Effect of Vitamin A on Glucose Tolerance in Female Undergraduates of Ambrose Alli University, Ekpoma

Abstracts

Background: This study explored the effects of Vitamin A supplementation on glucose tolerance among female undergraduate students at Ambrose Alli University, Ekpoma, adopting a comprehensive metabolic approach. Recent evidence has established that retinoid signaling pathways interact with glucose metabolism through nuclear receptor networks, particularly through Retinoid X Receptor (RXR) pathways, which regulate insulin sensitivity and glucose homeostasis. Objective: The primary goals were to assess the influence of Vitamin A supplementation on fasting blood glucose levels and to evaluate its impact on glucose tolerance test results, specifically through the oral glucose tolerance test (OGTT), based on the molecular understanding of retinoid-mediated metabolic regulation. **Method:** The research involved conducting an OGTT on participants under two conditions: one without Vitamin A supplementation and another following a 100,000 IU dose of Vitamin A. Blood glucose levels were measured at six intervals (0, 30, 60, 90, 120, and 150 minutes) using an ACCU-CHEK Active glucometer, allowing for a detailed analysis of temporal glucose responses. Statistical analysis was carried out using a two-way ANOVA with GraphPad Prism 5 software to rigorously examine variations in glucose metabolism. **Result:** The results revealed subtle but statistically significant fluctuations in blood glucose levels across different time points. However, the data indicated that Vitamin A supplementation had minimal direct effects on glucose tolerance. While the study was limited by its sample size and generalizability, it provides valuable baseline data on the metabolic responses of young female adults. **Conclusion:** This research highlights the complex interplay between micronutrient supplementation and glucose metabolism. By investigating the effects of Vitamin A intake on glucose metabolism, the study addresses a critical gap in understanding the metabolic role of this essential micronutrient.

Keywords: Glucose**,** Vitamin A**,** Tolerance**,** Insulin**,** Resistance, Female**,** Nutrition intake oral

UNDER PEER REVIEW

1. Introduction

Vitamin A deficiency remains a pressing public health issue in many developing countries, with significant health implications. These range from severe conditions such as xerophthalmia, which can lead to blindness, to heightened susceptibility to infections and increased mortality rates (Sommer & West, 1996). Efforts to mitigate Vitamin A deficiency through supplementation or food fortification have demonstrated substantial benefits, including improved child survival rates (Beaton et al., 1993; Sommer & West, 1996).

The investigation of Vitamin A's effects on glucose metabolism is grounded in molecular evidence demonstrating retinoid involvement in metabolic regulation. Retinoid X Receptors (RXRs) form functional complexes with metabolic regulators such as Peroxisome Proliferator-Activated Receptors (PPARs), directly influencing glucose homeostasis and insulin sensitivity. Furthermore, retinoic acid signaling affects pancreatic β-cell function and insulin secretion through both genomic and non-genomic pathways. These established molecular mechanisms provide the theoretical basis for examining Vitamin A's potential impact on glucose metabolism, particularly in the context of supplementation.

Historically, clinical vitamin A deficiency has been linked to poor growth outcomes in children. Research has shown that the severity of eye conditions such as xerophthalmia correlates with stunting and wasting (Sommer, 1982). Children with mild forms of xerophthalmia, such as night blindness or Bitot's spots, often experience slower weight and height gains compared to their peers. While spontaneous recovery from xerophthalmia can sometimes lead to improved weight gain, the associated catch-up growth in height tends to be less pronounced (Tarwotjo et al., 1992). This raises questions about whether the growth effects are directly attributable to Vitamin A or influenced by other factors, such as overall nutritional status and disease burden, both of which also play critical roles in growth.

Studies investigating the effects of Vitamin A supplementation in non-xerophthalmic children have produced mixed results. While some research has reported positive impacts on weight or height gain, others have found little or no effect, leaving uncertainties about the specific role of Vitamin A in supporting growth (Fawzi et al., 1997; Lie et al., 1993; Rahmathullah et al., 1991; Ramakrishnan et al., 1995).

The Oral Glucose Tolerance Test (OGTT) is a widely used diagnostic tool to evaluate how efficiently the body processes glucose. During this test, a person consumes a measured quantity

of glucose, and blood sugar levels are monitored over time. Elevated glucose levels during an OGTT may indicate impaired glucose tolerance, a condition that can precede diabetes mellitus. Gestational diabetes, a condition characterized by elevated blood sugar levels during pregnancy due to hormonal changes, also relies on OGTT for diagnosis. Notably, blood sugar levels in gestational diabetes typically normalize postpartum (Balk et al., 2007).

2. Materials and Methods

This study involved female undergraduate volunteers from Ambrose Alli University who were non-pregnant and not using anti-diabetic medications. Participants were randomly divided into two groups:

- **Vitamin A Supplemented Group**: Received a single dose of Vitamin A (100,000 IU).
- **Control Group**: Did not receive any Vitamin A supplementation.

Measuring Instruments

The following instruments and materials were utilized:

- Measuring tape
- Stand meter
- Blood pressure apparatus (OMRON, M2 Basic, Automatic)
- Glucometer (ACCU-CHEK Active, Roche Diagnostic)
- Water (EVA, Nigeria Bottling Co. Ltd)
- Glucose (Fisher Scientific Co., USA)
- Vitamin A carotene (100,000 IU and 200,000 IU formulations)

Oral Glucose Tolerance Test (OGTT) Protocol

- **Baseline Blood Sample**: A baseline blood sample was collected from each participant via finger prick.
- **Glucose Load**: Participants consumed 200 ml of a glucose solution containing 75 g of glucose within 5 minutes.
- **Blood Glucose Measurements**: Blood samples were subsequently collected via finger prick at six-time points: 0 (baseline), 30, 60, 90, 120, and 150 minutes.
- **Blood Glucose Analysis**: Blood glucose levels were measured at each time point using an ACCU-CHEK Active glucometer (Roche Diagnostic).

Key Methodological Features

1. The study utilized a 75 g glucose solution for the OGTT.
2. Blood glucose levels were monitored over 150 minutes at intervals of 30 minutes.

3. Two experimental conditions were evaluated:
    - Control group without Vitamin A supplementation.
    - Experimental group with Vitamin A supplementation (100,000 IU).
4. Glucose measurements were performed with precision using the ACCU-CHEK Active glucometer.

3. Analysis of Results

Table 1: Effect of Vitamin A on Glucose Tolerance ((mg/dL) in Female Undergraduate of Ambrose Alli University, Ekpoma

Post –Prandial Time (Min)	**Changes in Blood Glucose (mg/dL)**	**Without Vitamin A With Vitamin A (100,000 IU)**
0	63.74 ± 10.04 a	71.36 ± 10.13 a
30	102.7 ± 13.68 b	92.73 ± 13.68 a
60	112.91 ± 26.01 c	107.64 ± 17.77 a
90	98.18 ± 23.97 d	106.37 ± 21.37 a
120	98.18 ± 23.97 d	99.09 ± 17.33 a
150	85.73 ± 11.55 e	92.64 ± 16.09 a

Values are expressed as mean ± SD (Standard Deviation): The values in the same rows with different alphabetic superscripts are considered significantly different (p <0.05)

The analysis revealed that the highest glucose level occurred at 120 minutes (2 hours) with a mean value of 98.18 mg/dL. Lower glucose levels were observed at the start of the test (0 minutes) with a mean of 63.74 mg/dL and at the end of the test (150 minutes) with a mean of 85.73 mg/dL. The 2-hour glucose level fell within the normal range for non-diabetic individuals, which is defined as below the standard 2-hour mean glucose tolerance test (GTT) value of 140 mg/dL.

Vitamin A Supplemented Group

In participants who received Vitamin A supplementation, the highest glucose level was recorded

at 1 hour (107.64 mg/dL), while the lowest level was observed at 0 minutes (71.36 mg/dL). Statistical analysis revealed no significant differences ($p > 0.05$) in glucose levels between the 2-hour time point and other measured time points. Importantly, the 2-hour glucose level in this group also remained within the normal range for non-diabetic individuals, consistent with the standard 2-hour mean GTT value.

These findings indicate that glucose levels across time points in both groups were within normal limits, and the supplementation of Vitamin A did not significantly alter glucose tolerance.

4. Discussion

Vitamin A, or retinol in mammals, is a fat-soluble vitamin essential for numerous physiological processes, including growth, tissue differentiation, and immune function. Humans acquire Vitamin A through two main dietary sources: pro-vitamin A (carotenoids) from plant-based foods like carrots, spinach, and sweet potatoes, and preformed Vitamin A (retinol) from animal-derived products such as liver, whole milk, fish oil, and eggs. Increased intake of Vitamin A, either through supplementation or food fortification, has been shown to significantly enhance child survival rates in regions with Vitamin A deficiency (Beaton et al., 1993; Sommer & West, 1996). The Oral Glucose Tolerance Test (OGTT) is a widely used diagnostic tool for evaluating the body's ability to regulate blood sugar levels. During the OGTT, a measured glucose load is consumed, and blood sugar levels are monitored at specific time intervals. Elevated blood sugar levels during the test may indicate impaired glucose tolerance, a precursor to diabetes mellitus or gestational diabetes (American Diabetes Association, 2014).

This study explored the effect of Vitamin A supplementation on glucose tolerance in female undergraduate students. The findings revealed no significant differences in glucose levels between participants who received Vitamin A supplementation and those who did not. Glucose levels remained within normal limits for non-diabetic individuals across all time points, indicating that Vitamin A supplementation did not influence glucose metabolism.

Although Vitamin A plays a vital role in various cellular and metabolic functions, its impact on glucose tolerance appears to be minimal, as demonstrated by this study. These findings suggest that Vitamin A supplementation is unlikely to play a significant role in diabetes prevention or management. However, the study provides valuable baseline data on glucose response patterns in young adult females, with detailed measurements taken at 30-minute intervals over 150 minutes. The dataset offers comprehensive insights into glucose tolerance among the study population, contributing to the broader understanding of Vitamin A's role in metabolic health. Future research with larger, more diverse populations and varying supplementation protocols could further

elucidate the relationship between Vitamin A and glucose metabolism.

5. Conclusion

This study concluded that Vitamin A supplementation had no significant impact on glucose tolerance in female undergraduate students of Ambrose Alli University. After 2 hours of OGTT, glucose levels remained within the normal range for non-diabetic individuals, regardless of supplementation. These findings suggest that while Vitamin A is essential for various physiological functions, it does not substantially influence glucose metabolism or diabetes risk.

Abbreviations

OGTT: Oral Glucose Tolerance Test IU: International Units ANOVA: Analysis of Variance.

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