

# Nutritional Management of Monkeypox Virus Infection: The Need for Vitamin A in Improving Patient Care and Recovery: A Systematic Review

Joyce Samuel Inuwa Zalanga<sup>1\*</sup>; Maikano Mohammad Ari<sup>2</sup>; Akyala Ishaku Adamu<sup>3</sup>; Nkereuwem Sunday Etukudoh<sup>4</sup>; Jack Vala<sup>5</sup>; Orinya Agbaji Orinya<sup>6</sup>; Dr. Eno Chongs Mantu<sup>7</sup>; Susan A. J. Holdbrooke<sup>8</sup>; Joseph A. Iyanam<sup>9</sup>; Deborah Akpan Iyanam<sup>10</sup>; Joseph Ikang Ogbudu<sup>11</sup>

<sup>1,3</sup>Global Health and Infectious Diseases Control Institute (GHIDI), Nasarawa State University

<sup>2</sup>Nasarawa State University, Keffi. Nasarawa Nigeria

<sup>4,7</sup>Federal College of Medical Laboratory Science and Technology, JUTH Jos, Plateau State

<sup>5</sup>Department of Home Science and Management, Faculty of Agriculture, Federal University Gashua.

Yobe State

<sup>6</sup>Department of Sustainability Science, University of Lisbon, Portugal

<sup>8</sup>Biochemistry and Nutrition Department Nigerian Institute of Medical Research, 6, Edmund Cresecent

Yaba Lagos

<sup>9</sup>State Meteorological Manager, Nigerian Meteorological Agency, Magaret Ekpo International Airport

Calabar Cross River State

<sup>10,11</sup>Federal College of Medical Laboratory Science and Technology, JUTH Jos, Plateau State

Corresponding Author: Joyce Samuel Inuwa Zalanga\*

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**Abstract:** Monkeypox virus infection (MPXV) has for some time now been a public health concern, with patients recovery being majorly dependent of supportive care. Vitamin A, a major micronutrient for immune competence and epithelial integrity has been proposed as a potential adjunct therapy for improving patients care and recovery in the management of MPXV. This systematic review synthesizes current evidence on the nutritional management of MPXV, focusing on the effect of vitamin A on clinical outcome and recovery time. Searches were made on PubMed, Scopus, web of science and other reliable literatures for studies published up to 2025, that assessed the effect of vitamin A on MPXV. Studies that were eligible were further scrutinized for methodological quality using appropriate tools. Initial findings suggest that adequate vitamin A status correlates with reduces lesion severity, and shorter duration of viral shedding. The study recommends that vitamin A incorporation of between 5,000-10,000iu daily from foods such as dark leafy vegetables, liver, carrots and sweet potatoes especially Orange Flesh Sweet Potatoes (OFSP) could reduce the severity of monkeypox virus infection, as well as improve patients' recovery during management. This study also encourages, pairing vitamin A. with a balanced intake of zinc, protein and vitamin C, as well as adequate fluid for optimal support, and faster recovery. this systematic review also calls for the need for a well-designed randomized control trial to establish optimal vitamin A dosing, safety ranges, and its integration into an all-inclusive nutritional care pathway for MPXV patient management.

**Keywords:** Monkey Pox; Micro Nutrient; Vitamin A; Nutritional Management. Public Health.

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## I. INTRODUCTION

The Virus popularly known as MonkeyPox also referred to as (MPV) for short, whose precise origin is not well known. Nevertheless, it is believed to be mingling between Central and West African animals (Kaler et al., 2022), and many studies have posited that certain wild squirrels species could be the original accommodators or reservoirs (Khodakevich et al., 1986; Epidemioil, 2018; CDC, 2003;). Later the MPV spread among humans through means such as direct contact with infected animals. There seemed to be a direct correlation between hunting bush meat, handling, and/or consuming bushmeat with humans' epidemiology of contracting MPV disease (Kumar et al., 2022). Many studies have also established that MPV can also be spread from one individual to another, through intimate interaction through body fluids, or eruptions on the skin or respiratory droplet, of sick persons (Kumar et al., 2022). Known to be prevalent principally to Central and West Africa, infrequent reports and occurrences have been taking place outside Africa (Monajlovic et al., 1993).

These incidents have typically been linked to the importation of sick animals or travelers or tourists returning from areas with high Mpox virus prevalence. It is crucial to remember that the MPV's natural reservoir is not very clear. (Dom'an et al., 2023; Tseng et al., 2023). The exact transmission pathway and reservoir and/or hosts concerned in sustaining as well as circulation of the MPV in or within the environment continue to change.

During the most recent 2022 mpox outbreak, most infections were spread through close, intimate contact with symptomatic individuals, and various sexual contacts, especially male-to-male sexual contacts has been a noteworthy transmission mode (Karan et al., 2023; Thornhill et al., 2022; Viedma-Matinez et al., 2023; Del et al., 2022). Meanwhile, heterosexual transmission, transmission to children through nonsexual skin-to-skin contact with caregivers, needlestick injuries, body piercing, tattooing, and work-related exposures without proper Personal Protective Equipment (PPE) have also been reported (Kandra et al., 2023; Iroezindu et al., 2023).

Monkeypox, is also popularly known as Mpox, The virus is a double-stranded DNA virus (mpox virus) that is a long-standing public health threat, but its outbreak in May 2022 was severe enough to be declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO) on 23 July 2022 (Wenham and Eccleston-Turner, 2022) (the second disease to be declared PHEIC after COVID-19 (D'Souza and Adesola, 2023) in two years), is endemic in some African countries, and has crossed continents to American, European, and Asian countries, infecting over 97,745 people by 30th April 2024 (World Health Organisation, WHO, 2024).

### ➤ *Histological Epidemiology of Mpox*

The first case was reported in 1958 in Asian monkeys (*Macaca fascicularis*) imported from Singapore to a Danish laboratory where they exhibited vesicular pustules on

virtually all areas of the body that, after healing, left scaly, dry crusts that often shed (Zahmatyar et al., 2023). In the same year, it spread to other monkey species (*M. Mulatta*: Rhesus monkeys) and several other animals, including giant anteaters, orangutans, chimpanzees, gorillas, gibbons, and marmosets in the 1960s (Huang et al., 2022; Cohen, 2022; Bonilla-Aldana and Rodriguez-Morales, 2022). The diseases appear to have a sylvatic cycle, with rodents (especially squirrels) suspected to be the reservoir hosts and non-human primates as accidental hosts (Khodakevich et al., 1988; Tiee et al., 2018). The zoonotic nature of the disease was confirmed on 1st September 1970, in the Democratic Republic of Congo. where the first human infection of mpox was reported in a child about nine-years-old who showed symptoms of fever and rash (Ladnyj et al., 1972). Since then, and following the end of the smallpox vaccine in the 1980s (which was 85% effective against mpox), thousands of cases have been reported in Africa, particularly in the 13 central and western countries (with DRC reporting the majority of cases) that now constitute an endemic region (Lounis and Riad, 2023; Adetifa et al., 2023). The disease spread in this region has permitted the definition of two virus clades: the first clade (Clade 1) is endemic in Central Africa and the second (Clade 2) in West Africa. Recent data indicate that the genome sequences of the 2022 mpox virus belonged to the West African clade (lineage B.1) (Mit'ja et al., 2023). Mucosal transmission is associated with recto-genital lesions in men, vaginal lesions in women, and pharyngeal lesions in both genders. However, the mechanism of transmission via mucosal pathway of MPV is still being studied for further investigation. The identification of these different transmission routes could have public health implications, e.g., the risk of co-infections with HIV and its effect on vaccination reaction. Apart from this, Clade I, almost exclusively found in the Congo Basin or central Africa, associated with smallpox-like disease and has an estimated case fatality of 10%, and Clade II, found in west Africa, frequently gives rise to a milder disease with slight lesions, with reduced viraemia and transmissibility in those who are not at high risk, with a case fatality of 1–3%. (Nakazawa et al., 2015 Luna et al., 2022). Studies have shown the delineation of two Clade II sublineages, IIa and IIb. Clade IIb, derivative of IIa and thought to have originated from West Africa in 2017, is primarily behind the global outbreak and has mutated to be well adapted to human-to-human transmission than other monkeypox viruses (Luna et al., 2022; Dumonteil et al., 2023). Other Clade II sublineages have also been described (Dung et al., 2023). Mpox (formerly known as monkeypox) is a zoonotic viral disease endemic in parts of Africa. However, from January 2022 to February 2023, more than 85 000 cases and 100 deaths were reported in 110 countries, the vast majority high-income countries outside of the African continent, propagated almost exclusively by human-to-human transmission (WHO 2022-2023).

In 2003, the first human case was reported outside of Africa in the USA, where prairie dogs, which were infected from imported Gambian pouched rats from Ghana, were believed to be the cause of human disease (Titanji and Marconi, 2023). Subsequent cases and outbreaks in other

countries, including the United Kingdom (2018–2019 and 2021), Singapore (2019), and the USA in 2021, were mostly linked to travel to or importation of animals from endemic countries (Mitj'a et al., 2023). The 2022 occurrence also revealed that another route for MPV transmission mucosally was via sexual contact, in addition to close contact with pustules or pustular material (Thornhill et al., 2022).

#### ➤ *Basic Symptoms*

Skin lesions are the principal symptom of MPV infection, typically called rashes, and are repeatedly followed by oropharyngeal or anogenital/perioral mucosal lesions (Liu et al., 2023). Commonly reported symptoms include chills, fever, headache, and lymphadenopathy, and, very different from previous outbreaks, a little above half of the patients in fresh and existing outbreaks cited rash as their first symptom. Recent studies have demonstrated that patients can transmit the disease as early as the first day of symptoms, and some people have the capacity to spread the disease before they exhibit any kind of symptom, (Kubo et al., 2023). Initially, treatment responses against the variola virus acted as a source of protection to the tune of approximately 85% against MPV (Fine et al., 1988). This continued until 1980. Since vaccination against the variola virus was discontinued in 1980, a large proportion of the population was no longer immune to the variola virus or MPV viruses and became vulnerable to MPV infection. Furthermore, there is no precise treatment for mpox (Malone et al., 2023). This is why this review purposed to determine the vitamin A nutritional needs for the MPV disease and practices including local foods rich in vitamin A.

#### ➤ *Objective:*

The objective of this review is the nutritional management of monkeypox virus infection: the need for vitamin A in improving patient care and recovery.

## II. METHODOLOGY

The study carried out an in-depth literature review using online databases such as PubMed, Mendeley, Google Scholar, JSTOR, and The Lancet. Due to their ability to cover coverage of relevant medical and scientific publications, the platforms were selected based on these rationales. Apart from these, the platform provided access to recent, reliable studies and literature reviews on Monkeypox and the nutritional management of patients, especially as regards vitamins, with viral infections (Karem et al., 2021; WHO, 2020).

Precise keywords were used to conduct the searches, such as "Monkeypox," "nutrition," and "nutritional management, Google Scholar enhanced the identification of interdisciplinary publications, allowing for the integration of data from nutrition and infectious disease studies (Nguyen et al., 2022). While Mendeley was used for reference management as well as verification, making sure that well-organized sources were selected.

#### ➤ *Materials and Method*

##### ➤ *Search Strategy*

PRISMA Extension for Scoping Reviews guidelines (Tricco et al., 2018) were applied for selection procedures and presentation of the results. The review was registered on PROSPERO. The main Search strategy for this review was the identification and use of electronic search machines. We searched PubMed, SCOPUS, Google Scholar, MEDLINE, ISI Web of Science (Science Citation Index), Africa Wide Information, African Index Medicus (AIM), and AFROLIB databases for published studies on nutritional management of monkey pox virus infection: the need for vitamin A in improving patient care and recovery. The search included studies up to 2025. This search was conducted using a predefined comprehensive and sensitive search strategy combining relevant terms with names of countries in Africa, and the globe to obtain the maximum possible number of studies.

##### ➤ *Record Screening*

Duplicates were removed manually. The remaining titles and abstracts were entered into Microsoft Excel as a table for the selection process. Full text papers were evaluated.

##### ➤ *Data Extraction Process/Protocol.*

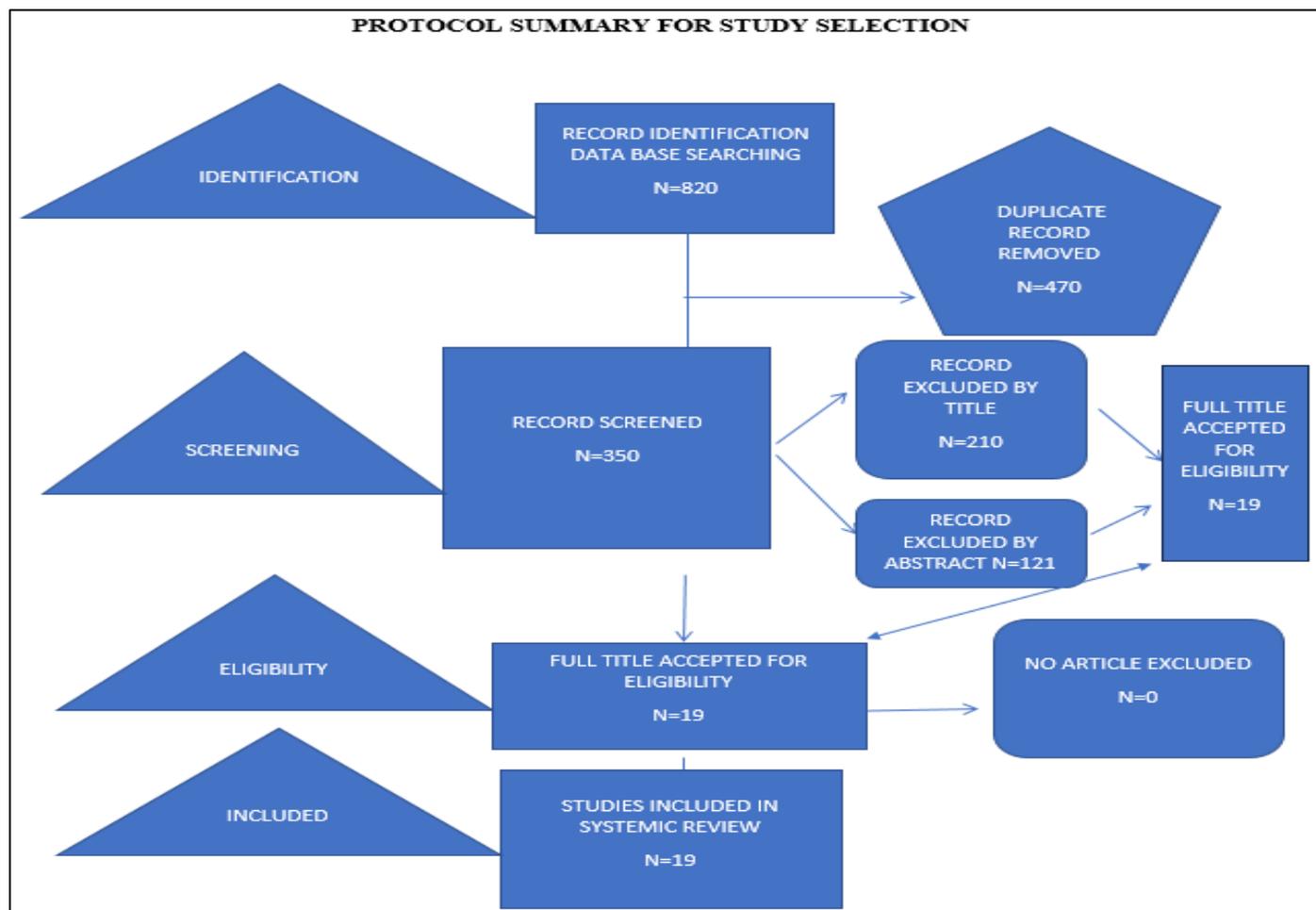


Fig 1 Protocol Summary for Study Selection

Information on the study was extracted by the author into an Excel spreadsheet. The second author cross-checked the data extracted from each publication.

### III. RESULTS

#### A. Publication Selection

Altogether, 820 publications were identified: PubMed,  $n = 7$ ; Scopus,  $n = 3$ ; Google Scholar,  $n = 780$ ; MEDLINE,  $n = 5$ ; ISI Web of Science (Science Citation Index),  $n = 3$ ; Africa Wide Information,  $n = 2$ ; African Index Medicus (AIM),  $n = 3$  and AFROLIB Web of Science,  $n = 9$ ; eLIBRARY.RU,  $n = 8$ ; After removing duplicates ( $n = 470$ ), 350 articles were evaluated by title, resulting in eliminating of 210 of them by title. Abstracts of the remaining articles were analyzed, and 121 papers were excluded based on the abstract. The full text of 19 articles was assessed by two authors, the main author and a second author. With no conflicts and consultations with the last-second author. After this assessment, 19 articles were selected for the final qualitative synthesis.

#### B. Brief Chemistry of Vitamin A

Vitamin A is generally known to be a subclass of a family of lipid-soluble compounds referred to as retinoic acids. These consist of four isoprenoid units joined in a head-to-tail fashion. Mainly, two forms of vitamin A are available

in the human diet: preformed vitamin A (retinol and its esterified form, retinyl ester) and provitamin A carotenoids (Johnson & Russell, 2010). The hypothesis that higher dietary  $\beta$ -carotene intake and serum level results in higher  $\beta$ -carotene-mediated signaling is not well understood. Alternative auto-regulatory mechanisms in  $\beta$ -carotene/retinoid mediated signaling are highlighted to better predict and optimize nutritional strategies involving  $\beta$ -carotene-related health-beneficial mediated effects (Bohn et al., 2019). Many forms of Provitamins A exist, but beta-carotene is the only one metabolizable form by mammals into vitamin A (Rougereau et al, 1987).

Preformed vitamin A (all-trans-retinol and its esters) and provitamin A (beta-carotene) are essential dietary nutrients that provide a source of retinol. Both retinol esters and beta-carotene are metabolized to retinol (Dawson, 2000). Vitamin A is now found in foods of both plant and animal origin, including dairy products, fish meat and liver. Studies by (Nkereuwem et al., 2024) also show that sweet potatoes, especially Orange Flesh Sweet Potato (OFSP) is also rich in provitamin A. It is important to note that Serum vitamin A concentrations do not reflect total vitamin A stores under certain conditions: Serum retinol levels may be artificially low (i.e., underestimate vitamin A stores) in the setting of severe protein-calorie malnutrition because dietary protein, energy, and zinc are required for synthesis of retinol binding

protein (RBP). Also, serum retinol levels may be low during intercurrent infection because of transient decreases in negative acute phase proteins including RBP. Conversely, in a patient with vitamin A deficiency, a dose of vitamin A may

cause a transient rise in serum retinol concentrations, leading to over estimation of the patient's vitamin A stores (Feingold et al., 2000).

Table 1 Dietary reference intake for vitamin A

Vitamin A	Age group	RDA/AI (Mcg daily)	UL (Mcg daily)	Effects of excess
1 mcg retinol activity equivalent = 3.3 unit vitamin A	Infants: 7-12 months	500	600	
	Children: 1 – 3 years	300	600	
	Children: 4 – 8 years	400	900	
	Males: 9- 13 years	600	1700	
	Males: 14 -18 years	600	2800	
	Males: > 19years	900	3000	
	Females: 9- 13 years	600	1700	
	Females: 14 -18 years	700	2800	
	Females: > 19years	700	3000	
	Pregnancy: <18 years	750	2800	
	Pregnancy: > 19 years	770	3000	
	Lactation: <18 years	1200	2800	
	Lactation: 19 years	1300	3000	

Source: Ahmed and Tosson 2021.

C. Physiological Role

Vitamin A has multiple functions due to its various active forms, which have specific roles in different tissues. Retinoids involved in processes such as vision, tissue growth and cell differentiation, epithelial health, reproduction, immune response, brain development, and development of the cornea, bones, and fetus. development. Carotenoids also act as antioxidant (Almaida et al., 2024). Vitamin A is essential throughout human life.

D. Viewing Vitamin A. and its Role Biologically

➤ Vitamin-A is indispensable for growth, reproduction and vision and to sustain regular epithelial cells.

• How Vitamin A Contributes To Vision:

Vitamin A controls the visual cycle (Wald's visual cycle):

- ✓ The Ability To Visualize Either Darkness Or Brightness Depends On The Action Of Vitamin A.
- ✓ Dim Light Vision Is The Responsibility Of Rods, However, Bright Light And Colours Are Made Possible By Cones.

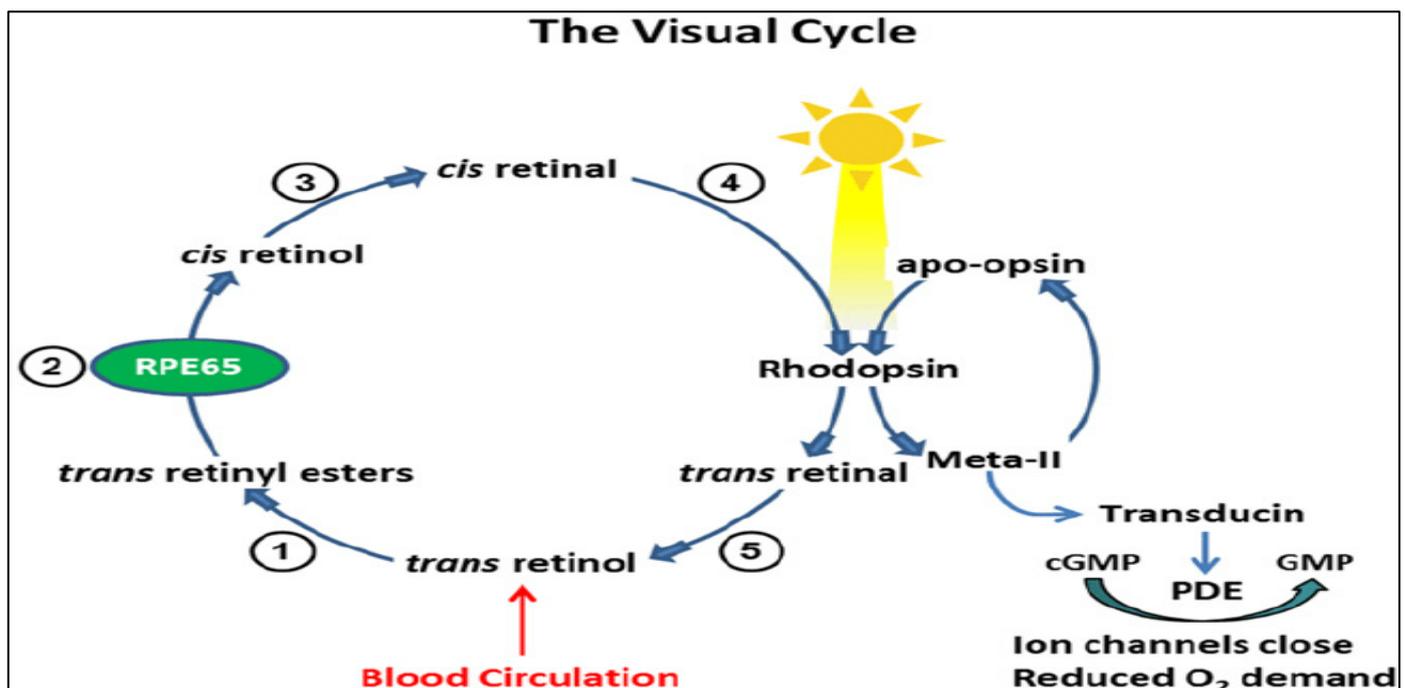


Fig 2 A Figure Showing the Visual Cycle

✓ *Dark Adaptation Time:*

- Dark adaptation time is prolonged when vitamin A is not made available.
- When an individual suddenly enter the dim light room rhodopsin are depleted.
- Individuals Rhodopsin are reduced when the person enters a dim light room in a sudden manner.
- The room appears dark until and unless rhodopsin is not regenerated.
- Until the restoration of rhodopsin, the room may appear dark continuously.
- It is for this purpose that vitamin A becomes an absolute necessity.

✓ *Color Vision:*

- Cones are responsible for color vision such as Iodopsin (green), cyanopsin (blue) and porphyropsin (red).
- These also form retinal complexes and upon bleaching release different colors, red, blue, and green which are transmitted as nerve impulse to central nervous system.

• *Maintenance of Healthy Epithelial Surfaces:*

- ✓ The regulation /control of the keratin gene are carried out by retinol and retinoic acid and this thwarts the development of horny-like appearance on the eyes..
- ✓ Likewise, retinyl-phosphate also participates in the synthesis of mucus (mucopolysaccharide) as well as glycoprotein, which is needed to maintain a smooth and moistened epithelial surface. (<https://www.onlinebiologynotes.com/vitamin-a-structure-derivatives-properties-biological-roles-and-deficiency>)

• *Cell Differentiation and Growth:*

- ✓ Retinol and retinoic acid have characteristics similar to steroid hormone and they play important role in cell differentiation and growth.

• *Metabolism of Lipids:*

- ✓ In the biosynthesis of cholesterol, and intermediate is formed called mevalonate
- ✓ Whenever vitamin A is low or unavailable, mevalonate is channeled towards the synthesis of co-enzyme Q
- In the absence of vit-A, glucocorticoids synthesis is inhibited which in turn inhibit the process of gluconeogenesis.
- Vit-A is also required for the proper functioning of immune system and for the formation of iron transfer protein transferrin.

*E. Vitamin A in Management of Mpox*

In order to project a very effective nutritional management strategy, as well as show the importance and need for vit A in the management of mpox, it is very

important to understand the pathophysiology of monkey pox which is a viral infection with its causative organism being the monkey pox virus an orthopox virus similar to small pox virus. It is also important to know that mpox virus can lead to sever complications especially in immuno compromised individuals as well as individuals who are malnourished. (Raynolds et al., 2019).

*F. Mpox Virus Symptoms Viz-a-Viz Metabolic and Nutritional Needs.*

One very common symptom of monkeypox is fever. Once this occurs there can be systemic inflammation which could further exacerbate the condition. one most common result is the occurrence of muscle catabolism leading to a reduction in nutritional reserves. Apart from this monkey pox triggers remarkable inflammatory response, leading to an elevated basal metabolic rate with increased protein and energy requirements which is needed to enhance immune system functions and tissue repair. (Nguyen et al., 2022).

On the other hand, intense and multiple studies have shown that monkeypox also disrupts the metabolism of micronutrients by reducing their absorption and increasing the rate of excretion of some essential nutrients such as iron, zinc, and vitamins that are observed to be antioxidant vitamins. The impact rests on the fact that modulation of immune responses will be affected, leading to the need for supplementation especially with vitamin A, from foods such as Orange Flesh Sweet Potato, as well as carrots, or vitamin A supplements, among at risk patients. At this point, it is important to know, that vitamin A can play crucial and important roles. studies have shown that for energy need one alternative pathway is gluconeogenesis, and based on this knowledge, the administration of Vit. A during mpox progression enhances glucocorticoid synthesis, which in turn enhances gluconeogenesis. Additional to this, vitamin A protects Coenzyme Q (CoQ) from oxidative damage due to its antioxidant's properties. Since CoQ is a lipid soluble antioxidant, that plays a key role in protecting cellular membranes from oxidative stress, therefore vit A antioxidant nature may support CoQ's functions in maintaining mitochondrial integrity during Mpox progression, this reduces the energy loss in terms of ATP, thereby reducing the requirement for energy. Vitamin A will also be very important in enhancing oxidative phosphorylation reduce protein leak as well as an optimal electron transport chain function and these cumulatively enhances the reduction in energy requirement during mpox viral infection.

Another very popular symptom of mpox infection is skin lesion, and vitamin A could be effective in the management of this symptom. Vitamin A plays a crucial role in cell growth and differentiation. This review has earlier stated that retinol and retinoic acids behave like steroid hormones, which are regulated for the growth and differentiation of cells. Studies have also shown that vitamin A is important in keratinocyte differentiation and proliferation, promoting healthy skin cell growth and turnover (Fisher et al., 1996). Vitamin A also enhances or stimulates collagen synthesis, which results in enhanced skin elasticity and texture (Shah et al., 2007). During mpox

progression, skin lesions not only lead to wounds on the skin, but the lesions also burst, releasing fluids, which could lead to dehydration.

The lesions during mpox progression contribute greatly to the formation of mouth and oral ulcers, which greatly reduce the patient's food intake due to intense pain, leading to loss of appetite. Oral lesions hinder chewing and swallowing, and a reduction in food intake and consumption ultimately increases the risk of malnutrition. With malnutrition being a major aggravating factor during mpox progression, administration of vitamin A helps to strengthen the immune system, increasing the body's ability to combat the infection and reducing the likelihood of severe complications such as secondary infection and organ failure (Karen et al., 2021). Improving patients' nutritional status with vitamin A can speed up mpox patients' recovery, and reduce infected patients' mortality rate, (Nguyen et al., 2022). This shows that apart from key micronutrients like zinc and selenium and vitamins C, vitamin A can be the ace to improving patient care in monkey pox progression and management as it will enhance speedy immune response. It is well known that the nutritional management of patients with Mpox can be challenging, but with adequate management, it can be overcome. Major challenges to the nutritional management of mpox virus include logistics, which could be due to poor road networks and insecurity, which could interfere with consistent transport of foods and medical supplies, such as supplements used for nutritional intervention (Nguyen et al., 2022).

Another major challenge to the nutritional management of mpox patients could be cultural factors. Cultural factors in various regions have the capacity to influence the acceptability of nutritional interventions, especially in the aspect of food. Traditional dietary beliefs and preferences could conflict with proposed recommendations, especially as regards to vitamin A and the food types that can be used in such situations, a culturally sensitive nutritional approach is required. This could cost more and may take more time. Major goals to nutritional management of mpox-infected persons should always align with food traditions to ensure community acceptance (Towers, 2021). Specific nutrition education on food sources of vitamin A could be of value to communities that suffer bouts of mpox virus infections to improve patient care.

Finally, since it is well documented that vitamin A boosts immune functions, tissue repair and epithelial integrity, incorporation of between 5,000-10,000iu daily from foods such as dark leafy vegetables, liver, carrots and sweet potatoes especially Orange Flesh Sweet Potatoes, can reduce the severity of monkeypox virus infection, as well as improve patients' recovery during management. Also, for optimal results, pairing vit. A. with a balanced intake of protein zinc and vitamin C with adequate fluid can optimally support faster recovery.

#### IV. CONCLUSION

This review has shed some light on the need for vitamin A incorporation in the management of Mpox virus infection. It is important to note that the Mpox virus continues to spread and evolve with time. The knowledge that vitamin A is crucial for immune functions, epithelial integrity, and overall health gives it a strong case for consideration as part of the regimen for Mpox virus infection management, since it plays key roles in skin health and promotes epithelial barrier function and reduce severity of the viral infection, thereby supporting and improving recovery. Therefore, incorporating Vitamin A into the nutritional management of Mpox virus, either through the use of vitamin A-rich foods such as orange flesh sweet potato, carrots, or other foods of animal origin rich in vitamin A, or the use of Vitamin A supplements, may enhance patient care and speed up or reduce recovery time.

#### RECOMMENDATION

- There is a need for further research on this to establish specific guidelines.
- Nutrition education on the role of Vitamin A should continue in all Public Health Centers (PHC)

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