ORIGINAL ARTICLE

# Chromium deficiency: a new public health problem?

## *Deficiência de cromo: um novo problema de saúde pública?*

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### ABSTRACT

**Introduction:** just as noted in many asymptomatic people, the deficiency in vitamin D plasma levels seems to occur with oligo-elements, especially chrome. So far, no causal relationship between these findings has been established. **Methods:** 42 patients without specific complaints have received doses of vitamin D and chromium in the blood, between July and September 2012. **Results:** significant deficiency of vitamin D (81% of cases) and absolute deficiency of chromium (100% of cases) were observed. **Conclusion:** deficiencies of oligo-elements, especially chromium, with un known consequences, deserve to receive attention from the authorities responsible for public health. Need to investigate whether the phenomenon stems from some sort of pollution or environmental degradation and scale their severity, as well as alert to the existence of new public health problem, with direct repercussions on the clinical and therapeutic conduct.


**Key words:** Avitaminosis; Vitamin D Deficiency; Chromium/deficiency; Trace Elements; Environmental Health; Environment and Public Health; Pandemics.


### RESUMO

***Introdução:*** *assim como se observa em muitas pessoas assintomáticas, a deficiência dos níveis plasmáticos de vitamina D parece ocorrer com os oligoelementos, especialmente o cromo. Não existe, até o momento, nexo causal entre esses achados.* ***Métodos:*** *42 pacientes sem queixas específicas foram submetidos a dosagens de vitamina D e cromo no sangue, no período de julho a setembro de 2012.* ***Resultados:*** *encontrou-se deficiência significativa de vitamina D (81% dos casos) e absoluta de cromo (100% dos casos).* ***Conclusão:*** *a deficiência de oligoelementos, especialmente do cromo, cujas consequências não são conhecidas, merece receber atenção das autoridades responsáveis pela saúde pública. É preciso investigar se o fenômeno decorre de algum tipo de poluição ou de degradação ambiental e dimensionar a sua gravidade, bem como alertar para a existência de novo problema de saúde pública, com repercussão direta sobre a conduta clínica e terapêutica.*


***Palavras-chave:*** *Deficiência de Vitaminas; Deficiência de Vitamina D; Cromo/deficiência; Oligoelementos; Saúde Ambiental; Meio Ambiente e Saúde Pública; Pandemias.*

## INTRODUCTION

Hypovitaminosis D[1] is frequently observed nowadays, however, the exactly origin of the disorder is not known. It was suggested that the "epidemic" is, in part, due to an excessive attention given to the problem from the moment in which a large contingent of people began to have access to laboratory dosages of vitamin D. This reality do not necessarily stick to the traditional concept of rickets, a condition resulting from low levels of vitamin D.[2] Even in the presence of an epidemic of Hypovitaminosis D, including in

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children, no cases of rickets are observed. That means that the ancient knowledge was mistaken: could we trust absolutely in information regarding other nutritional deficiencies? Gone are the days when children were given supplemental vitamin D (calciferol) to stay with "strong bones and strong muscles": actually, much more than that was at stake. Today, the hundreds of metabolic functions of vitamin D are known[3] as well as its role in the correct expression of thousands of genes.[4] Vitamin D is much more of a hormone, not exactly a vitamin, because it is produced endogenously; and it is not a nitrogen compound, i.e., what every vitamin should be. Animals of some species survive at the expense of endogenous calciferol exclusively, which can be seen from their diet and habits of life in such a way that a "vital amine" that needs to be ingested is out of question. Any biological concept applied in Medicine, however, has the human being in sight and ignores the reality of other forms of life, which must be discarded because it jeopardizes the ecological aspect of human Medicine.

With regard to chromium deficiency, little is known, and what is more serious: what is said about it is opposite to the results that will be presented here.[5] It has been around 50 years since chrome had been recognized for its essential function to health[6] especially with regard to the metabolism of lipids and carbohydrates, being recognized its association with improved glucose tolerance in patients with type II diabetes mellitus.[7] It is prudent to consider that the metabolic functions of oligoelements are virtually unknown, and many of the prevailing theories will become obsolete, as is the case of rickets. The existence of chromium deficiency in patients under parenteral nutrition has been reported;[5] however, in such cases, the existence of a serious underlying disease prevents the comparison with the situation of healthy humans, which is of little interest in this article.

Chromium belongs to the group of 15 oligoelements considered essential for homeostasis in higher life forms; and that number could increase as knowledge progresses, maybe even including all elements in the periodic table.[8]

This study aimed to evaluate serum levels of chromium.

## MATERIAL AND METHODS

This study was conducted in the Health and Assistance Management Service of the Legislative Assembly of the State of Minas Gerais, Belo Horizonte, from complementary propedeutics performed in patients with symptoms of low intensity and in periodic annual health examinations, aiming to find an explanation for changes related to: low vitamin D; cholesterol, and high ferritin and gamma glutamyl transferase; high thyroid stimulating hormone with invariably normal thyroid hormones; and especially some findings of very high levels of parathyroid hormone. All patients volunteered after learning about the results observed in co-workers.

The direction of the research was defined by its own results as they emerged. It was not necessary to perform specified dosages in a clinical point of view; therefore, a protocol of work was not elaborated from the beginning. For this reason, only two laboratory tests that were performed in all subjects in the group will be presented.

The study was authorized by the Health and Assistance Management Service from the Legislative Assembly of the State of Minas Gerais (ALMG), responsible for the ethical analysis of all health care provided in the district where the studied was conducted.

Blood dosing of vitamin D and chrome was performed in 42 people without complaints or sign of any disease, between July and September of 2012. Out of these, 17 were workers called for periodic health examinations, all employees of the Legislative Assembly of the State of Minas Gerais; 16 sought the medical service due to biochemical changes related to the mentioned examinations; and 9 were volunteers.

The blood dosing of vitamin D and chrome was performed in four laboratories certified by the Health Management from ALMG and spontaneously sought after by the patients. The laboratory technicians were unaware of the progress of this study. The 25-hydroxyvitamin D was dosed by the chemiluminescence method (Table 1);[9] alteration categories were grouped into a single category, excluding the toxicity category to standardize the evaluation of patients (Table 2).

**Table 1** - Range of serum Vitamin D values as a function of its normality

| Standard values | Laboratories A & B | Laboratories C & D |
|---|---|---|
| Deficiency | <10 ng/mL | <20 ng/mL |
| Insufficiency | 10 – 29.9 ng/mL | 20 – 29.9 ng/mL |
| Sufficiency | 30 – 100 ng/mL | >30 ng/mL |
| Toxic level | >100 ng/mL | - |

**Table 2** - Range of normal or altered serum Vitamin D values

| Standard values | Laboratories A B C & D |
|---|---|
| Inadequate value | <30 ng/mL |
| Adequate value | >30 ng/mL |

Chromium was measured by atomic absorption spectrophotometry in a graphite furnace.[7, 10] Most examinations included the Zeeman correction factor but not all. This correction allows the creation of a range of normality, which enables the assessment of levels of chromium as a nutrient. The uncorrected examination seems to have the objective of detecting toxic levels of the metal because it provides only the upper limit. This discrepancy had no impact on the results later verified. In the first case, the normality range is between 0.7 and 2.2 g/L, with 0.1 g/L being considered an undetectable chrome level; and in the second case, the normal value is below 5 g/L (Table 3).

It has not been possible to compare these results with other data due to the fact of having established a range of normality up to one single divider between normality and abnormality, i.e., 30 ng/mL.

The single-sample t test was applied to the results from the vitamin D group, assuming an average of 30 ng/mL.

## RESULTS

All participants lived in the metropolitan region of Belo Horizonte, Minas Gerais, Brazil and were represented by 16 males and 26 females. The age ranged was between 14 and 75 years, with an average age of 48 years old.

An adequate level of vitamin D was found in eight participants.

## DISCUSSION

The regular health evaluation using standardized tests for some laboratory exams revealed alterations in patients without clinical abnormalities. The immediate replacement of vitamin D and chromium was conducted; however, another relevant issue emerged - to find its cause - especially in the situation of missing signs and symptoms, which requires understanding that vitamin D and chrome deficiencies were in the subclinical horizon. The uniform reaction produced in the bodies of people at such different ages, which presupposes completely different lifestyles, suggests a slow adaptation mechanism to exposure to some unknown and ubiquitous environmental factor. The lack of specific physical findings is what kept the chromium deficiency hidden, even before asymptomatic or only mildly symptomatic people.

**Table 3** - Results from Vitamin D and chrome blood dosing as a function of each patient in the study

| Subject | Age | Gender | Vitamin D ng/mL | Chrome µg/L |
|---|---|---|---|---|
| 1 | 67 | F | 36.5 | <0.1 |
| 2 | 70 | F | 31.9 | <0.1 |
| 3 | 35 | M | 26.9 | <0.1 |
| 4 | 35 | F | 26.1 | <0.1 |
| 5 | 34 | F | 21.7 | <0.1 |
| 6 | 40 | M | 24.0 | <0.1 |
| 7 | 42 | M | 14.7 | 0.1 |
| 8 | 57 | M | 43.0 | 0.2 |
| 9 | 29 | F | 21.0 | <0.1 |
| 10 | 49 | F | 32.6 | <0.1 |
| 11 | 51 | M | 24.9 | <0.1 |
| 12 | 49 | F | 20.4 | 0.3 |
| 13 | 52 | F | 27.8 | <0.1 |
| 14 | 45 | M | 23.4 | <0.1 |
| 15 | 53 | M | 29.8 | <0.1 |
| 16 | 59 | M | 22.9 | <0.1 |
| 17 | 48 | F | 21.3 | <0.1 |
| 18 | 52 | F | 14.6 | <0.1 |
| 19 | 47 | F | 11.8 | <0.1 |
| 20 | 54 | M | 17.5 | <0.1 |
| 21 | 46 | M | 24.0 | <0.1 |
| 22 | 46 | M | 26.1 | <0.1 |
| 23 | 29 | M | 27.6 | <0.1 |
| 24 | 61 | M | 26.7 | 0.2 |
| 25 | 44 | F | 20.2 | <0.1 |
| 26 | 51 | M | 26.3 | 0.3 |
| 27 | 59 | F | 12.8 | 0.1 |
| 28 | 53 | M | 43.0 | <0.1 |
| 29 | 14 | M | 20.1 | <0.1 |
| 30 | 54 | F | 12.9 | <0.1 |
| 31 | 50 | F | 30.5 | <0.1 |
| 32 | 50 | F | 10.6 | <0.1 |
| 33 | 57 | F | 10.5 | 0.2 |
| 34 | 54 | F | 34.8 | <0.1 |
| 35 | 60 | F | 24.4 | <0.1 |
| 36 | 49 | F | 23.3 | <0.1 |
| 37 | 27 | F | 21.8 | <0.1 |
| 38 | 37 | F | 33.4 | <0.1 |
| 39 | 44 | F | 21.5 | <0.1 |
| 40 | 75 | F | 23.5 | 0.1 |
| 41 | 42 | F | 22.4 | <0.1 |
| 42 | 28 | F | 24.2 | 0.2 |

In addition to the event of confirming a pandemic specific malnutrition, which remained subclinical for decades, the possibility of unutterable ineptitude with which the modern scientific model addresses emotional, existential, and moral human being distress still exists.

In the view of the possibility of a serious environmental degradation, the Regional Council of Medicine of Minas Gerais was alerted about it through a document-letter dated August 27, 2012, long before we had the results from the 42 patients in hands. It is very likely that all these people are ingesting a poison that prevents the absorption of at least one oligoelement, and thus, leading to an overload in the mechanism mediated by intestinal uptake of vitamin D.

Blood glucose was not performed in all cases; however, two of the 42 patients known to have diabetes mellitus have returned values of chrome as at least detectable. Conversely, patients whose level of chromium was undetectable did not present signs of diabetes mellitus. Would the immediate association between chromium deficiency and glucose intolerance be one more of the myths that are not meant to survive? Would it be reasonable to consider the existence of an environmental factor or specific geographical region in Belo Horizonte that could explain the fact that a pandemic deficiency of chromium has been identified here and not elsewhere? It is known that the drinking water of the city contains a metal trivalent compound from ore deposits found around the metropolitan region; it is known that ions with the same number of oxidation compete with each other for intestinal absorption.

Although unlikely, this hypothesis cannot be ignored. A positive response certainly would help to reduce the severity of the problem, however, it should not be forgotten that other 3,000,000 people who also live in Belo Horizonte have not been examined. On the opposite side of the issue is the fact that Minas Gerais, a mediterranean state, works as a type of ballast to the Brazilian nation because the country and the State have common regional differences and ethnic diversity. Minas Gerais is the right place to start a research in a demographic circumstance that is relevant for all Brazil. It is expected that the results of a simple clinical study do not take the unassuming size of a catastrophe of unknown proportions that is about to take over our country or even all over the world.

Could there be a trend or a confusion factor able to completely invalidate our results? Ni jamais, ni toujours: maybe. The publication of results obtained by independent researchers is awaited. Would it be possible that all tests are wrong? This should not be possible because the correct chrome replacement led to normalization in at least two cases; and so far, to a partial vitamin D values recovery. The normalization of cholesterol and ferritin were also observed, however, such evaluation is outside the objectives of this article. In addition, the deficiency of other trivalent oligoelements most likely would occur if chromium deficiency can be explained by an absorption disorder; this could create the so called metalopenic syndrome. Therefore, one can expect that metabolic markers normalize only after complete eradication of all deficiencies.

## CONCLUSION

Some preliminary data about the low serum concentration of vitamin D and chromium were presented, conducted in patients undergoing medical consultation for several reasons and for periodic health evaluations. The results were surprising considering the significant reduction, without significant symptoms, of this vitamin and oligoelement, which suggests the need for more in-depth studies. The results serve as a warning to the possible existence of factor or factors in the metropolitan region of Belo Horizonte responsible for these alterations. New studies are underway to deepen the theme.

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