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Nutrition – The Key For Prevention And Management of Chronic Diseases In The Caribbean

Godfrey Xuereb^a

Over the last 10 to 15 years various regional institutions in the Caribbean have developed protocols for the clinical management of chronic diseases, which have been used to improve the quality of care given to persons with these diseases. However, the nutritional component of care has not been adequately addressed in these protocols and no standard guidelines existed in the region for their nutritional management.

In the late 1990's the Caribbean Food and Nutrition Institute (CFNI) developed a training manual on the dietary management of diabetes, hypertension and obesity aimed at primary health care workers. This was very successfully adopted by many of the region's healthcare workers and due to widespread demand for it, CFNI recognized the need for a formal protocol to be developed for use in primary care settings. In collaboration with the Caribbean Program Co-ordination Office of the Pan American Health Organization (CPC/PAHO), CFNI embarked on the development

of a regional protocol for the nutritional management of diabetes, hypertension and obesity.

The main goals of the protocol were to improve standards of care for, and the quality of life of, all those living with these chronic diseases in the Caribbean. It was to provide the necessary tools for the process of nutrition management, including assessment, planning, implementation, coordination and evaluation.

CFNI, in conjunction with the Diabetes Association of the Caribbean (DAC) obtained funding from the World Diabetes Foundation (WDF) to enable it to complete the protocol and also assist with the implementation training that was identified as one of the key barriers to success.

The protocol should provide a framework for nutritional care which will guide standard care using a set of core nutritional care parameters. It should serve as a practical management tool with timely referral of the client to the appropriate health professional for care beyond the

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knowledge, training and skills of particular members of the multi-disciplinary health care team.

In this edition of **Cajanus**, we will be looking at some of the information that is available in the protocol. The use of the protocol is also reinforced in the article by Patti Geil which looks at how diabetes outcomes can be improved through the use of nutrition practice guidelines.

The development of non-communicable diseases has been traced to the uterine development stages of life. The way the foetus grows in utero determines the development of many of the medical conditions and psychological functions later in life.

The aspect of psychological development is discussed in a paper by Baker-Henningham et al. and is complemented by a paper by Professor Susan Walker which looks at the factors associated with size and proportionality at birth. All these intra-uterine development factors have an important bearing on the health of the newly-born child but also on how that child will develop and the predisposition to non-communicable diseases in later life.

It appears then, that prevention of chronic non-communicable diseases should start very early in life and the concepts of healthy living should be extended to include the intrauterine life.

THE SIX FOOD GROUPS

1. STAPLES	2. FOODS FROM ANIMALS	3. LEGUMES
Bread Bammy Biscuits Noodles Cornmeal Breakfast Cereals Breadfruit Sweet Potato Irish Potato Green bananas Yams Rice Pasta	Chicken Ham Liver Fish Shrimps Cheese Goat Beef Pork Egg Milk Yogurt	Almonds Dried Peas and Beans Green peas Baked Beans Peanuts Textured Vegetable Protein
4. VEGETABLES	5. FRUITS	6. FATS & SUBSTITUTES
Cabbage Cucumber Lettuce Okra Tomato Carrot Pumpkin Onion String Beans	Grapefruit Orange Banana Guava Mango Papaya Watermelon Apple Peaches	Margarine Avocado Ackee (Jamaican) Peanuts Olives Butter Oil Salad Dressing Lard Shortening Coconut

Adapted from: CFNI's "Protocol for the Nutritional Management of Obesity, Diabetes and Hypertension."



The Nutrition Management Process for the Care of Non-Communicable Diseases in the Caribbean^a

Chronic non-communicable diseases in the Caribbean are now one of the main causes of morbidity and mortality. The main ones in this group that affect the Caribbean are hypertension, diabetes and cardiovascular disease. All three of these are very closely linked to obesity, which has also become a major problem in the Caribbean Region.

Obesity management is imperative in the management of these three chronic diseases and nutrition is a key factor in this management process. While the indicators for success and the outcome will be different, the principles of nutritional management of persons with chronic diseases are the same as those for management of any business or establishment. The process of nutrition management includes four stages: Assessment, Planning, Implementation, Coordination and Evaluation.

Assessment involves the gathering of information and analysis of data.

This provides information (historical data) on the person before nutrition intervention begins. Planning involves the interpretation of findings from the assessment and translating these to achievement targets. This process outlines the strategies and activities to be used to achieve these targets and how success will be evaluated. Planning includes information for the education process. Implementation is the actual process through which the plan is put into action, whilst coordination involves communication as well as documentation. All aspects of Nutritional Care should be communicated to other health care team members to facilitate reinforcement of the nutrition strategies by other team members. Achieving desired health outcomes is dependent on integrating Nutritional Care with other aspects of medical management. The final phase is Evaluation, which is the process of examining the implementation to determine if the process is achieving the set targets and

^aExtract from CFNI's "Protocol for the Nutritional Management of Obesity, Diabetes and Hypertension in the Caribbean".

yielding the desired results by comparing actual results with set goals. This also involves observation of the client's behaviour to determine if he/she is ready to accept a greater level of self-care. Evaluation may reveal unexpected findings, both positive and negative, which can be used to improve the care plan.

Managing NCDs demands effective allocation and use of resources. The health team offering Nutritional Care must focus its management skills to facilitate successful outcomes. Resources such as time, information, money and materials must all be carefully managed to ensure effective and efficient use for the benefit of the patients.

The Nutritional Care Process

Proper Nutritional Care is integral to the successful management of obesity, diabetes and hypertension. Compliance with the nutrition and meal planning principles, however, remains one of the most challenging aspects of care. The steps necessary for successful management are easy to follow and are important for any health care professional to achieve good management strategies.

An important first step in initiating Nutritional Care is evaluating the nutrition status of the individual. Nutrition assessment must be completed for every person with obesity, diabetes or hypertension who presents

for initial care. Nutritional assessment is an important tool for identifying existing or potential problems and identify clients needing a more comprehensive screening.

Assessment generates the information needed for a comprehensive approach to nutrition intervention. Some parameters will need to be assessed each time the individual presents for care. These include weight, blood pressure, dietary intake and blood glucose (only for diabetes). In defining the level of nutrition intervention for the targeted diseases, a total review of historical data is important. This will set the framework for all the problems/illnesses that must be targeted as part of the nutrition intervention process.

Indicators of Nutritional Risk

These indicators include:

1. Dietary intake – quality and/or quantity.
2. Decreased absorption of nutrients.
3. Decreased utilization of nutrients.
4. Increased nutrient losses.
5. Increased nutritional requirements.

The assessment process involves the systematic process of collecting objective information about the client, his/her environment and the support system. Results of assessment give

some insight into some of the challenges the client may face and the resources that are available to cope with them include:

1. Review of historical data.
2. Careful data collection:
 - Anthropometric
 - Biochemical
 - Clinical
 - Dietary
3. Determination of exercise/activity level.
4. Assessment of client's ability and readiness to participate in care plan.
5. Assessment of client support network – home/community.
6. Interpretation of data.
7. Use of the data to provide appropriate care.

Review of Historical Data

Historical data will provide an insight into any relevant past illnesses or circumstances that may directly or indirectly impact on the client's nutrition needs and health status. This data includes the health and diet history, the socioeconomic history and the diet history – all of which will help the professional build a better picture of the client and the environment he/she lives in.

Data Collection

This is an important phase of the assessment and involves various parameters which include the measurement of body height, weight and proportions such as waist and hip circumferences. These measures are non-invasive and are used to evaluate nutrition status, to monitor the effects of nutrition intervention and to provide information about the body's stores of fat and muscle.

Biochemical data such as blood glucose and lipid levels are also important for the establishment of control and planning strategies for management. Other clinical data such as signs and symptoms of disease and problems related to nutrition are also important to note, so as to establish a good management strategy. Finally, but very importantly, an accurate diet history must be taken as part of the overall nutrition history. The diet history provides valuable information about the client's past and current food behaviours. All these parameters help build an effective and efficient nutrition care plan.

The goals of nutrition therapy are mainly:

- To maintain near-normal blood-glucose levels by balancing food intake with insulin or oral medication and physical activity levels.

- To provide adequate calories to attain and maintain reasonable weights for adults, normal rates of growth and development in children and adolescents, increased metabolic needs during pregnancy and lactation or recovery from catabolic illnesses.
- To control blood pressure.
- To achieve optimal blood lipid levels.
- To prevent, delay or treat acute insulin-related complications such as hypoglycaemia, short-term illness and exercise-related problems.
- To prevent, delay or treat long-term complications of obesity, diabetes or hypertension. These include, but are not limited to, renal disease, neuropathy and cardiovascular disease.
- To improve health through optimal nutrition.

Thus in devising a nutrition care plan one must ensure that this is integrated into the overall management plan for the client and should be focused on the desired treatment outcomes and aims for permanent modification of lifestyles including eating behaviours. An essential component of the Nutritional Care process is the measurement and documentation of outcomes. An

evaluation of the medical, clinical, biochemical, educational and psychological outcomes provide information on the effectiveness of nutrition therapy in the overall management plan.

The client's long- and short-term nutritional needs should be clearly identified in a plan of action based on findings from the assessment. The Nutritional Care Plan should outline the objectives for meeting nutrition and educational needs as well as the content of the counselling sessions and the time frame for achieving the objectives.

The individual's nutrient requirements, their sources and the strategies for meeting them should be considered. The plan should be discussed with the client and his/her family. The final plan should be achieved in discussion with the other members of the healthcare team. Seek the assistance of Nutrition/Dietetic personnel in developing the plan. Counselling sessions should then be planned to provide instructions and recommendations for the client. The counselling process may require several sessions to address the care plan, the diet and to evaluate the client's understanding as well as responses to the plan.

The next step in the management process is the implementation of the plan. This should involve meal

planning which is mainly the use of foods, food groups and nutrients to facilitate variations for individual/group preferences, cultural habits, health status and socio-economic factors to achieve specific objectives. It is an interactive process between the client and the health care provider. Meal planning is a focal point in the management of obesity, diabetes and hypertension. The meal planning process requires input from the client, including financial, religious and cultural considerations.

The purpose of meal planning in the management of NCDs is to control weight, blood pressure and/or blood glucose, as well as to ensure that the right types and amounts of food are eaten. Another purpose of the meal planning is to control the specific nutrients that are appropriate to the targeted disease and to generally improve overall quality of life.

Meal planning ensures that the diet provides adequate amounts of all the essential nutrients, energy and fibre to maintain health while ensuring any required nutrient modification specific to the disease. It also manages the amount of energy consumed without over- or under-eating. This is done by choosing foods that give a good variety of nutrients for a small number of calories as well as by selecting foods from each of the food groups in proportion to each other thus preventing nutritional risks. Meal

planning allows the client to choose foods within a practical and creative setting. Meal plans that are rigid do not encourage compliance.

Thus the meal plan should be tailored to the needs of the individual while targeting the disease. There are many meal planning options, but, generally, the exchange system is used in the Caribbean. A food exchange is a measure or portion of one type of food that may be eaten instead of another type of food and provides similar nutrients and calories. To achieve all these goals the meal plan should be evaluated periodically and altered if necessary.

Implementing the Nutritional Care Plan involves providing both the appropriate meal plan and education. This process includes follow-up appointments to ensure timely incremental understanding, motivation and compliance.

Evaluation is usually a statement of the efficiency and effectiveness of the intervention and should be done at regular intervals, the frequency depending on the client's status. All the strategies that were implemented must be evaluated. The client's nutrition status and needs may change as his/her situation changes. The client's participation in developing the plan and his/her compliance will influence whether or not goals will be met. It is possible that more flexibility will be

required and different strategies and techniques may be needed to achieve desired results. The plan may also need to be revised because the client has achieved short-term goals and is ready to move on to the next level or because his/her socio-economic situation has changed.

The expected outcome of nutrition care is an improved nutrition status through improved food and nutrient intake. This can only be achieved through improved knowledge and a positive behaviour change. If the nutrition status is improved, then there should also be an improvement in the laboratory values, weight, blood pressure and thus a reduction in the risk factors and a paralleled delay of complications. All of this should improve the general quality of life of the client and his immediate family.

To achieve these expected outcomes, the health care team must involve the client and family members (including siblings) in all management discussions. This should result in an individualized approach to nutritional care which provides culturally appropriate information and educational materials and involves the client in the development of realistic plans, which include a variety of foods which are liked, available and fit his/her schedule and self-care regimen. The system should also facilitate follow-up visits and modification of goals when necessary. Schedule on-going education,

reviews, support and dialogue to improve acceptance and compliance are essential.

Another important aspect to the management process is the documentation of all the processes. There are specific factors that should be included in the documentation that captures information from the assessment process. All interventions of Nutritional Care including initial nutritional assessment must be documented in the client's medical records. The medical record is a permanent legal document that records the client's history, assessment and diagnosis.

Documentation serves to establish a record of the Nutritional Care process and maintain a strong professional communication network to inform all members of the health care team of the client's status, plans and actions taken. It also provides a framework/indication for intervention, re-assessment or follow-up care by other members of the care team and facilitates continuity of care, thus contributing to accuracy and better quality management. The document also provides a reference point for evaluating the impact of medical nutrition therapy on medical and clinical outcomes and client's quality of life by linking assessment with goals, intervention and strategies. It can thus be used to provide data for establishing cost-benefit and cost-

effectiveness of medical nutrition therapy.

An important aspect of the nutritional management of clients in the Primary Care System is recognizing the need for timely referral for specialist care. It takes an active health team to provide care for a client with chronic diseases. The chart below provides guidelines for referral of

clients to specific members of the health care team.

Working as a team the healthcare professionals, the client and his supporting environment (family and friends) should be able to plan and execute strategies that not only control the clinical condition but also ensure an improved quality of life.

Indications for Referral to Health Care Team Members

Indicator	Team member to whom client should be referred
Development of Meal plan	Nutritionist/Dietitian
Inter-current illnesses	Physician/Family Nurse Practitioner
Recurrent hypoglycaemia	Physician/Family Nurse Practitioner
Poor self-management	Management team
Infections	Physician/Nurse/Family Nurse Practitioner
Poor appetite or client not eating	Physician/Nutritionist/Dietitian
Vomiting	Physician/Nurse/Family Nurse Practitioner
Clients whose medication has finished	Physician/Nurse/Family Nurse Practitioner
Clients who express difficulty following any treatment regimen that must be handled beyond your level of competence or expertise	Doctor, Nurse, Family members, Nutritionist/Dietitian
Clients who have difficulty maintaining treatment targets, e.g. acceptable blood pressure, blood sugar or weight goals	Physician/Nutritionist/Dietitian, Family Nurse Practitioner
Change of treatment, e.g. from diet only to oral hypoglycaemic agents or a shift to insulin	Nutritionist/Dietitian, Nurse/Family Nurse Practitioner, Physician/Pharmacist

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Nutritional Management of Obesity^a

Obesity Management is the key strategy to the management and control of most non-communicable chronic diseases. Within the Caribbean region the problem of obesity has reached an epidemic proportion and interventions for its control have been postulated by various organizations.

The World Health Organisation has classified weight through the Body

Mass Index (BMI). This is a ratio between the height and weight of the person and is used to calculate risk to co-morbidities such as hypertension, diabetes and cardiovascular disease. The classification shown in Figure 1 annotates how the BMI is classified and related to risk of co-morbidities.

The effective management of obesity on a personal basis needs to be directed and monitored by a health

Figure 1: Standard Classification of Overweight in Adults by BMI (WHO)

CLASSIFICATION	BMI Kg/m ²	RISK OF CO-MORBIDITIES
Underweight	<18.5	Low <i>(but risk of other clinical problems increased)</i>
Normal range	18.5–24.9	Average
Overweight	≥ 25	
Pre-obese	25–29.9	Increased
Obese class I	30.0–34.9	Moderate
Obese class II	35.0–39.9	Severe
Obese class III	≥ 40.0	Very severe

Source: Obesity: preventing and managing the global epidemic: report of a WHO consultation. WHO technical report series; 89, Geneva 2000

^aExtract from CFNI's "Protocol for the Nutritional Management of Obesity, Diabetes and Hypertension in the Caribbean."

care professional. The strategies used would be planned and agreed upon by both the professional and the client. These strategies should not only result in a reduction in weight but also produce lifestyle modifications which will not only maintain the weight lost but also improve the general quality of life.

Effective weight management involves a careful balance of nutrient intake, physical activity, behaviour modification and a positive attitude toward achieving appropriate body weight. The overall aim should focus on achieving good health. The same eating and exercise habits that support a healthy lifestyle often achieve appropriate body weight.

During weight loss, approximately 20 kcals/kg (10 kcals/lb) of current weight is needed to spare lean body tissue while losing fat. A weight loss of 0.5-1kg (1-2 lbs) per week is usually recommended. In order to achieve desirable, practical weight loss which can be maintained, a reduction of 500 kcals/day from present caloric intake is recommended. At the end of one week, this should achieve a reduction of 3500 kcals, which translates to 0.5 kg (1 lb) of fat. It usually takes about three months to see the real effects of this intervention.

The causes of obesity are multifactorial. Metabolic, genetic, environmental, cultural, sociological, psychological and behavioural factors

all contribute but the complete aetiology remains unknown. Some key factors contributing to obesity include dietary intake, sedentary lifestyle and changes in diet, particularly increased intake of fat and simple sugars. Obesity results when more food energy is consumed than expended over a period of time.

Achieving weight loss in the obese individual is not usually easy. Additionally, only a small percentage of those who lose weight are able to maintain the weight loss. There are no consistent criteria that will categorize the type of people who will successfully lose weight.

The main objective of nutritional management of obesity is to achieve and maintain body weight whilst providing a nutritionally balanced, decreased calorie diet which will achieve healthy weight loss of 0.5-1kg (1-2 lb) per week. Another objective is to prevent or control complications such as high blood pressure, diabetes, heart disease and elevated uric acid levels. All this can be achieved by avoiding or correcting unhealthy eating behaviour.

In planning the treatment strategies, one has to first determine the level of obesity and the specific intervention needs of the client, e.g. elevated blood lipids. The classification for overweight and obesity can be calculated using the BMI and interpreted as per Figure 1.

After the needs of the client are established it is important to set realistic goals. The health care professional should assist the client to set his/her own short, medium- and long-term goals. A realistic goal is a loss of 5-10% of initial body weight at a rate of 0.5-1 kg (1-2 lb) per week. There is no magic food that will achieve and maintain weight loss and a meal plan which distributes calories over approximately six meals for the day, including snacks, is one of the best strategies to prevent over-eating. Where this is not possible, the health care professional should work within the client's schedule of activities.

Another important strategy is to increase the fibre content of the diet to encourage longer chewing, create more bulk and increase satiety. This can be achieved by including in the diet, fibre-rich foods like fruits, vegetables and legumes. This strategy should be accompanied by a decrease in the intake of high caloric foods such as fats (9 Kcal/g) and alcohol (7 Kcal/g). Low-calorie alternatives to high-calorie foods in the diet should also be identified. The diet should avoid severe restrictions, since very low calorie diets may lead to reduced Resting Energy Expenditure (REE) and affect the rate of weight loss. Normally, caloric intake less than 1200 Kcalories will require strict clinical supervision and should only be recommended in specific cases.

Since weight reduction requires behavioural change in many areas of life it is important that the healthcare professional schedules follow-up appointments to monitor progress and monitor weight using the same scale. These appointments will also be used to reinforce behavioural change, review targets and adjust strategies to ensure success. For those clients who need peer support a formal support group and family involvement need to be facilitated.

Along with a healthy, calorie-reduced diet, the health care professional needs to encourage regular physical activity. This should be done in accordance with the medical physicians recommendations and client's preference.

Self management is the key to successful weight reduction. This can be achieved by developing a weight loss programme with the input of the client. This therapy may take time, as weight loss is a slow process, thus it is important that the health care professional provides guidance to the client on how to maintain the diet and encourage changes in eating behaviour and general lifestyle behaviour to facilitate weight loss.

The strategies that can be deployed include the keeping of food diaries, including food choices, situations that encourage unhealthy eating. This is useful in identifying

triggers and sources of excess calories. Another strategy is the monitoring and recording of body weight on a monthly basis as well as the participation in moderate physical activity for most days of the week for at least 1 hour each day. It is important that once triggers that may contribute to over-eating are identified these are discussed and suggestions on how to modify or alter these triggers be implemented. Other strategies that might be deployed are those of reducing portion sizes, eating slowly, using smaller plates and eating utensils as well as choosing different foods and methods of preparation. All this should also help in substituting low-calorie alternatives for high-calorie foods.

Health care professionals should discourage fad dieting as this can lead to a weight loss/weight gain pattern that may demotivate the client and make weight loss more difficult. On the other hand they should assist them in self management through techniques such as promoting food label reading so that they will be able to make appropriate food choices and avoid foods which are excessively high in calories.

Regular physical activity is an essential component of any weight management programme and complements dietary measures. While exercise does not necessarily reduce body weight, body fat is reduced and basal metabolic rate is increased during and after exercise. Persons are more likely

to exercise if the activity is enjoyable. The type, duration and frequency should be tailored to individual ability and health status, but may include swimming, brisk walking, jogging and playing games, such as soccer and cricket. Joining with friends and family to exercise should also be encouraged.

All these strategies need to be put in place to assist the client to change lifestyle and behaviour. These changes will result in a decrease in body weight and thus a reduction in the risk for non-communicable diseases and their complications. Reducing weight will not only reduce risk of disease but will also help the individuals lead a better quality of life.

CAJANAQUOTE

“Overweight people desperate for quick and easy solutions to their problem have often followed fad diets to the detriment of their health. Most of the fad diets are scientifically questionable and potentially harmful. In addition, none of them has been shown to be a lasting answer to the tenacious and complex problem of obesity.”

*Quoted in “The Beverley Hills Diet” by G.B. Mirkin and Ronald Shore.
J. Am. Med. Ass., Nov. 13,
1981*

Nutritional Management of Diabetes Mellitus^a

Diabetes mellitus is a metabolic disorder characterized by elevated blood glucose levels resulting from defects in insulin secretion and/or uptake. It develops when insulin is absent, not secreted in adequate amounts or there is diminished tissue response and consequently the insulin is not used properly by the target tissues. There may also be a combination of these factors. As a result, the body cannot properly metabolize the macro-nutrients (carbohydrates, fats and proteins) in the normal way to effectively convert glucose into energy. High levels of glucose accumulate in the blood and spill into the urine. This can result in several complications involving long-term damage, dysfunction and failure of various organs including the eyes, kidneys, nerves, heart and blood vessels.

Several symptoms can indicate the presence of elevated blood glucose (hyperglycaemia). These include frequent urination, increased thirst, weight loss, sometimes increased hunger, blurred vision, itching and susceptibility to certain infections. In

children, there may be growth impairment. Some persons experience no symptoms and are diagnosed at health screening sessions or when they seek medical care for other problems. Some acute life-threatening consequences are associated with diabetes and include hyperglycaemia (high blood sugar) with ketoacidosis or the non-ketotic hyperosmolar syndrome, both of which can lead to coma.

Diabetes mellitus can be grouped into three main categories: Type 1, Type 2 and Gestational. Type 1 diabetes results from an autoimmune destruction of beta cells of the pancreas. The rate of beta-cell destruction varies and is quite rapid in some persons (mainly infants and children) and slower in adults. Type 1 diabetes is more common in younger persons but can occur at any age. As a consequence of the beta-cell destruction there is little or no insulin secretion and the individuals with this type of diabetes must rely on external sources of insulin for survival. In Type 2 diabetes the body develops insulin resistance which results in a

^aExtract from CFNI's "Protocol for the Nutritional Management of Obesity, Diabetes and Hypertension in the Caribbean"

relative rather than absolute insulin deficiency. Most persons with this type of diabetes do not need insulin treatment to survive, but some may require short-term insulin therapy to stabilize the disease especially in periods of stress, pregnancy and surgery. The insulin resistance is increased as the body weight increases and because of this for those diabetics who are obese, diet and exercise to achieve weight loss are normally the main lines of therapy. Medications should only be introduced when these measures do not achieve desired results. Approximately 90-95% of all persons with diabetes have Type 2 and it is more common among adults. Recently, a number of children are being diagnosed with Type 2 diabetes. These children are usually obese and are therefore developing insulin resistance at a much earlier age.

As the insulin resistance increases gradually so does the hyperglycaemia and because of this diabetes may not be diagnosed for several years. Persons with Type 2 diabetes are at increased risk for macrovascular and microvascular complications. Obesity, age, lack of physical activity and genetic pre-disposition, increase the risk of developing Type 2 diabetes. It occurs more frequently in women with previous history of gestational diabetes. Weight loss and/or pharmacological treatment of hyperglycaemia may improve insulin resistance.

The final classification of diabetes is that known as "Gestational Diabetes". This is defined as a degree of glucose intolerance which begins or is first recognised in pregnancy. Women who are markedly obese, have a personal history of gestational diabetes or glycosuria or a strong family history of diabetes are especially susceptible.

The general criteria for diagnosing diabetes suggested by The World Health Organization (WHO) Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (2000) outlines three ways to diagnose the disorder. These are:

1. Symptoms of diabetes plus random (casual) plasma glucose concentration >200 mg/dl (11.1 mmol/L). Casual is defined as any time of day without regard to time since last meal. The classic symptoms of diabetes include polyuria, poly-dipsia, and unexplained weight loss.
2. Fasting Plasma Glucose (FPG) >126 mg/dl (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 hours.
3. 2-hr PG >200 mg/dl (11.1 mmol/L) during an Oral Glucose Tolerance Test (OGTT). The test should be performed as described by WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.

Each test must be confirmed, on a subsequent day, by any one of the three methods.

Once diagnosis is confirmed nutrition therapy becomes an integral component of successful diabetes management and is one of the most challenging aspects of care due to the complexity of nutrition issues. Input from the client in developing intervention is extremely important in ensuring that the plan is appropriate to the individual's lifestyle and cultural practices. All nutrients play an important role in diabetes management, moderation in intake is usually the key. The major goals of therapy are to achieve metabolic control and to prevent or delay the macro-vascular and micro-vascular complications of diabetes.

Overall therapy for diabetes includes:

- Education
- Nutrition Therapy
- Physical activity and exercise
- Blood glucose monitoring
- Behaviour modification and self-care
- Management of medication (if required).

The main objectives are to achieve and maintain near normal blood glucose levels, i.e. Fasting – 80-120 mg/dL (4.4-6.7 mmol/l) and HbA1C – <7%. This should be done by providing a nutritionally adequate diet

which has a structured individualized meal plan with regular mealtimes and snacks as necessary to balance peak insulin activity and exercise. All this needs to be tailored to individual requirements.

The calorie distribution in the meal plan should be the same as that recommended for healthy eating which advises that the energy contribution from carbohydrates should be around 50-60%, with no more than 10% of the energy coming from added sugar. Proteins should contribute 15-20% of the total energy whilst the total contribution from fat should be less than 30% of which no more than 10% should be saturated fats. This distribution of calories should be worked out in the context of achieving and maintaining a healthy body weight and preventing or minimizing complications.

Nutrition therapy for persons living with diabetes should be developed on the same lines as any other type of nutrition therapy. Thus the therapy should be started with a nutrition assessment after which appropriate goals are set and agreed on by all the parties concerned. The nutrition intervention should be monitored and evaluated by the health care professional and strategies should be adjusted as necessary to ensure compliance and achievement of goals.

In children, adolescents and pregnant woman, nutrition therapy

should not only have the goal of achieving diabetes control but it should also ensure that normal growth and development is facilitated.

Therefore, nutrition therapy for persons with diabetes should include an individualized meal plan based on usual food intake interrelated with exercise and medication regimens. For persons on conventional insulin therapy, care must be taken to ensure consistency in the timing and amount of food eaten and the time and action of the insulin used. Individuals should be educated to monitor their blood-glucose levels and adjust insulin where necessary. The aim of all the therapy is to achieve lipid and blood sugar control.

The benefits of physical activity are greatest in the early progression of the disease. Nevertheless, regular physical activity is encouraged for all persons with diabetes. Overall persons living with diabetes should be asked to undergo a detailed medical evaluation before embarking on an exercise regime. They should try to engage in aerobic physical activity daily and pay careful attention to hydration status during and after exercise.

The main physical activity strategies for persons living with diabetes should be developed after the health care professional has assessed the diet and physical activity history, and determine the appropriate caloric level based on height,

weight, age, sex and activity level. The diet should encourage the intake of complex (higher fibre) carbohydrate foods such as corn, brown rice, yam, green bananas, cassava and ground provisions, whilst limiting the intake of simple sugars and controlling the intake of salt. Salt intake should be limited to no more than 6 g (1 tsp) per day and in the presence of hypertension, more severe restriction may be necessary. Finally, the diet should recommend less fried and high fat foods, cholesterol and saturated fats.

In persons who are obese, the BMI should be calculated and the level of weight loss necessary should be determined. The dietitian, in collaboration with the client should set the weight goal (short- and long-term). Once this has been set, the dietitian should develop weight-reducing meal plan with input from client. The carbohydrate component should be distributed throughout the day. It is always important to counsel the client and significant others and this is especially important to help reinforce any suggested behaviour modification and lifestyle changes.

The dietitian should monitor progress by regularly checking the client's weight, compliance to the diet, treatment goals and any additional needs required to reach these goals. All the information obtained from the updates should be documented in the

client's medical records so that information can be shared with other health care professionals in the near and distant future.

Clients who have diabetes and become pregnant will require some re-assessment and modification in their management. The aim is for the diet to achieve appropriate weight gain or control measures and match age needs, thus contributing to a healthy outcome. Usually a total weight gain of about 11.8 kg (26 pounds) is recommended. Approximately 0.9-1.8 kg (1-2 lbs) should be gained during the first trimester and not more than 1 kg (2.2 lbs) every fortnight thereafter. It is important that blood glucose levels and urine ketones are monitored regularly. Weight should also be monitored frequently and adjustments to the meal plan made throughout the pregnancy to achieve desired results.

Gestational diabetes is a type of diabetes that can occur in pregnant women who have not been known to have diabetes before. Gestational diabetes usually subsides during the early post-partum period, however, it may recur in subsequent pregnancies. Women who have had gestational diabetes are at greater risk of developing Type 2 diabetes later in life. Factors relating to diabetes in pregnancy will also apply to gestational diabetes.

The management of diabetes rests heavily with the individual and his/her

ability to cope with the challenges of living with diabetes. One important management tool is education. Clients who understand what to do and why it should be done are more likely to be motivated to participate in achieving and maintaining good health outcomes. The healthcare professional should ensure that the client understands what is diabetes and what are the signs and symptoms of the condition. Understanding is also required as to the causes and management of hypoglycaemia, hyperglycaemia and ketoacidosis. The healthcare professional should discuss the role of diet, medication and physical activity in controlling diabetes with emphases on the role of blood glucose monitoring and use of the results. The client should be trained to detect and manage complications as well as how and where to access information and resource persons in the community.

To help manage their diabetes, clients should be taught nutrition label reading with importance on how to recognize ingredients that mean sugar or carbohydrate. They should also be able to use the food groups in formulating meal plans.

All these factors are essential for the successful management of persons living with diabetes. The early management of diabetes is key to the prevention of secondary complications. Reducing these complications is, in turn, essential for sustained and/or improved quality of life.

Nutritional Management of Hypertension^a

Hypertension is a major health problem affecting a large percentage of the adult population in most Caribbean countries. The risk of cardiovascular complications and organ damage in persons with high blood pressure is increased when other risk factors such as smoking, obesity, elevated cholesterol and diabetes are also present. Untreated hypertension can result in a number of problems such as stroke, congestive heart failure, renal disease and myocardial infarction.

Diagnosis of hypertension must be established by a doctor, medex or nurse practitioner. The following criteria have been internationally established for the diagnosis of hypertension:

1. If the initial systolic reading is between 120 and 139 and/or diastolic reading between 80-89 mm Hg, and there is no evidence of end-organ damage, repeated BP measurements over six months are necessary. Here the diagnosis is pre-hypertension.
2. If initial diastolic readings are between 90-100 mm Hg, and there is no evidence of end-organ damage, repeated BP measurements over three months are necessary. The diagnosis of high blood pressure in this group is established by a persistent systolic value ≥ 140 mm Hg or diastolic value ≥ 90 mm Hg (Stage 1).
3. If initial BP readings are $\geq 160/100$ mm Hg (Stage 2) and there is no evidence of end-organ damage, BP measurements should be repeated on at least one other occasion within one month. A diagnosis of hypertension is made if BP is consistently $\geq 140/90$ mm Hg.
4. If initial readings are $\geq 180/110$ mm Hg (Stage 3) and there is no evidence of end-organ damage, the patient should be re-examined within one week. In some cases therapy should be started, if the risk level assessment so warrants.
5. Labile hypertensives will show fluctuation of BP from normal to Stage 1 or higher hypertensive ranges and such patients should be monitored regularly. Persistence of diastolic readings above 90 mm Hg will usually indicate established hypertension.

^aExtract from CFNI's "Protocol for the Nutritional Management of Obesity, Diabetes and Hypertension in the Caribbean"

6. Diagnosis can be established on the basis of a single diastolic pressure >100 mm Hg, if there is evidence of target organ damage. The patient should be classified as hypertensive with specific target organ disease, risk level assessed and treatment begun.
7. Isolated systolic hypertension is diagnosed when there is an average of four readings ≥ 140 mm Hg on two occasions with a diastolic BP <90 mm Hg (JNC 7 criteria). Isolated systolic should be carefully re-evaluated at intervals.
8. "White-coat hypertension" may occur in patients whose BP is raised only in the clinic but not at other times. A White-coat effect may further raise BP in a patient with hypertension.
9. Ambulatory BP Monitoring (ABPM) over 24 hours is warranted for evaluation of White-coat Hypertension or White-coat effect or for evaluation of patients with resistant hypertension, i.e. hypertension uncontrolled by triple therapy.

Tables 1 and 2 show a summary of the diagnosis criteria for hypertension and the International classification of stages for risk assessment and medical management.

Managing hypertension efficiently is important in achieving maximum reduction in the total health risk of

cardiovascular morbidity and mortality. All risk factors and co-morbid conditions must be identified and treated. These include smoking, obesity, hypercholesterolaemia, diabetes and other clinical conditions.

A comprehensive nutrition assessment and review of historical and laboratory data will provide a good indication of need for nutrition intervention. Laboratory data should include determination of haemoglobin, serum sodium, potassium, creatinine, fasting blood glucose and lipid profile. Urine examination should include microscopy and analysis for blood and protein.

Unless hypertension is at an urgent level, lifestyle modifications should initially be employed and form the cornerstone of treatment at all stages of high blood pressure. These include weight loss in the overweight or obese, regular physical activity, reduction in dietary sodium and reduced consumption of caffeine and alcohol. If these modifications do not achieve treatment goals or if there are signs of target organ damage, medication should be added to the treatment regimen.

Hypertension is both a cause and a consequence of renal disease. In hypertensive patients with Type 1 or Type 2 diabetes who have micro-albuminuria or clinical albuminuria,

treatment must be effected to delay progression from albuminuria to overt nephropathy. Such individuals should be referred to medical and nutrition specialists.

The objectives for diet management in hypertension are to control blood pressure at a safe level to prevent damage to target organs, e.g. heart, kidneys, brain, thereby reducing the likelihood of congestive heart failure, renal failure and stroke. This is normally achieved by modifying the diet to reduce excessive intake of sodium, alcohol and caffeine, as well as increase the intake of potassium and calcium. If the client is overweight or obese, then a weight loss regimen should also be employed.

The steps in the nutritional management of persons with hypertension are very similar to those with other chronic diseases. Thus, the client with the healthcare professional needs to set treatment goals. Following this, a nutritional care plan needs to be developed and implemented. This needs to be continuously evaluated and the necessary corrective actions taken to ensure that the set goals are achieved. All these processes need to be documented in the client's medical records.

The start of the dietetic management process should always begin with a thorough review of the clinical history and a physical examination to

identify factors which may impact on blood pressure levels. Once the severity of the hypertension is determined, specific intervention needs of patients are developed. These usually include a reduced sodium intake, weight loss, increased potassium intake and need to lower blood lipids. The dietitian would determine the caloric/nutrient needs to facilitate weight loss, if necessary, whilst other members of the health care team would monitor blood pressure levels and laboratory values. The diet prescription should provide a nutritionally balanced diet with a variety of foods from all the food groups and the dietitian should monitor sodium intake and limit the consumption of caffeine and alcoholic beverages. Decaffeinated beverages may be substituted for caffeinated ones.

More importantly behaviour modification, to include healthy lifestyle practices, must be part of the treatment goals and apart from diet they should also include a regular physical activity programme as agreed on with the doctor.

The self management of hypertension through a well balanced diet and a healthy exercise programme will help prevent complications and early disability or death. Thus a good healthy lifestyle can ensure a good

Table 1: Classification and Management of Blood Pressure for Adults

BP Classification	SBP* MMHG	DBP* MMHG	Lifestyle Modification	Initial Drug Therapy	
				Without Compelling Indication	With Compelling Indications
Normal	<120	and <80	Encourage		
Prehypertension	120-139	or 80-89	Yes	No anti-hypertensive drug indicated	Drug(s) for compelling indications. ‡
Stage 1 Hypertension	140-159	or 90-99	Yes	Thiazide-type diuretics for most. May consider ACEI, ARB, BB, CCB, or combination.	Drug (s) for the compelling indications. ‡ Other anti-hypertensive drugs (diuretics, ACEI, ARB, BB, CCB) as needed.
Stage 2 Hypertension	≥160	or ≥100	Yes	Two-drug combination for most † (usually thiazide-type diuretic and ACEI or ARB or BB or CCB).	
Stage 3 Hypertension	>180	> 110	Yes	Three drug combination	

DBP, diastolic blood pressure, SBP, systolic blood pressure.

Drug abbreviations: ACEI, angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; BB, beta -blocker; CCB, calcium channel blocker.

* Treatment determined by highest BP category

† Initial combined therapy should be used cautiously in those at risk for orthostatic hypotension.

‡ Treat patients with chronic kidney disease or diabetes to BP goal of <130/180 mmHg.

Source: Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure - 7th Report 2003.

CHRC/PAHO 2004 Managing Hypertension in Primary Care in the Caribbean- Working Document.

Table 2: Stratification of Risk to Quantify Prognosis of Hypertension

Other Risk Factors & Disease History	BLOOD PRESSURE (mmHg)		
	Grade 1 (mild hypertension) SBP 140-159 or DBP 90-99	Grade 2 (moderate hypertension) SBP 160-179 or DBP 100-109	Grade 3 (severe hypertension) SBP \geq 180 or DBP \geq 110
1. No other risk factor	LOW RISK	MED RISK	HIGH RISK
2. 1-2 risk factors	MED RISK	MED RISK	V HIGH RISK
3. 3 or more risk factors or TOD1 ² or diabetes	HIGH RISK	HIGH RISK	V HIGH RISK
4. ACC ³	V HIGH RISK	V HIGH RISK	V HIGH RISK

²TOD = Target Organ Damage

³ACC = Associated Clinical Conditions, including clinical cardiovascular disease and renal disease.

Source: Adapted from 2003 European Society of Hypertension – European Society of Cardiology guidelines for the management of arterial hypertension. Guidelines Committee Journal of Hypertension 2003

Nutrition Practice Guidelines Care Improves Diabetes Outcomes

Patti Geil^a

Introduction

Nutrition recommendations for individuals with diabetes have evolved over the years from starvation diets and no concentrated sweets meal plans to the current precise approach of carbohydrate counting. Medical nutrition therapy (MNT) for diabetes is not “one size fits all”. Each person with diabetes is an individual and finding the optimal approach to his or her nutrition care is a challenge for the registered dietitian. Nutrition Practice Guidelines (NPGs) for diabetes have been developed to guide the nutrition

professional in providing medical nutrition therapy that individualizes as well as improves diabetes care and outcomes.

Clinical Goals for Medical Nutrition Therapy in Diabetes

Medical nutrition therapy is an essential part of attaining the clinical goals of diabetes management^{1,2} as outlined below. Clinical goals for MNT should be individualized, with certain populations, such as pregnant women, requiring special considerations.

Clinical Goals for Medical Nutrition Therapy in Diabetes: Non-pregnant Adults

Glycemic Control	
A1C	<7.0%*
Preprandial plasma glucose **	90-130 mg/dl
Blood Pressure	
	<130/80 mmHg

*More stringent glycemic goals (i.e. A1C <6%) may further reduce complications at the cost of increased risk of hypoglycemia

**Postprandial glucose measurements should be made 1-2 h after the beginning of the meals, generally peak levels in patients with diabetes.

^aPatti Geil, *Diabetes Care and Communications, Lexington, KY,*

Lipids	
Total Cholesterol	<200 mg/dl
LDL	<100 mg/dl
Triglycerides	<150 mg/dl
HDL	>40 mg/dl (men) >50 mg/dl (women)

Clinical Goals for Medical Nutrition Therapy in Diabetes: Gestational Diabetes

Fasting plasma glucose or 1-h postprandial plasma glucose or	≤105 mg/dl ≤155 mg/dl
2-h postprandial plasma glucose	≤130 mg/dl

Nutrition Practice Guidelines

Nutrition practice guidelines (NPG) are systematically developed statements designed to guide practitioner and patient decisions about appropriate health care for specific clinical circumstances.³ They are based on the best available research and professional judgment. NPGs are comprehensive, specific and manageable. They are thoroughly researched and validated through field-testing by a pool of practitioners. NPGs outline the process the nutrition professional should follow in providing medical nutrition therapy to individuals with Type 1, Type 2, and gestational diabetes mellitus.^{4,5}

Specific recommendations are made regarding data to collect pre-visit, during the visit and post-visit to assist in tracking outcomes, as well as standards for determining the level of care to provide and suggestions for frequency of visits for each disease. NPGs are not a “cookbook approach” but do offer a step-by-step roadmap to medical nutrition therapy. Following a predetermined process helps the registered dietitian proceed through each step without omitting important aspects of care. Although NPGs are intended primarily for use by dietetic professionals, others such as health care providers, institutions and policy makers may find them useful for many purposes.

Nutrition Practice Guidelines: Research Validation

Practice guidelines work! Results of NPG field-testing showed that blood glucose control improved when individuals with diabetes received practice guidelines care. Specifically, in individuals with Type 1 diabetes, the A1C values at three months improved in 88% of the practice-guideline patients compared with 53% of the usual-care patients.⁶ Among individuals who had Type 2 diabetes for more than six months, those who received practice guideline care had significantly lower A1C values at the three-month follow-up than those who received basic nutrition care.⁷ Cost-effectiveness of diabetes treatment was also enhanced when dietitians were involved in active decision-making about interventions based on

the patients needs.⁸ For women with gestational diabetes mellitus, field-testing of GDM-specific NPGs showed that women who received practice guideline care had a lower frequency of insulin use and a lower frequency of abnormal A1C at follow-up.⁹

Nutrition Practice Guidelines: The Process

A registered dietitian who uses the NPGs follows a systematic process that includes the familiar four-step approach to nutrition intervention: assessment, goal setting, intervention, and evaluation.¹⁰ NPGs expand these four steps to five by adding the development of the nutrition care plan into the goal setting step, and an additional step for documentation and communication prior to evaluation and reassessment.

Four Step Approach	Nutrition Practice Guidelines
Assessment	Nutrition-Focused Assessment
Goal Setting	Goal Setting and Establishing the Nutrition Care Plan
Intervention	Intervention
Evaluation	Documentation and Communication Evaluation and Reassessment

Nutrition-Focused Assessment

A comprehensive assessment is the crucial step in providing individualized diabetes nutrition therapy. Assessments are based on referral data, which includes medical history, medications, and laboratory data as well as information provided by the individual with diabetes and family members. Other team members often provide valuable information. A complete nutrition assessment includes all past nutrition education or lack thereof, as well as the individual's perception of that experience. It establishes rapport, which is particularly helpful in the goal setting stage. The professional uses the assessment to determine the best way in which the individual with diabetes learns. Health beliefs, attitudes, and behaviors should be considered. It is key to inquire about specific food habits that may be unique to an individual. Whether or not family members are supportive may not be obvious unless an in-depth assessment is undertaken. Literacy level, visual status, disabilities, and socioeconomic status are all important factors in the assessment.

A careful assessment allows the nutrition professional to tailor the intervention and diabetes nutrition therapy to the individual. The registered dietitian requires a sound basis of information to establish goals

or determine a care plan and intervention. The nutrition-focused assessment provides this basis for establishing goals, as well as determining a care plan and strategy for self-management training.

Goal Setting and Establishing the Nutrition Care Plan

The second step is to establish goals and determine the nutrition care plan. When attempting to establish goals, the registered dietitian must distinguish between short-term and long-term goals, and also between the goals of the individual with diabetes and those of the health care provider. Goals for both parties should be reasonable, attainable and measurable. If the professional has established a good rapport with the client, it is easier to negotiate attainable goals. Goals evolve and need to be evaluated and frequently re-negotiated as circumstances change. For example, the nutrition professional and individual with diabetes may decide together that a reasonable goal is to "substitute water or diet soda for a sugared soft drink at lunch three days a week". After this goal has been reached, it may be changed to "substitute water or diet soda for a sugared soft drink at lunch seven days a week".

Once goals are set, the nutrition care plan can be established. An analysis of the assessment data helps

the registered dietitian determine attitudes and beliefs about diabetes. It also gives the professional some insight into the individual's ability and motivation to make the lifestyle changes necessary to manage their disease. Prochaska's transtheoretical behavioral change model¹¹ outlines the stages of change (pre-contemplation, contemplation, preparation, action and maintenance) and allows the registered dietitian to understand and help the individual at each of the stages. Appreciating these stages and the fact that individuals don't always move through them in a systematic fashion, helps to frame realistic expectations. If the individual with diabetes has never been introduced to the concept of self-management and believes that the health professional should make all health care decisions, it is naïve to think he or she will be willing to take charge of their own health. However, it is appropriate at this stage to introduce the concept of self-management for future consideration.

Intervention

The third step is to implement the intervention. According to Holler and Pastors, intervention refers to the diabetes educator's activities, specifically those that facilitate or support the patient's diabetes nutrition self-management plan.¹⁰ Information from the assessment and goals for diabetes management enable the registered

dietitian to calculate a nutrition prescription. Once the nutrition prescription has been established, meal planning skills can be taught. The meal planning approach should be selected with the understanding that this method may change as the individual's understanding of the disease and motivation to self-manage evolve. An individual with newly diagnosed Type 2 diabetes may begin with The First Step to Diabetes Meal Planning and within weeks progress to the more complex consistent Carbohydrate Counting approach. A complete listing of diabetes nutrition resources from the American Diabetes Association is available.¹²

Education, which consists of providing accurate and timely information to the individual with diabetes, is the main focus at this step. However, the role of the educator goes beyond merely supplying facts. The educator is a counselor and a coach, helping the individual understand the disease and cope with its implications. The educator is a partner to the individual with diabetes in disease management, helping him or her discover how they may be motivated to change their behaviour to improve their health.

Documentation and Communication

The fourth step in the NPG process is to document efforts in the medical record and communicate to

other members of the health care team. Clear documentation of both clinical and behavioural goals, including the nutrition prescription, meal planning approach, and educational topics covered, should be accomplished after the first visit. The NPG materials have progress notes specifically designed to be used for documentation.^{4,5} At each subsequent visit, it is important to document and communicate acceptance and understanding, behavioral changes made, and plans for on-going care to the primary care giver (usually the referral source) and other team members. Written documentation can be shared with the individual with diabetes to demonstrate their progress to them and encourage further efforts.

Evaluation and Reassessment

The fifth step in nutrition practice guideline care is an on-going evaluation and reassessment. The measurable goals established earlier will make evaluation a straightforward task. If the evaluation reveals changes are needed, it is helpful to put these changes into perspective as merely course corrections without “threatening” the individual with diabetes. If initial goals have not been met, they may need to be changed or renegotiated. If the goals have been met, new reasonable, attainable, and measurable goals may be designed.

Case Study: Using the NPGs to Manage Gestational Diabetes

Working through the following case study¹³ will help illustrate the application of nutrition practice guideline care in a woman with gestational diabetes mellitus. Using nutrition practice guidelines simplifies practice, individualizes the care plan to ensure success for the patient, and produces improved diabetes care and outcomes that can be clearly documented.

Case Study: Managing Gestational Diabetes Mellitus

Assessment

Caucasian female, twenty-fifth week of second pregnancy

66 inches tall

Currently 185 lbs, pre-pregnancy weight 175 lbs

BMI= 28 kg m⁻²

31 years of age

Family history of Type 2 diabetes mellitus

Results of 50 g glucose challenge test:
BG 155 mg/dl 1 hr post glucose load

Results of 100 g OGTT:

- Fasting: 90 mg/dl
- 1 hour: 230 mg/dl
- 2 hour: 168 mg/dl
- 3 hour: 136 mg/dl

Additional laboratory values are within normal range for pregnancy.

MB is married with a three-year-old son and works full-time. She does not smoke cigarettes or drink alcohol. Her only medication is a prenatal vitamin prescribed by her OB. She has no regular program of physical activity.

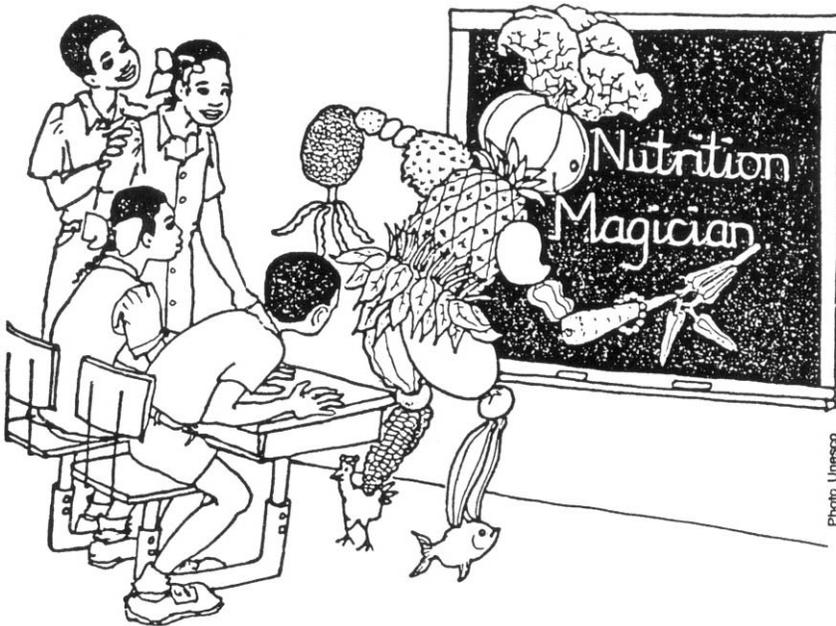
Diet recall reveals intake of approximately 3500 calories with 425 grams of CHO. MB is eating frequently to prevent nausea. Breakfast is typically sweetened cereal, skim milk, fruit juice and a sweet roll. Lunch is often a fast food "value meal" with a regular soft drink. MB snacks on chips or popcorn from the office vending machines. Supper is usually late in the evening and often consists of a casserole-type dish served with a salad, bread and dessert. MB has a bedtime snack every evening of a large bowl of ice cream.

- List three goals that would be reasonable for this client.
- What should be included in the nutrition care plan for this client?
- What nutrition education resources would you use for this client?
- How would you document an encounter with this client?
- How soon would you set a follow-up appointment for this client?
- What would you evaluate on the return visit?

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Mothers of Undernourished Jamaican Children Have Poorer Psychological Functioning and this is Associated with Stimulation Provided in the Home^a

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Objectives: To compare mothers of undernourished children with mothers of adequately nourished children on maternal depression, parenting self-esteem, social support and exposure to stressors and to determine if these variables are independently related to undernutrition and stimulation provided in the home after controlling for socio-economic status.

Design: A case control study.

Setting: Children and their mothers were recruited from 18 government health centres in the Kingston, St. Andrew and St. Catherine parishes of Jamaica.

Subjects: One hundred and thirty-nine mothers of undernourished children ($WAZ \leq 1.5$ – scores) aged 9-30 months and 71 mothers of adequately nourished children ($WAZ > -1z$ scores) matched for sex and age group were enrolled into the study.

Results: Mothers of undernourished children came from poorer homes but had similar social support to mothers of adequately nourished children. They were more depressed, had lower levels of parenting self-esteem (both $P < 0.01$), reported higher levels of economic stress ($P < 0.001$) and provided a less stimulating home environment ($P < 0.05$). However, after controlling for social background variables, there was no independent relationship between either

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psychosocial function or home stimulation and nutritional status. Undernutrition was found to be mainly explained by economic factors. The mothers' self-esteem was independently associated with the level of stimulation provided to the child.

Conclusions: *When caring for undernourished children, attention should be paid to the psychosocial status of the mother as well as the physical condition of the child.*

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Keywords: *undernourished; maternal depression, self-esteem, stimulation*

INTRODUCTION

Few studies have examined psychosocial characteristics of mothers of undernourished children in developing countries. In Barbados, mothers of 5-11 year-old children who had been severely malnourished in the first year of life were more likely to be depressed than a control group, but this difference was explained by the lower socio-economic status of the former group (Salt et al, 1988). We found no studies investigating the psychosocial function of mothers of currently undernourished children in developing countries. A few studies with failure to thrive children in developed countries have examined the psychosocial characteristics of mothers but the results have been inconclusive (Boddy & Skuse, 1994).

Maternal psychosocial characteristics have been shown to affect maternal-child interaction. For

example, mothers with postnatal depression have been found to exhibit less mutuality and be less responsive towards their children (Murray et al, 1996) and the children are less likely to form a secure attachment (Martins & Gaffan, 2000). These behaviours are similar to those described in mothers of undernourished children and it is possible that the less stimulating behaviour of mothers of undernourished children is caused, in part, by poor psychosocial functioning. Mothers of undernourished children have been found to provide less stimulation in the home than mothers of adequately nourished children, the quality of maternal-child interaction has also been found to be poorer (Graves, 1976; Chavez & Martinez, 1982; Sigman et al, 1989; Grantham-McGregor et al, 1991; Meeks-Gardener et al, 1999; Pollitt et al, 2000) and their child is likely to form a secure attachment (Valenzuela, 1990). These maternal behaviours

have been found to be related to poor development in undernourished children (Chavez and Martinez, 1982; Sigman et al, 1989; Meeks-Gardner et al, 1999; Pollitt et al, 2000). Poor maternal-child interaction may also contribute to undernutrition. We are aware of only one prospective study which examined this issue and mothers of severely malnourished children were found to be less responsive and affectionate to their children and provide poorer stimulation in the home preceding the onset of undernutrition (Cravioto & DeLicardie, 1976). The quality of caregiving may mediate the relationship between psychosocial function and the child's nutritional status.

Lack of social support and high levels of stressors have also been found to be associated with poor parenting behaviours (Crnic et al, 1983; Burchinal et al, 1996). There is little information on the level of social support and stressors experienced by mothers of undernourished children in developing countries.

The aims of the study were (1) to compare mothers of undernourished and adequately nourished children on the following: depressive symptoms, parenting self-esteem, stimulation provided by the mother, social support and daily stressors; (2) to examine the independent correlates of stimulation in the home and (3) to examine whether depressive symptoms,

parenting self-esteem and stimulation in the home were independently associated with undernutrition controlling for socio-economic variables, stressors and social support.

We hypothesized that (1) the mothers of undernourished children would be more depressed, have lower self-esteem, more stressors, less social support and provide poorer stimulation in the home than mothers of adequately nourished children; (2) psychosocial function would independently predict stimulation in the home after controlling for socio-economic factors; and (3) poor stimulation in the home would mediate the effect of poor psychosocial function on nutrition.

METHODS

Sample

Samples were chosen from government health centres in the parishes of Kingston, St. Andrew and the urban areas of St. Catherine in Jamaica. These serve predominantly poor urban populations. All centres in the areas that had both nutrition and maternal-child health clinics were identified. All children who attend the maternal-child health clinics are weighed and those found to be underweight (weight for age $< -2z$ scores) are routinely referred to the nutrition clinics for more specialized care including monthly weighing, food supplementation and nutritional

advice. Only centres with at least 10 children enrolled in the nutrition clinic were included. Two groups, undernourished and adequately nourished controls, were enrolled.

Undernourished group. Undernourished children were identified from nutrition clinic records and all those who were aged between 9 and 30 months and had recorded weights for age less than $-2z$ scores of the National Centre for Health Statistics (NCHS) references (Hamill et al, 1977) in the previous 3 months were located and weighed. All children who fulfilled the following criteria were then enrolled: weight currently less than $-1.5z$ scores, birth weight greater than 1.8 kg, singleton birth, absence of chronic disease and/or obvious disability and maternal consent. Eight mothers refused and the remaining 139 children were enrolled. All of the undernourished children had thus been identified by the primary health care personnel as being in need of nutritional surveillance and their mothers invited to attend monthly nutrition clinic.

Control group. In each health centre, every other undernourished child was matched for sex and age group (9-18 months or 19-30 months) with an adequately nourished child attending the maternal-child health clinic. The well-nourished children had a weight for age above $-1.0z$ scores of the NCHS references and no

previous record of weight below $-2z$ scores. Seventy-one adequately nourished children were enrolled.

Measurements

Child anthropometry. The children's weight and height or length was measured according to standard anthropometric procedures (Lohman et al, 1989). Measurements were conducted by two research assistants and the interobserver reliability (intraclass correlation coefficients) was >0.98 for all measures ($n=10$). Anthropometric measures were converted into height for age, weight for height (WHZ) and weight for age (WAZ) and expressed as z scores of the NCHS references.

Economic background and parental characteristics. The mothers were interviewed at home to obtain information on parental characteristics and family structure. Standard of housing was measured by crowding (number of people per room), a sanitation score (rating of toilet and water amenities summed) and the number of household possessions from a list of 10 items. The mother's vocabulary was assessed using the Peabody Picture Vocabulary Test – Revised (Dunn & Dunn, 1981). As the test was not standardized for Jamaica, we used the raw score in the analysis. Mother's height was also measured.

Psychosocial function, stress and social support

A questionnaire to measure psychosocial function, stress and social support was administered to 20 non-study mothers on two occasions approximately 3 weeks apart to determine test-retest reliability using intraclass correlation coefficients. In addition, Chronbach's alphas were calculated for each scale to assess internal reliability.

Depression. The depression scale was based on the Centre for Epidemiological Studies Depression Scale 9CES-D (Radloff, 1977). In addition, three questions were adapted from the Maternal Morale Index used in Barbados (Sale et al, 1988; Galler & Harrison, 2000). The CES-D scale was designed to assess the frequency of depressive symptoms in non-clinical populations. After piloting, the wording of the questions was adapted to be more culturally appropriate and several of the questions were omitted. Respondents were asked how frequently they experienced each symptom in the last week and the number of days was recorded. The responses were summed making a summary score of 0-105 representing the number of days of depressive symptoms. Three of the questions were worded in a non-depressed direction to assess positive affect and to avoid response set. These questions were reverse coded and added to the negative items. The test-

retest for the depression scale was $R = 0.71$, and the internal reliability $\alpha = 0.90$.

Parenting self-esteem. Parenting self-esteem encompasses both perceived self-efficacy and the satisfaction derived from parenting (Coleman & Karraker, 1997). Self-efficacy was construed as being situation specific (Bandura, 1989) and 10 items addressed mothers feelings of competence in relation to specific parenting acts such as coping with sickness, feeding and discipline. One item referred to global feelings of efficacy in parenting. For each item, mothers were asked to rate themselves as one of the following: good (3), okay (2), have some trouble (1), not so good (0). These responses were drawn on a ladder, which the mothers used as a visual aid when answering the questions. Parenting satisfaction describes the quality of affect associated with parenting and the degree of satisfaction derived from it. The questions were drawn from the Maternal Morale Index (Salt et al, 1988) and the Parenting Stress Index (Abidin, 1986). One example is 'If I could start all over again, I would not have children'. A 4-point response scale was used: agree completely (0), agree a little bit (1), disagree a little bit (2) and disagree completely (3). Questions worded in a negative direction were reverse coded.

Item scores for the satisfaction and self-efficacy subscales were summed

to yield a parenting self-esteem score of 0–51. The scale had a test-retest of $R = 0.95$ and a Chronbach's alpha of 0.81.

Social support. This scale measured tangible and emotional support and was based on the Medical Outcomes Study Social Support Survey (Sherbourne & Stewart, 1991) which was designed for use in the general population. Mothers were asked if they received specific types of support on a 5-point scale: no (0), a little of the time (1), sometimes (2), most of the time (3), always (4). The response set was also presented on a pictorial ladder. Responses were summed to form a cumulative score of 0–20. The test-retest for the scale was $R = 0.86$ and the internal reliability was $\alpha = 0.66$.

Stressors. The stressors questionnaire was designed for this study and comprised nine questions. The questionnaire included some of the most common problems faced by low-income Jamaican mothers. These were violence in the community, yard (group of houses around a common space) and household, food security, insufficient income and stressful interpersonal relationships. The test-retest for the sum of the items in the stressors scale was $R = 0.95$. Factor analysis of the items in the questionnaire produced four factors which explained 75% of the variance. These concerned economic stress (eigenvalue = 2.7), partner stress

(eigenvalue = 1.3), domestic violence (eigenvalue = 1.1) and community violence (eigenvalue = 1.0).

Home Observation for Measurement of the Environment (HOME) Scales.

The HOME questionnaire (Caldwell & Bradley, 1979) was developed in the United States and measures the responsiveness and stimulation of the home environment through a combination of systematic observations and maternal report. The HOME has been modified for use in Jamaica previously and was found to be associated with current and future development (Grantham-McGregor et al, 1991; Meeks-Gardner et al, 1999).

For this study, further adaptations were made which included the addition of more questions relating to activities the mother does with the child and the extension of the response scale of the maternal report items from a dichotomous response to a 6-point scale: never or less than once a week (0), once a week (1), 2–3 times a week (2), 4–6 times a week (3), every day (4), more than once a day (5). These adaptations resulted in a larger range of scores, thus making the instrument more sensitive to small differences in the homes.

We retained the dichotomous scoring (behaviour occurred or not) for the observations. All items were coded so that a high score indicates more appropriate maternal behaviour. Total HOME scores were obtained by

summing the items giving a range of 0-96. Only the maternal reported questions were repeated for test-retest as it was not feasible to do home visits at that time. Test-retest was $R = 0.92$ and the cronbach's alpha was $\alpha = 0.80$.

Interobserver reliability. One interviewer administered the questionnaires in the mothers' homes. Interobserver reliabilities between trainer and interviewer were >0.9 for each scale in 10 consecutive interviews prior to the study and in ongoing quality control of 10% of interviews.

Ethical consent. Ethical consent was given by the University of the West Indies Medical Sciences Ethics Committee and the Ministry of Health in Jamaica.

Analysis

All variables were checked for normality. The depression score was negatively skewed so was normalized with a square root transformation. The social support score was positively skewed and was transformed by squaring. Factor analysis was used to identify the underlying constructs in the stressors scale and the factor scores were used in the analysis.

Independent samples *t*-tests for continuous variables and chi-squared analysis for categorical variables were

performed to determine the difference between the undernourished and adequately nourished groups. Correlation coefficients (Pearson's product moment or Spearman's rank) were computed to examine the relationship between nutritional group, home stimulation and all variables in Tables 1-3. In order to determine the independent risk factors for undernutrition, we conducted a logistic regression of nutritional group offering all variables that were significantly different between the groups. Stepwise multiple regression analysis was used to determine the independent predictors of stimulation in the home.

RESULTS

All the measurements were completed.

Differences between the Nutritional Groups

Background variables. There was no difference between the undernourished and adequately nourished children in birth order or age (Table 1). As expected, there were significant differences in their weight for age, height for age and weight for height. In the undernourished group, 67 of the children (48%) were moderately underweight ($WAZ < -2z$ scores) and 14 (10%) were severely underweight.

Table 1: Child Characteristics on Enrolment by Nutritional Group (mean±s.d.)

	Underweight (n = 139) Mean ± s.d.	Adequate weight (n=71) Mean ± s.d.
Age on enrolment (months)	18.53±4.98	19.38±4.80
Birth order	2.29±1.60	1.97±1.22
^a Weight for height (z score)**	-1.64±0.62	0.03±1.04
Weight for age (z score)**	-2.22±0.53	0.14±1.00
Height for age (z score)**	-1.57±0.92	0.36±0.89

^at-test of transformed variable **P<0.001

There were no significant differences between the groups in maternal age, education, marital status or the number employed (33%) (Table 2). The mother's mean age was 26 years and more than half of them had not completed secondary education. Few of the mothers (13.9%) were married. Fewer of the undernourished children's fathers lived with them than in the adequately nourished group (P<0.001). The undernourished group had significantly worse sanitation scores (P<0.05) and fewer possessions (P<0.001), but there was no difference in crowding. Compared with the controls, the mothers of undernourished children had poorer PPVT scores, lower skilled occupations

(both P<0.05) and were shorter (P<0.001).

Maternal psychosocial characteristics and experiences and home stimulation. The mothers of undernourished children had significantly more depressive symptoms and lower parenting self-esteem than the mothers of adequately nourished children (both P<0.01) (Table 3). They also reported higher levels of economic stress (P<0.001). There were no differences between the groups in partner stress, domestic violence, community violence or social support. They also provided a less stimulating home environment for their child (P<0.05).

**Table 2: Family Characteristics on Enrolment by Nutritional Group
(mean ± s.d.)**

	Underweight (n = 139) Mean ± s.d.	Adequate weight (n=71) Mean ± s.d.
Sanitation*	7.84±3.05	8.71±2.96
Possession**	5.13±1.98	6.17±1.82
Mother's PPVT*	93±21.27	100±25.12
Mother's height**	159.3±5.9	163.8±6.8
Baby's father living there %**	41.0	65.7
Mother's work*%		
Non/unskilled	36.7	19.1
Semi-skilled	42.4	44.1
Skilled	20.9	36.8

*P<0.005

**P<0.001

Maternal psychosocial characteristics and experiences and home stimulation: The mothers of under-nourished children had significantly more depressive symptoms and lower parenting self-esteem than the mothers of adequately nourished children (both $P<0.01$) (Table 3). They also reported higher levels of economic stress ($P<0.001$). There were no differences between the groups in partner stress, domestic violence, community violence or social support. They also provided a less stimulating home environment for their child ($P<0.05$).

Variables Associated with Home Stimulation

The HOME is a broad indicator of quality of parenting. Higher scores on

the home were associated with increased maternal schooling ($r=0.16$, $P<0.05$) and verbal intelligence ($r=0.36$, $P<0.001$), less crowding ($r=0.16$, $P<0.05$), more possessions ($r=0.21$, $P<0.01$) and presence of the baby's father ($r=0.19$, $P<0.01$). Higher scores on the HOME were also associated with lower maternal depression ($r=0.17$, $P<0.05$), higher maternal self-esteem ($r=0.33$, $P<0.0005$), less economic stress ($r=0.16$, $P<0.01$), less partner stress ($r=0.17$, $P<0.05$), less domestic violence ($r=0.17$, $P<0.05$) and more social support ($r=0.22$, $P<0.01$). In order to determine if the mother's psychosocial characteristics independently predicted the HOME scores, depression and self-esteem along with

Table 3: Maternal Characteristics and Experience and Home Stimulation by Nutritional Group (mean ± s.d.) and Median (range)

	Underweight (n = 139)	Adequate weight (n=71)
	Mean ± s.d.	Mean ± s.d.
Self-esteem*	32.2±8.3	35.4±8.2
HOME**	46.7±12.4	50.8±14.0
	Median (range)	Median (range)
^a Depression*	26 (0-91)	16.5 (0-86)
^a Social support	16 (1-20)	17 (3-20)
^b Economic stress index***	3 (1-10)	1 (1-10)
^b Partner stress index	3 (1-7)	3 (1-7)
^b Domestic violence index	1 (1-6)	1 (1-5)
^b Community violence index	2 (1-4)	2 (1-4)

*P<0.01

**P<0.01

***P<0.001

at-test of transformed variable

bt-test of factor score

nutritional group and other significant correlates were offered stepwise in a multiple regression. The variables independently associated with the HOME were higher maternal verbal IQ higher parenting self-esteem and decreased levels of partner stress

(Table 4). These variables accounted for 25% of the variance in HOME scores. Interaction terms between group and the significant covariates were also offered but were not significant.

Table 4: Standardised Beta Coefficients $\hat{\alpha}$ and Amount of Variance Explained (R^2) from Multiple Regression of Stimulation in the Home with Groups Combined

	Adjusted R^2	$\hat{\alpha}$
PPVT***	0.12	0.36
Self-esteem***	0.23	0.30
Partner stress**	0.25	-0.16
		F = 23.39***

**P<0.01

***P<0.001

Table 5: Logistic Regression on Nutritional Group

	Odds Ratio	95% Confidence Interval
Maternal height	0.893	0.845, 0.944
Economic stress	1.623	1.051, 2.508
Skill level of work	0.692	0.489, 0.979
Father not there	2.162	1.087, 4.301
Possessions	0.830	0.687, 1.002

77.7% placed correctly, 89.9% undernourished and 52.9% adequately nourished; 1 = undernourished, 0 = adequately nourished.

Logistic Regression of Nutritional Group

We examined the independent risk factors for undernutrition in a logistic regression of nutritional group. The variables which were significantly different between the groups were offered stepwise (possessions, sanitation, maternal height, skill level of work, depression, self-esteem and verbal IQ, the presence of the baby's father, economic stress, stimulation in the home). The independent predictors for being undernourished were low maternal height, higher levels of economic stress, lower skill level of work, the baby's father not living in the household and fewer possessions. The model correctly placed 77.7% of the sample. The odds ratios and 95% confidence intervals are given in Table 5.

DISCUSSION

In keeping with our first hypothesis, mothers of under-nourished

children reported more depressive symptoms, had lower parenting self-esteem and more economic stress than mothers whose children were adequately nourished. There was, however no difference between the groups in the availability of social support and in stressors relating to the mother's partner and domestic and community violence. Depression in this study refers to the frequency of depressive symptoms rather than to clinical depression and so mothers with high scores may not be clinically depressed. We did not use cut off points due to difficulties in transferring across cultures. All the measures used in the study had good interobserver reliability and good test-retest over a 2-week period. The scores were also correlated with other measures in a theoretically sensible way, which promotes confidence in the validity of the measures.

It was not surprising that the mothers of undernourished children

scored lower on economic variables than mothers of adequately nourished children. They were also less likely to live with the baby's father, which is consistent with other studies in the literature (Goodall, 1979; Dixon et al, 1982).

The mothers of undernourished children in this study provided a less stimulating home environment for their children than the control group. Self-esteem and partner stress were independent predictors of the level of stimulation in the home indicating that the psychosocial status of the mother and the level of daily stressor experienced affected the quality of the child's home environment. Hence, there was an independent association between maternal psychosocial function and stimulation in the home in accordance with our school hypothesis. Maternal IQ was the only other variable to contribute to home stimulation.

Contrary to our third hypothesis, neither mothers' psychosocial function nor home stimulation were associated with being undernourished once environmental factors were taken into account. The environmental factors predicting nutritional group were economic stress, low skill level of occupation, fewer possessions and absence of the baby's father which are all indicators of poverty. Mother's height was also independently associated with nutritional group and in this population reflects the

intergenerational cycle of poverty, that is, women who are stunted in early childhood due to undernutrition are more likely to be poorer and have children who are undernourished. Although the mothers in the sample all came from poor neighbourhoods, which would have limited the variance in economic status, indicators of poverty were still the most powerful predictors of nutritional status. We had hypothesized that stimulation in the home may mediate the relationship of psychosocial function with nutritional status, but this was not the case in this population.

Little attention has been paid to the psychosocial function of mothers of undernourished children. Maternal distress, a combination depression, anxiety and psychosomatic problems has been found to be associated with behaviour problems in preschool and school-aged children (McGee et al, 1984; Sommerfelt et al, 2001). Depression of the mother has also been found to be associated with poor school achievement (Salt et al, 1988) and cognition (Peterson & Albers, 2001).

We had no measures of child development in the present study, but it is likely that the increased frequency of maternal depressive symptoms and less stimulating environment experienced by undernourished children would be associated with poorer mental development. The association

between home stimulation and development has been demonstrated in other studies in Jamaica (Grantham-McGregor et al, 1991) and other developing countries (Grantham-McGregor et al, 1998).

Most of the undernourished children in this study were only mildly to moderately undernourished. In countries where poverty and malnutrition are more severe, poor psychosocial function is probably a greater problem and could have a serious impact on children's development.

In conclusion, mothers of undernourished children had more depressive symptoms and poorer self-esteem than mothers of adequately nourished children. These differences were explained by more stressful environments. They also provided a less stimulation in the home for their children, that was partly explained by poor self-esteem. It is thus important that when treating undernourished children, attention is paid to the psychosocial status of the mother and to potential stressors in their environment.

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CAJANAQUOTE

"But the worsening economic situation in recent years in most developing countries means that in certain instances health is slowly deteriorating. Political commitment in words to improve people's health is high, but the allocation of resources still remains heavily in favour of urban, hospital-based medical care.

There have been concrete achievements and there is much to build on, but some of the fundamental principles of Primary Health Care (PHC) remain mere rhetoric in too many countries. Take one of the pillars of primary health care, namely, community involvement. In all countries the nature of the prevalent health problems is such that many essential activities can be undertaken by ordinary people in their own homes. But quite insufficient progress has been made in enabling people to take health into their own hands. Community health workers have been put in place but early enthusiasm and high expectations have always been well founded. In some cases they have received training, only to abandon their tasks after a relatively short time because they have not received support and supervision for their activities. Providing them with ideas and advice on how they can be more effective, even where conditions are difficult and resources are scarce, is of vital importance if we are to achieve health for all".

*Appropriate Technology for Health
"10 Years After Aims Alert"
Newsletter 20*

Factors Associated with Size and Proportionality at Birth in Term Jamaican Infants

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The objective of this study was to identify the factors associated with size and proportionality at birth in a cohort of term infants established to investigate their growth and development. One hundred and forty term low-birth-weight (birth-weight <2,500 g) infants and 94 normal birth-weight infants (2,500–<4,000 g) were recruited within 48 hours of birth at the main maternity hospital, Kingston, Jamaica. Birth anthropometry and gestational age were measured, and maternal information was obtained by interview and from hospital records. Controlling for gestational age, variables independently associated with birth-weight were rate of weight gain in the second half of pregnancy, maternal height, haemoglobin level <9.5 µg/dL, time of first attendance in antenatal clinic, birth order, pre-eclampsia, and consumption of alcohol, with 33% of the variance in birth-weight explained. Birth length was associated only with maternal height and age, while measures of proportionality (ponderal index and head/length ratio) were associated with characteristics of the environment in late pregnancy, including rate of weight gain, weight in late pregnancy, and pre-eclampsia. The variation in maternal characteristics associated with size or proportionality at birth may reflect the times during gestation when different aspects of growth are most affected.

Key words: Birth-weight; Infant, Low birth-weight; Weight gain; Pregnancy; Pregnancy outcomes; Maternal nutritional status; Jamaica.

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INTRODUCTION

Twenty million infants with low birth-weight (<2,500 g) are born each year in developing countries, representing 16% of all births.¹ The majority of these infants are born at term and are growth-retarded.^{1,2} Intrauterine growth retardation is associated with increased mortality and morbidity^{3,4} and may also lead to later developmental and behavioural deficits.^{5,6} It is important to understand the factors that contribute to growth retardation in different populations to devise appropriate interventions to improve maternal and infant outcomes.

There is consistent evidence that maternal pre-pregnancy weight, weight gain during pregnancy, and maternal height are associated with birth-weight.^{7,8} Other influences on birth-weight are more variable among populations and include the gender of the infant⁷, late attendance for antenatal care^{9,10}, smoking^{11,12}, consumption of alcohol¹³, young maternal age^{14,15}, anaemia^{16,17}, parity^{7,10} and hypertension.^{18,19}

Although there are many studies of the maternal and socioeconomic characteristics associated with birth-weight, other measures of size at birth have been included in only a few studies.^{20,21} Foetal weight gain occurs predominantly in the second half of pregnancy, and birth-weight can, therefore, be affected by conditions relatively late in pregnancy as shown

by the effect of supplementation of maternal diet after 20-24 weeks gestation.²² Other dimensions and proportionality may be more greatly affected at specific times during gestation.^{23,24} This may explain why the longer-term effects of variation in size at birth are sometimes more strongly linked to measures, such as birth length, head circumference, and the proportionality of the infant at birth than to birth-weight.²⁵ It is, therefore, important to understand the factors that contribute to different aspects of growth in utero to promote optimal foetal growth.

We have begun a longitudinal study of a cohort of term low-birth-weight and normal birth-weight Jamaican infants. In this first report, we examined the factors that influenced size at birth in this cohort

MATERIALS AND METHODS

Participants

The sample was recruited from the Victoria Jubilee Hospital, the main maternity hospital in Kingston, Jamaica. Most (>90%) births in Jamaica take place in hospital²⁶, and this public hospital serves predominantly low-income women, with approximately 12,000 deliveries per year. One hundred and forty term low-birth weight infants (birth-weight <2,500 g) and 94 normal birth-weight infants (birth-weight \geq 2,500–<4,000 g) who fulfilled the selection criteria

were recruited. Inclusion criteria were: gestational age ≥ 37 completed weeks, maternal report of at least two visits to antenatal clinic, education of mother not more than two subjects passed in secondary-level examinations, and residence within the Kingston metropolitan area. The recruited infants participated in a two-year study of their growth and development, and the maternal education and residence criteria were included for that aspect of the study to reduce the recruitment of middle-income women and to facilitate follow-up. Twins and infants with congenital abnormalities or whose mothers were HIV-positive were excluded from the study. In addition, infants admitted to the special care nursery of the hospital for more than 24 hours were excluded. Recruitment was conducted on six days of the week, and all eligible low-birth-weight infants whose mothers agreed to participate were enrolled. The normal birth-weight infants were matched for gender to the first two of every three low-birth-weight infants. The next eligible normal birth-weight infants born following the low-birth-weight infants were enrolled. More low-birth-weight than normal-birth-weight infants were enrolled as the low-birth-weight infants were divided into two groups in the follow-up study which included an intervention trial.

Infants were recruited during March-October 1999. During this period, there were 5,720 deliveries at

the hospital, of which 664 (11.6%) infants weighed < 2.5 kg. There were 148 eligible infants, of whom eight mothers declined to participate. Of the remaining 516 infants, 463 (89.7%) were livebirths. The main reasons for these infants being ineligible for the study were admission to the special care nursery (47.1%), residence outside the study area (16.8%), twins (12.3%), and the mother being unavailable for interview (14.9%).

The study was approved by the Ethics Committee of the University of the West Indies, and the mothers gave signed informed consent.

Measurements

Infant

All measurements were conducted by one of two observers within 48 hours of birth. Gestational age was determined by the Dubowitz clinical examination.²⁷ Inter-observer reliability was determined in 20 non-study infants, and the intra-class correlation coefficient was 0.97. Weight, length, and head and chest circumferences of the infants were measured according to the standard procedures.²⁸ Inter-observer reliability was high (intra-class correlation coefficients ≥ 0.98). The ponderal index (weight/length³) and head-to-length ratio were calculated as indices of disproportionality at birth.^{23,25}

Mother

A questionnaire was administered to the mothers on enrollment in hospital to obtain information on age, education, occupation, marital status, parity, and medical history. Information on consumption of cigarettes, marijuana, and alcohol during pregnancy, and type and duration of work done during pregnancy was also collected. Information on hypertension and pre-eclampsia, and delivery details were obtained from hospital records, and weight and haemoglobin levels during pregnancy from antenatal records. Homes of infants were visited one week later to assess the socioeconomic status (housing quality and possessions) and to measure maternal height.

Statistical Analyses

Although all the recruited mothers reported attending antenatal clinic, no records could be found for four mothers in the normal birth-weight group and 15 mothers in the low-birth-weight group. A further two mothers in the low-birth-weight group had no weights recorded in their antenatal records. The only difference between mothers with no antenatal records and the remaining sample was consumption of alcohol during pregnancy ($p < 0.05$) which was greater in the mothers with no records.

Two maternal weights were used in the analyses – the latest weight

recorded (median gestational age 37 weeks) and the first available weight recorded at or after 20 weeks (median gestational age 26 weeks). Weight after 20 weeks was the earliest weight that could be used in analyses as fewer than 40% of the mothers attended antenatal clinic before this. Weight gain per week between these two weights was calculated for those women who had two measurements at least three weeks apart (low birth-weight, $n=106$; normal birth-weight, $n=72$). A single measure of socioeconomic status was derived from factor analysis of crowding (persons/room), water and toilet facilities, and household possessions, and this was used in all multivariate analyses.

Multiple linear regression analyses were used for determining which infant and maternal characteristics were independently associated with each of the measurements and indices of size at birth. Infants were selected across a continuous range for birth-weight, however because the subjects comprised two groups (low birth-weight and normal birth-weight) which could potentially have led to a non-normal distribution, the residuals from all regressions were checked for normality and homogeneity of variance. There were no deviations from the assumptions of normality and homoscedasticity required for linear regression. It is often of interest to identify mothers at risk of having a low-birth-weight

infant. We, therefore, also used logistic regression for determining which variables predicted low birth-weight and low ponderal index (less than the 10th percentile of the references).²⁹

RESULTS

Measurements at Birth

Anthropometry at birth and gestational age of the infants are shown in Table 1. As expected, the normal birth-weight babies had significantly larger weights, lengths, head and chest circumferences, and ponderal indices, and had smaller head/length ratios (all $p < 0.001$). Gestational age was also significantly

greater in the normal birth-weight infants, although the mean difference between the groups was less than a week. The low-birth-weight infants were more likely to be first born (47.1% of low-birth-weight group and 34.0% of normal birth-weight group, $p < 0.05$), but there was no association with high birth order (birth order > 5 , low birth-weight 5.0%, normal birth-weight 4.3%). Apgar scores at five minutes were 8 for all infants and were not different between the low-birth-weight and the normal birth-weight groups (scores were missing for 7 low-birth-weight infants who were born before their mothers reached the hospital).

Table 1: Characteristics of Infant at Birth

Characteristics	Low Birth-weight (n=140)		Normal Birth-weight (n=94)	
	Mean	SD	Mean	SD
Birth-weight (kg)	2.23	0.19	3.12	0.31
Length (cm)	45.4	1.4	49.2	1.8
Ponderal index (g/cm ³ 100)	2.38	0.20	2.62	0.22
Head circumference (cm)	32.0	0.9	34.2	1.2
Chest circumference	28.6	1.2	32.4	1.3
Head length ratio	0.71	0.02	0.69	0.02
Gestational age (weeks)	38.6	0.9	39.4	0.7

*All significant different between the groups $p < 0.001$

SD= Standard deviation

Maternal Characteristics

Maternal and socioeconomic characteristics of the groups are shown in Table 2. There were no significant differences between the groups in socioeconomic status or in age, height, education, occupation, and marital status of mothers. Mothers of low-birth-weight infants weighed less in mid- and late pregnancy (Table 3). Weight at mid-pregnancy did not correlate with the gestational age at the time of the measurement, and weight in late pregnancy was only weakly correlated ($r=0.15$, $p<0.05$). We, therefore, did not adjust for gestational age at the time of measurement in further analyses.

Haemoglobin levels had been measured at an antenatal clinic visit in 105 of the low-birth-weight mothers and 73 of the normal birth-weight mothers at a mean gestational age of 23 weeks. The mean haemoglobin levels were not significantly different between mothers of low-birth-weight or normal birth-weight infants. Birth-weights were lower in infants born to mothers with haemoglobin levels of $<9.5 \mu\text{g/dL}$ (mean \pm SD 2.44 ± 0.47 kg), but there was little difference in birth-weights among mothers with haemoglobin levels of $9.5\text{-}10.9 \mu\text{g/dL}$ (2.66 ± 0.52 kg), $11\text{-}12.4 \mu\text{g/dL}$ (2.63 ± 0.49 kg), and $\geq 12.5 \mu\text{g/dL}$ (2.65 ± 0.53 kg). The mean birth-weight of infants was significantly lower among mothers with haemo-

globin levels of $<9.5 \mu\text{g/dL}$ compared to the other groups combined (t-test, $p<0.02$). A dichotomous variable was, therefore, used in the analyses, $1=\text{hb} <9.5\mu\text{g/dL}$, $0=\text{hb} \geq 9.5 \mu\text{g/dL}$.

Women who had low-birth-weight infants attended antenatal clinic for the first time later in pregnancy and made fewer clinic visits. Among mothers who had one or more other child(ren) (low birth-weight, $n=74$, normal birth-weight, $n=62$), mothers of low-birth-weight infants were more likely to report having had a previous low-birth-weight infant (51.4% of low-birth-weight mothers compared to 17.7% of normal birth-weight mothers, $p<0.001$).

Consumption of alcohol during pregnancy was greater among low-birth-weight mothers compared to normal birth-weight mothers ($p<0.05$). Smoking of cigarettes and consumption of marijuana were reported by the same percentages of mothers in the low birth-weight and normal birth-weight groups (cigarettes 10%, marijuana 5%). The frequency of consumption was low (once a week or less) for the majority of mothers who reported consuming alcohol and once a day or less for cigarettes or marijuana. No mothers reported the consumption of cocaine.

There were no differences between the groups in whether the mothers worked during pregnancy. As only work involving prolonged

standing, walking, and activities, such as carrying and lifting, is likely to affect birth outcome, we compared the groups according to the type of work

done in the second half of pregnancy. There were no differences between the mothers of low birth-weight and normal birth-weight infants (Table 3).

Table 2: Maternal and Socioeconomic Characterised by Birth-Weight Control

Characteristics	Low Birth-weight (n=140)		Normal Birth-weight (n=94)	
Age of mothers (years, mean \pm SD)	23.8	6.9	24.9	7.3
Height of mothers (cm mean \pm SD)	161.2	5.8	162.4	5.3
Education (no., %)				
Primary or less	8	5.7	2	2.1
Junior secondary	55	39.3	34	36.2
High (>grade 9)	77	55.0	58	61.7
Occupation (no., %)				
None/unskilled	44	31.4	22	23.4
Semi-skilled	28	20.0	31	33.0
Skilled	68	48.6	41	43.6
Marital status (no., %)				
Single	81	57.9	45	47.9
Married/cohabiting	59	42.1	49	52.1
Crowding (persons room (mean \pm SD)*	2.7	1.4	2.5	1.3
No. of possessions** (mean \pm SD)	5.1	1.9	5.2	1.5
Sanitation rating* ** (water+toilet rating,, mean \pm SD)	7.7	2.8	7.9	2.7
SES factor* (mean \pm SD)	-0.05	1.03	0.07	0.95

*Low-birth-weight group (n=139)

**Sum of gas or electric stove, refrigerator, radio, television, video player, cable television, bicycle, motor bike, and car.

***From factor analysis of crowding, possessions and sanitation.

SD = Standard deviation.

SES = Socioeconomic status.

Table 3: Antenatal History by Birthweight

Maternal Characteristics	Low Birth-weight (n=140)		Normal Birth-weight (n=94)	
Weight of mothers [†]				
After 20 weeks (kg, mean ± SD)	63.7	13.5	69.4	12.5**
Late pregnancy (kg mean ± SD)	67.4	13.6	73.7	12.6***
Weight gain from 20 weeks to late pregnancy (kg/week, mean ± SD) [‡]	0.37	0.26	0.43	0.24
Haemoglobin (µg/dL, mean ± SD) [¶]	10.3	1.8	10.7	1.5
Gestational age at first antenatal visit (weeks, mean ± SD) [§]	24.0	7.4	21.4	7.9*
Number of antenatal visits (mean ± SD)	4.0	2.8	4.9	2.9*
Hypertension (no., %)	29	20.7	14	14.9
Pre-eclampsia (no., %)	17	12.1	5	5.3
Consumption of alcohol (no., %)	27	19.3	9	9.6*
Work during second half of pregnancy (no. %)				
Some walking/standing/carrying	16	11.4	10	10.6
Mostly walking /carrying	15	10.7	14	14.9

† Low birth-weight (n=122), normal birth-weight (n=88), and median gestational age 26 weeks (after 20 weeks) and 37 weeks (late pregnancy)

‡ Low birth-weight (n=106) and normal birth-weight (n=72)

¶ Low birth-weight (n=105) and normal birth-weight (n=73)

§ Low birth-weight (n=124) and normal birth-weight (n=90)

*P<0.05, ** p<0.01, ***<0.001

Factors Associated with Size at Birth

Multiple regression analyses were conducted for determining which characteristics of the mother and child were independently associated with each of the anthropometric measurements at

birth. The dependent variables were weight, length, head and chest circumferences, ponderal index (weight/length³), and head circumference/length ratio (larger values for the ratio indicate more disproportionate babies).

Gestational age was significantly related to all measurements at birth and was entered in all regressions, as we were interested in variables which were related to growth and not any effects on size mediated through effects on gestational age. Variables that were significantly related to at least one of the measurements of size at birth in preliminary univariate analyses were then offered stepwise. The variables offered were sex of infant, being first born (first born=1, other=0), young maternal age (<18 years=1, ≥18 years=0), gestational age at first antenatal visit, pre-eclampsia, hypertension (pregnancy-induced hypertension or essential hypertension), consumption of alcohol during pregnancy, socioeconomic status, low maternal haemoglobin levels (<9.5 µg/dL=1, ≥9.5 µg/dL=0), height of mother, last recorded weight in pregnancy (median gestational age 37 weeks), weight after 20 weeks gestation (median gestational age 26 weeks), and weight gain per week between these two points. The regression coefficients are shown in Table 4.

Infant Characteristics

First born infants weighed less than infants whose birth order was >1. No other measures were related to birth order, and there were no differences by gender.

Maternal Characteristics

The rate of weight gain in the second half of pregnancy was associated with birth-weight, ponderal index, and head circumference/length ratio, and weight of mothers in late pregnancy was

associated with the ponderal index and head and chest circumferences. Shorter mothers had babies who weighed less, were shorter, and had smaller head and chest circumferences. Haemoglobin levels below 9.5 µg/dL were associated with lower birth-weights, smaller chest circumferences, and larger head/length ratios.

Fifty mothers in the sample were younger than 18 years. Their infants were significantly shorter than infants of older mothers. Mothers who attended antenatal clinic for the first time later in gestation had infants with lower birth-weights and smaller head circumferences.

Mothers with pre-eclampsia had infants with lower birth-weights, smaller chest circumferences, and larger head/length ratios, and infants of hypertensive mothers had lower ponderal indices. Mothers who reported that they had consumed alcohol during pregnancy had infants with lower birth-weights and smaller chest circumferences.

Factors Predicting Low Birth-Weight and Low Ponderal Index

Logistic regression analysis was used for determining which factors identified children born with low birth-weight or with low ponderal index. All variables that were significant in the multiple regression analyses and any others that were significantly different between the groups were offered stepwise using the likelihood ratio method (Table 5).

Table 4: Regression Coefficients and Standard Error from Regressions of Birth Measurements on Infant, Maternal and Socioeconomic Characteristics

Characteristics	Weight (kg)		Length (cm)		Ponderal Index		Circumference Head (cm)		Circumference Chest (cm)		Head/Length Ratio	
	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Gestational age (weeks)	0.25	0.04**	1.15	0.16***	0.06	0.02**	0.57	0.10***	0.93	0.16***	-0.0003	0.002
Weight gain after 20 weeks (kg/week)	0.37	0.14	-	-	0.22	0.07**	-	-	-	-	0.02	0.01*
Height of mother (cm)	0.02	0.006**	0.08	0.03**	-	-	0.04	0.02*	0.05	0.03	-	-
First born (yes = 1, no = 0)	-0.17	0.07*	-	-	-	-	-	-	-	-	-	-
Gestational age at first antenatal visit (weeks)	-0.01	0.005*	-	-	-	-	-0.03	0.01*	-	-	-	-
Low haemoglobin ($\mu\text{g/dL} < 9.5 = 1, \geq 9.5 = 0$)	-0.21	0.08*	-	-	-	-	-	-	-1.20	0.34***	0.01	0.004*
Consumption of alcohol during pregnancy	-0.25	0.12*	-	-	-	-	-	-	-0.94	0.46*	-	-
Pre-eclampsia (no=0, yes = 1)	-0.22	0.11	-	-	-	-	-	-	-1.27	0.47**	0.01	0.006*
Young maternal age (<18 years =1, 18 years = 0)	-	-	-0.85	0.37*	-	-	-	-	-	-	-	-
Weight in late pregnancy (kg)	-	-	-	-	0.005	0.001***	-	-	-	-	-	-
Hypertension (no=0, yes =1)	-	-	-	-	-0.11	0.05*	-	-	-	-	-	-
Adjusted R ²	0.33		0.22		0.17		0.18		0.3		0.09	

*p<0.05; **p<0.01; ***p<0.001

SE = Standard error

Although all infants were born at term, increasing gestational age was still associated with decreased risk of low birth-weight or low ponderal index. Taller mothers were less likely to have a low-birth-weight infant, and greater rate of weight gain in late pregnancy was associated with a decreased risk of having a low-birth-weight infant. Late attendance at antenatal clinic and low haemoglobin levels were associated with approximately three-fold increases in the odds of having a low-birth-weight infant. Mothers who consumed alcohol were also at an increased risk of having a low-birth-weight infant, however the confidence intervals were very wide. Late attendance at antenatal clinic was also associated with an increased risk of having a thin baby. Hypertension during pregnancy increased the risk of the infant being born with low ponderal index, while increasing maternal weight in late pregnancy was associated

with a decreased risk. Surprisingly, mothers aged less than 18 years were at a decreased risk. Surprisingly, mothers aged less than 18 years were at a lower risk of having a thin baby than older mothers.

Discussion

Size and nutritional status (height, weight, rate of weight gain, and haemoglobin levels) of mothers were significant contributors to infant size at birth in this group of low-income women from a developing country. Non-nutritional factors, associated with size at birth, were maternal age, birth order, the gestational age at which the mother first attended antenatal clinic, consumption of alcohol, and pre-eclampsia or hypertension during pregnancy. Although many significant associations with size at birth were observed, we cannot conclude that those variables which were not related to size at

Table 5: Logistic Regression of Variables Associated with Term Low Birth-Weight and Low Ponderal Index

Variable	Low Birth-weight		Low Ponderal Index	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Gestational age (weeks)	0.21	0.12, 0.39	0.51	0.34, 0.75
First antenatal visit after 20 weeks (yes=1, no=0)	2.87	1.27, 6.51	2.59	1.18, 5.6
Low haemoglobin level (<9.5 µg/dL=1, ≥9.5µg/dL=0)	3.16	1.11, 8.98	–	–
Height of mother (cm)	0.92	0.86, 0.98	–	–
Weight gain of mother after 20 weeks (kg/week)	0.11	0.02, 0.62	–	–
Consumption of alcohol during pregnancy (yes=1, no=0)	5.68	1.19, 26.99	–	–
Young maternal age (<18 years =1, 18 years=0)	–	–	0.36	0.14, 0.92
Hypertension (yes=1, no=0)	–	–	2.92	1.15, 7.42
Weight in late pregnancy (kg)	–	–	0.96	0.93, 0.99

CI = Confidence interval

birth in this cohort would not be predictive elsewhere or in a larger sample. The selection criteria for this study, which was designed to establish a cohort for follow-up, limited the range of socioeconomic status and also restricted the sample to healthier term low-birth-weight infants as those who required an extended stay in the special care nursery were not recruited. The results, therefore, apply to infants with 'simple' growth retardation without additional health complications. The antenatal variables were obtained retrospectively by maternal interview and from clinic and hospital records, which may affect the accuracy of the measurements that were collected as part of routine care at many different centres. This also limited the range of variables which could be included and the number of measurements available. Despite these limitations, several significant relationships were identified, and 33% of the variance in birth-weight was explained.

More variables were related to birth-weight, and more of the variance was explained than for any other measure of size at birth. This may be because birth-weight is affected by conditions throughout gestation, whereas some other measures may be predominantly affected at particular times during gestation. Many variables that affected birth-weight also predicted chest circumference and the percent of variance explained approached that for birth-weight. Chest circumference has been suggested as the best proxy for

birth-weight³⁰, and the results of this study suggest that growth in chest circumference is affected by many factors that influence birth-weight.

Timing of the maximum period of growth may explain the differences in the relationships with the different measures of size at birth. The peak in length velocity occurs at mid-gestation²³, and length was not affected by the environment in late pregnancy such as the rate of maternal weight gain. Other studies have shown length to be affected by weight gain in mid-gestation but not in late gestation.^{24,31} In contrast, birth length was related to young maternal age and maternal height which reflect conditions existing from the onset of pregnancy.

Ponderal index and the head/length ratio were influenced by the rate of weight gain in late pregnancy suggesting that disproportion at birth arises relatively late in pregnancy. The head/length ratio was also influenced by pre-eclampsia – a late pregnancy event – and low haemoglobin levels, the majority of which were measured after 20 weeks gestation. However, only 9% of the variance in this ratio was explained which suggests that other unmeasured factors influence disproportion. The variance explained in the ponderal index was also relatively low (17%). Similarly, maternal characteristics were poor predictors of ponderal index in other studies.^{20-21,32}

Head circumference was relatively explained poorly by the variables

measured in this study with only modest associations with height, weight in late pregnancy, and gestational age of mothers at first antenatal visit. To some extent this may reflect sparing of head growth compared to the growth of other dimensions which may be more affected by conditions during pregnancy.²⁵

Rate of weight gain in the second half of pregnancy was a risk factor for low birth-weight. In many developing countries, pre-pregnancy weights are unknown and, thus, absolute gain in weight cannot be determined. It is, therefore, important that the rate of weight gain can be used for identifying mothers likely to have a growth-retarded infant.³³ Low rates of weight gain in the second and third trimesters have also been associated with an increased risk of intrauterine growth retardation in other studies.^{31,34,35}

Haemoglobin levels were measured once at varying times during gestation, with the majority (64%) measured after 20 weeks gestation when expansion of the maternal plasma volume would have already occurred. Despite the limitations of the data, haemoglobin levels were associated with birth-weight, chest circumference, and the head/length ratio. Differences in size at birth were seen only when haemoglobin levels were below 9.5 µg/dL which would agree with the suggestion that, because of the expansion of maternal plasma volume, only haemoglobin levels below 10 µg/dL are likely to reflect poor maternal nutritional status³⁶.

Many variables examined were significantly associated with size at birth, however, there were no associations between any of the measures of socioeconomic status and birth size. We had 90% power at the 0.05 level to detect a difference of one in the number of possessions owned or of 0.5 standard deviation in the measures of crowding, sanitation, or the socioeconomic status factor. These indicators of socioeconomic status are predictive of postnatal undernutrition in the urban Jamaican population.^{37,38} It is, thus, more likely that the lack of association was due to the limited range of socioeconomic status among the mothers in this study. The majority of the women who attended the hospital in which the study was conducted had low income, and our enrollment criteria restricted the range for maternal education. This suggests that the socioeconomic status may be a relatively insensitive indicator of risk of smallness at birth and is likely to be related only where the range includes low through to middle and high income.³⁹

The evidence for an association between low-moderate consumption of alcohol and size at birth is inconsistent.⁴⁰ Given the low levels of consumption of alcohol among women in this study, the associations with birth-weight and chest circumference are more likely due to consumption of alcohol acting as a proxy for some other unmeasured variable.

As in many developing countries, late attendance at antenatal clinic is common in Jamaica⁴¹ and is associated with poor outcomes in several different countries.^{9,10,42,43} Early attendance at antenatal clinic may allow identification of high-risk mothers and appropriate interventions. However, the extent to which improved outcomes are due to the antenatal care received or to other characteristics of mothers who chose to initiate care early remains uncertain. Randomized trials have generally compared different levels of care and have shown that the number of scheduled visits can be reduced without affecting outcomes.^{44,45} However, even the reduced number of visits is often greater than that received by many women in developing countries. The maternal and socioeconomic characteristics measured in this study did not identify those mothers who were late attenders at the antenatal clinic. Previous work in Jamaica, based on a national birth cohort, suggests that late attenders are more likely to be teenagers, unmarried, or multigravid with uneventful prior pregnancies, and the current pregnancy was less likely to have been planned⁴¹, similar to factors associated with poor attendance elsewhere.⁴³

The maternal characteristics, associated with size at birth or which predicted low birth-weight, could be helpful in identifying women at risk of having small infants. Some of these are well-established, but the usefulness of rate of weight gain in the second half of

pregnancy, particularly in developing countries, merits further evaluation and emphasis. The variability in the maternal characteristics which best predicted birth size or proportionality may reflect the time during gestation when different aspects of growth are most affected by the maternal environment.

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