Dietary Zinc Intake of a Group of Long-Stay Mentally Handicapped Women

Some Bioavailability Considerations

IBRAHIM B. RAZAGUI,1 PHILIP J. BARLOW,1 K. D. ANTHONY TAYLOR,*,1 AND MOHAMED G. A. IZMETH†,2

School of Applied Sciences and Technology, University of Lincolnshire and Humberside, Humber Lodge, 61 Bargate, Grimsby, North East Lincolnshire, DN34 5AA UK; and 2Mental Handicap Services Section, Greaves Hall Hospital, Banks, Southport, Merseyside, PR9 8BL UK

Received April 20, 1998; Accepted July 25, 1998

ABSTRACT

Dietary factors affecting zinc bioavailability were evaluated according to their relative distribution in the individual daily meals making up the basic diet of 17 institutionalized, mentally handicapped adult women. Mean intake values of zinc, phytate, nonstarch polysaccharides (NSP), calcium, protein, and energy were calculated from a dietary survey of 7 consecutive days, which also served to obtain values for the two zinc bioavailability predictor formulas, phytate/Zn millimolar ratio and [Ca][phytate]/[Zn][energy] ratio. Mean daily zinc intake was 8.5 ± 1.8 mg, with noon and evening meals accounting for the highest contribution to this value (45% and 35%, respectively), whereas breakfast meals’ contribution was 16%. The mean protein intake was 55 ± 13 g, with noon and evening meals being the major contributors to total daily intake (42% and 38%, respectively). Breakfast meals accounted for 77% of daily phytate intake, giving a respective phytate/Zn millimolar ratio of 20.4 ± 7.6 and a [Ca][phytate]/[Zn][energy] ratio of 336 ± 127 mmol/Mcal. Values for both ratios based on noon and evening meals were negligible in comparison. The mean daily NSP intake was 9.8 ± 4.2 g, with 53% of total daily intake supplied from breakfast meals, whereas noon

*Author to whom all correspondence and reprint requests should be addressed.
†Present address: Psychiatric and Community Services Unit, The Mesketh Centre, Southport, Merseyside, UK.
and evening meals accounted for 30% and 14%, respectively. The results, while suggesting that zinc bioavailability is unlikely to be adversely affected, indicated that dietary fiber intake levels are probably inadequate, particularly in view of the nonambulant condition and low physical activity prevalent in such individuals, who may, as a consequence, be susceptible to health disorders associated with impaired bowel function and constipation.

**Index Entries:** Zinc; diet; bioavailability; women; mentally handicapped.

## INTRODUCTION

The importance of zinc as an essential nutrient in animals and humans is well recognized (1,2). Biological processes dependent for their optimum functioning on zinc include lipid and carbohydrate metabolisms and nucleic acid and protein synthesis (3). Major clinical manifestations of overt clinical deficiency include growth retardation, male hypogonadism, impaired wound healing, parakeratosis, and compromised immune and olfactory functions (1). Evidence of frank zinc deficiency in humans was first reported in Iran (4), and factors associated with the etiology and symptomatology of zinc deficiency have subsequently become a major area of nutritional research (1,5–7). Zinc nutriture has become widely recognized as being affected not only by the quantity of the mineral ingested, but also by its interactions with other dietary components influencing its absorption and subsequent utilization (8–10). The inhibitory effects of dietary phytate and fiber on zinc absorption have become important factors when evaluating the interrelation between dietary zinc intake and zinc nutritional status (11,12). Although both dietary components are known to inhibit zinc absorption (13), the mechanisms and consequences of inhibition have not been fully elucidated (14–17).

The phytate/zinc molar ratio has been introduced as a predictive index for zinc bioavailability in animals and, by extrapolation, in humans. A value of this ratio higher than 10 has been suggested as indicative of poor zinc availability (18), and daily ratios consistently higher than 20 may be associated with deleterious effects on zinc status in humans (19,20).

Calcium has been suggested as having a potentiating effect on the inhibition of zinc absorption by phytate (21), and some bioavailability assessment studies have included calcium concentration in the ratio formula (21–23). Furthermore, as the phytate/zinc molar ratio has been derived from experimental observations on laboratory animals fed dried diets, the inclusion of energy density in the ratio formula has been suggested as giving a more satisfactory predictive index of dietary zinc bioavailability from human diets. Thus, the ratio [Ca][phytate]/[Zn][energy] (mmol/Mcal) has been used with values higher than 100 being suggested as indicative of poor zinc availability (24). However, there is still a lack of data from large