities that require treatment in order to prevent premature mortality, disability and reduced quality of life. Since these conditions are often not associated with particular

⁵ An indicator of the metabolic syndrome considered a risk factor for cardiovascular disease

⁶ The study aimed to show the impact of consanguineous marriage as a factor predisposing to T2DM; a double danger for Omani families where about half of all marriages are consanguineous)

symptoms and signs, the only way to detect such risks is to carry out screening among the general (middle-aged) population.

Non-communicable diseases constituted 58% of outpatient morbidity and 38% of inpatient morbidity in MoH institutions in 2007. These have *increased* from previous levels of 42.5% and 37.4%. Cardiovascular disease (CVD) was the leading cause of hospital deaths in 2007, accounting for 29.3% of deaths, followed by cancer that accounted for 17.2% of hospital deaths.

The prevalence of lifestyle-linked risk factors is high, as overweight and obesity among adults in Oman were 30% and 20% respectively in 2000. High total cholesterol ($>5.2\text{mmol/l}$) was present in 40% in the surveyed adult population. Metabolic syndrome was also observed in 21% of this adult group. Only 40% of adults in this survey reported engaging in physical activity at leisure time. In addition, at least 13% of Omanis are smokers.

The national NCD screening program was started in 2006 that provided a screening service for all Omanis aged 40 years and above who had never been previously diagnosed with diabetes, hypertension, or chronic kidney disease. The screening service targets five common conditions: diabetes, hypertension, chronic renal impairment, obesity, and hypercholesterolemia. The program for detection of non-communicable diseases in adults above 40-years of age in 2012 showed the following (Table 1): 18.2% have hypertension ($\geq 140/\geq 90$), 8.9% have elevated fasting blood sugar ($\text{FPG} \geq 7.0\text{ mmol/l}$), 38.2% were overweight ($\text{BMI} > 25$), 33.5% obese ($\text{BMI} > 30$), while 62.5% have high waist circumference as evidence of abdominal obesity. New registered diabetic cases were 4832 cases in 2012, females constituted 50.5%.¹⁸

Table 1: Total Screened 2012:		15,083
<i>Source: National Screening Program for NCDs</i>		
BMI %	25 - <30	38.2
	30+	33.5
Waist %	M $\geq 94\text{cm}$, F $\geq 80\text{cm}$	62.5
Blood Pressure %	130-139/85-89	20.1
	$\geq 140/\geq 90$	18.2
B.glucose %	FPG ≥ 5.6 & < 7.0	33.5
	FPG ≥ 7.0	9.8
TSC %	≥ 5.2	48.7
eGFR %	< 90 & ≥ 60	22.7
	< 60 & ≥ 30	6.1
	< 30	0.5

Status of children's nutrition

Child undernutrition – underweight, wasting, stunting

The prevalence of wasting, stunting and underweight was 7.0%, 10.6%, and 17.9% respectively in

a study done in 1999 and published in 2006 by Alasfoor, *et al.*³⁶, using the old NCHS growth standards. The study demonstrated the typical pattern of increasing rates of stunting until around two years of age, after which they plateaued. Although these numbers showed significant improvement over nearly a decade (1991 = 20.7%, 1995 = 15.7%, 1999 = 10.7%) there was concern when compared to levels in countries with similar economic and social conditions as Oman (i.e., UAE = 8%, and Morocco = 6%). The report noted the wide regional variation in findings: North Sharqiyah having the highest rates of underweight, stunting, and wasting (26.6%, 14.8%, 9.8%), with comparable results in Dakhiliyah, South Batinah and Musandum. Dhofar had the lowest levels where the prevalence of stunting was only 5.5%.

Data presented in the National Nutrition Surveillance report (2010) from the last national nutrition survey done in 2009, (Figure 8) show underweight with the most consistent improvement, with wasting and stunting reduced from 1995 levels, but unchanged in the subsequent decade.²

The omission of reference to the nutrition of women before and during pregnancy reflected the times in 1999 before the strong association (i.e., 50%) of stunting having its origins *in utero*^{37,7}

This study examined low birth weight and identified mother's stature, level of literacy, and children of working mothers as associated with a higher risk for developing 'malnutrition'. A multivariate analysis joined birth-weight, mother's stature, and diarrhea in the past 15 days, mother's employment, and water quality index as significantly associated with underweight.

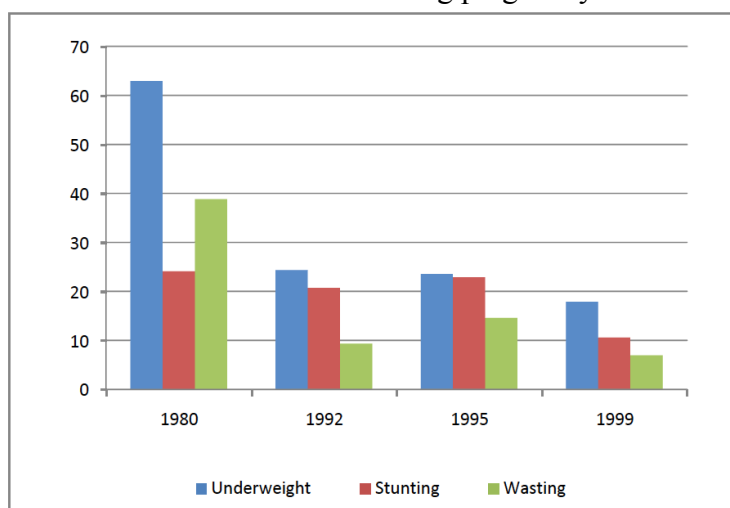


Figure 8: Trend in underweight, stunting and wasting in under-five year olds in Oman Source: ²

A more recent report of a review of the Protein Energy Malnutrition (PEM)⁸ program in the country was delivered by Prinzo in 2010 as a WHO consultant¹⁵. This report indicates improvement in indicators of undernutrition, using the more recent WHO growth standards (2006)³⁸. The author summarizes the changes over the decade from 1999 – 2009 (Table 2), showing improvements in stunting and underweight but not in wasting.

Year	Stunting	Underweight	Wasting
1999	12.9%	11.3%	7.3%
2009	9.9%	8.7%	7.2%

⁷ Also, this was a survey of undernutrition in children, and although the Uniscale[®] was used and women were weighed along with their infants, no mention is made of mothers' nutritional status.

⁸ PEM is a general term for undernutrition including stunting, wasting and underweight

The annual progress report 2012 showed that 25.6% of PEM cases were managed and converted to normal. Regional differences were also defined: PEM was highest in the North Sharqiyah Region (75%); underweight was highest in Ash-Sharqiyah region (both north 14.5 % and south 11.7 %) followed by Adh-Dhahira region; wasting was highest in Musandum (11.5) followed by Adh-Dakhiliyah and Ash-Sharqiyah regions; stunting was highest in Wusta (21.5) followed by Ash- Sharqiyah (North = 18% and South = 15%) and Musandum (16%).

Children's undernutrition: low birth weight

A study published in 2013 reports on data extracted from the National Health Survey (2002) regarding the rates of Low Birth Weight (LBW) in Oman. In this report, there is concern expressed that LBW rates are increasing. The survey data in 2000 estimated a LBW rate of 9.2%, a non-statistically significant increase over the 8% estimates by the MOH based on health services statistics for 2000. The change was sufficient to define LBW as an emerging challenge for public health in Oman, with a further note that the figure might be underestimated, biased by the selection of only women with a growth card from birth. The UNICEF Oman Country Office lists the rate of LBW (2007-2011) as 12%⁹

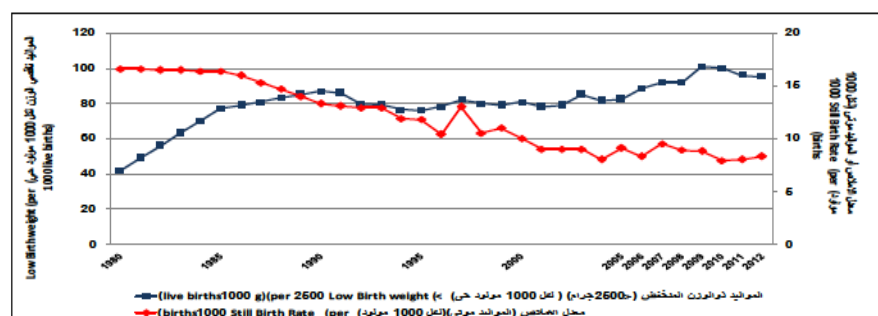


Figure 9: Low birth weight trends in live births 1980 – 2013 Source: ⁶

Low birth weight hospital-based data from the Annual Health Report 2012 show a rate of 9.49% of live births. This shows an improving trend since 2009 when it was at a high of 10.07%. However, it is worse than the prevalence in 2000 when it was 8.13%.⁶

(Figure 9) The prevalence of low birth weight in countries of the WHO Eastern Mediterranean Region (EMRO) was 11.1% in 2012.

Children's micronutrient status

Anemia: Anemia prevalence in preschool children was 42% in the national micronutrient survey¹, and was significantly higher in children <2 years (66%) compared to children 2.5 years(26%). Although anemia levels in Oman have been decreasing (the report states that these are the lowest ever) these levels of anemia (particularly in non-pregnant women) remain significantly high, and constitute a severe public health problem. From the DoN update on the status of micronutrients, 50.5% pre-school age children were anemic.¹⁶

Anemia persists as a problem though the high proportion of consanguineous marriages suggests that causes other than iron deficiency may be implicated (i.e., alpha- and beta-thalassemia, sickle cell, G6PD, etc.) According to the General Blood Disorders Survey³⁹, the prevalence of all the genetic blood disorders studied (i.e., sickle cell and beta-thalassemia trait and carriers) was nearly 10%; in addition, G6PD was more common (18%).

⁹ Available at http://www.unicef.org/infobycountry/oman_statistics.html, accessed 26 February 2014

Many women and children have only mild anemia and the prevalence of low serum ferritin levels (an index of iron stores) has reduced. In a recent study (2004) conducted by the Ministry of Health to assess iron status and to evaluate the impact of the fortification programs on iodine, vitamin A and iron status, the prevalence of iron deficiency (measured by serum ferritin) was 19% in preschool children and 33% in women of child-bearing age. While these show improvement, they remain causes of concern.¹

Vitamin A: Less than 6% of children 6-59 months had vitamin A deficiency. However, among children <2 years old almost 18% were vitamin A deficient; for children 2-5 years, that figure was 3% who were vitamin A deficient. This may be a reflection of the vitamin A supplementation program that has reportedly reached 96% of preschool children. Less than 0.4% vitamin A deficiency was found among women of reproductive age^{1,23}. As a result of the national program, in 2004 the prevalence of vitamin A deficiency was 5.5% among infants and less than 0.4% among women of childbearing age as measured by serum retinol levels.

Iodine: The WHO recommends as a population goal for the control of IDD, a urinary iodine (UI) level of 100 µg/L among at least 50% of the population and no more than 20% to have less than 50 µg/L. The food fortification survey in 2004 showed that 16.8% of the population were at level <100 µg/L, and 4.9% at <50 µg/L; an indication of the progress made in reducing IDD through salt fortification. In 2005 MOH initiated screening for Thyroid Stimulating Hormone (TSH), as it is considered an important and more specific indicator for iodine status in the population. The results indicated that less than 2% of infants screened were at risk of hypothyroidism.

Vitamin D: In a recent study, researchers measured vitamin D levels in 206 healthy Omani volunteers in Muscat, Oman, aged 18-55, and found that most of the participants were lacking in vitamin D. The mean vitamin D level was 13.1 ng/ml, with levels being slightly higher in men than women. The prevalence of vitamin D deficiency in the study population was 87.5%; this was higher than the rates

reported for the British, European, Hispanic, and African-Americans. The researchers speculate that this may be linked to sun avoidance, particularly as it relates to women's clothing when outside of the house, inadequate dietary vitamin D, and virtual non-intake of supplemental vitamin D.⁴⁰ Additional reviews have been found in Omani women working in a hospital in Muscat⁴¹, and a regional study done of children and women in the middle east.⁴²

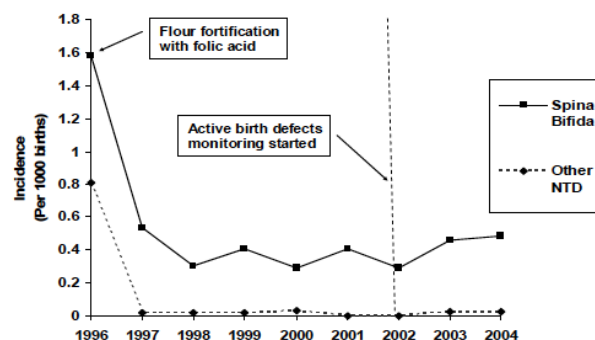


Figure 10: incidence of neural tube disorders following flour fortification with folic acid Source:¹

Folic Acid and Neural Tube Defects (NTD): Flour in Oman is fortified with folate, which may explain the substantial reduction in NTD in the country since the start of the flour fortification program (Figure 10). These latter programs are clear reminders of the importance of involving the private sector and Ministry of Commerce and Industry.¹

Children's over-nutrition

Obesity among infants and young children aged 0-5 years old has increased from 1.9% in 1999 to 10.7% in 2009: a 5 fold increase.² (Figure 11) The 2012 Annual Report indicates an increase in the incidence of new cases among school children in higher grades. Of those Grade 1 students surveyed, 10% of students surveyed were overweight, of which 17% were found to be new cases of obesity. The prevalence increased with Grade 7 students: 18% overweight, of which 23% were obese. In grade 10, of 20% overweight, 27% were found to be obese.⁶

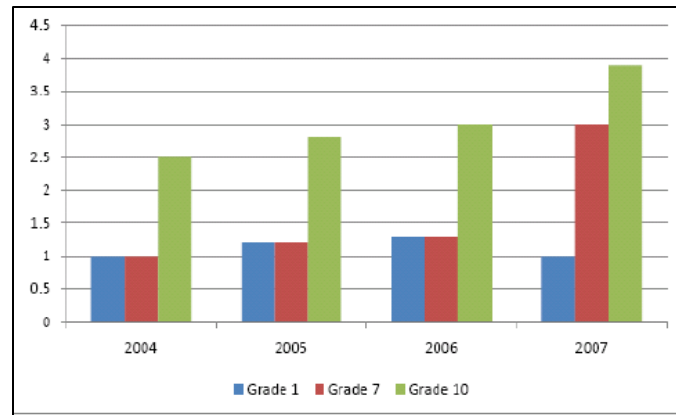


Figure 11: trends in overweight and obesity affecting children in grades 1, 7, and 10. Source:²

Status of factors affecting nutrition specific causes (direct)

The following factors have a major direct impact on the nutrition of women and children in Oman. As these are nutrition specific, they are generally the responsibility of and implemented by the Ministry of Health.

Infant and Young Child feeding

Breastfeeding status and infant formula use: Exclusive breastfeeding rates have decreased since recording began in annual health reports in 2005. At that time, EBF at birth was 97.5% and EBF at 6 months was 31.3% with the remaining 60.7% receiving 'formula & others'. By 2012, the EBF rates around birth had dropped to 94.9 and the EBF rates at 6 months were down to 9.1%, with 90.1% receiving 'formula & others'.⁶ Of interest, during that same period of time, the rate of PEM per 1000 children < 5 years went from 22 to 4.6; however, the rate of severe cases as a percent went from 7.1% in 2005 to 10.1% in 2012. As with other parts of the newly developed nations, increasing household income, and a greater participation of women in the workplace influences this rise in use of formula¹⁰. This association between EBF and PEM is clearly defined in the Standard Operating Procedures for managing PEM.⁴³ Introduction of infant formula is mentioned first in the description of inappropriate feeding practices leading to PEM. When this report was prepared the data used was from 1999. They mention that EBF for the first 4 months of life does not exceed 26%. The document also identifies the link between formula, water, and herbal solutions in the first 6 months with diarrhea and increased susceptibility to undernutrition. In addition, they note that mothers with limited income may be forced to dilute the formula to make it last longer; unhygienic preparation of formula is also noted.

Introduction of complementary foods: In determining the causal factors of persistent underweight in Omani children, a 2002 study revealed that child feeding practices involving regular feeding of formula, the child eating from a separate plate, and poor water quality (also associated with

¹⁰ see <http://www.ubic-consulting.com/template/fs/documents/Nutraceuticals/Ingredients-in-the-world-infant-formula-market.pdf> for the industry's analysis of how to increase formula use, and of the factors that facilitate that. Accessed on 19 April 2014.

diarrhea in the two weeks preceding the study were all significantly related, as was low birth weight. The issues around poor complementary feeding practices in three of the regions sampled in the study, “the variety, quality, and adequacy of complementary foods given to children,” were affected by lack of nutritional awareness among mothers.⁴⁴

In an earlier study, complementary foods were introduced earlier than 4 months to 17.6% of the 1500 children in the study, whereas 14.6% of the mothers introduced complementary foods later than six months. It was also found that 10.6%, and 8.1% of Omani mothers gave their children only breast-milk during the age groups of [6-8], and [9-11] months, respectively. The age of 812 infants in the sample ranged between 12-24 months, out of whom 66.9% were still being breastfed while given complementary foods. The mean duration of breastfeeding males and females was 16.14 months (SD=6.8) and 15.34 months (SD= 7.17) respectively. Slightly more than half (53.5%) of mothers reported feeding their children three times a day. This figure dropped among older children 12-24 months, 53.7% of whom were judged to be fed less than times daily.⁴⁵

Dietary quality and diversity

Dietary diversity is a marker of food security and contributes to micronutrient nutrition, which is essential for normal growth and development. FAO notes that dietary diversity is inhibited by urbanization, high levels of processed imported foods, increasing costs of foods – particularly those organically grown and a preference for grains and cereals; all of these are found in Oman. “Junk food” is a major constraint to dietary diversity.¹¹ In a school-based student survey in 2005 of 2979 students from grades 7th to 10th, 19.5% described themselves as slightly overweight or overweight, 31.5% were trying to lose weight. 77.2% of students usually ate fruit, and 73.4% ate vegetables one or more times a day. 50.3% ate breakfast most of the time. One third usually drink carbonated soft drinks two or more times per day during the 30 days prior to the survey. 10% ate at a fast food restaurant like McDonalds, on three or more of the past seven days before the survey.⁴⁶

These numbers changed five years later. The Oman Global School based Student Health Survey in 2010, showed that 41.6% of the surveyed sample usually ate fruit two or more per day, while 17.9% usually ate vegetables three or more times per day. 45.1% of the sample ate breakfast most of the time, and nearly one in two students drink carbonated soft drinks one or more times per day while 24.1% ate fast food. As for physical activity, 22.7% of the students were physically active five or more days per week for a total of 60 minutes. This behavior was more predominant in males than females.⁴⁶

A recent study from the Philippines of 200 pre-school aged children (2-5 years) suggest that home gardens can contribute to increased dietary diversity.¹² While the presence or absence of a home garden did not have an effect on food security, children from homes with gardens ate vegetables more frequently than those from homes without gardens.

¹¹ see <http://www.omantribune.com/index.php?page=news&id=145668> from Sunday 20 April 2014.

Adolescent nutrition and adolescent pregnancies

Adolescent nutrition: An adolescent health survey conducted by the government in 2004¹², showed that only 45% of 13-15 year olds had breakfast on a daily basis. The Global Health Survey in 2004, identified the following behaviors that could lead to overweight and obesity among that age group: consumption of fast foods, sugary drinks, skipping breakfast, and high consumption of crisps as well as carbonated drinks. The responses in the 2010 Global School-health Student Survey were similar: 45.1% reported eating breakfast most of the time. There was a large difference between boys and girls: 55.8% of 13-15 year old males vs 35.8% of 13-15 year old females.

Dietary diversity in this age group seems to be lacking as well: 18.2% ate vegetables three or more times a day in the month prior to the survey (boys: 19.6%; girls: 16.5%); 42% ate fruit two or more times a day during the same period (boys: 46.6%; girls: 38.5%)⁴⁶

Adolescents measured as part of the annual school health examination from grade 10 in 2007 showed a prevalence of underweight of 11%, which represented a small increase from the year before. This is similar to the rates of underweight in 20-34 year old women (12%). Historically, the rate of anemia in school children in Oman has been very high. A study in 1996 showed a prevalence of almost 50%. School reports showed this level to be 14% in 2005-2007.² UNICEF refers to the increasing problems of rising obesity (and substance abuse) in adolescents in Oman⁴⁷.

Other studies in Arab countries, including other member countries of the GCC have shown increasing rates of overweight and obesity in adolescents. The data suggests a causal association between changes in dietary habits, physical activity and urbanization, as well as the Westernization which occurred in the Arab countries during the past three decades, and the high prevalence of overweight and obesity in the region²⁰. Other measures of adolescent nutrition are often embedded in the findings for non-pregnant women of child-bearing age (15 -49 yrs) and not disaggregated for the 15-18 yr old. However, this would still suggest that the problems facing non-pregnant women can be assumed to be affecting adolescents as well: anemia, vitamin D deficiency, short stature, etc.

Adolescent pregnancy: In 1996, the World Health Organization reported that in Oman 16-18% of girls had their first pregnancy before the age of 15.⁴⁸ UNICEF in 2012 reported an adolescent birth rate of 12.4/1000 adolescent girls. A retrospective study in 2013 from Sultan Qaboos University Hospital of all teenage

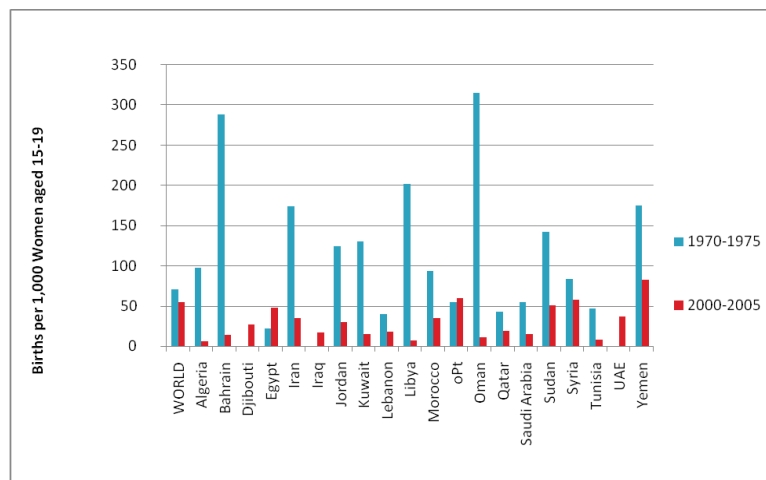


Figure 12: Adolescent fertility rates Source: ³

¹² KAP Survey on lifestyle among students in Universities, College and Higher Institutes, MOH-Sultanate of Oman, 2009.

mothers 13-19 between 2007-2011 in the hospital revealed a 2.2% incidence of teenage pregnancy. The study further revealed that teenage pregnancy was associated with anemia, preeclampsia, LBW, and premature rupture of membranes.⁴⁹

Oman addressed the issue of adolescent pregnancy and within 25 years reduced its prevalence from over 300 births per 1000 girls 15-19 to just above 20 births, well below the regional average of 55.³ (Figure 12)

Disease prevention and treatment: Common seasonal diseases were ARI (winter), and Diarrheal diseases, which were seasonal. Where prevalence of these was high, they were linked to PEM. Recent information is not readily available on parasite load, though a study published in 2001 from Dhofar noted marked improvement in school aged children treated with annual mass chemotherapy (i.e., albendazole) for hookworm infestation. Prevalence dropped from 40% to 1.3% in rural children, and from 6% to 0% among urban children. An additional publication from 1999 reviewed infectious and tropical diseases in Oman. At that time, intestinal parasite rates in school children (from Muscat and Nizwa) ranged from 27.5% to 33.3% respectively. No data was available on *Helicobacter pylori*. Toxoplasmosis was then considered to be endemic in Oman (e.g., in Dhofar, 59% of the population was seropositive). Many of these infestations can be associated with anemia, and some (e.g., toxo) with low birth weight. *H.pylori* is particularly associated with an iron-resistant anemia due to alterations in iron absorption as well as blood loss in the GI tract.

Status of factors affecting nutrition sensitive causes (indirect)

The finding of an association between persistent underweight in children and drinking of poor quality water presented in the previous study raise issues related to other ministries and implicate what are called nutrition sensitive causes. As mentioned above, these are factors that have an indirect impact on nutrition and generally are the responsibility of ministries other than Health. They are mentioned here in general terms as they are common to all countries in the GCC and will later form the content of a multisectoral approach, though not directly involved in the Health and Nutrition strategy. The Ministries who are involved and who have provided input to this analysis include: Ministry of Agriculture, Ministry of Education, Ministry of Commerce and Industry, Ministry of Social Development, Ministry of Regional Municipalities and Water Resources, the Consumer Protection Authority, representatives from academia, and the Supreme Council for Planning. A more thorough description of their involvement can be found in the annexes.

Fertility rates and birth spacing

Fertility Rate – Global and Regional (GCC): The total fertility rate is given in the 2012 Annual Health Report as 3.7 births per woman through her reproductive age. In 2009, a report from UNICEF showed Oman as having the highest fertility rate in the MENA region in 2009. The CIA Factbook for Oman projects the 2014 TFR to be 2.86⁵⁰, which would place it 64 on the list of 224 nations; despite the significant improvement, it would still place Oman with the highest TFR in the GCC: Kuwait (2.53), UAE (2.36), Saudi Arabia (2.17), Qatar (1.92) and Bahrain (1.87).³

Birth spacing: Most of the clients for birth spacing methods were below 30 years of age (57.3%) 73.7% of those were having less than 5 children. Most were new users. The preferred methods were oral contraceptive pills (33.2%), injectable (28.4%), and condoms (18.1%). 26% of those new patients seen in birth spacing clinics in 2012 had more than 5 children.

The urban environment

There has been considerable rural to urban migration as a consequence of rapid growth in population leading to an estimated 84% urbanization (2009). (United Nations Population Division) A recent international conference was held in March 2014 at the German University of Technology in Oman entitled *Challenges of Urbanization in Arab Gulf Countries*.¹³ It raised the issue of the encroachment of population and structures on agricultural land as cities grow, thus creating yet increasing rural – urban migration. The objective of the conference was the presentation of results from a three-year joint research project by GUTech and SQU. As most urban spaces in the Gulf are presently designed for cars not for people, the result often intensifies the sedentary lifestyle that is an important factor in increasing cases of obesity. The creation of public spaces reflects different contexts of urban areas and depends on culture and geography. The GCC countries are aware that the urban city standards of the 20th century in developed countries may not be suitable for countries like Oman, where initiatives are being taken to create sustainable cities outside the main urban centers like Muscat.¹⁴

A study of public spaces in various urban settings emphasizes the need to take into consideration all requirements for active living and social capital when doing urban planning.⁵¹ This would include green areas that are exercise-friendly, and transformation of some urban areas to make them suitable for urban agriculture, thus reducing the impact of the urban encroachment on agricultural lands mentioned above.⁵²

Educational completion rates

It is known that premature pregnancy in adolescent girls is associated with lower retention in school. UNICEF did a qualitative study of school retention in 2012 in which it commented on causes of high rates of school dropouts in Oman, but the absolute figures were not given. The study was delivered to the MOE in November 2012. This study was done in conjunction with Ministries of Health, Social Development and Manpower. The issues that related to drop-out included family socio-economic status; health issues of the children, and some structural barriers related to the education systems.⁴⁷

The 1997-98 Statistics Yearbook of the Ministry of Education showed a girls' drop out rate at 10th grade to be 20%; dropout rates for boys were 30%.¹⁵ More recent data from the UN looks at a different indicator: enrolment in secondary education and finds it increasing to 88% by 2012 but then dropping off in 2013 to 84%. The problem of dropouts seems to be shared in the region, and is met with alarm by other governments, including those in the UAE as reviewed in a recent newspaper article (June 2010) from the UAE, which also commented on the higher number of boys than girls in that country dropping out of school (21% dropout rate among boys in UAE), and saying that similar problems existed in Qatar and Oman.¹⁶

¹³ See http://urbanoman.org/downloads/CUAGC_2014_Program.pdf accessed 15 April 2014

¹⁴ See <http://www.blurb.com/b/3978302-al-hamriya-urban-revitalization> accessed 20 April 2014

¹⁵ See http://www.unesco.org/education/wef/countryreports/oman/rapport_2_4.html (accessed 15 April 2014)

¹⁶ see <http://www.thenational.ae/news/uae-news/education/alarm-over-school-dropout-rate> (accessed 15 April 2014)

The Sultanate has made special efforts to educate girls, and to reduce literacy since the ascendancy of the current Sultan in 1970. At present the illiteracy rate in Oman 9.1% in the age group 15 to 45 years, according to statistics of the final year of the census of population and housing facilities conducted in 2003¹⁷. This number was expected to decline over the decade to below 7% in the same age category.

Water quality and quantity

Water quality and quantity is major concern in all of the GCC countries. It is of vital importance for food security, food self-sufficiency, and essential for hygiene including personal and environmental. In the study mentioned above of feeding practices, among children older than 4 months, 32.1 % of males, and 31.4% of females were fed by hand, a factor of importance in educating women about hand-washing.⁴⁵ Oman has dealt with this problem successfully for centuries. However, now, with new pressures on the environment from population growth, concentration of population in urban centers, climate change affecting weather patterns and contributing to extreme weather events in every region of the world, it takes on new challenges. It is clear that water is essential for both crops and livestock, and that this contributes to the dietary diversity that is needed for normal growth, physical and mental development over the entire life cycle. It is also essential for both personal and environmental hygiene.

Food security and food self-sufficiency

Food self-sufficiency: In a 2010 IFPRI publication, Oman is rated as food secure but not food self-sufficiency. Food security was defined in the 1996 World Food Summit as follows: ‘When all people at all times have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life’ [World Food Summit 1996]⁵³ Oman’s food security depends on its economic ability to import the necessary foods to satisfy the needs of its citizens.⁵⁴ Although it only produces a fraction of the food it consumes (it imports most of its meat and grain) constraints of land and water are such that it is predicted by 2050 Oman will be dependent solely on its imports to meet food security.⁵⁵ At present as shown in the table below (Table 3), it is nearly self-sufficient in fruits and vegetables, however, it can satisfy only 0.80% of its grain requirements using domestic production, and only 34% in red meat. Any food that is produced or imported requires careful management, processing and storage.

17 see <http://www.moe.gov.om/portal/sitebuilder/sites/EPS/English/MOE/literacy.aspx> (accessed 15 April 2014)

Table 3: Oman self-sufficiency ratio for important food groups for 2010^{55,18}

Food group	Domestic production (×1,000 tons)	Imports (×1,000 tons)	Available for consumption (×1,000 tons)	Self-sufficiency ratio ^a
Grains ^b	4.60	630.60	570.30	0.80
Vegetables	271.47	162.97	372.98	72.80
Fruits	365.51	147.04	494.16	74.00
Red meat	24.00	60.63	70.53	34.00
Chicken meat	42.10	74.56	103.31	40.80
Eggs	10.06	16.39	19.68	51.10
Milk	69.60	147.40	155.71	44.70

Food wastage in the GCC: An issue raised by the Ministry of Agriculture is that of food wastage, a problem affecting each country of the GCC. A fact sheet from UAE¹⁹ notes that the GCC countries are among the highest food wasters in the world. Not unlike other developed countries that waste about 51% of their food from restaurants, caterers and households, in Oman, the average family wastes about a third of all food prepared within the household²⁰. In medium/high-income countries wastage mainly relates to consumers' behavior and poor coordination of the supply chain. In the GCC, food can be wasted due to quality standards where 'imperfect' foods are discarded, due to expiry before 'sell-by' dates, and due to attitudes of well-off consumers who can afford to waste food. On average, developing countries lose or waste 64% of their food even before it is processed or sent to the market. Food wastage is found closer to the production and processing sources: harvesting techniques, storage and cooling facilities in difficult climates, infrastructure including transport, and so on.⁵⁶ The MoAG officials noted that in countries where an increase of 2-5% in production is significant, a reduction of food wastage by half could essentially increase production by five to six times that without requiring more water or land, and contributing to reduction in global climate change at the same time.

Vulnerability and coping to food price increases: The food price crisis of 2008 offered a preview of what could happen in the future if subsequent conditions converge to cause another crisis. Countries with less self-sufficiency in food are more vulnerable to food price changes than others that produce most of their food. Families tend to cope with increasing food prices by decreasing dietary diversity, and sacrificing quality for quantity by moving toward staple foods and away from nutrient-rich foods like meat and vegetables. This is the stimulus for greater household food sufficiency (e.g., through home gardens).

Physical activity and active living

Physical activity is now accepted as of major importance for health. Not only does activity improve the body's responses to food with clear evidence of its helping to prevent obesity, diabetes, heart disease, strokes and several cancers, but it is well recognized as treatment and

¹⁸ Data from Ministry of Agriculture, Department of Statistics; and Royal Oman Police, Directorate General of Customs.

^aDomestic production as a percentage of the amount available for consumption. ^bStatistics for 2008.

¹⁹ https://envirocompetition.ead.ae/_layouts/15/IMAGES/EAD.EnvironmentalCompetition/_data/global/facts/FactSheet.pdf

²⁰ Study quoted Asma Al Beloushi, Dept of Natural Resource Economics, SQU in <http://gulfnews.com/news/gulf/oman/average-omani-family-wastes-one-third-of-food-1.1039366>

prevention of such mental health problems as depression. A physically inactive population requires tight dietary controls to prevent over-storage of unused calories. It also appears that people engaged in a sedentary life style, in constant proximity to high energy density foods and snacks tend to eat more. Even those diet-conscious individuals who try to consume low-fat foods, may be fooled by the substitution of carbohydrates for fats. High carbohydrate diets are dangerously associated with both obesity and heart disease⁵⁷. Furthermore, obese people tend to program food use and expenditure differently. Under these conditions, Omanis may find it very difficult to eat appropriate amounts given their biological drive and their sedentary lifestyle.

The Global School-health Based Student Survey in both 2005 and 2010 identified the importance of physical activity throughout the life-span to maintain normal weight and to prevent the onset of chronic diseases. The reports also note that habits developed in youth are those that continue through adult-hood. Approximately 60% of the world's population does not get enough physical activity, which may be contributing to the global epidemic of overweight and obesity.

In Oman in 2010, 22.7% of all students (including 13-15 year olds) were physically active for a total of at least 60 minutes per day on five or more days in the week preceding the survey. This represented a significant decrease from the 2005 survey, where 75.5% reported participating in physical activity for a total of at least 60 minutes per day on five or fewer days per week. Girls (15.9%) were half as active as boys (29.0%)⁴⁶. In the survey, two thirds said they did not walk or ride a bicycle to school in the past seven days.

Preliminary results of a recent KAP²¹ study conducted among students in Universities, College and Higher Institutes in 2009, showed a gap between knowledge and behavior regarding physical exercise. Knowledge was high regarding the importance of physical activity in comparison to actually practicing it, with the percentage of females who demonstrated adequate physical activity being half that found in males. However, the percentage of students who walk is high (83.5%) in comparison to 28.7% who are sedentary for more than two hours per day. Lack of Time (53.5%), accessibility of places to practice (48.7%), weather conditions (46.8%) and social network support (34.2%) were the main challenges and difficulties for not practicing physical activity.

The current and developing urban planning and traffic policies in Oman, with the dominance of the motor car, is not conducive to active living. Oman at present lacks an effective integrated public transport system. The lack of contiguous and pedestrian friendly sidewalks with frequent cross walks, separate bicycle paths, and green areas planted with indigenous drought tolerant plantings that offer respite from the glaring sun contribute to physical inactivity with major health consequences for the population. Promoting an interest in sport has not worked, even in the most sports-conscious country, Australia; while encouraging individuals to go to sports facilities/gyms helps the small minority who do so, this approach is not the answer for all children and adults from the age of 3 years to 75 years of age in Oman. The future of physical activity has to be in the promotion of Active Living: an active way of life that integrates physical

²¹KAP Survey on lifestyle among students in Universities, College and Higher Institutes, MOH-Sultanate of Oman, 2009.

activity into everyday routines – walking, biking, climbing stairs, as well as playing sports and games.

On-going programs and interventions

Supplementation and Fortification Programs

Supplementation programs

Iron Supplementation: Supplementation of women with Iron / Folic Acid began in 1990 and continues to date. However, in the latest national nutrition survey in 2000, anemia during pregnancy still had a prevalence of 42%.¹⁶ The reasons for the persistence of this problem include the delay in initiation of antenatal supplements, inefficiencies in the health system delivery of the program, insufficient daily doses, poor adherence to the required dose because of side-effects, poor monitoring, forgetfulness, etc. A recommendation for offering weekly iron supplements for several months before conception is under consideration, based on positive results from many studies.⁵⁸ Consideration is also being given to adding direct supplements to the food of infants and young children through micronutrient sprinkles.

Vitamin A supplementation: A national vitamin A supplementation program was started in 1998 and continues to this date targeted at pre-school children and post-partum women. Vitamin A capsules are given to under two year olds at 9 and 18 months²², with coverage levels high (estimated at 99% in 2008)¹⁶.

Food fortification programs

The National Micronutrient Status and Fortified Food Coverage Survey²³, conducted in 2004 indicated “an improvement in the micronutrient status of the Omani population, and ... impressive progress towards achieving the millennium development goals”. It recommended the sustainability and upgrading of the various programs in relation to fortified food products (i.e., fortified flour, iodized salt,) as well as supplementation programs (i.e., iron and Vitamin A supplementation programs). The report recommended that consumers be informed about the importance of vitamins and minerals in their diets and consumption of fortified foods as an inexpensive strategy to improve the health status for all people, especially women and children. Furthermore, it requested the establishment of a social marketing plan to promote adequate dietary habits and re-enforce optimum intake of micronutrients.

Food fortification programs for the delivery of these essential micronutrients are critical for reaching pre-pregnant women. This is of particular importance for iodine, as levels in the first trimester are considered to be of critical importance for early brain development.

Vitamin A: Standards for flour fortification were established in 1995 with later extension to include fortification of oil. Fortification of white flour is mandatory. In a survey of 359 households done in 2004, fortified flour was available in 81%.⁵⁹ In addition, milk labeled as

²² See <http://www.emro.who.int/child-health/strategy-adaptation/prevention-vitamin-a-and-vitamin-d-supplementation.html> accessed on 05/05/14

²³ The National Micronutrient Status and Fortified Food Coverage Survey, Oman 2004, Ministry of Health-Sultanate of Oman, UNICEF Muscat, WHO-EMRO, 2006.

vitamin A fortified was found in 80% of households. Oil was also available in 95% of households. It was unclear from the survey if it was fortified or not.

Though the coverage of supplementation is high for vitamin A, the frequency of supplementation makes the significant improvements in serum retinol are less likely to be the result of the supplements than of the fortification program. Also, although there is a study in 2001 documenting the use of mass chemotherapy with albendazole over a four period for a population of school children in Dhofar in reducing the prevalence of hookworm in rural children from 40% to 1.3%⁶⁰, association of this treatment with Vitamin A supplementation is not documented.

Iron: In the same study referenced for Vitamin A, it was found that approximately 85% of the household flour samples (from both Oman and Salala flour Mills) were fortified with iron. This would be in keeping with a Ministry of Commerce mandate to fortify white flour with iron (electrolytic) and folic acid in 1997.

Iodine: The first national survey carried out in 1993 set the stage for the establishment of the national salt iodization program. Despite legislation on the marketing of iodized salt, only about two thirds of households consume iodized salt. A new survey is planned to take place in 2014. This survey will be the first to assess median urinary iodine levels in children, the first since 1994; it is hoped that the results will give a comprehensive picture of the progress made in Oman towards universal salt iodization and the eradication of IDD.

In the national micronutrient survey referenced above, despite the near elimination of iodine deficiency in Oman, surveyors found variable iodine status – both high and low - in women associated with the iodine content of household salt: Approximately 17% of non-pregnant women had UI <100 µg/L, one third of the women had UI >300µg/L; 40% of households had salt iodized with < 15 ppm, in approximately 13% of households salt had iodine levels >80 ppm.⁵⁹

Salt was collected from almost all households (99%). The median iodine content in salt was 31 ppm. Approximately 59% of the 390 households had adequately iodized salt (≥15ppm) available at the time of the survey. This is a level that could be improved, given the extent of the salt iodization program. As expected, in those households where salt was adequately iodized, UI levels were above 100.

Baby Friendly Hospital Initiative

The Baby Friendly Hospital Initiative (BFHI) was initiated in the early 1990s to promote exclusive breastfeeding of infants up to 6 months. However, after an initial increase in breastfeeding coverage at the onset of the initiative, EBF rates have fluctuated subsequently. Between 2005 and 2012, the rates of exclusive breastfeeding at six months dropped significantly, despite the emphasis in the MoH Five Year Plan of Action 2011-2015 on promotion and management of infant and young child nutrition with a strategy to revitalize the BFHI as its objective. The program was dealt with as a vertical program initially, in secondary rather than primary health care facilities. Community support (the 10th step of the BFHI) was lacking and sustainability was affected.⁶¹ In addition, it was felt that education of care providers as well as the community was needed to improve breastfeeding rates, particularly among low birth weight babies.⁶² The revitalization of this initiative is a critical link to the revision of the current ‘Omani Code for Marketing of Breast milk Substitutes’. There is updated information added to the new

draft according to the recommendations of assembly resolutions. In addition, monitoring mechanisms for the implementation of the code are being strengthened.

Infant and Young Child Nutrition

In 2002, the Fifty-fifth World Health Assembly and the UNICEF Executive Board endorsed *The Global Strategy for Infant and Young Child Feeding*. Subsequently, the Nutrition Department of MoH elaborated its present IYCF Policy and Strategy for 2009-2013. It is structured around five broad categories that reflect the interconnected aspects of good infant and young child feeding practices:

- Public policies that assist in achieving IYCF recommendations.
- Health service environments that support implementation of IYCF policies and recommendations.
- Health services reoriented to provide integrated delivery of effective services that enable families and health workers to implement recommended IYCF practices.
- Community involvement in IYC nutrition strengthened through targeted action.
- Families are facilitated to develop the personal skills to implement IYCF recommendations

Programs for women

Focus on women: pregnant and non-pregnant

A report of a study of risk factors associated with Protein Energy Malnutrition (PEM) in children less than three-years old places maternal education, care practices and water quality factors as the major risk factors for PEM in young children. The study was a case-control study in three regions of Oman²⁴ done between May and August 2002. The authors showed a statistically significant association between income and underweight.¹⁵ The main reason for PEM mentioned by all interviewed was lack of knowledge, large family size, reduced time for each child, reduced maternity leave (2 weeks²⁵), and lack of support for breastfeeding; the result is low EBF rates and high artificial feeding rates were high with untimely introduction of adequate and appropriate complementary foods. Counseling of mothers is done in PEM, though it is not stated if they are counseled on care of their adolescent children, especially girls before they become married and pregnant.

From the review of the literature, there seems to be an inadequate recognition of and emphasis on the fetal origins of adult diseases (i.e., the Barker hypothesis)⁶³. The focus of most aspects of under and over-nutrition are on the post-natal period: IYCF, disease prevention, appropriate diet and exercise of children and adults, etc. The significance of prenatal maternal health and nutrition, and pre-pregnancy health and nutrition of young women is not emphasized. Focus on this period of the life-cycle, i.e., keeping all girls in school longer to preventing adolescent pregnancies, focusing on anemia reduction before pregnancy, emphasizing disease prevention before and during pregnancy could make a difference in the emerging problem of obesity and overweight, with the increase in Type 2 DM, CVD, and obesity. The children of 35 years ago and today born with low birth weight and stunting are vulnerable to the fetal conditions that led to adult onset diseases. Exposure of these children, who were exposed to intrauterine

²⁴ Based in observations and discussions in Muscat, North Sharquiya, and South Batinah Regions

²⁵ In this report, 2 weeks. But secondary to Royal Decree 113/2011, now extended to 50 days fully paid.⁴⁷ UNICEF. Oman Country Office Annual Report 2012. Muscat: UNICEF, 2012.

undernutrition, to abundant calories in later childhood⁶⁴ is now acknowledged to lead to rapid increases in rates of over-nutrition. There is growing evidence that exposing these low birth weight babies, who grew up in an under nourishing intrauterine environment, to excessive calories after the first two years of life leads to their later obesity and the non-communicable diseases associated with the metabolic syndrome, i.e., coronary artery disease, cerebrovascular diseases and, Type 2 Diabetes among others.³⁷

It is clear that the intrauterine insults that impact on the later health of the child occur early in pregnancy. In the classic study of vulnerability to famine *in utero* that would lead to later obesity, Susser and Stein demonstrated the association between early deficiencies in pregnancy and later obesity.⁶⁵ The peri-conception period is known to be sensitive to micronutrient deficiencies (i.e., folic acid) that later lead to neural tube birth defects. The growth spurt in the first 14-18 weeks of gestation is a further reflections of the sensitivity of this period.

Reaching Women: The rationale for multi-sectoral involvement

To ensure that women are reached around conception and early in the first trimester they must be seen before they become pregnant, which means before they are known to the health system. This means examining other sectors for their resources and programs in the community where girls and young women participate: education, agriculture, water and sanitation, social development, commerce and industry, regional municipalities and water resources, consumer protection, media, and so on. The potential for significant involvement leading to social change in women's nutrition is represented in the output from a recent multi-sectoral nutrition strategy workshop on public nutrition – *Partners for Public Nutrition*. (See Annex XX for output from that conference.)

SWOT analysis of Oman nutrition program

Strengths	Weaknesses
- Significant and stable government commitment to improving nutrition and maternal and child health - Achievement of MDGs particularly in improvement of mortality and reduction of underweight. - Ministry of Health has programs directed at most of the nutrition specific causes of undernutrition. - Multi-sectoral interest in improving public nutrition exists, with defined roles of each sector outlined. - Oman is food secure, and has resources to continue food security for at least two decades. - High technical capability in clinical health and nutrition exists with sufficient resources to implement programs. - Highly educated population. - Little evidence of gender inequity. - Exclusive breastfeeding at birth is > 95% showing a willingness and ability of all mothers	- Focus on maternal health instead of on women's health before, during and between pregnancies leaves stunting and LBW as persistent problems. - Nutrition problems outside of the MDGs have not been addressed leading to growing problems of overweight and obesity, and Non-communicable diseases. - Only working on nutrition specific causes of malnutrition improves indicators in the short run but will not lead to sustainable solutions to underlying problems. - Lack of food self-sufficiency with net importation of 85% of food places Oman in a vulnerable position to global shifts in oil and food prices that could threaten food security. - Human Resource Capacity in public nutrition is limited. - Lack of physical activity with sedentary lifestyle due to urban environment that is more car-friendly than pedestrian friendly contributes

to breastfeed. • Many studies have been done to measure obesity and overweight	to obesity. • Importation of processed, high caloric density foods contributes to obesity and overweight. • EBF at 6 months drops to xx as evidence of cultural, social and structural barriers to breastfeeding • Data from multiple studies with different populations at different times are inconsistent and sometimes confusing
Opportunities	Threats
• Workshop on <i>Partners for Public Nutrition</i> stimulated considerable interest in the topic, with defined inputs from each sector to improve public nutrition • Supreme Council for Planning interested and willing to assume oversight of multi-sectoral approach to public nutrition. • Government's awareness of the significant cost of NCDs as a drain on the budget offers excellent motivation for change that can win political support from all stakeholders.	• Without action and a defined structure of multi-sectoral involvement from the highest office in the land, the interest in multi-sectoral planning and implementation will drop off. • Climate change could lead to global increases in food prices due to decreases in crop yields and global crisis with water. • Vulnerability to changes in demand for non-renewable energy sources and to decreases in oil supplies could threaten social progress in food and nutrition security.

The Vision for 2050

An equitable, environmentally sustainable and increasingly self-sufficient Oman, with a population physically fit and well-nourished at all ages committed to an active life style and balanced diet that secures women's nutrition throughout the life-cycle, making it a regional model of health and well being.

Main Goals for 2050 and Strategies

To achieve the Vision for 2050 in health and nutrition, the following goals are presented according to the key domains that will impact most on public nutrition by the year 2050: Health and Nutrition, Food and Nutrition Security, and Physical fitness through active living. In all domains, Ministry of Health is the lead.

Health and Nutrition:

1. Reduce the prevalence of overweight and obesity to < 5% of the population through exercise and a balanced diet of fresh vegetables and fruits.
 - a. *Strategy:* Multi-sectoral approach through coordination of planning and inputs from Ministries of Agriculture, Municipalities and Water Resources, Commerce, Consumer Protection, Education and Health.
 - b. *(See Strategies for Food Security and Physical Fitness below)*

2. Reduce levels of stunting and low birth weight to < 3% of the population through improvement of all women's health and nutrition before, during and after pregnancy, and emphasis on .
 - a. *Strategy:* Focus health and nutrition programs primarily on pre-pregnant, prenatal, and lactating women in order to improve potential for normal height and cognitive development.
 - b. *Strategy:* To reach pre-pregnant women, collaborate with other ministries who reach adolescent girls and women in the community (e.g., Education, Agriculture, etc.)
 - c. *Strategy:* Improve NMIS through digitized record keeping that records all birth weights and transmits them to central servers; and laser height measures for calculating height and length, and BMI.
 - d. *Strategy:* Reduce unmet need for contraception and increase birth spacing; continue progress on reduction of TFR to reach replacement rates.
3. Raise exclusive breastfeeding rates at 6 months to >90% to improve nutritional and cognitive potential of children.
 - a. *Strategy:* Strengthen education and assessment of all hospitals and clinics so that 100% are Baby Friendly.
 - b. *Strategy:* In collaboration with Ministry of Labor, ensure adequate space for continued breastfeeding in all workplaces.
4. Reduce anemia and all micronutrient deficiencies through consumption of appropriate micronutrient rich foods.
 - a. *Strategy:* Collaborate with MoAG and Academia to develop and promote biofortified²⁶ foods (including increasing bioavailability of iron) to provide adequate micronutrients to children > 2years of age, pre-pregnant and pregnant women.
 - b. *(See Strategies for Food Security and quality below)*

Food security and quality:

3. Increase diet of non-obesogenic fresh fruits and vegetables by reducing importation of cardiotoxic processed, high-density foods to <30% of all intake through cooperative agreements with regional suppliers, and increased regulation and import tariffs on non-healthy foods.
 - a. *Strategy:* Through regional conferencing and cooperation on a multi-sectoral basis, develop regional guidelines, policies, and sourcing for importation of nutritious foods (i.e., low in carbohydrates, trans-fats, and other non-nutritious additives)
4. Increase local food self-sufficiency and dietary diversity through organically grown vegetables and fruits by introducing high-tech (i.e., nutrient and water efficient) rural and urban gardens in 80% of all households.

²⁶ Biofortification involves growing and breeding crops to increase their nutritional value, either through conventional selective breeding, or through genetic engineering. Biofortification differs from ordinary fortification by focusing on making plant foods more nutritious as the plants are growing, rather than having nutrients added to the foods when they are being processed.
(source: Wikipedia)

- a. *Strategy:* Through multi-sectoral collaboration with Ministries of Health, Agriculture, Municipalities and Water Resources, and academic centers, scale up models of rural and urban agriculture using water and nutrient efficient technologies (e.g., hydroponics, aquaponics) to facilitate adoption of home and business gardens in 80% of establishments for local production of vegetables, fruits, (and fish).
- b. *Strategy:* Through collaboration between Ministry of Health, Ministry of Agriculture, and Ministry of Commerce and Industry, develop vertical farms⁵² in all new urban structures.

Physical fitness through active living:

3. Improve physical fitness of the population at all ages through measures to increase active living to 1 hour / day of aerobic heart-friendly exercise (i.e., walking, jogging, bicycling, gardening).
 - a. *Strategy:* Public transport would be expanded for ecological as well as health reasons. Auto or bicycle trains that allowed transportation of a personal vehicle to an area outside of the cities could reach tourist destinations. The concept of ‘city bikes’ – short use bike rentals (Pick up – use – Drop off) used in many cities in the Europe and North America – would be introduced.
 - b. *Strategy:* In new structures consider ways to increase use of staircases by making them cool and clean, and by having elevators (other than for emergencies or disabilities) originate on the second floor or be discretely placed behind open staircases.
4. Create urban green-spaces and pedestrian transport routes (e.g., biking, walking, jogging paths) in all cities that are pedestrian friendly and open for safe exercise and intra-city travel throughout the day and night.
 - a. *Strategy:* Harmonize local tradition with modern technology to create ‘green tunnels’ with indigenous or drought-tolerant trees and shrubs to link government buildings and parks within major cities, for use by pedestrians in all seasons; Arabian wind towers to funnel cooling desert breezes to pedestrian walkways or shaded shopping areas styled after ancient Souks to reduce air conditioning needs; batteries of solar energy panels that reflect sunlight and heat to keep shaded spaces cool.
 - b. *Strategy:* Create pedestrian walkways and bikeways through wind-tunnels that extend above traffic (with elevated cross walks) without interruption that join new green spaces (i.e., parks and gardens of indigenous vegetation) as social and fitness centers in the city.

Implementation arrangements and the way forward

The following arrangements are necessary first steps for any implementation of the strategy. The development of a multisectoral approach establishes the core system for proceeding with national public nutrition policies and interventions; the public nutrition knowledge base is essential for identifying and prioritizing issues and disparities in order to target programs appropriately; the improvement in capacity in public nutrition is essential before any programs can be planned, implemented or evaluated.

Development of a multisectoral approach

Multisectorality is key to the achievement of the vision and goals for public nutrition in 2050. Public nutrition is too large and multi-faceted a topic in its causes and consequences to be improved by a single sector, although clearly the Ministry of Health must initially lead the way in this initiative. Recognizing the inter-generational aspect of under- and over-nutrition means reaching women and children through all stages of their growth and development. Understanding the contributions of nutrition specific and nutrition sensitive interventions means engaging Ministries of Health along with Agriculture, Commerce and Industry, Education, Municipalities and Water Resources, Media and so on. Organizing multisectoral collaboration and cooperation around this topic will require the following arrangements²⁷:

- Identifying public nutrition as a national priority, create a **National Board of Public Nutrition** (NBPN) with membership of Secretary-level representatives from each of the involved Ministries under the direction of the Supreme Council for Planning.
- Enhance inter-sectoral technical coordination and cooperation among key stakeholders through the formation of a multi-sectoral **Multisectoral Public Nutrition Technical Committee** (MSPN Technical Committee) that reports to the National Board of Public Nutrition, with a rotating Secretariat that begins in the Ministry of Health.
- The multi-sectoral National Public Nutrition Technical Committee will draft a Multisectoral National Nutrition Policy for approval by the National Board of Public Nutrition.
- The Policy will be developed upon review of existing food and nutrition-related policies and programs being implemented by different stakeholders in order to assess the strengths and challenges in their implementation
- The Policy will be implemented synergistically through a *convergence strategy* wherein all on-going efforts of different sectors in implementing food and nutrition-related programs and interventions are implemented in the same place to impact on the same populations at the same time. Planning should be integrated; implementation should be sector-specific. Scaling up of programs should be evidence based with deliberate targeting of vulnerable populations in order to address disparities.
- The NBPN would be the logical body to take responsibility for funding of all public nutrition interventions (including the national nutrition survey). Under the direction of the Supreme Council for Planning, a detailed funding strategy will be developed to match the Policy document.

Establishment of a public nutrition knowledge base

For the *convergence strategy* to work, and for inequities in nutrition to be further defined and vulnerable communities identified, better and more up-to-date data will be necessary.

- Complete a national nutrition survey to review and reassess the nutrition situation of all age groups and identify priority health and nutrition interventions to be scaled up.
- Through regional academic and political networking, develop a Regional (i.e., GCC) Public Nutrition Database Library that includes (i) cross regional nutrition status of all populations,

²⁷ Interest in multisectoral collaboration was evident in a workshop held in Muscat under the auspices of the Department of Nutrition, Ministry of Health on 5-6 February 2014. Output from that workshop is presented in the Annexes to this strategic study.

- (ii) descriptions of on-going programs and policies aimed at improving similar public nutrition problems across the region, (iii) available resources for sharing between countries that will impact on implementation of programs (e.g., joint research, shared results, lessons learned, trained human resources, etc.). This will be a virtual library, accessible to all member-countries (and others as desired) of the GCC.
- Identify areas for further investigation and research related to either nutrition specific or nutrition sensitive issues in Oman. A national and/or regional research strategy will be essential for on-going contribution to the knowledge base.

Improving public nutrition capacity:

Capacity in Public Nutrition is lacking in Oman. Most graduates in Nutrition or Food Sciences have expertise in dietetics and clinical nutrition and are oriented towards individuals. Few have sufficient knowledge or experience in population based Public Nutrition. The following is recommended to remedy this situation:

- Complete an assessment of capacity in public nutrition at four levels (i.e., Individual/community, Workplace, Organization, System) as applicable to the situation in Oman:
 - (i) Individual/community level: examining the critical link between communities – represented often by mothers groups and village health committees – and health and social service systems. A focus on the community is essential as this is where inequalities have their greatest impact; capacities at this level dictate those needed at each level of the system;
 - (ii) Workplace level: define job competencies needed for public nutritionists, along with those needed for supportive supervisors. Review available job descriptions; (
 - (iii) Organizational level: include assessment of government service delivery sectors, NGOs, educational and training institutions, and factors that enable workforce effectiveness in leadership, human and financial resource availability, management and so on;
 - (iv) Systems level: considering the broader socio-, cultural, economic, academic and political environment that influences how nutrition capacity develops and has its operational effects. The System level includes the legal framework (global and national) and supporting policies, as well as states' commitments to human rights instruments: the ICESCR, CEDAW, and the CRC; includes mechanisms for accreditation of training institutions and certification of graduates in Public Nutrition; assessment of regulatory councils (similar to those found in medicine and nursing) that could be used for public nutritionists.
- Improvement in capacity will require more than training. Once the assessment is completed, a full plan for capacity enhancement at all four levels will be developed by the MSPN Technical Committee to be endorsed by the National Board of Public Nutrition.
- As training is one of the components of capacity development, there will be the need to develop a cadre of Trainers. Consideration should be given to doing this on a Regional basis in order to share resources and costs. Omani trainers can be trained in Public Nutrition through one (or more) of three methods: (i) a Training of trainers workshop to be held in Muscat (or Regionally) run by technical advisors from the global Public Nutrition faculty; (ii) staff selected for training can participate in an off-site course being offered regionally; (iii) either as a stand-alone or in coordination with these face-to-face trainings, staff can enroll in on-line courses in public nutrition.

Conclusion

Looking ahead to the next 35 years is nearly unimaginable given the enormous changes over the previous four decades since the Sultan ascended to the throne in 1970: the remarkable gains in life expectancy, health and life choices for the people of Oman, significant improvements in education, particularly of girls, greater involvement of women in government and in each sector. All of this in the context of a changing world: the advent of the internet, the spread of mobile phone technology, the first commercial success of personal computers, the inauguration of the laptop, improvements in transportation both global and local, and so on.

Global technology has brought with it an amazing spread of ideas, at lightening speeds, and a universal sharing of knowledge and information. But with it has also come lifestyle changes within the society: more time spent sitting than engaged in physical activity, more time spent exposed to a media that creates demand and stimulates desires, potentially generating a sense of inequity and dissatisfaction, access to global foods processed in energy-dense and often unhealthy forms. The citizens of Oman have more choices than many people in the world, given the present status of their government, their education, their economy and the strength of the industry upon which their standard of living depends. Yet the choices that some take are not always the right ones: over consumption of energy dense processed foods, a need to drive everywhere rather than walk, poor exercise levels in general with more time spent sitting before a computer than ever before, poor access to organically grown vegetables and fruits. In addition, the nutritional needs of women are often not attended to until they are pregnant.

The choices have resulted in persistent low birth weight babies in some areas; universally disappointing rates of exclusive breastfeeding at six months despite early initiation; the encroachment of infant formula and processed foods for children; higher than expected stunting rates from poor nutrition *in utero* and in the first two years of life; micronutrient deficiencies (particularly iron and Vitamin D), in part from lack of dietary diversity; a growing epidemic of overweight and obesity accompanied by non-communicable diseases like CVD, CAD, Diabetes and cancer that are imposing great costs to human and financial capital.

These differences in choices, some of them socially, some culturally, some economically driven lead to disparities; reducing them remains the ultimate challenge to a government that has done so much for so many of its citizens. The challenge is to identify through improved data and information the areas and the populations where the greatest needs remain, to increase the capacity of the system in public nutrition throughout the society and in every relevant sector, and then to mobilize and coordinate all relevant multisectoral resources so that they converge on the areas of greatest need. This Strategy defines trends and issues, and suggests future possibilities that the country can reasonably be expected to achieve in health and public nutrition over the next three and a half decades in order to reach the Vision for 2050.

Annex 1: Output from *Partners for Public Nutrition*: opportunities for multi-sectorality

NOTE: The following is the output of a workshop held 5-6 February 2014 under the leadership of the Department of Nutrition, Ministry of Health, Sultanate of Oman. The output is restricted to those Ministries / Departments present at the workshop. Not all relevant Ministries attended, though having expressed an interest to do so, because of schedule conflicts.

Partners for Public Nutrition: Education

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Education	Access to all children from primary, through tertiary levels Access to 15 – 18 year olds; 19 – 24 year olds; access to parents and families School retention delays age of marriage and age of first pregnancy Ultimate system for the dissemination of information and knowledge; respected member of community with great credibility School Dropouts are under investigation by the Ministry – would represent highly vulnerable / high risk population. Instilling skills and right behavior start at early stage Providing information and instilling behavior requires casual implementation The school environment is the right place to support the right application- an opportunity to provide the right nutrition including curriculum details and influencing provisions in the school canteens	. School Teachers . Administrators . Educational Planners . School Health Nurses . School staff . Social worker . Health educator . Psychologist . School health doctor . Dietician . Financial specialist . Peers/students . Parent-teacher association . Students clubs/activities	• Pre-service teacher training schools/colleges/universities • And in service • Accreditation boards • Professional associations • Parent Teacher Associations • Extra-curricular school nutrition societies for outreach to communities • Qualification exam preparation • Staff development programs • Integration in all academic subjects • Adolescents strategy – revise nutrition component • Enhance pre-marital counseling to emphasize on nutrition	Appropriate nutrition early in pregnancy improves cognitive development and hence school performance of children Appropriate nutrition in/before class improves in-class school performance Improved school performance and capacity of students reduces failure/drop-out rate/absence Involvement of expert staff from other sectors could enrich classroom teaching and afterschool activities Reduce financial costs Education activities & awareness programs Reduce double unnecessary efforts

	School provides the right place for performing medical screening and collecting data for statistical purpose and providing care Schools provide different ways and specialist to educate and raise awareness An opportunity to target different members of society through designing different manuals targeting different groups in a way that suits them (age-specific)			
--	--	--	--	--

***Partnership advantage** describes the strength of the partner that could be best applied to improving National Nutrition.

****Capacity Development Opportunities** describe on-going training programs, system strengths, monitoring or evaluation strategies to which public nutrition topics could be added to enrich the program.

****Benefit to partner** describes how partner programs can benefit from public nutrition inputs

Partners for Public Nutrition: Commerce & Industry

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Commerce and Industry	Regulatory body → sets rules and has power to determine enforcement regarding importation of all foods and nutrients; Has the capability to regulate imports of processed foods damaging to health; could amass data for challenge to the WTO Has potential to influence MoF re taxes on unhealthy food Connections to GCC for advocacy Can provide data on imports and quality; key ministry for food safety Connections to Consumer Protection Organization Provide guidance on restricted infant formula use and enforcement of the code of marketing of breastmilk substitutes (BMS)	. National professional staff . Legal departments . (field staff for enforcement is present but in insufficient numbers; monitoring needs strengthening)	- Provides expertise in the business side of public nutrition → could be resource in this topic for other training programs. - Has done surveys and studies of imports and legal aspects of international laws related to world trade (?) - Could provide source material for financial monitoring - Support monitoring of foods regarding compliance to fortification standards, adherence to the code of marketing of BMS, etc	Training in public nutrition could improve staff competence in challenging unsafe imports Could win recognition from Supreme Council of Planning for service to the country in protecting trade in unhealthy commodities (Gatekeepers for Good Nutrition)

Partners for Public Nutrition: Social Development

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Social Development	Links to Omani Women's Organizations; could provide vital link to pre-marital and pre-pregnant women Has access to highly vulnerable, welfare families where double burden of malnutrition might be most prevalent Capable of doing good social research; key organization for examining the social determinants of malnutrition Nursery institutions/KG – teachers + parents Nutrition indicators used in the targeting of social welfare beneficiaries particularly in areas of social disparities	. Omani Women's associations . Social services, social workers . Counselors . Researchers . Social center staff . NGO . Mental health (eating disorders/poor coping skills) . Psychologist . Orphan children	• Social worker training (in-service and pre-service?) • Social center staff training (in-service and pre-service?) • Social research institute staff: awareness of full range of public nutrition capacity needs • Strengthen existing programs- awareness program for adolescents on marriage • Implement women rights – importance of mother being there (maids, special places at work, work hours) • Focus on psychological aspects • Men's role • Domestic violence? • Microcredit? • Voucher system targeting the highlight vulnerable?	• Could improve status of welfare families by preventing under and over nutrition • Reduction in costs to society by reducing number of women with unwanted pregnancies, low birth weight babies, etc. by counseling and providing social services. • Public nutrition is ultimately a human rights issue (assists SD in supporting CRC and CEDAW)

Partners for Public Nutrition: Regional Municipalities and Water Resources

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Regional Municipalities and Water Resources	Monitoring of food safety of food chain means involvement in most aspects of production to consumption (field to fork). Will consider including questions regarding food quality (i.e., trans fats, xs carbohydrates) in ~5 years once food safety problems are well cared for; could sensitize the community to food quality issues. A Center for Food Safety and Quality could become showcase for reducing foods dangerous to the health of the country. Member of GCC food safety committee – access to GCC. Monitors food fortification; can fine violators. 1. Increase awareness about food safety 2. Prevent & reduce food poisoning and food borne diseases (decrease food contamination) 3. Prevent water contamination 4. Fluorination of water	. Researchers . Regional committees . Regional food inspectors . Laboratories . Legal department for food law . Health inspector	• Introduce public nutrition to regional food safety staff • Bring public nutrition to attention of GCC food safety committee → regional impact • Use of extensive monitoring system for assessment of spread of high fat/high carbohydrate foods • Fill the gap between safe food and healthy food • Well trained staff on nutrition	• Involvement in public nutrition could expand the scope of influence of MMRWR. • Involvement in quality issues would require closer links and support from UN Agencies, etc. • Be able to: - Expand the scope to involve healthy food - Improve experiences especially activities Decrease load on ministry of health Share knowledge and experience

Partners for Public Nutrition: Agriculture

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Agriculture	Is developing an expansive food security strategy. Agricultural extension workers reach families. Work directly with women agriculturalists. One of the most important ministries for reaching women before they become pregnant. <u>Innovative</u>: looking at establishing farm schools, youth clubs; re-establishing school gardens, home gardens – entry points for community and household discussions about the causes of double burden of malnutrition, importance of micronutrients; looking for involvement in sports and sport foods. Intent on reduction of food wastage Intent on national dietary survey done jointly with Health. Working on marketing strategies to change consumption patterns. Interested in a joint program for monitoring and evaluation (NMIS?) of food/nutrition. Already doing joint programs; example for others. Advocating for joint examination of all policies related to food and nutrition to bring them under one roof.	. Extension workers . Rural development staff . Trainers of extension workers . Faculty and staff of agricultural schools / programs . Nutrition officer = food safety and protection officer	- Public nutrition content in agricultural institutions and schools - Involvement in training of agricultural extension workers so they understand end point of good food production and importance of women's nutrition. - Linkages and harmonization of Agriculture Food Security Strategy as key element of National Multisectoral Public Nutrition Strategy - Can influence agricultural education institutions and introduce public nutrition into those curricula.	- Elements of MoAg Food Security Strategy become key elements in Vision strategies for country's future. - Achievement of MoA Food Security Strategy goals is accelerated - Public Nutrition / Agriculture Extension workers find farmers and families easier to convince about modern methods - Joint efforts with Education, Health, Social Development, Consumer Protection could lead to significant reduction of food wastage and 'virtual' increase in food production - Access to schools through school gardens would advance influence and motivate change. - Media connection with CPA would be valuable for rapid dissemination of information. - Would be active member of Multisector Nutrition Technical Steering Committee - Joint programs could ease some financial restraints

Partners for Public Nutrition: Consumer Protection Authority

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Consumer Protection Authority	• Possibly strongest media unit in the government. • Knowledge and extensive use of social media (i.e., Twitter, Facebook, Instagram, WhatsApp, YouTube) (with 50,000 followers) • Capability of generating awareness in the community, particularly among the younger demographic • Vehicle for consumer education and would welcome input from partners in public nutrition • Could monitor food price fluctuations as possible warning of impending problems or means of targeting vulnerable populations • Monitor differential food prices of high quality food vs junk food. • Increase awareness about food labeling • Increase awareness on public nutrition (pre-pregnancy, pregnancy, children ...etc) through social media + buses and available routes • Control the market of unhealthy food • Awareness in the markets about expiry dates, labeling, instructions for use, storage, ...etc	• Media department staff • Community based monitors • Regional trainers (outsourced)	• Train media staff in multisectoral public nutrition content to facilitate inclusion of nutrition information through social media • Introduce public nutrition content into training of field monitors • Use outreach and contact monitoring to determine extent of spread of public nutrition information. • Train staff in public health • Links with other sectors to provide articles and information to educate consumers	• Consumer is better protected due to increased awareness of dangers of poor quality nutrition, etc. • Media Unit reputation extends to all stakeholder ministries • Staff is capable of responding to consumer demands for better, more affordable foods. • Spread public nutrition information through social media

Partners for Public Nutrition: Supreme Council for Planning

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Supreme Council for Planning	• Apex body for strategies and programs affecting national nutrition • Strategic entity replacing cabinet by Royal Decree to coordinate implementation of policy and strategy • Access to the highest authority in the land. • Council has power to convene multisectoral nutrition steering committee (technical) and assign accountabilities.	• Council members • Public sector • Private sector	• Individual advocacy and sharing of information to each member of the council • Monitoring & evaluation • Plans for short and long term periods	• Council recognizes the importance of public nutrition for national security.

Partners for Public Nutrition: Academia

Academia SQU=college of agricultural and marine sciences, college of nursing, college of medicine and health sciences, college of education	• Access to age group ≥ 18 to 25 yrs • University elective courses • Degree required courses • Students in health related degree programs – Food, nutrition and dietetics, nursing • Student societies in all colleges – community service on campus and off campus • Community services activities via courses work – health related majors (change 4 life; my mother and me; healthy village) • Student research projects at undergraduate level – FURAP- research council • Graduate degrees – projects • Consultancy via center for community service – DVCUDC •	. Researchers at PhD level, academic staff at FSHN, NURSING, MEDICINE & PE; technical staff; lab facilities; statistics (college of science); . Students at undergraduate and graduate levels . SQU staff . Center for community services . Center for education technology and instructional media (CET) . Student concealing center . Deanship of student affairs	• Introduce university required course (s) on nutrition/PA and national health concerns • Introduce nutrition course work to PE major • Review efficiency of nutrition course work for all health related majors • Conduct workplace advocacy for nutrition/PA programs •	• Publication and visibility of SQU nationally and internationally • Attract consultancy funds to SQU • Increase the credibility of SQU nationally and internationally • Increase awareness/knowledge about significance of nutrition and its relationship to NCD and other national health concerns (increase awareness/knowledge on health and nutrition and improve pregnancy outcomes and PEM, anemia and probably other NCDs) • Better utilize SQU research funds to serve the nation and to have a national impact study projects • Guide and open opportunities of research areas to be focused on in relation to research council funds
--	--	---	--	--

Partnership for Public Nutrition: Health

Ministry / Department	Partnership Advantage*	Human Resources	Capacity Development Opportunities**	Benefit to partner**
Health / Department of Nutrition	Traditional home for maternal and child nutrition Multiple programs for women and children with many venues to reach target population for improving nutrition. Ability to reach pregnant women; programs for adolescents; called in for any programs in other ministries with a health content. Has programs (e.g., EPI) with massive outreach and high coverage Is involved in training of nurses, clinical nutritionists, and dietitians. Would be able to identify candidates for future training in public nutrition from health sector. Successful in reducing mortality rates (child > maternal) and in achieving health-related MDGs; good track record. Involved with staff from the highest level of government to village level. Has both clinical and public health expertise. Department of Nutrition has excellent research and publication history. Knows how to produce evidence to support programs. Has been involved in other multisectoral programs.	. Doctors . Nurses . Hospital staff . Public Health workers . Medical and Nursing students . District Health Officers . Community health workers	• Pre-service training option for all staff: nursing, medicine, primary health care. • Precedent for in-service training; staff have a vocabulary that would match well with public nutrition • Public health staff understand population based programs; would adapt well to public nutrition concepts. • Respected as focal points for nutrition in most situations (even though clinical nutrition). Could make shift to leadership in public nutrition with appropriate training.	• Staff would learn about a new field: population based nutrition. • Public health nutrition (a sub-category of public nutrition) is to public health as dietetics are to clinical medicine. • Would benefit in many programs from collaboration with other sectors, particularly in other than only leadership role. • Would gain greater influence over education and agricultural programs. • New initiatives would open up new avenues for research and publication for health and medical staff.

References

1. MOH-UNICEF-WHO. Exec Sum: National Micronutrient Status and Fortified Food Coverage Survey, Oman 2004. Muscat, 2004.
2. DoN-MOH. National Nutrition Surveillance Report. Muscat, 2009.
3. UNICEF. The Situation of Adolescents and Youth in the Middle East & North Africa Region. Amman, Jordan: UNDG, 2010.
4. Falkner F, Holzgreve W, Schloo R. Prenatal influences on postnatal growth: overview and pointers for needed research. *European Journal of Clinical Nutrition* 1994; **48**(1): 15-24.
5. Shrimpton R. Life cycle and gender perspectives on the double burden of malnutrition and the prevention of diet related chronic diseases. *SCN News* 2013; (33): 11-4.
6. MOH. Annual Health Report 2012. Muscat: Directorate General of Planning, 2012.
7. Victora CG, de Onis M, Hallal PC, Blössner M, Shrimpton R. Worldwide timing of growth faltering: revisiting implications for interventions. *Pediatrics* 2010; **125**(3): e473-e80.
8. Black RE, Victora CG, Walker SP, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet* 2013.
9. Hales CN, Barker DJ. The thrifty phenotype hypothesis. *Br Med Bull* 2001; **60**: 5-20.
10. Tanner JM. Fetus into man: Physical growth from conception to maturity: Harvard University Press; 1990.
11. Winick M. Cellular growth during early malnutrition. *Pediatrics* 1971; **47**(6): 969-78.
12. Cabalda AB, Rayco-Solon P, Solon JAA, Solon FS. Home gardening is associated with Filipino preschool children's dietary diversity. *Journal of the American Dietetic Association* 2011; **111**(5): 711-5.
13. WHO. The world health report 2000: health systems: improving performance: World Health Organization; 2000.
14. MOH. Annual Health Report, 2012.
15. Prinzo ZW. Mission Report: Review of the Protein Energy Malnutrition Programme of the Sultanate of Oman. WHO Geneva: Nutrition in the Life Course Unit, 2010.
16. DoN-DGHA. Report 11: Update on the status of micronutrients with relevance to UNICEF report 2009. Muscat, 2009.
17. MOH-DN. Food Based Dietary Guidelines: Technical background and description, Communication and Advocacy Plan. In: Nutrition Do, editor. Muscat, Oman: MOH, SoO; 2009?
18. Al-Waili M, Al-Qasbi, A.H., Al-Harthi, A.M., Al-Jufaili, F.H., Al-Rashidi, F.A., Al-Kharusi, K.W., Al-Anqodi, N.S., Al-Kindi, N.M., Al-Shukaili, S.S. National Nutrition Security Plan 2050. Muscat, 2013.
19. Al-Lawati JA, Mohammed AJ, Al-Hinai HQ, Jousilahti P. Prevalence of the metabolic syndrome among Omani adults. *Diabetes care* 2003; **26**(6): 1781-5.
20. Musaiger AO. Overweight and obesity in eastern mediterranean region: prevalence and possible causes. *Journal of obesity* 2011; **2011**.
21. Mokdad AH, Jaber S, Aziz MIA, et al. The state of health in the Arab world, 1990–2010: an analysis of the burden of diseases, injuries, and risk factors. *The Lancet* 2014.
22. Rahim HFA, Sibai A, Khader Y, et al. Non-communicable diseases in the Arab world. *The Lancet* 2014.
23. WHO-EMRO. Report on the Technical consultation on scaling up nutrition in the Eastern Mediterranean Region. Amman, Jordan: Eastern Mediterranean Regional Office, 2012.

24. NPC-GoN. Multi-sector Nutrition Plan: for accelerating the reduction of maternal and child under-nutrition in Nepal, 2013-2017(2023). In: Commission NP, editor. Kathmandu: Government of Nepal; 2012.
25. Shrimpton R, Victora CG, de Onis M, Lima RC, Blossner M, Clugston G. Worldwide timing of growth faltering: implications for nutritional interventions. *Pediatrics* 2001; **107**(5): E75.
26. Li H, Stein AD, Barnhart HX, Ramakrishnan U, Martorell R. Associations between prenatal and postnatal growth and adult body size and composition. *The American journal of clinical nutrition* 2003; **77**(6): 1498-505.
27. Dobbing J. The later growth of the brain and its vulnerability. *Pediatrics* 1974; **53**(1): 2-6.
28. UNICEF. Strategy for Improved Nutrition of Children and Women in Developing Countries. . UNICEF, New York, 1990.
29. Afifi M. Anemia in pregnancy at South Sharqiya health centers, Oman. *The Journal of the Egyptian Public Health Association* 2002; **78**(1-2): 39-54.
30. Al Riyami A, Elaty MAA, Morsi M, Al Kharusi H, Al Shukaily W, Jaju S. Oman world health survey: part 1-methodology, sociodemographic profile and epidemiology of non-communicable diseases in oman. *Oman medical journal* 2012; **27**(5).
31. DGHA. National Nutrition Surveillance results. Muscat: Ministry of Health, 2010.
32. Al-Riyami AA, Afifi MM. Prevalence and correlates of obesity and central obesity among Omani adults. *Saudi medical journal* 2003; **24**(6): 641-6.
33. Alasfoor D, Rajab, H., Hadaad, R., Al-Rassasi, B., . Food Based Dietary Guidelines: Technal background and description. In: Department of Nutrition DGoHA, editor. Muscat, Oman: MOH; 2013.
34. Sinani S, Shafaei, M., et. al. Familial Clustering of Type 2 Diabetes among Omanis. *OMan Medical Journal* 2014; **29**(1): 51-4.
35. Al-Shookri A, Khor G, Chan Y, Loke S, Al-Maskari M. Type 2 diabetes in the sultanate of Oman. *Malaysian journal of nutrition* 2011; **17**(1).
36. Alasfoor D, Elsayed M, Al-Qasbi A, Malankar P, Sheth M, Prakash N. Protein-energy malnutrition among preschool children in Oman: results of a national survey. *Eastern Mediterranean health journal* 2007; **13**(5): 1022-30.
37. Victora CG, Adair L, Fall C, et al. Maternal and child undernutrition: consequences for adult health and human capital. *Lancet* 2008; **371**(9609): 340-57.
38. De Onis M, Onyango AW, Borghi E, Garza C, Yang H. Comparison of the World Health Organization (WHO) Child Growth Standards and the National Center for Health Statistics/WHO international growth reference: implications for child health programmes. *Public health nutrition* 2006; **9**(07): 942-7.
39. Al-Riyami A, Ebrahim G. Genetic blood disorders survey in the Sultanate of Oman. *Journal of tropical pediatrics* 2003; **49**.
40. Abiaka C, Delghandi M, Kaur M, Al-Saleh M. Vitamin D Status and Anthropometric Indices of an Omani Study Population. *Sultan Qaboos University medical journal* 2013; **13**(2): 224.
41. Al-Kindi MK. Vitamin D status in healthy Omani women of childbearing age: study of female staff at the Royal Hospital, Muscat, Oman. *Sultan Qaboos University medical journal* 2011; **11**(1): 56.
42. Fuleihan GE-H. Vitamin D Deficiency in the Middle East and its health consequences for children and adults. *Clinical Reviews in Bone and Mineral Metabolism* 2009; **7**(1): 77-93.
43. Alasfoor DH, Roushdi, A.E., . Standard operating procedures for management of protein energy malnutrition in primary and secondary health care services in Oman. In: Department of Nutrition DGoHA, editor. Muscat: Ministry of Health; 2004.

44. Alasfoor D, Traissac P, Gartner A, Delpuech F. Determinants of persistent underweight among children, aged 6–35 months, after huge economic development and improvements in health services in Oman. *Journal of health, population, and nutrition* 2007; **25**(3): 359.
45. Alasfoor MD, Rawas MS, Al-Farsi MY, Alshishtawi M. National Study on the Role of Care in the Nutritional Status of children under 2 years old in Oman. *Muscat: Ministry of Health* 2000: 30.
46. Abdou SAH, Al-Muzahmi, S., Hilmy, S.A. Oman Global School-based Student Health Survey. Muscat: MOH-MOE, 2010.
47. UNICEF. Oman Country Office Annual Report 2012. Muscat: UNICEF, 2012.
48. WHO. Adolescent pregnancy-Unmet needs and undone deeds. A review of the literature and programmes. Issues in Adolescent Health and Development. 2007. *whqlibdoc who int/publications/2007/9789241595650_eng.pdf* Revisado 07-12 2011.
49. Machado L, Saquib, S., Zulfikar, S. . Teenage Pregnancy in Oman: Maternal and Fetal Outcome and Implications. Muscat, Oman: Sultan Qaboos University Hospital, , 2013.
50. CIA. The World Fact Book - Oman. 2014. <https://http://www.cia.gov/library/publications/the-world-factbook/geos/mu.html> (accessed 22 March 2014 2014).
51. Madanipour A. Whose public space?: international case studies in urban design and development: Routledge; 2013.
52. Despommier D. The vertical farm: controlled environment agriculture carried out in tall buildings would create greater food safety and security for large urban populations. *Journal für Verbraucherschutz und Lebensmittelsicherheit* 2011; **6**(2): 233-6.
53. Pinstруп-Andersen P. Food security: definition and measurement. *Food security* 2009; **1**(1): 5-7.
54. Breisinger C, van Rheenen T, Ringler C, et al. Food security and economic development in the Middle East and North Africa. *Current State and Future Perspective IFPRI Discussion Paper* 2010; **985**.
55. Mbagha MD. Alternative mechanisms for achieving food security in Oman. *Agriculture & Food Security* 2013; **2**(1): 3.
56. Gustavsson J, Cederberg C, Sonesson U, Van Otterdijk R, Meybeck A. Global food losses and food waste. *Food and Agriculture Organization of the United Nations, Rom* 2011.
57. Yang Q, Zhang Z, Gregg EW, Flanders WD, Merritt R, Hu FB. Added Sugar Intake and Cardiovascular Diseases Mortality Among US Adults. *JAMA internal medicine* 2014.
58. Al-Ghannami S. The Effectiveness of Iron Supplementation in the Prevention of Anemia during Pregnancy.
59. MOH-CDC-IMMPaCt-WHO-UNICEF. National Micronutrient Status and Fortified Food Coverage Survey. Muscat: MOH, 2009.
60. Idris M, Shaban M, Fatahallah M. Effective control of hookworm infection in school children from Dhofar, Sultanate of Oman: a four-year experience with albendazole mass chemotherapy. *Acta tropica* 2001; **80**(2): 139-43.
61. Alasfoor D. Trends in breastfeedin Rates in Oman; Impact of the Baby Friendly Hospitals Initiative. In: Department of Nutrition DGoHA, editor.; 2006.
62. Islam MM. Incidence of and Risk Factors for Low Birth Weight in Oman: A Population Based Study. *International Journal of Maternal and Child Health* 2013; **1**(4): 77-86.
63. Barker DJ. Fetal origins of cardiovascular disease. *Ann Med* 1999; **31 Suppl 1**: 3-6.
64. Lindsay RS, Bennett PH. Type 2 diabetes, the thrifty phenotype - an overview. *Br Med Bull* 2001; **60**: 21-32.
65. Ravelli G-P, Stein ZA, Susser MW. Obesity in young men after famine exposure in utero and early infancy. *New England Journal of Medicine* 1976; **295**(7): 349-53.