What is G6PD deficiency?

Glucose-6-phosphate dehydrogenase deficiency, or G6PD deficiency for short, is the most common enzyme deficiency worldwide. This is an x-linked inherited disorder which means that from the time a baby is born, there is already something wrong with how his body makes and breaks important substances. According to statistics, about 400 million people have G6PD deficiency, and it is most common in Africa, Southeast Asia and the Middle East.

Babies with G6PD deficiency have very little or no enzyme called Glucose-6-Phosphate Dehydrogenase (G6PD). An enzyme is a kind of protein that speeds up chemical reactions in the body. The enzyme G6PD is especially important to red blood cells. If this enzyme is lacking or missing, red blood cells are easily destroyed. Another name for G6PD deficiency is favism because some people who have it, usually those living in the Mediterranean region, react very badly after ingestion of fava beans.

What causes G6PD deficiency?

In order to understand what causes G6PD deficiency, one must first learn a bit about genes and chromosomes. Genes are like the body's blueprints. They contain instructions on how specific arts of the body are made. For example, if the instructions in your hair genes say your hair is black, your hair will be black. Genes are packaged into threadlike structures called chromosomes. A chromosome is very much like a beaded bracelet. The beads are the different genes that give instructions for different part of the body; the entire bracelet is the chromosome. Genes usually come and act in pairs. One member of a specific pair comes from the father, and the other member comes from the mother. The members of a pair are located on paired chromosomes.

All normal human beings have 23 pairs of chromosomes. Each of the first 22 pairs contains the same number and kind of genes. The last and 23rd pair is the sex chromosomes. They are different from the first 22 pairs in that they do not have the same number and kind of genes. The sex chromosomes contain the genes that determine whether a baby will be a girl or a boy.

There are 2 kinds of sex chromosomes, X and Y. All baby girls have two X chromosomes. All baby boys have one X and one Y. The gene that gives instructions on how G6PD is made is found in the X chromosome only, thus G6PD deficiency is described as X-linked.

If a baby girl gets one defective G6PD gene from either of her parents, she will not have G6PD deficiency because she has another G6PD gene that can do the work (remember: a baby girl has two X chromosomes, thus two G6PD genes). But if she gets two defective G6PD genes from both her parents, she will have G6PD deficiency. On the other hand, a baby boy whose G6PD gene is defective will surely get G6PD deficiency because the Y chromosome has no G6PD gene.

A defective G6PD gene will give wrong instructions on how to make the enzyme G6PD. As a result, too little or none of it is made.

What are the harmful effects of G6PD deficiency?

G6PD has a very small but strategic role in protecting the body from substances that can cause damage to cells or oxidative substances. Because of this important role, G6PD is normally found in all parts of the body. To be sure, most parts of the body also keep a "spare" enzyme, one that can do the work of G6PD in case it is lacking or missing entirely. Unfortunately, this is not the case with red blood cells. They do not have spare enzymes that can do the work of G6PD. If a baby does not have enough G6PD, his red blood cells lack protection from the harmful effects of oxidative substances.

A baby with G6PD deficiency appears and remains healthy until he is exposed to a large amount of oxidative substances. When this happens, his red blood cells are destroyed, a process known as hemolysis. Red blood cells carry oxygen to all parts of the body. When they undergo hemolysis, the baby will have hemolytic anemia. The signs and symptoms of hemolytic anemia are paleness, dizziness, headache, tea-colored urine, and abdominal or back pain or both. Hemolytic anemia, when very severe, can end in death.

Destroyed red blood cells are brought to the liver to be broken down to smaller pieces for disposal. One of the end products of this process is bilirubin, a yellowish substance that accumulates in different parts of the body when too much of it is produced. Quite often, bilirubin accumulates in the skin and causes it to appear yellowish. In the worst cases, bilirubin accumulates in the brain and causes mental retardation or death.

Where do oxidative substances come from?

Hemolysis of red blood cells will only occur IF and WHEN a G6PD deficient child is exposed to oxidative substances. Oxidative substances are found in certain drugs, foods, and beverages. The body also produces oxidative substances during severe infections or illnesses such as typhoid fever, pneumonia, or kidney failure.

Most drugs with strong oxidative effects are of kinds:

1. antibiotics of the sulfa group
2. medicines for malaria
3. some medicines for fever

How is G6PD deficiency treated?

When a child has taken oxidative substances and suddenly shows the signs and symptoms of hemolytic anemia, he is said to have a hemolytic crisis. During such crisis, the goal of doctors and nurses is to prevent the harmful effects from getting worse. Blood transfusion, oxygen, and folic acid may be given.

The ultimate treatment for G6PD deficiency is gene therapy (replacing a defective gene with a good one), but this is not yet available at the present time.

As parent, what should I do to prevent a hemolytic crisis?

1. Tell your child's pediatrician that your child has G6PD deficiency. This is very important so that he will not prescribe oxidative drugs in case your child gets ill. He would also be able to watch out for hemolytic crisis and would immediately know what to do just in case it happens.

2. Keep your list of oxidative substances in a handy place. Better yet, post it in a convenient spot on the kitchen wall. Always double-check food, beverage, and medicine labels against the list.

3. Memorize the signs and symptoms of hemolytic anemia: paleness, dizziness, headache, difficulty in breathing, rapid and strong heartbeats, tea-colored urine, and abdominal or back pain. Bring your child to his pediatrician as soon as these signs and symptoms appear.

4. Do not ignore infections. Persistent fever signals an infection. Bring the child at once to his pediatrician.

5. As your child gets older, honestly and gently tell him about his condition and teach him to be careful about what he eats.

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National Institutes of Health-Philippines

Glucose-6–Phosphate Dehydrogenase Deficiency

www.newbornscreening.ph

My baby did not go through newborn screening. What should I do to make sure that he/she is not G6PD deficient?
You can bring your child to a pediatrician for a thorough medical check up. If the age of your baby is already beyond the limit for newborn screening, he/she can still undergo confirmatory testing for G6PD deficiency. However, for the other diseases included in the newborn screening, it will depend on the assessment of your pediatrician if your baby will need a referral to an endocrinologist or geneticist for further evaluation.

My baby has G6PD deficiency and I feel devastated. Did I do something wrong when I was pregnant? Could I have done something while I was pregnant for my baby to avoid it?
You did nothing wrong. It is a genetic disorder, hence, there is nothing you can do as a mother to prevent it.

My firstborn was diagnosed with G6PD deficiency. I am pregnant again and worried – will my next baby also have it?
Once you have a child with G6PD deficiency, there is always a possibility of having a child with G6PD deficiency for every succeeding pregnancies. All your babies must undergo newborn screening.

Is it possible that the confirmatory test of my child is negative?
Yes. If negative, then you do not have to worry about the medicines and the food items. If positive, make sure that your attending physician knows that your child has G6PD deficiency.

I am a parent. Should I get tested for G6PD deficiency?
Yes, you may want to have yourself tested by requesting for G6PD assay using the confirmatory test in designated confirmatory centers. However, only males who are G6PD deficient and affected females (homozygous for G6PD) can be identified. A female with a carrier status (heterozygous for G6PD) cannot be detected by this kind of test.

I am trying to conceive. Should I be tested for G6PD deficiency?
It is your choice if you want to be tested but the probability of having a child with G6PD deficiency does not solely depend on your status. Your spouse's G6PD status can also affect the probability of having a child with G6PD. It will be more practical to just have your new baby undergo the routine newborn screening after birth.

Where is G6PD Deficiency Confirmatory Testing done?
At the moment, there are 15 Confirmatory Testing Centers in the country. You may want to contact them directly regarding their testing schedule. Please visit www.newbornscreening.ph for details.

Is formula milk safe for my son who has G6PD deficiency?
Although soya and soy lecithin are both included in the list, many products contain very small amount of soya including the common milk formulas. There has not been any report of hemolysis due to milk products containing soya. Soy lecithin, which is present in different brands, is an important component of milk but it does not make up the whole milk. **REMEMBER: Breastfeeding is still best for babies. Breastfeeding is healthier for both babies and mothers.**

I am breastfeeding my son. When I haven't received the newborn screening result I ate the foods that need to be avoided. Will they take effect on my son?
Theoretically, food and chemicals can be excreted through the milk. If your son did not develop hemolysis due to that event in the past, then probably they were not excreted at all through the milk or the amount was too small to cause significant reactions.

I have donated blood several times without knowing I am a G6PD carrier. Can I still donate blood?
Yes, you may still donate. There is no contraindication as a person with G6PD deficiency. There is also no policy written that you cannot donate.

Is it transmissible via blood transfusion?
No, it is not transmissible via blood transfusion.

My baby has G6PD deficiency; vitamins are on the restricted list. How can I keep him healthy?
Multivitamins are generally not contraindicated. Vitamin C or ascorbic acid can be given for as long as the dose is within the recommended dosage. Multivitamins are considered food supplements, BUT there is no substitute to nutritious, freshly prepared food and a well-balanced diet.

Is it okay to eat chocolates even they have soy content?
Although soya is included in the list, many products contain very small amount of soya. So generally patients with G6PD deficiency can eat chocolates except if it is a fava bean coated with chocolates. Please read the product label.

Is malunggay leaves safe to eat? Because I read in some website that malunggay isn't safe for people with G6PD deficiency.
For as long as it is not included in the official list of NIH as foods to avoid, then there is no basis to withhold malunggay from persons with g6pd.

I have a son who has G6PD deficiency and now he has a cold and cough, it is safe to use oregano for his medication?
Since oregano is not included in the list it can be given. However, you should exercise caution in giving commercially produced herbal preparations because they might contain unreported chemicals. Generally, cough and colds can be treated with lots of fluids. If proven to be bacterial in origin, they should be given antibiotics.

Is infant cereal safe for newborns with G6PD deficiency?
So far, there are no reported cases of hemolysis secondary to rice infant cereals (eg Cerelac). It contains a very small amount of soya in the first place.

Is insect repellant safe to use?
If you are not comfortable in using insect repellant, you can look for an organic type . If not available, you can just apply the commercial ones on your baby's clothes.

What toothpaste brand is safe for babies with G6PD?
The amount of menthol that is in ordinary toothpastes so far has not caused hemolysis in G6PD deficient patients.

What about blueberries? In other countries, they are not listed as contraindicated food.
If there is confusion about blueberries then it might be best to avoid it until extensive evidence that it is safe for patients with G6PD deficiency becomes available. Please note that patients with G6PD deficiency are not the same all over the world because of differences in mutations and therefore phenotypes, some of them will react consistently with some of the items in the list and some would not. As an organization, we are just giving the parents some guidance on what to avoid for the good of their children. It is still up to the parents to accept our recommendations.

What are the signs of hemolysis?
Signs of hemolysis include tea colored urine, yellowish discoloration of the skin, weakness and irritability. A child may look clinically pale but may actually have normal CBC results. So a CBC should be requested to confirm if the child has anemia.

My son exhibited symptoms of a viral infection (vomiting, lbm, lack of appetite). I saw on his diaper that the stain of his urine is somewhat tea colored. Should I be worried? What should I do?
Bring him to his pediatrician for check up. Please do CBC APC, and urinalysis. Check for urine hemoglobin.

Have there been reported cases of hemolysis here in the Philippines because of G6PD deficiency? If so, what were the most common causes?
Yes, there have reports of hemolysis among patients with G6PD deficiency. There are also claims registered at PhilHealth. Some of the causes of hemolysis recorded in Philippine Children's Medical Center are infections (Flu, hepatitis) and exposure to moth balls. Fortunately, none of these patients died because of severe anemia. They were brought immediately to the hospital as soon as the initial signs of hemolysis became evident

What are the chances of getting a different result if we undergo another Confirmatory Test?
The family of a child confirmed with G6PD deficiency may always opt to have another confirmatory test if they are having doubts. If the result is below the borderline, the patient will most likely get a positive result in another test.

As a mom, can I use menthol-containing products?
The use of menthol and camphor containing products are not recommended if the goal is to reduce or eliminate the pain. These products only divert attention away from the painful area by producing cooling effects and sensation on the skin. It is always better to know the real cause/s of the pain/discomfort by consulting your doctor about it.

Is there a contraindication to any vaccination for patients with G6PD deficiency?
None.

I. DRUGS TO BE AVOIDED	
Generic Name	Common Brand Names
A. Antibacterial	
*Nalidixic acid	
Nitrofuran 1. Nitrofurantoin 2. Furazolidone 3. Nitrofurazone / nitrofural	Macrodantin Diafuran, Diapectolin, Furoxone Furacin
*P- aminosalicylic acid	
B. Analgesic/ Antipyretic	
*Acetanilid	
C. Antihelmentic	
*B-naphthol	
*Niridazole	
*Stibophan	
D. Sulfonamides and Sulphones	
Dapsone	Lepravir
*Glucosulphone sodium	
Glyburide/ Glibenclamide	Euglucon Gluban Lodulce Orabetic
*Mafenide acetate	
*Salicylazosulphapyridine/ Sulfasalazine	
Stibophen	(2-(2-Oxido-3,5-Disulphonatophenoxy)-1,3,2,Benzodioxastibole-4-6-Disulphonate)
Sulphacetamide/ Sulfacetamide	Cetapred Sensocet
*Sulphadimidine	
*Sulphafurazone	
Sulphamethazole/ Sulfamethazole	Bacidal Bactille Forte Bactrim Bacxal DLI Cotrimoxazole Forteprim Globaxol Pharex Cotrimoxazole Ritemed Cotrimoxazole Septrin Trim S
Sulphanilamide/ Sulfanilamide	
Sulphapyridine	
*Sulphoxone/ Sulfoxone	
Sulfasalazine, Salazosulfa-pyridine	Salazopyrin
E. Antimalarials	
Chloroquine	Aralen, Chlorofoz
*Pamaquine	
Primaquine	
Pentaquine	
F. Miscellaneous	
Acetylphenylhydrazine	
Dimercaprol	
Futamide	
Isobutyl nitrate	
Mepacrine	
Phenazopyridine	Azomir
Probenecid	
Thiazolesulfone	
Urate oxidase/ Rasburicase	
II. CHEMICALS TO BE	**AVOIDED**
Methylene Blue	
Arsine	
Phenylhydrazine	
Toluidine blue	
Trinitrotoluene	
Aniline dyes	
III. FOOD/DRINKS TO BE AVOIDED	
Fava beans	Dingdong nuts, Mr. Bean
Red wine	
Legumes	Abitsuelas, Garbanzos, Kadyos, Munggo
Blueberry	
Soya food	Taho, Tokwa, Soy Sauce
Tonic water	
Bitter melon / ampalaya	
I. OTHERS	
Menthol	Alaxan Gel Ben-gay Efficascent Oil Listerine mouthwash Listerine Pocketpacks Megascent Oil Mentopas Medicated Plaster Omega Pain Killer
Camphor	Liniments
Naphthalene	Moth balls
Parabenzene dichloride / dichlorobenzene	Toilet deodorizer
Henna	
Herbs	Cattle gallstone bezoar Honeysuckle flower Chimonanathus flower 100% pearl powder Figwortflower Acalypha indica
IV. DRUGS SAFE TO TAKE	**IN THERAPEUTIC DOSES**
Acetaminophen	Paracetamol, tylenol
Acetophenetidin/ phenacin	
Aspirin/ Acetylsalicylic acid	Alka-seltzer Aspilets Cor-80 Cortal
Ascorbic acid	
Chloramphenicol	Chlormycetin Chloro-S Chlorsig Klorfen Oliphenicol Optomycin Pediachlor Penachlor Speradex
Ciprofloxacin	Ciprobay CIpromax Cipromet Qinosyn-500 Quilox Xipro
Diphenhydramine	
Isoniazid	
Phenytoin	
Quinidine	
**Vitamin K analogues/ Phyto-menadione	Hema-K Konakion MM Phil Pharmawealth/ Atlantic Phytomenadione

*Not available in the Philippines

**Should be water soluble

IMPORTANT REMINDERS for G6PD deficiency Individuals (*MGA MAHAHALAGANG PAALALA SA TAONG MAY G6PD DEFICIENCY)*

1. Avoid ingestion of or exposure to the listed drugs and chemicals. *(Iwasan ang mga nakalistang gamot at kemikal*.

2. If you have coughs, cold or other bacterial or viral infections, make sure to inform your doctor that you have G6PD eficiency. *(Kung mayroon kang ubo't sipon o iba pang sakit, huwag kalimutang sabihin sa doctor na mayroon kang G6PD deficiency).*

3. If you have ingested or were exposed to any medication and your urine became tea-colored, inform your doctor immediately. *(Kung may nainom kang gamot at ang ihi mo ay kulay tsaa, tumawag kaagad sa iyong doktor.)*

4. If you have yellowish discoloration of skin, sclera or any part of your body, consult your doctor immediately. *(Kung napansin mong naninilaw ang iyong balat, mata o alinmang bahagi ng iyong katawan, kumunsulta kaagad sa doktor.)*

NOTE:
All effort has been made to ensure that the information presented is correct and updated. Data collected are from foreign studies. These drugs, chemicals, food and drinks may have different reaction to the G6PD deficiency mutations found in our country. We recommend that this data be followed until local studies have been done. We encourage parents, guardians and caregivers to continually update themselves on G6PD deficiency. Some drugs that can cause problems are not available in the Philippines but may be elsewhere and should also be avoided. These drugs are in italics in the table. Make sure that your attending physician knows that your child has G6PD deficiency.

THIS IS JUST AN INFORMATION MATERIAL GIVEN TO ALL PATIENTS WHO UNDERWENT G6PD CONFIRMATORY TESTING, WHETHER DEFICIENT OR NOT. WHILE WAITING FOR THE RESULT, AVOID THE FOOD AND DRUGS LISTED IN THIS BROCHURE.

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