Dairy in the Diet of South Africans: Implications for health

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Consumer Education Project of Milk SA
Dairy Day CNE 2024

Stronger for longer

Introduction

- Dairy intake has **multiple beneficial functions** that have been widely studied and are fundamental to the health and development of people

- This presentation will highlight:
- the **intake of dairy foods over the past 25 years**
- **Implications for health**, including aspects such as

Glycaemic index of dairy

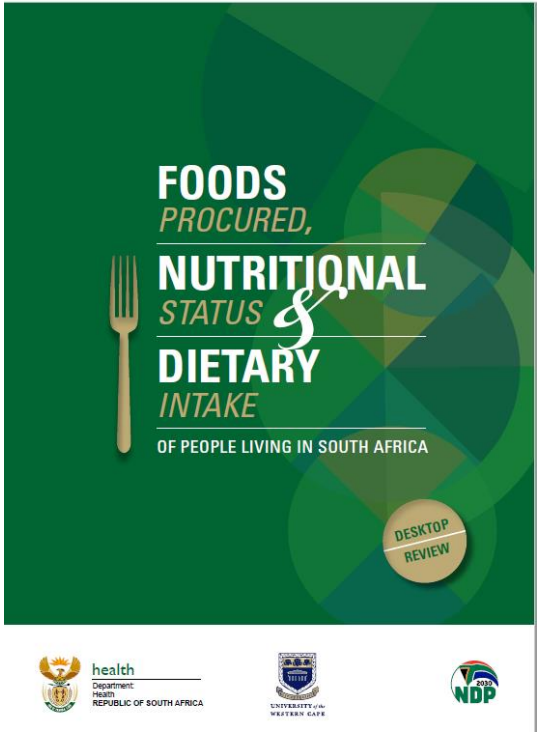
Calcium absorption

Background

- In 1997, Vorster et al. published a set of comprehensive reference tables based on a **review of the literature from 1975 to 1996** about the nutritional status of South Africans
- Depicted **inadequate diet** and **malnutrition**
- Since then, a number of **SA national surveys** and **various regional studies**:
  - provided **much-needed information** on the health and nutritional status of South Africans
  - BUT **did not include a comprehensive assessment of the dietary intake** of South Africans

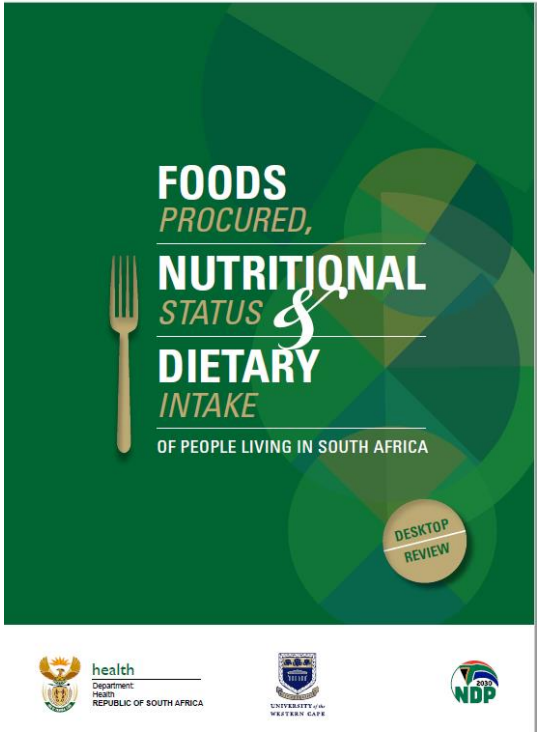
Identified the need for a SA National Dietary Intake Survey (NDIS 2022)

Vorster HH, Oosthuizen W, Jerling JC. et al. (1997) The nutritional status of South Africans: A review of the literature from 1975–1996. Durban, South Africa: Health Systems Trust



Aim of the Desktop Review

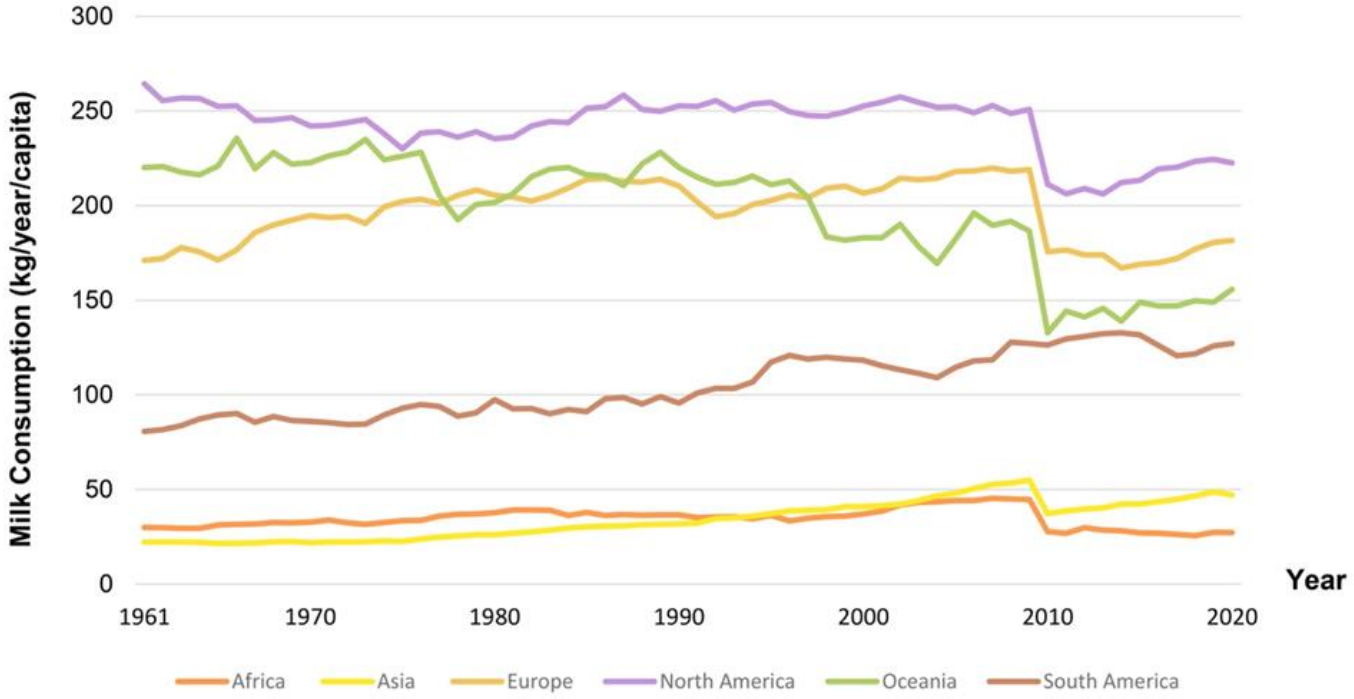
- To conduct a comprehensive, **systematic review of the available literature published from 1997 to 2019** on the dietary intakes and nutritional status (biochemical indicators and anthropometry) of South African adults
- To determine:
  - **Extent of SA research on nutritional status**
  - **Representation**
  - **Methods and cut points used**



Aim of the Desktop Review

- To report on **trends - improvement/deterioration** – over time in dietary intakes and nutritional status of children and adults over the period **1997–2019**
- To inform the **methodology for NDIS 2022**
- To extract and summarise the data in comprehensive reference tables for general use for **research, intervention and policy planning** related to South Africans

Global per capita milk consumption



Organization for Economic Co-operation and Development– Food and Agricultural Organization [OECD-FAO]. Agricultural Outlook – Dairy and Dairy Products [Internet]. OECD-FAO; 2021

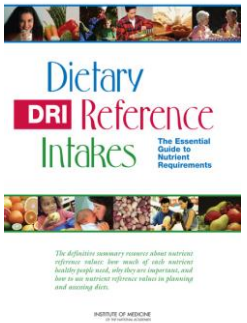
Dairy intake in SA

- In all groups, the **frequent intake of milk and milk products was relatively low** (except among those who lived on farms and in upper-class urban areas)
- When milk was consumed, it **was usually in small amounts** (e.g. in tea and coffee)
- The consumption of **cultured milk (amasi)** was reported in some studies

Nutrient intake

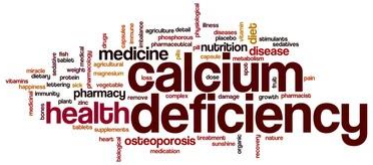
The limitations associated with the assessment and presentation of data related to nutrient adequacy made it **impossible to make valid conclusions about the adequacy of energy and nutrient intakes**:

- Most publications **reported only means or medians**
- Ideally, the **percentage of people in the group with intakes less than the EER for energy or the EAR for macronutrients is necessary** to make sense of the findings
- **Two standards** were used to evaluate **adequacy**:
  - 1989 Recommended Dietary Allowance (RDA)
  - The newer Dietary Reference Intakes (DRIs)
- A wide **variety of cut-points** were used to evaluate **adequacy**:
  - Percentage of participants with intake below the RDA
  - Percentage of participants with intake below 67% of the RDA or the Estimated Average Requirement (EAR)



Barr S, Murphy S, Poos M (2002) Interpreting and using the dietary references intakes in dietary assessment of individuals and groups. J. Am. Diet. Assoc. 102(6), 780–788

Calcium and potassium

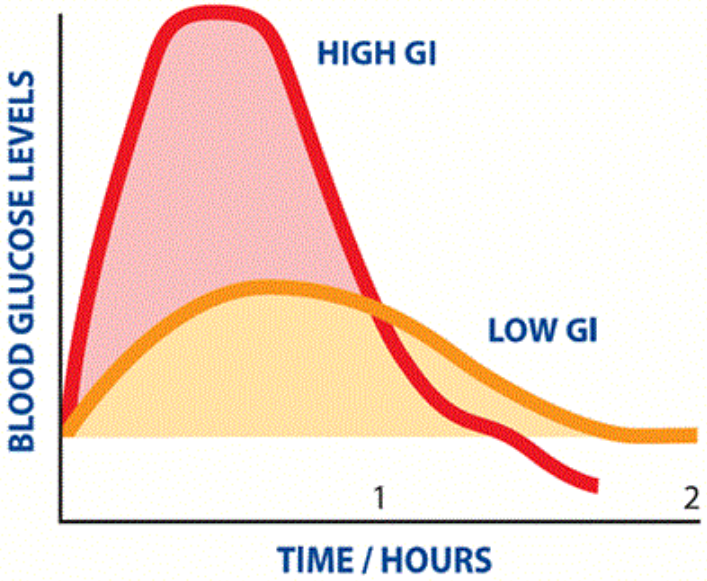


- **Inadequate intakes of calcium and potassium** were high across all strata represented in the studies
- EAR values for calcium were first published in 2011; before that, calcium requirements were based on AI
- **Thirteen (13) studies** reported calcium intakes in women (ranging from 116 to 690 mg/day) and **10 in men** (ranging from 229 to 620 mg/day)
- **Calcium intakes were lower in rural compared to urban dwellers**
- The low calcium and potassium intakes agree with the low milk, fruit and vegetable intakes that were reported for South African adults, especially Black Africans

Health implications of inadequate dairy intake

Glycaemic index

- The glycaemic index (GI) **ranks carbohydrate-containing foods on a scale of 0 to 100 based on how quickly they increase blood glucose levels compared to pure glucose**, which has a GI of 100
- Foods with a **high GI (above 70)** are rapidly digested and absorbed, leading to a more **substantial** increase in blood glucose levels
- Foods with a **low GI (below 55)** result in a **slower and more gradual** increase



Augustin LSA et al. Glycemic index, glycemic load and glycemic response: An International Scientific Consensus Summit from the International Carbohydrate Quality Consortium (ICQC. Nutr Metab Cardiovasc Dis. 2015;Sep;25(9):795-815.

Glycaemic index

- In comparison to the disaccharides, **sucrose** (GI approximately 65-68) and **maltose** (GI approximately 105-115), **lactose has a GI of approximately 45**, which is considered low

- When considering the GI of the monosaccharides, **galactose and glucose** (23 and 100, respectively), one **would expect the GI of lactose to be higher**

- Although **lactose itself has a low GI**, milk and other **dairy products all have a low GI**, ranging from **15 in some fermented milks to 51 in ice cream**

Romero-Velarde E, Delgado-Franco D, García-Gutiérrez M, Gurrola-Díaz C, Larrosa-Haro A, Montijo-Barrios E, et al. The Importance of Lactose in the Human Diet: Outcomes of a Mexican Consensus Meeting. Nutrients 2019, Vol 11, Page 2737. 2019 Nov 12;11(11):2737.

Glycaemic index

- Diet-related illnesses, such as **obesity, type 2 diabetes, and cardiovascular disease**, have been associated with **postprandial glycemia**

- The **low GI of lactose and dairy foods** may be a reason why they do not contribute to obesity and type 2 diabetes the way other sugars do

Feng Y et al. Consumption of Dairy Products and the Risk of Overweight or Obesity, Hypertension, and Type 2 Diabetes Mellitus: A Dose–Response Meta-Analysis and Systematic Review of Cohort Studies. Adv Nutr. 2022 Dec 22

Glycaemic index

- Several **factors** collectively **contribute to the rate** at which carbohydrates, such as lactose, enter the bloodstream and **increase blood glucose** levels:
  - **Amount and type** of carbohydrates present in the food
  - **Particle size**
  - **Cooking and processing** methods
  - **Rate of gastric emptying, hydrolysis, and absorption** of carbohydrates
  - **Individual variations** in lactose digestion and tolerance

Shkembi B, Huppertz T. Impact of Dairy Products and Plant-Based Alternatives on Dental Health: Food Matrix Effects. Nutrients. 2023 Mar 18;15(6):1469.

Glycaemic index

- Many of the mechanisms that influence the GI of carbohydrates can be ascribed to the substantial effect that the **food matrix in which the carbohydrates occur** has on postprandial glycaemic responses
- The **dairy matrix regulates postprandial glycemic responses by**:
  - controlled **gastric emptying**
  - regulated **enzymatic hydrolysis** of lactose to glucose and galactose
  - stimulated **insulin secretion** to improve blood glucose uptake from the bloodstream

Shkembi B, Huppertz T. Impact of Dairy Products and Plant-Based Alternatives on Dental Health: Food Matrix Effects. Nutrients. 2023 Mar 18;15(6):1469.

Glycaemic index

- **Gastric emptying** is a key factor in how quickly glucose reaches the bloodstream after eating
- While **slow gastric emptying** could decrease postprandial glucose, **rapid gastric emptying** may cause a significant increase in it
- **Dairy products**, often contain varying amounts **of fat and protein**
- Eating a **meal high in protein or fat** can lower the glycaemic response by:
  - delaying stomach emptying
  - stimulating insulin secretion

Marathe CS, Marathe JA, Rayner CK, Kar P, Jones KL, Horowitz M. Hypoglycemia and gastric emptying. Diabetes Obes Metab. 2019;Mar;21(3):491-498.

Glycaemic index

Reasons **for slow gastric emptying for milk**:

- The milk matrix contains **carbohydrate, fat and protein**
- Protein and fat in dairy foods can lower the glycemic response by **stimulating insulin secretion** through effects on gastric pH levels and **increased concentrations of glucagon-like peptide 1 (GLP-1), glucose-dependent insulinotropic peptide (GIP), and incretin hormones**
- When milk is consumed, the **pH of the stomach rises**, and it takes a significant volume of gastric fluid to lower it again (buffering effect)

Liu W, Jin Y, Wilde PJ, Hou Y, Wang Y, Han JM. Physiology, and Recent Research Progress of Gastric Emptying. Crit Rev Food Sci Nutr. 2021;61:2742–55.

Glycaemic index

- The lower expected GI value of dairy may further be ascribed to the **slower hydrolysis and absorption of lactose** compared to sucrose
- The chemical structure of lactose requires the **enzyme lactase to break it down into its individual monosaccharide components** before they can be absorbed.
- Enzymatic control systems are not required for **sucrose or other saccharides**, whose hydrolysis is markedly quicker
- The enzymatic control mechanisms result in a **slower hydrolysis and absorption of lactose** and consequently a more gradual and controlled release of glucose into the bloodstream and a lower glycaemic response

Holesh JE, Aslam S, Martin A. Physiology, Carbohydrates. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Sep 22]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK459280/

Glycaemic index

- Collectively, the mentioned mechanisms explain why **consuming** lactose-containing foods, such as **milk or yogurt**, is **unlikely to cause a sharp rise in blood glucose levels**

There is a **synergy between the dairy matrix and the human body** that results in glycaemic response control, allowing milk to supply a substantial amount of energy in the form of lactose without significantly raising blood glucose levels

Shkembi B, Huppertz T. Impact of Dairy Products and Plant-Based Alternatives on Dental Health: Food Matrix Effects. Nutrients. 2023 Mar 18;15(6):1469.

Calcium absorption

- Despite the importance of calcium for human health, **calcium absorption from different foods varies considerably**, with net absorption ranging from **less than 10% to more than 50%**

- **Dairy products make a substantial contribution to calcium intake** due to:
  - **High proportion** of calcium in dairy
  - **Calcium in the dairy matrix is more bioavailable** than calcium in other foods

Shkembi B, Huppertz T. Calcium Absorption from Food Products: Food Matrix Effects. Nutrients. 2021 Dec 30;14(1):180.

Calcium absorption

- Intestinal **calcium absorption has been described to be positively modulated by lactose**, a fact that has been established in several animal studies

- **Replacing lactose with glucose or galactose** does not notably influence calcium absorption (possibly because the products of lactose hydrolysis, namely, glucose and galactose, also enhance calcium absorption); however, **lactose does show enhanced absorption of calcium in humans** compared with other types of nonabsorbable sugars (such as mannitol, lactitol or corn starch)

Moya M, Cortes E, Ballester MI, M V, Juste M. Short-term polycose substitution for lactose reduces calcium absorption in healthy term babies. J Pediatr Gastroenterol Nutr. 1992;14:57–61.

Calcium absorption

- In infants, **lactose may enhance the absorption efficacy of calcium from formula**

- The **absorption of calcium was significantly higher** in infants fed a **lactose-containing formula** than in those fed a **lactose-free formula** that contained corn maltodextrin and corn syrup solids

Shertukde SP, Cahoon DS, Prado B, Cara KC, Chung M. Calcium Intake and Metabolism in Infants and Young Children: A Systematic Review of Balance Studies for Supporting the Development of Calcium Requirements. Adv Nutr. 2022 Oct 2

Calcium absorption

A variety of **factors play a role in calcium absorption**:

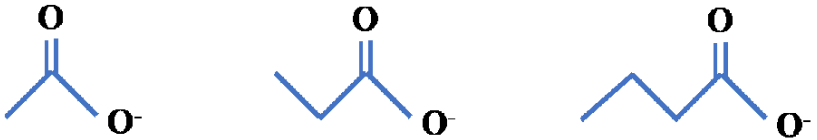
- Before it can be absorbed, **calcium must be in solution in the ionized form** (Ca2+)
- Two different transport methods, namely, **transcellular active transport** and **paracellular passive transport**, are used to absorb calcium in the gastrointestinal tract - **lactose increases passive intestinal calcium absorption**
- Although some calcium may already be in ionized form when eaten, the **acidic environment of the stomach increases the solubility of calcium salts and complexes** that are not ionized
- The brush border enzyme **intestinal alkaline phosphatase is stimulated by calcium**

Shkembi B, Huppertz T. Calcium Absorption from Food Products: Food Matrix Effects. Nutrients. 2021 Dec 30;14(1):180

Calcium absorption

In contrast to sucrose, **lactose may modulate the gut** to improve calcium absorption

- The **pH reduction caused by lactose fermentation** in the large intestine produces **short-chain fatty acids (SCFAs)**, which enhance calcium solubility and osmotic pressure
- Lactose may further **encourage the formation of nondigestible oligosaccharides** such as trans-galacto-oligosaccharides, also increasing the production of **SCFAs and other organic acids** that promote the **growth of lactic acid bacteria** and the absorption of calcium



Acetate Propionate Butyrate

Romero-Velarde E, Delgado-Franco D, García-Gutiérrez M, Gurrola-Díaz C, Larrosa-Haro A, Montijo-Barrios E, et al. The Importance of Lactose in the Human Diet: Outcomes of a Mexican Consensus Meeting. Nutrients 2019, Vol 11, Page 2737. 2019 Nov 12;11(11):2737.

Calcium absorption

- People with **lactase non-persistence**, who have reduced lactase activity, may **limit their intake of dairy**, thus compromising their calcium intake

- However, those with **lactase non-persistence may exhibit enhanced calcium absorption from dairy products**, possibly owing to the **prebiotic effect of lactose** in sustaining the growth of gut flora such as bifidobacteria and lactobacilli

Romero-Velarde E, Delgado-Franco D, García-Gutiérrez M, Gurrola-Díaz C, Larrosa-Haro A, Montijo-Barrios E, et al. The Importance of Lactose in the Human Diet: Outcomes of a Mexican Consensus Meeting. Nutrients 2019, Vol 11, Page 2737. 2019 Nov 12;11(11):2737.

Conclusion

- Dairy intake is fundamental to the health of people
- In SA, dairy consumption is largely inadequate
- Consuming milk or yogurt is unlikely to cause a sharp rise in blood glucose levels
- Dairy enhances the absorption of calcium

Thank You
Dankie

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