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W.D.J.K Amarasena

jinadarikaushalya@gmail.com

Epidemiology unit

Sampatha Goonewardena

University of Sri Jayewardenepura

Deepa Gamage

Epidemiology unit

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Penile HPV prevalence among high-risk men in Sri Lanka: Baseline insight for HPV prevention strategies in a lower-middle-income country

W D J K Amarasena¹, Sampatha Goonewardena²,
Deepa Gamage³

^{1,2}Epidemiology Unit, Ministry of Health, 231 De Saram Pl, Colombo 10, 01000, Sri Lanka.

³Faculty of Medical Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Colombo, 10250, Sri Lanka.

Contributing authors: jinadarikaushalya@gmail.com;
sampatha4@yahoo.co.uk; deepagamage@gmail.com;

Abstract

Background:

Human Papilloma Virus (HPV) infection is the most common sexually transmitted viral infection in the world. Persistent infection lasting more than two years with high-risk genotypes has the potential for malignant transformation. High-risk (HR) HPV is responsible for nearly all cases of anal squamous cell carcinoma (SCC), approximately 53% of penile SCC, and 13-70% of oropharyngeal SCC in men. Male HPV prevalence among high-risk men in Sri Lanka is crucial for establishing a baseline to guide prophylactic vaccination and high risk precancer screening strategies for men in Sri Lanka.

Method:

A hospital-based descriptive cross-sectional study was conducted to estimate the prevalence of HPV infection among 20-70-year-old men (n=187) attending sexually transmitted disease (STD) clinics in Gampaha district, Sri Lanka. Patients were consecutively recruited based on a probability proportionate to the reported STD clinic attendance in 2021. Data was collected using interviewer administered questionnaire and HPV detection was performed via PCR using GP5+/GP6+

primers to amplify HPV DNA in penile samples and genotyping of positive samples were performed using Sanger sequencing. Penile prevalence of any and HR HPV genotype was estimated and distribution of HPV infection acquisition and persistent related factors were assessed and described.

Results:

Among STD clinic attendees 5.3% reported having over 51 male sex partners, with 42.8% having 2-5 male partners in their lifetime. Despite being a high-risk group 26.2%(n=56) of attendees, reported never using condoms. Penile HPV prevalence among STD clinic attendees was 24.6% (n=46) (95% CI: 18.6,31.4) for any and 5% (95% CI:1.5,12.3) for HR HPV genotype. Identified HR HPV genotypes were, 16(n=3) & HPV 31(n=1) however, HPV 18 was not detected (Gene-sequencing done only for first 80 samples).

Conclusion:

The percentage of having more than 51 male sex partners among men is alarming and low condom usage among STD clinic attendees underscores the urgent need to promote and increase safe sexual practices. The penile HPV prevalence is high while vaccine-preventable HPV HR genotype 16 is the most prevalent HR genotype among STD clinic attendees, detection and monitoring of HPV prevalence over time is important for policy making for introduce HPV prophylactic vaccination.

Keywords: HPV male prevenances Lanka, STD clinic attendees

1 Introduction

Human papillomavirus (HPV) is one of the earliest DNA viruses that have evolved over millions of years, leading to the most prevalent sexually transmitted infection (STI) worldwide [1]. Among HPV genera, sexually transmitted, Alfa HPV viruses are categorized into high-risk (HR) and low-risk (LR) genotypes based on their potential for malignant transformation. More than 75% of males will acquire HPV infection at some point in their lives after become sexually active [2]. Among men, HPV prevalence is relatively stable across all age groups compare to female [3]. However, for any HPV genotype prevalence is 19% at the penis, 13% at the scrotum, 8% at the perineal/perianal region, and 21% at any site [3], [4], [5]. Further, the rate of infection and persistent rate is higher among individuals with high-risk sexual behaviors, especially men with STI, including people living with HIV(PLWH) and Men who have Sex

with Men (MSM) [2], [6]. The estimated HPV prevalence among MSM is 78% in the anal site, 36% in the penile site, 17% in the oral site, and 15% in the urethral site [7]. Most infections among males clear within 1-2 years, however, 6-9% of males will persist HPV infection and smaller percentage of persistent HR HPV genotypes may have the potential of developing anogenital precancerous lesions and progress to anogenital squamous cell carcinoma (SCC) [8]. In contrast to the well-studied cervical HPV infection, there is limited data on the natural history of anogenital HPV infection progression and cancer burden among males. However, it had been proven that 13-60% of the oropharyngeal SCC, 53% of penile SCC and 100% of anal SCC cancers are attribute to HR HPV infection and 87% of anal SCC caused by HPV 16 [9],[10],[11]. In 2018, total of 69,600 of HPV related cancers were estimated among males including 33000 anal SCC and 3800 penile SCC [10]

Screening for anal and penile SCC has not been considered due to their comparatively lower incidence among general community [12]. However high HPV prevalence, along with immune suppression and increased HPV oncogene expression, significantly raises the risk of HPV related SCC in these high-risk men. In addition recent findings from the Anal Cancer Outcomes Research (ANCHOR) study have demonstrated that screening and treating anal high-grade squamous intraepithelial lesions (HSIL) can substantially reduce the risk of anal cancer in PLWH [13], [14]. In light of these findings, updated guidelines for screening precancerous anal lesions in PLWH were established in 2024, marking a shift toward preventive care in this high-risk population [14]. Further, a biennial cross-sectional study conducted among 575 MSM reported that MSM and Trans-Gender Women (TGW) have no significant declines in the HPV prevalence up to 8 years after the introduction of girls-only HPV16/18 vaccination [15],[16]. Therefore, gender-neutral HPV vaccination and opportunistic prophylactic HPV vaccination for high-risk males when they visit STD clinics started in some countries [16], [17]. Universal single-dose and two-dose HPV vaccination is proven to be a

cost-effective especially when female vaccine coverage is less than 50% and strategy in comparison to female-only two-dose HPV vaccination with or without cervical cancer screening, as reported by modal-based studies conducted within the Italian and in some European contexts [11], [18], [19]. Limited knowledge of HPV prevalence among high-risk males in lower and middle-income countries (LMICs) will hinder future male HPV vaccination strategies and the adoption of anal cancer screening for high risk groups such as PLWH and MSM as outlined in new guidelines [20], [21]. This study aimed to estimate penile HPV prevalence and high-risk genotype distribution among men aged 20–70 attending selected STD clinics in Sri Lanka. Additionally, it assessed sexual behavior patterns and circulating genotypes to inform vaccine policy strategies in future.

2 Method

A hospital-based descriptive cross-sectional study was conducted to estimate the penile prevalence of HPV infection among 20–70-year-old men attending selected STD clinics in the Gampaha district in Sri Lanka. The study was conducted from August 2022 to June 2023 in the 4 main STD clinics in the Gampaha district. Sexually active men who were attending STD clinics in the Gampaha district for any condition, seeking medical care, and residing for at least 6 months in the Gampaha district were included. Individuals with diagnosed sexual dysfunction, physical disabilities hindering penetrative sexual activities, or psychiatric illnesses impairing questionnaire responses were excluded. The degree of accuracy was specified as 0.05 and prevalence as 14% to obtain the maximum value of the sample size of 194. The sample was collected based on the probability proportionate to the patients reported to the STD clinic during 2021. Consecutive patients who attended the clinic were selected and screened for eligibility to recruit.

An interviewer-administered questionnaire was used for data collection. The interviewers were medical officers(MO) working in the respective STD clinics in their duties. They were trained using the training manual to administer the questionnaire and for the specimen collection and to emphasize the importance of the study to minimize non-response. After the informed written consent, the questionnaire was administered by MOO followed by the specimen collection during the same visit. All participants were provided with the contact number of the Principal Investigator (PI) if any additional information was needed and were informed of the results through their contact details collected. Medical officers were trained in penile swab collection, with instruction sheets provided to ensure consistency and safety. Penile swab samples were collected under aseptic conditions from consented study participants using sterile cotton wool swabs. The swabs were gently rolled over the shaft, glans, and coronal sulcus, avoiding the urethral opening. Swabs were stored in sterile tubes securely capped, and labeled without personal identifiers. All samples were transported under strict cold chain conditions to the Molecular Diagnostic Laboratory within six hours of collection. HPV DNA was detected using GP5+/GP6+ primers (L1 region, 150 bp), and DNA quality was confirmed with β -globin primers (PC03/PCO4, 110 bp). Products were visualized on 2% agarose gels stained with SYBR Green. Positive and negative controls were included in all runs. All PCR-positive samples underwent Sanger sequencing for genotyping. The results included aligned sequences, Sanger chromatograms, and FASTA(Fast Sequence Alignment) files. The HPV detection was done by PCR testing using the primers GP5+/GP6+ for HPV DNA detection. Data was entered and processed using the Statistical Package for Social Sciences (SPSS) 23rd version software and analyzed using the same software. Ethical clearance was obtained from an Ethical Review Committee in the Post Graduate Institute of Medicine Colombo. Participation was voluntary, with minimized risks and no impact on medical care.

3 Results

The majority were Sinhalese (96.8%) and Buddhists (78.7%) and 78.1% were completed General Certificate of Education (GCE) Ordinary Level (O/L) or above with a higher University degree. Almost half (52.4%) earned 312 USD or more per month, while 4.3% had an income of less than 156 USD per month (Refer supplementary table 1). Further to Sociodemographic factors associated with HPV infection, selected behavioral, medical and surgical factors were assessed. Behavioral factors include factors related to risky sexual behaviors and substance abuse. Frequency distribution of selected sexual behaviors and practices related to HPV infection of the study participants are summarized in Table 1.

Among study participants, 62% used tobacco products with varying frequency, and 77% consumed alcohol at different rates. However, the majority (87.2%) reported never using illegal drugs (Refer supplementary table 2). The medical and surgical factors among the study participants, 20.9% had been diagnosed with HIV, and 6.4% were co-infected with another STI. Importantly, 41.8% were either unaware of their diagnosis or still undergoing investigation. Table 2 outlines HPV-related risk factors among study participants by HPV status.

The Table 3 illustrates the frequency distribution of selected HPV-related factors among respondents based on their HPV status. None of the participants had received the HPV vaccination.

The overall HPV prevalence among STD clinic attendees was 24.6, 95%CI (18.6,31.4). Only 80 study participants were considered for HR HPV prevalence calculation among them, 76 were negative for HR HPV and 4 of them were positive for HR HPV. The overall HR HPV prevalence among STD clinic attendees was 5%(n=4) (95%

Table 1 Frequency distribution of sexual behaviours & practices of the respondents

Characteristics	No (n=187)	%
Having knowledge on oral sex		
Yes	185	98.9
No	2	1.1
Practiced oral sex		
Yes	161	86.1
No	26	13.9
Having knowledge on anal sex		
Yes	177	94.7
No	10	5.3
Practiced anal sex		
Yes	83	44.4
No	104	55.6
Type of sexual activities during past one year		
Peno-Vaginal	27	14.4
Peno vaginal, insertive oral	74	39.6
Peno vaginal, insertive oral and insertive anal	37	19.8
Peno vaginal, insertive oral, insertive anal and receptive anal	25	13.5
Insertive oral, insertive anal	10	5.3
Insertive oral, insertive anal and receptive anal	7	3.7
Other	7	3.7
Usage of condoms during sexual activities		
Never used	49	26.2
Used occasionally	113	60.4
Used every time	25	13.4
Having sex with a sex worker (male or female)		
No	116	62
Yes	71	38
Having sex with foreigners		
No	171	91.4
Yes	16	8.6
Number of foreign sexual partners		
< 5 partners	184	98.5
5 or $\geq$ 5 partners	3	1.5
Total	187	100

Table 2 Frequency distribution of socio-demographic & HPV related factors by HPV status.

Characteristics	HPV Positive		HPV Negative		Total	Proportion of HPV Positive
	Number	%	Number	%	Number	%
Age Categories in years						
20-29	14	30.4	52	36.9	66	21.2
30-39	11	23.9	35	24.8	46	23.9
40-49	11	23.9	31	22.0	42	26.2
50-59	8	17.4	13	9.2	21	38.1
60-70	2	4.3	10	7.1	12	16.7
Marital status						
Never married	16	34.8	74	52.5	90	17.8
Married (legally/customary)	26	56.5	57	40.4	83	31.3
Separated/divorced	2	4.3	9	6.4	11	18.2
Spouse died-widowed	2	4.3	0	0.0	2	100.0
Other	0	0.0	1	0.7	1	0.0
History of genital wart						
Yes	17	38.6	31	21.7	48	35.4
No	27	61.4	112	78.3	139	19.4
History of phimosis						
Yes	2	4.3	6	4.3	8	25.0
No	44	95.7	135	95.7	179	24.6
History of anogenital injury						
Yes	6	13.0	15	10.6	21	28.6
No	40	87.0	126	89.4	166	24.1
History of HIV						
Yes	11	23.9	40	28.4	51	21.6
No	35	76.1	101	71.6	136	25.7
History of IMMD*						
Yes	1	2.2	17	12.1	18	5.6
No	45	97.8	124	87.9	169	26.6
Total	46	100.0	141	100.0	187	24.6

CI:1.3,12.3). Identified HR HPV genotypes were, 16(n=3) & HPV 31(n=1) however, HPV 18 was not detected (Gene-sequencing done only for first 80 samples).

Table 3 Frequency distribution of sexual behaviors and HPV status

Characteristics	HPV Positive Number (%)	HPV Negative Number (%)	Total Number	Proportion of HPV Positive %
Age at sexual debut in years-Mean 21.9 /SD4.9				
12-18	14 (30.4%)	43 (30.5%)	57	24.6%
18-21	9 (19.6%)	28 (19.9%)	37	24.3%
22-24	10 (21.7%)	23 (16.3%)	33	30.3%
More than 25	13 (28.3%)	47 (33.3%)	60	21.7%
Sexual orientation				
Heterosexual	28 (60.9%)	71 (50.4%)	99	28.3%
Homosexual	3 (6.5%)	15 (10.6%)	18	16.7%
Bisexual	15 (32.6%)	55 (39%)	70	21.4%
Number of lifelong male partners				
No partners	28 (60.9%)	71 (50.4%)	99	28.3%
1	9 (19.6%)	26 (18.4%)	35	25.7%
2-5	2 (4.3%)	16 (11.3%)	18	11.1%
5-10	1 (2.2%)	10 (7.1%)	11	9.1%
10-50	4 (8.7%)	10 (7.1%)	14	28.6%
More than 50	2 (4.3%)	8 (5.7%)	10	20.0%
Number of lifelong female partners				
No partners	3 (6.5%)	15 (10.6%)	18	16.7%
1	11 (23.9%)	53 (37.6%)	64	17.2%
2-5	27 (58.7%)	53 (37.6%)	80	33.8%
5-10	0 (0%)	13 (9.2%)	13	0.0%
Number of male partners during last year				
No partners	28 (60.9%)	71 (50.4%)	99	28.3%
1	11 (23.9%)	41 (29.1%)	52	21.2%
2-5	3 (6.5%)	20 (14.2%)	23	13.0%
5-10	1 (2.2%)	4 (2.8%)	5	20.0%
10-50	3 (6.5%)	4 (2.8%)	7	42.9%
More than 50	0 (0%)	1 (0.7%)	1	0.0%
Number of female partners during last year				
No partners	3 (6.5%)	15 (10.6%)	18	16.7%
1	24 (52.2%)	82 (58.2%)	106	22.6%
2-5	18 (39.1%)	41 (29.1%)	59	30.5%
5-10	0 (0%)	3 (2.1%)	3	0.0%
Total	46 (100%)	141 (100%)	187	24.6%

4 Discussion

The present study is the first to assess HPV prevalence among high-risk men in Sri Lanka and among the few conducted in the Southeast Asian region. To minimize non-response and information biases, we employed multiple strategies, including structured interviewer training, standardized protocols, and comprehensive participant information sheets. The data collection questionnaires underwent face and content validity assessments through expert review and literature analysis, with translations and back-translations into Sinhala and Tamil to ensure linguistic accuracy. Pretesting further validated the instrument, while agreement and consistency checks at two intervals enhanced data reliability. The Kappa coefficient results indicated strong intra-rater and test-retest reliability. For HPV DNA detection, the PCR test using primers GP5+/GP6+ was chosen for its high sensitivity and capability to detect multiple genotypes. Inter- and intra-laboratory reliability checks ensured the validity and accuracy of results, with negative control tests safeguarding procedural integrity.

In our study, the mean age of sexual debut among STD clinic attendees was 21.9 years (SD 4.9), while earlier research among Sri Lankan youth indicated a mean age of 18.6 years (SD 1.8) [22]. Findings from a study conducted in 2019 among never-married Sri Lankan youth indicated that pre-marital sexual activity was reported by 24.5% of Moor youth and 19.6% of Sinhalese youth [23].

HPV positivity in this study was highest among those with sexual debut between 22–24 years (30.3%) and those under 18 (24.6%), indicating that early initiation of sexual activity is a key risk factor. Early sexual debut is also common in other settings; for instance, Brazilian adolescents report an average age of first sexual activity at 13.2 years ([24]). In Asian LMICs, such as India and Vietnam, early sexual debut among youth has also been documented, often influenced by socio-cultural factors and limited access to reproductive health education ([25]). These findings highlight the urgent need for HPV vaccination prior to sexual debut and comprehensive STI prevention

programs tailored to adolescents, especially in LMIC contexts where awareness and access remain limited.

In contrast, nearly half (48.1%) of the STD clinic attendees in our study reported being in sexual relationships without being married, which is approximately double the rate among the youth in 2019. This early initiation of sexual activity and pre-marital sex are known risk factors for HPV infection, which in turn increases the risk of developing HPV-related cancers. Among the study participants, 20.9% had been diagnosed with HIV, and 6.4% were co-infected with another STI. Importantly, 41.8% were either unaware of their diagnosis or still undergoing investigation. The risk of HPV infection is further heightened when individuals lack knowledge about transmission risks. Therefore, these factors should be considered in policy-making for HPV prevention strategies targeting high-risk groups.

In our study, heterosexual individuals had the highest HPV positivity (28.3%) compared to bisexual (21.4%) and homosexual participants (16.7%).

Among STD attendees 56.1% (105/187) were having more than one female partner during life time. However, having more than 51 male sex partners was 5.3% (n=10) and having more than 2-5 male sex partners was 42.8% during their lifetime indicated the trend towards homosexuality as there were no study participants with more than 50-lifetime female partners among STD attendees. Being a risk group, among STD attendees 26.2% declared they have never used a condom. In a Brazilian follow-up study, men who used condoms in the previous 6 months had a 50% lower risk of acquiring new HPV infections over 12 months compared to non-users [8]. Sex education across different life stages starting in schools, out-patient departments visit, and targeted STD clinics can promote safe sex practices, reduce HPV prevalence, and HPV related disease burden. The penile prevalence of HPV was highest among heterosexual males (28 out of 46) compared to homosexual and bisexual males who attended

STD clinics. The relatively low prevalence of HPV infection among homosexual individuals could be attributed to the fact that many engage exclusively in receptive anal sex, which may make them more likely to test positive for HPV in anal specimens as opposed to penile specimens. Therefore, when collecting specimens for HPV testing, it is crucial to consider an individual's specific sexual practices.

However, This study revealed high engagement in oral (86.1%) and anal sex (44.4%) among young adults attending STD clinics, consistent with international findings among homosexual populations. Studies from China and Belgrade show increased oral and anal sexual behaviors among homosexual individuals, often with multiple partners and rising trends.

However, overall penile HPV prevalence among STD clinic attendees in our study was 24.6% (n=46) (95% CI: 18.6-31.4) for any and 5% (95% CI:1.5-12.3) for HR HPV genotype. It was 18.5% (95%CI: 15.4,21.8) among HIV sero-negative MSM in Brazil, 69.8% (95%CI63.9,75.3) among STD attendees in Canada and 49.5% (43.9,55.2) among HIV positive MSMs in Netherlands [14]. The HPV prevalence studies carried out among attendees at STD clinics in the Asian region were, conducted in China, involving 305 participants, and it estimated an HPV prevalence rate of 13.8% in 2006. Similarly, in Japan, a study conducted in 2005, encompassing 204 participants, reported an HPV prevalence rate of 5.9% [23]. However, it is important to highlight that the STD prevalence rate observed in the present study (24.6%) surpasses those earlier findings and it is similar to HPV prevalence reported in a study conducted among urology clinic attendees 2011-2015 in Japan [21]. This disparity could be attributed to the rising occurrence of high-risk sexual behaviours associated with contemporary culture with time.

However, there has been a substantial body of research conducted recently among MSM with HIV, obtaining anal specimens. In China, these studies have reported a wide

range of anal HPV prevalence rates, spanning from 58.9% to as high as 96%. In Thailand, another Asian nation, similar studies among MSM with HIV have reported anal HPV prevalence rates ranging from 30% to 89.4% [23]. However a study conducted in Brazil among HIV-positive MSMs found the penile prevalence of 18.4% and an anal prevalence of 42.4% in the same study participant. Therefore to better understand the complete picture of HPV prevalence and transmission dynamics among STD attendees especially MSMs, it's perfect if consider both penile and anal infections which was not considered in the present study due to logistic reasons. According to National STD/AIDS control annual reports from 2017 to 2023, the main probable mode of HIV transmission among PLWH reported was homosexual relationships. There were 613 men diagnosed with HIV out of total new 693 patients in 2023, the majority of men (62%) reported a history of male-male sex exposure and only 19% report heterosexual exposure [26]. The frequent HR HPV types associated with anal cancer in the Asian region were HPV type 16(67.3%), 35(3.8%), 18(3.8%), 56(1.9%), and 58(1.9%) based on studies conducted in Bangladesh, India and South Korea [23]. The most common HPV genotypes associated with anal and penile squamous cell carcinoma (SCC) in the Asian region are 16, 35, 45, and 33. However, our study identified HPV genotypes 16, 35, and 45. [21]. In addition, HPV 18 was not detected among males as detected among the female HPV prevalence study in 2008 and 2018. Therefore, comprehensive future research among HIV patients, particularly MSM, will be crucial for monitoring HPV prevalence and different genotype variations in both anal and penile specimens.

Conclusions

The prevalence of homosexual behaviour and low condom usage among STD clinic attendees underscores the urgent need to promote and increase safe sexual practices. The high prevalence of penile HPV among high-risk males in Sri Lanka highlights the need for cost-effectiveness analyses to guide decisions on implementing evidence-based

practices, such as screening for anal lesions in PLHW and providing HPV prophylactic vaccination to high-risk men in Sri Lanka. As vaccine-preventable HPV HR genotype 16 is the most prevalent HR genotype among STD clinic attendees, detection and monitoring of HPV prevalence over time is important for informed policymaking to prevent HPV-related cancers.

Abbreviations

A/L	– Advanced Level
GCE	– General Certificate of Education
HPV	– Human Papillomavirus
HR	– High Risk
LR	– Low Risk
LMICs	– Low- and Middle-Income Countries
MO	– Medical Officer
O/L	– Ordinary Level
OR	– Odds Ratio
PHI	– Public Health Inspector
PCR	– Polymerase Chain Reaction
SCC	– Squamous Cell Carcinoma
WHO	– World Health Organization

Supplementary information

Additional file 1: supplementary tables of frequency distribution of socio-economic, selected behavioral risk factors and contributory factors of the HPV infection among respondents Additional file 2: Interviewer administered Questionnaire .The datasets

used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Authors contribution

WDJKA contributed to the study design, data collection, analysis, and interpretation of the patient data on HPV prevalence among males and associated factors, and drafted the manuscript. SG and DG served as supervisors, overseeing all stages of the research and contributing to each step of the process. All authors (WDJKA, SG, and DG) read and approved the final manuscript.

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Data availability

The datasets used to analyze this study are available at the corresponding author upon reasonable request.

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Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee in the Post Graduate Institute of Medicine Colombo 22nd July 2022 to 22nd July 2023 and the research ethics review committee of WHO regional office for South-East Asia (SEARO-ERC) 23rd August 2022. Informed written consent was secured before the study. All measures were taken to minimize risk and maximize benefits. Participation was voluntary, with the option to withdraw at any time without penalty or loss of medical care. Informed written consent was obtained from all subjects involved in the study to publish this paper.

Consent for publication

Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests Funding The research leading to these results received funding from the World Health Organization, via the Epidemiology Unit of the Ministry of Health

Author details

¹WDJKA Consultant Community Physician, Epidemiology Unit, Ministry of Health, Colombo 10, Sri Lanka

²SG Consultant Community Physician, Epidemiology Unit, Ministry of Health,

Colombo 10, Sri Lanka

³DG Senior Lecturer, Faculty of Medical Sciences, University of Sri Jayewardenepura,
Nugegoda, Sri Lanka

References

- [1] Winther JF, Møller H, Tryggvadottir L, Kjær SK. Biological agents. *Journal of Pathology, Microbiology and Immunology - the APMIS journal*. 1997 Dec;105:120–131. Publisher: Wiley. <https://doi.org/10.1111/j.1600-0463.1997.tb05615.x>.
- [2] Sichero L, Giuliano AR, Villa LL. Human Papillomavirus and genital disease in men: What we have learned from the HIM study. *Acta Cytologica*. 2019;63(2):109–117. Publisher: S. Karger AG. <https://doi.org/10.1159/000493737>.
- [3] Smith JS, Gilbert PA, Melendy A, Rana RK, Pimenta JM. Age-specific prevalence of human papillomavirus infection in males: a global review. *Journal Adolescent Health*. 2011;48(6):540–552. Publisher: Elsevier BV. <https://doi.org/10.1016/j.jadohealth.2011.03.010>.
- [4] Olesen TB, Munk C, Christensen J, Andersen KK, Kjaer SK. Human papillomavirus prevalence among men in sub-Saharan Africa: a systematic review and meta-analysis. *BMJ*. 2014;90(6):455–462. Publisher: BMJ. <https://doi.org/10.1136/sextrans-2013-051456>.
- [5] Vardas E, Giuliano AR, Goldstone S, Palefsky JM, Moreira ED Jr, Penny ME, et al. External genital human papillomavirus prevalence and associated factors among heterosexual men on 5 continents. *The Journal of Infectious Diseases*. 2011;203(1):58–65. Publisher: Oxford University Press (OUP). <https://doi.org/>

[10.1093/infdis/jiq015](https://doi.org/10.1093/infdis/jiq015).

- [6] Baussano I, Lazzarato F, Ronco G, Franceschi S. Impacts of human papillomavirus vaccination for different populations: A modeling study. *International Journal of Cancer - IJC*. 2018;143(5):1086–1092. Publisher: Wiley. <https://doi.org/10.1002/ijc.31409>.
- [7] World Health Organization Organisation. Human papillomavirus vaccines: WHO position paper (2022 update). *Weekly Epidemiological Record = Relevé épidémiologique hebdomadaire*. 2022;97(50):645–672. Place: Geneva = Genève Publisher: World Health Organization Section: 28 p.
- [8] Pamnani SJ, Sudenga SL, Rollison DE, Ingles DJ, Abrahamsen M, Villa LL, et al. Recurrence of genital infections with 9 human Papillomavirus (HPV) vaccine types (6, 11, 16, 18, 31, 33, 45, 52, and 58) among men in the HPV infection in men (HIM) study. *The Journal of Infectious Diseases*. 2018;218(8):1219–1227. Publisher: Oxford University Press (OUP). <https://doi.org/10.1093/infdis/jiy300>.
- [9] Taylor S, Bunge E, Bakker M, Castellsagué X. The incidence, clearance and persistence of non-cervical human papillomavirus infections: a systematic review of the literature. *BMC Infectious Diseases*. 2016;16(1). Publisher: Springer Nature. <https://doi.org/10.1186/s12879-016-1633-9>.
- [10] de Martel C, Georges D, Bray F, Ferlay J, Clifford GM. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. *Lancet Global Health*. 2020;8(2):e180–e190. Publisher: Elsevier BV. [https://doi.org/10.1016/S2214-109X\(19\)30488-7](https://doi.org/10.1016/S2214-109X(19)30488-7).

- [11] Whitworth HS, Gallagher KE, Howard N, Mounier-Jack S, Mbwanji G, Kreimer AR, et al. Efficacy and immunogenicity of a single dose of human papillomavirus vaccine compared to no vaccination or standard three and two-dose vaccination regimens: A systematic review of evidence from clinical trials. *Vaccine*. 2020;38(6):1302–1314. Publisher: Elsevier BV. <https://doi.org/10.1016/j.vaccine.2019.12.017>.
- [12] Brotherton JML, Giuliano AR, Markowitz LE, Dunne EF, Ogilvie GS. Monitoring the impact of {HPV} vaccine in males .Considerations and challenges. *Papillomavirus Res*. 2016;2:106–111. Publisher: Elsevier BV. <https://doi.org/10.1016/j.pvr.2016.05.001>.
- [13] Palefsky JM, Lee JY, Jay N, Goldstone SE, Darragh TM, Dunlevy HA, et al. Treatment of anal high-grade squamous intraepithelial lesions to prevent anal cancer. *N Engl J Med*. 2022;386(24):2273–2282. Publisher: Massachusetts Medical Society. <https://doi.org/10.1056/NEJMoa2201048>.
- [14] Stier EA, Clarke MA, Deshmukh AA, Wentzensen N, Liu Y, Poynten IM, et al. International Anal Neoplasia Society’s consensus guidelines for anal cancer screening. *Int J Cancer*. 2024;154(10):1694–1702. Publisher: Wiley. <https://doi.org/10.1002/ijc.34850>.
- [15] Sauvageau C, Dufour-Turbis C. HPV Vaccination for MSM: Synthesis of the evidence and recommendations from the Québec Immunization Committee. *Hum Vaccin Immunother*. 2016;12(6):1560–1565. Publisher: Informa UK Limited. <https://doi.org/10.1080/21645515.2015.1112474>.
- [16] Woestenberg PJ, van Benthem BHB, Bogaards JA, King AJ, van der Klis FRM, Pasmans H, et al. HPV infections among young MSM visiting sexual health

- centers in the Netherlands: Opportunities for targeted HPV vaccination. *Vaccine*. 2020;38(17):3321–3329. Publisher: Elsevier BV. <https://doi.org/10.1016/j.vaccine.2020.03.002>.
- [17] Palefsky JM. Human Papillomavirus-Related Disease in Men: Not Just a Women’s Issue. *Journal of Adolescent Health*. 2010;46(4):S12–S19. <https://doi.org/10.1016/j.jadohealth.2010.01.010>.
- [18] Baussano I, Lazzarato F, Ronco G, Lehtinen M, Dillner J, Franceschi S. Different challenges in eliminating HPV16 compared to other types: A modeling study. *J Infect Dis*. 2017;216(3):336–344. Publisher: Oxford University Press (OUP). <https://doi.org/10.1093/infdis/jix299>.
- [19] Baio G, Capone A, Marcellusi A, Mennini FS, Favato G. Economic burden of human papillomavirus-related diseases in Italy. *PLoS One*. 2012;7(11):e49699. Publisher: Public Library of Science (PLoS). <https://doi.org/10.1371/journal.pone.0049699>.
- [20] Nielson CM, Flores R, Harris RB, Abrahamsen M, Papenfuss MR, Dunne EF, et al. Human papillomavirus prevalence and type distribution in male anogenital sites and semen. *Cancer Epidemiol Biomarkers Prev*. 2007;16(6):1107–1114. Publisher: American Association for Cancer Research (AACR). <https://doi.org/10.1158/1055-9965.EPI-06-0997>.
- [21] Matsuzawa Y, Kitamura T, Suzuki M, Koyama Y, Shigehara K. Prevalence, genotype distribution, and predictors against HPV infections targeted by 2-, 4-, 9-Valent HPV vaccines among Japanese males. *Vaccines (Basel)*. 2020;8(2):221. Publisher: MDPI AG. <https://doi.org/10.3390/vaccines8020221>.

- [22] Mataraarachchi D, Vithana PVSC, Lokubalasooriya A, Jayasundara CJ, Suranutha AS, Pathirana TEA, et al. Knowledge, and practices on sexual and reproductive health among youth trainees attached to youth training centers in Sri Lanka. *Contracept Reprod Med.* 2023;8(1):18. Publisher: Springer Science and Business Media LLC. <https://doi.org/10.1186/s40834-023-00216-0>.
- [23] Bruni L, Albero G, Serrano B, Mena M, Collado JJ, Gómez D, et al.: ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre). Human Papillomavirus and Related Diseases in Japan 2023. Available from: <https://hpvcentre.net/statistics/reports/JPN.pdf>.
- [24] Trindade R, Xavier-Souza E, Timbó M, Lessa K, Souza C, Travassos AG. p3.185 Adolescents with hpv: the profile of young people attending a sti and hiv reference centre in salvador bahia. *Sexually Transmitted Infections.* 2017 Jul;93(Suppl 2):A161. <https://doi.org/10.1136/sextrans-2017-053264.420>.
- [25] Houlihan CF, de Sanjosé S, Baisley K, Chantalucha J, Ross DA, Kapiga S, et al. Prevalence of Human Papillomavirus in Adolescent Girls Before Reported Sexual Debut. *The Journal of Infectious Diseases.* 2014 Sep;210(6):837–845. <https://doi.org/10.1093/infdis/jiu202>.
- [26] Ariyaratne M KA, Jayanthi E, Geethani S, Nimali J, Vino D, Janaka W, et al. Annual Report 2023 National STD/AIDS Control Programme. Ministry of Health, Sri Lanka; 2023. Available from: https://www.aidscontrol.gov.lk/images/publications/annual_reports/2023/NSACP_Annual_report_2023_Final_draft-2662024.pdf.

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Review Article

Dietary diversity among children under five years in Sri Lanka: A narrative review

*Thilini Mapatuna¹, Maheeka Seneviwickrama², Anusha Jatheesasan³, Usha Hettiaratchi⁴, Guwani Liyanage¹

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(Key words: Child, Dietary diversity, Nutritional status, Prevalence, Sri Lanka)

Introduction

Dietary diversity (DD) refers to consumption of a variety of foods from different food groups¹. In Sri Lanka, in under-5-year-old children, both undernutrition and overweight/obesity are prevalent. Poor DD is a major contributor to this problem¹. DD is a crucial component of infant and young child feeding (IYCF) practices². A diversified diet provides children with essential nutrients needed for optimal growth and development^{3,4}. Studies have shown that consuming a variety of foods improves linear growth, prevents stunting and underweight, prevents chronic disease, decreases micronutrient deficiencies, supports physical and cognitive development, and helps children reach full potential. Therefore, DD is recognized as a critical indicator of the quality of children's diets⁵⁻⁹.

Several methods are used to measure DD, such as the dietary score created by Guthrie and Sheers¹⁰, the food variety score¹¹, and the minimum dietary diversity (MDD) score¹². MDD is one of 8 indicators for IYCF developed by the World Health Organization (WHO) to offer simple, valid, and reliable metrics for evaluating IYCF practices at population level¹². It is straightforward and easy to interpret, reflecting complementary feeding diet rather than breastfeeding (BF) status. According to 2021 IYCF definition, MDD is defined as consuming foods and beverages from at least 5 of 8 specified food groups within the past 24 hours. These 8 food groups are 'breast milk', 'grains, roots & tubers', 'pulses, nuts & seeds', 'dairy products', 'flesh foods', 'eggs', 'vitamin A-rich fruit & vegetables' and 'other fruits & vegetables'¹³. The 2008 WHO IYCF definition of MDD required consumption of

4 of 7 food groups¹². This definition was revised in 2021 to include 5 of 8 food groups, as it is associated with a better-quality diet for both BF and non-BF children¹³.

In Sri Lanka, despite its lower-middle-income status, malnutrition remains a significant problem, particularly among children under 5 years old¹⁴. The latest data from the Demographic Health Survey (DHS) indicate that in Sri Lanka, 17% of children under 5 years are stunted (low height for age), 21% are underweight (low weight for age), and 15% are wasted (low weight for height)¹⁵. Additionally, 8% of children under 5 years are overweight, which is a growing concern in the country¹⁵. Micronutrient deficiency is also considerably high among 6-59-month-old children, with subclinical vitamin A deficiency at 29.3%, zinc deficiency at 5.1%, calcium deficiency at 47.6%, and iron deficiency at 25.2%¹⁶. It is reported that 67% of children under 5 years are zinc deficient in the Western Province¹⁷. Two studies have reported vitamin D deficiency among infants and preschool children^{18,19}. A study conducted in 2017 found that only 6% of Sri Lankan children under 5 years of age were consuming a diverse diet¹⁵. This is alarming, as DD is essential for ensuring that children receive all the necessary nutrients for growth and development²⁰.

There is no comprehensive review of IYCF practices or DD among under-5 children in Sri Lanka. Various small studies have assessed IYCF practices, but there is great variation and inconsistency in diversified dietary feeding practices and reporting. Therefore, a review on DD among children in this age group is needed to search for and analyse all available studies on this topic, assess current state of knowledge, and identify any gaps in research. To address this gap, a review was undertaken to provide a precise summary and collate DD among children under 5 years in Sri Lanka. The review also presents a summary of other IYCF practices and the relationship of DD to growth among children under 5 years in the reviewed studies. This will enable comparisons across studies and between different subgroups within the population. Findings of this review will be useful for policymakers, programme planners and researchers to design appropriate interventions or plan future research.

Objectives

To review published literature on DD among under-5 in Sri Lanka to assess status and identify gaps in research and practices. Additionally, we aimed to describe the relationship between DD and growth in the reviewed articles.

¹Department of Paediatrics, Faculty of Medical Sciences, University of Sri Jayewardenepura, Gangodawila, Sri Lanka, ²Department of Community Medicine, Faculty of Medical Sciences, University of Sri Jayewardenepura, Gangodawila, Sri Lanka, ³Department of Basic Sciences, Faculty of Dental Sciences, University of Sri Jayewardenepura, Gangodawila, Sri Lanka, ⁴Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura, Gangodawila, Sri Lanka

*Correspondence: thilini.mapatuna@gmail.com

 <https://orcid.org/0009-0001-2184-3272>

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Method

Literature related to DD in children in Sri Lanka was searched using the following key terms: 'food diversity', 'dietary diversity', 'food varieties', 'feeding practices', 'complementary feeding', 'Sri Lanka', and 'infant/preschool child'. We searched PubMed, Google Scholar, and Scopus, as well as Sri Lanka online journals, published abstracts from scientific sessions of professional colleges, dissertations and theses from the Post Graduate Institute of Medicine, repositories of all universities, repository of the National Science Foundation, and official websites of non-governmental organizations and governmental organizations (Ministry of Health, Medical Research Institute, and Family Health Bureau) until December 2023. All original articles written in English which explored DD in children <5 years in Sri Lanka were considered eligible. Screening of articles was conducted independently by 2 authors. Any differences in

these outcomes were discussed and consensus reached with a 3rd author for resolution and/or confirmation.

Results

Study characteristics: We identified 10 studies^{9,15,17,20-26}, and the summary is given in Table 1. Participants were children <5 years. All were cross-sectional studies except 1 longitudinal study²⁰. Various sampling methods were employed across studies, including random sampling, cluster sampling and convenience sampling. Sample sizes ranged from 374-7,303 children. All studies except 1 were conducted at the community level²⁰. In 4 studies^{9,15,21,26} participants were recruited to represent the national level, including 2 DHS, while 6 studies²⁰⁻²⁵ focused on regional level. One study was a secondary data analysis of a DHS⁹. All studies explored IYCF practices and 3 investigated the nutritional status of children²¹⁻²³.

Table 1: The summary of studies

Reference study	Sample size	Study design, region	Age	Study instruments	Food groups	Dietary diversity definition	Guideline
Lucas MN, <i>et al</i> (2022) ²⁰	374	Longitudinal, Colombo District	0-24 months	24-hour dietary recall	Breast milk; grains, roots, tubers, plantains; pulses, nuts and seeds; dairy products; flesh foods; eggs; vitamin-A rich fruits & vegetables; other fruits & vegetables	Consumed at least 5 out of 8 food groups during previous day.	UNICEF/WHO 2021 IYCF guidelines
Sirasa F, <i>et al</i> (2020) ¹⁷	597	Cross-sectional analysis, Kurunegala District	2-6 years	Food Frequency Questionnaire	Rice, lentils, green leafy vegetables, yellow/orange fruits, egg, fish, chicken, meat other than chicken, milk and milky products	Cut-off values from 9 food groups [low (<3.0), medium (3.1–6.0) and high (6.1–9.0)]	Based on Rah JH, <i>et al.</i> (2010) ⁴
Perkins JM, <i>et al</i> (2018) ²¹	7303	Cross-sectional, Island-wide	6-59 months	24-hour dietary recall	Grains/roots/tubers, legumes/nuts, dairy products, flesh foods, eggs, vitamin A-rich foods, other fruits & vegetables	Consumed at least 5 out of 7 food groups	UNICEF/WHO 2008 IYCF guidelines
DHS (2017) ¹⁵	2289	Cross-sectional survey, All provinces except northern	6-23 months	24-hour dietary recall	Grains/roots/tubers, legumes/nuts, dairy products, flesh foods, eggs, vitamin A-rich foods, other fruits & vegetables	Consumed at least 4 out of 7 food groups	UNICEF/WHO 2008 IYCF guidelines
Jeyakumaran D (2016) ²⁵	1122	Cross-sectional, Jaffna District	6-11 months	24-hour dietary recall	Grains/roots/tubers, legumes/nuts, dairy products, flesh foods, eggs, vitamin A-rich foods, other fruits & vegetables	Consumed least 4 out of 7 food groups	UNICEF/WHO 2008 IYCF guidelines
Jeyakumaran D (2012) ²⁴	374	Cross-sectional, Sandilipay MOH, Jaffna	4-23 months	24-hour dietary recall	Grains/roots/tubers, legumes/nuts, dairy products, flesh foods, eggs, vitamin A-rich foods, other fruits & vegetables	Consumed least 4 out of 7 food groups	UNICEF/WHO 2008 IYCF guidelines
Senarath U, <i>et al</i> (2012) ⁹	2106	Secondary data analysis DHS 2006/07, All provinces except northern	6-23 months	24-hour dietary recall	Grains/roots/tubers, legumes/nuts, dairy products, flesh foods, eggs, vitamin A-rich foods, other fruits & vegetables	Consumed least 4 out of 7 food groups	UNICEF/WHO 2008 IYCF guidelines
Abhayagunaratne TR (2012) ²²	294	Cross sectional, Kaduwela MOH	6 - 23 months	24-hour dietary recall	Grains/roots/tubers, legumes/nuts, dairy products, flesh foods, eggs, vitamin A-rich foods, other fruits & vegetables	Consumed least 4 out of 7 food groups	UNICEF/WHO 2008 IYCF guidelines
Soloman CS (2007) ²³	423	Cross-sectional, Trincomalee MOH	6-9 months	24-hour dietary recall	Grains, tubers, vitamin A-rich fruit/vegetables, green leafy vegetables, any other fruits & vegetables, animal protein food, any dairy products, legumes & any oils	A score (low, medium & high) given based on the number of food groups	Daelmans B, <i>et al</i> (2002) ²⁷
DHS (2006/07) ²⁶	2119	Cross-sectional survey, All provinces except northern	6-23 months	24-hour dietary recall	Infant formula & milk products other than breast milk, foods made from grains, roots & tubers, vitamin A-rich fruits & vegetables, other fruits & vegetables; eggs, flesh foods, legumes & nuts, foods made with oil /fat/ butter	≥3 food groups in breastfeeding, ≥4 food groups non-breastfeeding out of 8 food groups	WHO 2005, Guiding principles for feeding non-breastfed children aged 6-24 months ²⁸

Methods used to assess dietary diversity: All except 1 used 24-hour dietary recall as recommended by WHO^{15,19,20-25}. One study used the food frequency questionnaire¹⁷. Different studies used different definitions for MDD. One study utilized the newer version of the WHO IYCF 2021 guidelines for children 0-23 months, defining MDD as the consumption of 5 or more food groups out of 8¹³. Seven studies used the previous version (WHO IYCF 2008), where MDD is defined as the consumption of 4 of 7 food groups^{15,21,22,24,25}. Sirasa F, *et al* in a study in older children (24-72 months) defined DD using 9 food groups¹⁷.

Dietary diversity: Table 2 summarizes various IYCF indicators, with particular focus on MDD across multiple studies and surveys conducted over different years. DHS conducted in 2006 and 2017 revealed a notable decline in MDD over time. In 2006 MDD was 88% and by 2017, this had dropped to 73%. Senarath U, *et al* (2012)⁹ reports an MDD of 71%, which aligns more closely with the 2017 DHS data. Jeyakumaran D (2016)²⁵ shows a lower MDD of 45% among children aged 6-8 months in Jaffna, but it is higher and comparable to 2017 DHS figures among 9-11-month-old infants. Lucas MN, *et al* (2022)²⁰ reports a very high MDD at 94%, with 100% early initiation and

exclusive BF in a longitudinal study which included individual counselling of caregivers. Perkins JM, *et al*²¹ reported high rate of MDD (91%) among older children (24-59 months).

Secondary analysis of DHS 2006/07 and 2017, using the same method to analyse DD, remained the same over time (73% vs. 71%)^{9,15}. Another island-wide study in 2018, reported MDD of 78%²¹. Yet, other small studies demonstrated varying rates of MDD (44% to 94%) with the same tools^{22,24}. Lucas MN, *et al* (2022)²⁰ in a

longitudinal study reported an improvement in MDD with individual counselling of the caregivers.

Relationship of dietary diversity to growth among children under 5 years in Sri Lanka: Three studies have reported impact of DD on child growth²¹⁻²³. Perkins JM, *et al*²¹ showed that DD is linked to growth in Sri Lankan children aged 6-59 months. However, the association was not straightforward for children aged 6-12 months. Abhayagunaratne TR (2012)²² reported a statistically significant association to stunting and wasting, but not to underweight among children aged 6-23 months

Table 2: Summary of infant and young child feeding (IYCF) indicators

Reference study	Age (months)	MDD%/ DDS	EvBF	EIBF	EBF2D	EBF	CBF	ISSSF	MMF	MAD	IYCF Guideline	Association between IYCF indicators and growth
Lucas MN, <i>et al</i> (2022) ²⁰	0-24	94.0	-	100.0	100.0	72.0	75.0	82.0	93.5	94.0	UNICEF/WHO 2021	NR
Sirasa F, <i>et al</i> (2020) ¹⁷	24-72	53.1	-	-	-	-	-	-	-	-	Based on Rah et al., (2010) ⁴	NR
Perkins JM, <i>et al</i> (2018) ²¹	6-59 6-12	*91.0 *78.0	-	-	-	-	-	-	-	-	UNICEF/WHO 2008	MDD associated with HAZ but not with WHZ, WAZ, underweight, wasting or stunting
DHS (2017) ¹⁵	6-23	*73.0	99.4	90.4	97.4	82.0	95.0	88.0	80.0	62.0	UNICEF/WHO 2008	NR
Jeyakumaran D (2016) ²⁵	6-11	*58.05	-	-	-	-	-	95.6	80.95	49.75	UNICEF/WHO 2008	NR
Jeyakumaran D (2012) ²⁴	6-11 12-23	*44.0 *69.8	-	-	-	-	-	93.5 97.7	88.2 73.7	42.3 49.6	UNICEF/WHO 2008	NR
Senarath U, <i>et al</i> (2012) ⁹	6-23	*71.0	-	-	-	-	-	84.0	88.0	68.0	UNICEF/WHO 2008	NR
Abhayagunaratne TR (2012) ²²	6-23	*94.2	100.0	-	-	61.6	63.08	100	-	-	UNICEF/WHO 2008	MDD is associated with stunting and wasting
Solomon CS (2007) ²³	6-9	57.0	-	-	-	-	-	44.2	-	-	Arimond M & Ruel M. (2002)	Complementary feeding composite index is associated with WHZ, WAZ, HAZ and BMI
DHS (2006/07) ²⁶	6-23	84.8	99.0	99.0	97.0	75.8	88.0	86.6	88.4	80.9	WHO 2005	NR

*MDD measured using UNICEF/WHO 2008 IYCF guidelines. MDD: Minimum dietary diversity, DDS: Dietary diversity score, EvBF: Ever breastfed, EIBF: Early initiation of breastfeeding, EBF2D: Exclusively breastfed for the first two days after birth, EBF: Exclusive breastfeeding, CBF: Continued breastfeeding, ISSSF: Initiation of solid semisolid foods, MMF: Minimum meal frequency, MAD: Minimum acceptable diet, HAZ: height-for-age z-score, WAZ: weight-for-age z-score; WHZ: weight-for-height z-score, BMI-Body mass index, NR-Not related

Discussion

The objective of this review was to examine the extent of DD among children under 5 years old in Sri Lanka. The findings demonstrate that the prevalence of minimum DD among children ranged from low to high at regional and national level.

This review summarizes various IYCF indicators, particularly focusing on MDD across several studies and surveys over different years. The DHS 2006/07 and 2017 show a stagnant MDD over time^{15,26}. Some regional data and DHS 2006/07 have shown extreme values for MDD; however, making comparisons with the other reviewed studies is not suitable since different measurement tools have been used^{20-22,26}. The lowest percentage of adequate MDD measured using WHO/UNICEF IYCF-2008 was reported by Jeyakumaran D, in Jaffna in 2012, during the post-war period, suggesting potential issues with food security, availability, and possible gaps in nutritional education and interventions²⁴. The study by Lucas MN, *et al* (2022)²⁰ reports a higher MDD of 94%, following an individualized nutrition education programme. This study also stands out with 100% early initiation and exclusive breastfeeding for the first two days, suggesting strong adherence to recommended BF practices, which may correlate with better overall dietary practices. Infant feeding practices, including DD, ensure essential nutrients

necessary for their growth as well as development²⁹. A diverse diet provides a balanced intake of vitamins, minerals, proteins, and other vital nutrients that support physical growth, cognitive development, and immune function²⁹. Therefore, it is important that targeted interventions such as nutritional education and counselling are crucial to achieving the target set for 2030³⁰.

This is the first review conducted in Sri Lanka synthesizing evidence on DD. It contributes to understanding dietary practices, providing valuable insights for public health interventions and policies. However, the findings should be interpreted with the following limitations. The methodological approaches varied among studies. The tools used to assess the diet varied. Also, the definitions of DD were different. Therefore, inaccuracies are expected in comparisons and synthesized evidence. In addition, there was heterogeneity among the samples, in terms of age, sample size and socio-economic groups. Also, reviewed studies were conducted during different time periods spanning over almost two decades and different regions. Despite these limitations, the review provides an understanding of DD in Sri Lanka, highlighting areas for further research and the need for standardized methodologies in future studies to improve the accuracy and comparability of findings.

Conclusion

Although the national target for DD by 2030 is set at 95%, we are still significantly behind, and substantial improvements have not been observed over the years. The reviewed studies have indicated that MDD is associated with growth. Therefore, it is crucial to design and implement targeted interventions aimed at improving DD within this population. Collaborative efforts among governmental and non-governmental organizations addressing the barriers to adequate feeding practices is important in achieving the desired results.

References

1. Molani Gol R, Kheirouri S, Alizadeh M. Association of dietary diversity with growth outcomes in infants and children aged under 5 years: a systematic review. *Journal of Nutrition Education and Behavior* 2022; **54**(1): 65–83. <https://doi.org/10.1016/j.jneb.2021.08.016> PMID: 35000681
2. Ariff S, Saddiq K, Khalid J, Sikanderli L, Tariq B, Shaheen F, *et al.* Determinants of infant and young complementary feeding practices among children 6–23 months of age in urban Pakistan: a multicenter longitudinal study. *BMC Nutrition* 2020; **6**: 75. <https://doi.org/10.1186/s40795-020-00401-3> PMID: 33323127 PMCid: PMC7739450
3. Likhar A, Patil MS. Importance of maternal nutrition in the first 1,000 days of life and its effects on child development: a narrative review. *Cureus* 2022; **14**(10): e30083 <https://doi.org/10.7759/cureus.30083>
4. Rah JH, Akhter N, Semba RD, de Pee S, Bloem MW, Campbell AA, *et al.* Low dietary diversity is a predictor of child stunting in rural Bangladesh. *European Journal of Clinical Nutrition* 2010; **64**(12): 1393–8. <https://doi.org/10.1038/ejcn.2010.171> PMID: 20842167
5. Torheim LE, Ouattara F, Diarra MM, Thiam FD, Barikmo I, Hatloy A, *et al.* Nutrient adequacy and dietary diversity in rural Mali: association and determinants. *European Journal of Clinical Nutrition* 2004; **58**(4): 594–604. <https://doi.org/10.1038/sj.ejcn.1601853> PMID: 15042127
6. Onyango A, Koski KG, Tucker KL. Food diversity versus breastfeeding choice in determining anthropometric status in rural Kenyan toddlers. *International Journal of Epidemiology* 1998; **27**(3): 484–9. <https://doi.org/10.1093/ije/27.3.484> PMID: 9698140
7. Rakotonirainy NH, Razafindratovo V, Remonja CR, Rasoloarijaona R, Piola P, Raharintsoa C, *et al.* Dietary diversity of 6- to 59-month-old children in rural areas of Moramanga and Morondava districts, Madagascar. *PLoS One* 2018; **13**(7): e0200235. <https://doi.org/10.1371/journal.pone.0200235> PMID: 30005067 PMCid: PMC6044523
8. Onyango AW, Borghi E, de Onis M, Casanovas M del C, Garza C. Complementary feeding and attained linear growth among 6-23-month-old children. *Public Health Nutrition* 2014; **17**(9): 1975–83. <https://doi.org/10.1017/S1368980013002401> PMID: 24050753 PMCid: PMC11108726
9. Senarath U, Godakandage SSP, Jayawickrama H, Siriwardena I, Dibley MJ. Determinants of inappropriate complementary feeding practices in young children in Sri Lanka: secondary data analysis of Demographic and Health Survey 2006–2007. *Maternal and Child Nutrition* 2012; **8**(Suppl 1): 60–77. <https://doi.org/10.1111/j.17408709.2011.00375.x> PMID: 22168519 PMCid: PMC6860785
10. Ruel MT. Operationalizing dietary diversity: a review of measurement issues and research priorities. *Journal of Nutrition* 2003; **133**(11): 3911S–3926S. <https://doi.org/10.1093/jn/133.11.3911S> PMID: 14672290
11. Steyn NP, Nel JH, Nantel G, Kennedy G, Labadarios D. Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? *Public Health Nutrition* 2006; **9**(5): 644–50. <https://doi.org/10.1079/PHN2005912> PMID: 16923296
12. World Health Organization, United Nations Children's Fund (UNICEF). Indicators for assessing infant and young child feeding practices: definitions and measurement methods. Geneva: WHO; 2008. p. 19. Available from: <https://iris.who.int/bitstream/handle/10665/340706/9789240018389-eng.pdf?sequence=1>
13. World Health Organization, United Nations Children's Fund (UNICEF). Indicators for assessing infant and young child feeding practices: definitions and measurement methods. Geneva: WHO; 2021. Available from: <https://iris.who.int/handle/10665/340706>
14. Central Bank of Sri Lanka. Annual report 2022. [cited 2024 Jun 7]. Available from: https://www.cbsl.gov.lk/sites/default/files/cbslweb_documents/publications/annual_report/2022/en/13_Box_05.pdf
15. Sri Lanka Department of Census and Statistics. Demographic and Health Survey report 2016. [cited 2024 Jun 5]. Available from: <http://www.statistics.gov.lk/Resource/en/Health/DemographicAndHealthSurveyReport-2016-Contents.pdf>
16. Marasinghe E, Chackrewarthy S, Abeysena C, Rajindrajith S. Micronutrient status and its relationship with nutritional status in preschool children in urban Sri Lanka. *Asia Pacific Journal of Clinical Nutrition* 2015; **24**(1): 144–51. <https://doi.org/10.1111/mcn.13006> PMID: 32351007 PMCid: PMC7507074
17. Sirasa F, Mitchell L, Harris N. Dietary diversity and food intake of urban preschool children in North-Western Sri Lanka. *Maternal and Child Nutrition* 2020; **16**(4): e13006. <https://doi.org/10.1111/mcn.13006> PMID: 32351007 PMCid: PMC7507074
18. Thillan K, Lanerolle P, Thoradeniya T, Samaranayake D, Chandrajith R, Wickramasinghe P. Micronutrient status and associated factors of adiposity in primary school children with normal and high body fat in Colombo municipal area, Sri Lanka. *BMC Pediatrics* 2021; **21**(1): 14. <https://doi.org/10.1186/s13052-021-00911-1> PMID: 34050753 PMCid: PMC8000000

- <https://doi.org/10.1186/s12887-020-02473-3>
PMid: 33407272 PMCID: PMC7786904
19. Wickramasinghe VP, Edirisnghe NS, Lucas MN, Hills AP, Lanerolle P, Senarath U. Vitamin D status of pregnant mothers and its effect on anthropometric measures in the offspring: a preliminary study. *Sri Lanka Journal of Child Health* 2018; **47**(3): 207–11.
<https://doi.org/10.4038/sljch.v47i3.8540>
20. Lucas MN, Edirisnghe NS, Lanerolle P, Senarath U, Hills AP, Wickramasinghe VP. Infant and young child feeding (IYCF) practices from birth to 2 years: a longitudinal follow-up study in healthy children from Colombo, Sri Lanka. *Ceylon Medical Journal* 2022; **67**(3): 148–57.
<https://doi.org/10.4038/sljch.v51i3.10243>
21. Perkins JM, Jayatissa R, Subramanian SV. Dietary diversity and anthropometric status and failure among infants and young children in Sri Lanka. *Nutrition* 2018; **55–56**: 76–83.
<https://doi.org/10.1016/j.nut.2018.03.049>
PMid: 29980091
22. Abhayagunaratne TR. Nutritional status of 6 to 23 months old children and its association with complementary feeding practices in Medical Officer of Health area, Kaduwela [Thesis]. 2012 [cited 2024 Jun 5]. Available from: <http://librepository.pgim.cmb.ac.lk/handle/1/1370>
23. Solomon CS. Factors influencing complementary feeding practices among infants aged six to nine months in Trincomalee MOH area [Thesis]. 2007 [cited 2024 Jun 5]. Available from: <http://librepository.pgim.cmb.ac.lk/handle/1/1192>
24. Jeyakumaran D. Complementary feeding practices and associated factors among infants and young children in the Medical Officer of Health area Sandilipay [Thesis]. 2012 [cited 2024 Jun 5]. Available from: <http://librepository.pgim.cmb.ac.lk/handle/1/1388>
25. Jeyakumaran D. Complementary feeding practices among infants in Jaffna district: prevalence, risk factors for poor feeding and the effectiveness of an educational intervention for its improvement [thesis]. Colombo: Postgraduate Institute of Medicine, University of Colombo; 2016. In: Annotated bibliography of dissertations and theses presented to PGIM 2016-2019 [Internet]. [cited 2024 Jun 22]. Available from: https://library.pgim.cmb.ac.lk/wpcontent/uploads/2021/03/Annotated-Bibliography-of-Dissertations-and-Theses-Presented-to-PGIM-2016-2019_compressed.pdf
26. Department of Census and Statistics. Final report. [cited 2024 Jun 5]. Available from: <http://www.statistics.gov.lk/Resource/en/Health/FinalReport.pdf>
27. Daelmans B, Dewey K, Arimond M, Working Group on Infant and Young Child Feeding Indicators. New and updated indicators for assessing infant and young child feeding. *Food and Nutrition Bulletin* 2009; **30**(2 Suppl): S256-62.
<https://doi.org/10.1177/15648265090302S204>
PMid: 20496613
28. Department of Child and Adolescent Health and Development (CAH), World Health Organization. Guiding principles for feeding non-breastfed children 6-24 months of age [Internet]. Geneva: World Health Organization; 2005. Available from: <https://iris.who.int/bitstream/handle/10665/43281/9241593431.pdf>.
29. Berti C, Socha P. Infant and young child feeding practices and health. *Nutrients* 2023; **15**(5): 1184.
<https://doi.org/10.3390/nu15051184>
PMid: 36904182 PMCID: PMC10005283
30. Ministry of Health, Nutrition, and Indigenous Medicine. National Nutrition Policy of Sri Lanka 2021-2030 [Internet]. [cited 2024 Jun 4]. Available from: <https://nutrition.health.gov.lk/wp-content/uploads/2020/11/NNP-English.pdf>