

Infant and Young Child Feeding Practices and Associated Factors Among Mothers of Children Aged 0-23 Months in Kalu District, North-East Ethiopia: Community Based Cross-Sectional Study

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ABSTRACT

Background: Infant and young child feeding (IYCF) is a cornerstone of care for ensuring optimal child growth and development during the first 2 years of life. Scientific evidence indicates that various poor IYCF practices have been shown to have numerous negative effects on children's health. Therefore, Improving IYCF practice is critical to improved nutrition, health, and development of these age group children. This study aims to assess IYCF practices and associated factors among mothers of children aged 0-23 months in Kalu district, Northeast Ethiopia.

Methods: A community based cross-sectional study was conducted from 15 to 05/2019-15/06/2019. A total of 605 mothers who had a child aged 0-23 months were included in the study using multi-stage sampling followed by a simple random sampling technique. Data were collected using a pretested semi-structured interviewer-administered questionnaire. Bi-variate and multivariate logistic regression models were used to identify factors associated with IYCF practices. Statistical significance was determined at the p-value < 0.05

Result: Of six hundred five (605) sampled mothers having an IYC age 0 to 23 months, 589 were successfully included in the study making the response rate of 97.35 %. The overall prevalence of appropriate complementary and breastfeeding practices was 9.6% and 32.1% respectively. Place of delivery (AOR=1.653; 95% CI (1.044, 2.615)), fathers occupation (AOR =2.278; 95% CI:(1.156, 4.489)) and age of child (AOR =0.634 95% CI: (0.409, 0.983) were independently associated with appropriate breastfeeding practice. On the other hand, PNC service (AOR =2.972; 95% CI: (1.229, 7.186), place of residence (AOR =2.473; 95% CI: (1.275, 4.797), age of child (AOR =3.015; 95% CI: (1.282, 7.092) and household family size (AOR=2.398; 95% CI (1.062, 5.416) were factors significantly associated with appropriate complementary feeding practices in Kalu district.

Conclusion: Both the breastfeeding and complementary feeding practices were inappropriate (sub-optimal) in Kalu district. As a result, interventional initiatives should focus on improving the coverage of PNC, institutional delivery service are crucial to implementing appropriate IYCF practice. Standardizing the basic health care elements and PNC package are also critical in addition to increasing service utilization..

Keywords: IYCF practice; Kalu district; Ethiopia

INTRODUCTION

Infant and young child feeding is a cornerstone of care for ensuring optimal child growth and development during the first 2 years of life, as this period is the "critical window" for the promotion of health, good growth, behavioral, cognitive

development and overall well-being in early vulnerable years of life [1-3]. Poor infant and young child feeding (IYCF) practices in this windows period are among the major causes of childhood malnutrition resulting in permanent outcomes of stunting, poor cognitive development, and significantly increases risks of many

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chronic and infectious diseases [4-6]. The potential negative impact of undernutrition during this critical period is not limited to childhood life rather it diminishes the individual level of productivity during adulthood, negatively affecting the future social and economic development of countries and leading the vicious cycle of intergenerational malnutrition [7-10].

A major contributor to their deaths is poor breastfeeding practices. The risk of death from diarrhea of partially breastfed infants 0-6 months of age was 8.6 times more risk than exclusively breastfed children [11]. In low-and middle-income countries, recent data revealed that optimal breastfeeding prevents about 12% of under-5 child mortality every year. Other contemporary studies in Ethiopia, Ghana, Bolivia and Madagascar have shown that breastfeeding prevents 20-22% of neonatal deaths. Suboptimal IYCF practices increase the risk of infant and child morbidity and mortality by up to fivefold [12-14]. Child malnutrition causes approximately 2.7 million deaths per year, 156 million stunting, 50 million wastings. In developing countries, approximately 25–50% of infant mortality is attributed to suboptimal IYCF practices. The Central Statistical Agency (CSA) 2016 report indicated that the neonatal mortality rate in Ethiopia accounts for 43% of under 5 mortality.

MATERIALS AND METHODS

Study design, time and setting

A community-based cross-sectional study was conducted from May 15/2019 to June 20/2019 in Kalu District. Kalu district is located in the South Wollo zone of the Amhara National Regional State, Ethiopia. This is located at 375 kilometers (km) far from Addis Ababa (Capital city of Ethiopia). It is bordered on the west by Dessie Zuria, on the north by Were Babu, on the south and east by the Oromia Zones, on the southeast by Argobba special woreda, and on the southwest by Abuko. The administrative center for this woreda is Kombolcha; other towns in Kalu include Harbu, Ancharo, Gerba, and Degan. There are three agro-ecological zones (high land, middle land, and low land) in the district in a range between 800 meters above sea level in the lowlands bordering of the Oromia Zone and 1,750 m at the foot of the mountains north of Kombolcha. The district is the first ranked populated among the twenty-three districts in south wollo Zone. It is administratively subdivided into five urban and thirty-five rural kebeles (the smallest administration unit) with an estimated total population size of about 231,087 according to the 2018 district-based census [15,16].

Population, sample size calculation, and sampling technique

The source populations for the study were all mothers/caregivers having an infant and young children aged 0 to 23 months living in the district. The study population was selected mothers / caregivers of children aged less than 24 months who lived in the study area for more than six months. In the case of, households with multiple children, a child was selected randomly using the lottery method. Those mothers who are unable to communicate due to serious illness at the time of data collection and those children having any illness 15 days before the survey were

excluded from the study because they affect feeding practices during data collection.

The sample size was determined using Epi-info version 7.2. by considering the proportion of appropriate IYCF practices 50% in the study area since there is no study showing the proportion of appropriate IYCF practices, with the assumptions of 95% level of confidence, 5% margin of error, 5% non-response rate, and a design effect of 1.5.

Data collection procedures and quality issues

Infant and young child feeding practices were assessed using eight-core and seven optional feeding practice indicators developed by WHO to assess the adequacy of IYCF practices [17]. However, these guidelines on infant and young child feeding practices do not provide the baseline or the minimum standard that needs to be reached nor what percentage should be considered alarming for public health significance. Logically, all children 0-23 months should meet the recommended feeding practices. To appreciate the similarities and differences of the prevalence and factors associated with infant and young child feeding practice with other studies are difficult due to the lack of study on IYCF practices in a composite of similar indicators. These study findings were discussed based on the individual components of IYCF practice [16].

Inclusion and exclusion criteria

All mothers /caregivers who have children aged less than 24 months who lived in the study area for more than six months. In the case of, households with multiple children, a child was selected randomly using the lottery method. Those mothers who are unable to communicate due to serious illness at the time of data collection and those children having any illness 15 days prior to the survey were excluded from the study because they affect feeding practices during data collection.

Operational and standard definition.

Appropriate complementary feeding practice: Defined as five core WHO recommended practices for timely initiation (introduce complementary feed 6-8 months), minimum meal frequency, minimum meal diversity (fed four or more foods within 24 h) minimum acceptable diet, and consumption of iron-rich foods. Complementary feeding practice was considered appropriate if all the five indicators mentioned above were summed score is equal to 4 or above. Otherwise, a practice that was inappropriate (suboptimal). If the summed score of the indicators is less than 4 [15].

Appropriate (Optimal) breastfeeding practice: Defined as three core WHO recommended practices for exclusive breastfeeding in children age less than 6 months, early initiation of breastfeeding, and Continued breastfeeding at 1 year.

Infant and young child (IYC): children 0-23.9 months of age

Exclusive breastfeeding: Proportion of an infant and young child receives only breastmilk and no other liquids or solids, not even water, except for drops or syrups consisting of vitamins, mineral supplements, or medicines

Pre lacteal feeding: Proportion of children given something other than breast milk during the first three days of life.

Continued breastfeeding at 1 year: Proportion of children 12-15 months of age who are fed breast milk.

Introduction of solid, semi-solid or soft foods: Proportion of infants 6-8 months of age who receive solid, semi-solid or soft foods in addition to breastmilk or a breastmilk substitute

Timely initiation of breastfeeding: Putting neonate on mother breast to suck within 1 hour of delivery (including 1 hour).

Ever breast feeding: Proportion of children 0-23 months of age who received breastfeeding any time since birth.

Consumption of iron-rich foods: Proportion of children 6-23 months of age who receive an iron-rich food or iron-fortified food that is specially designed for infants and young children, or that is fortified in the home.

Minimum dietary diversity:: Proportion of children 6-23 months of age who consume 4 or more food groups from 7 food groups with 24 hours of dietary recall.

Minimum meal frequency: Proportion of children age 6-23 months who receive solid, semi-solid, or soft foods the minimum number (3 times for breastfed children and 4 times for non-breastfed children with 24 hours dietary recall. (fed minimum of three meals/day and four times/day for children aged 6-8 months and 9 months and above respectively) [17].

Minimum acceptable diet: a composite indicator of minimum dietary diversity and minimum meal frequency. When a currently breastfed and non-breast fed child meets both the minimum diversity and the minimum meal frequency.

Maternal knowledge on IYCF practice was measured by using twelve questions .those respondents who score ≥ 10 was taken to 'high knowledge' 7-9 medium knowledge' and < 7 taken as 'low knowledge'.

Attitude towards IYCF practices was measured using 5 points Likert scale. There were a total of 8 questions assessing the attitude of mothers. The order of scoring for positive statements was (strongly agree = 5, agree = 4, undecided = 3, disagree = 2, strongly disagree = 1) and vice versa for negative statement.

Data processing and analysis

The data were edited, coded, and entered into Epi data version 3.1 and exported to SPSS version 21 statistical software for analysis. Further, data cleaning (editing, recording, checking for missing values, and outliers) was made after exported to SPSS. Descriptive statistics like frequency, proportions, mean and standard deviation were computed when necessary. The percentage of infants meeting the recommended IYCF practices was reported as a percentage. Besides, bivariate and multivariable logistic regression was also carried out to see associations. Crude and Adjusted Odds ratios (COR, AOR) were computed for each explanatory variable to determine the strength of association and to control the confounders [18].

RESULTS

Socio-demographic and household characteristics related variables of the child and the family

Of six hundred five (605) sampled mothers having an infant and young children age 0 to 23 months, 589 were successfully included in the study making the response rate of 97.35%. Almost 562 (95.4%) Biological mothers were involved for caregivers, while 27(4.6%) were other caregivers such as grandmothers. The mean age of the infant and young child 11.97 months \pm 6.52 (SD) .121 (20.5%) were in the age range from 0 to 5 months and 468 (79.5%) were between 6 to 23 months. Of these 280 (47.5%) were male and 309 (52.5 %) were female with male to the female sex ratio of 0.91. The mean age of mothers/caregivers was 27.1 (\pm 5.89) years and nearly half of the 244 (41.4 %) were in the age range of 25-35 years. Concerning religion, almost all 575 (97.6%) mothers were Muslim.

Maternal health care utilization and maternal support related factors for IYCF practices

Almost all, 563 (95.58%) of mothers attended antenatal care (ANC) follow up at least once during the last pregnancy. About 118 (20%) had ANC follow up greater than or equal to four times as recommended and only 26 (4.4%) had not followed ANC at all for their last birth. About 400 (81.5%) of mothers / caregivers delivered their last child at health institution and 109 (18.5%) of mothers delivered at home. Approximately 373 (63.32%) of mothers/caregivers had received postnatal care (PNC) at least once and 216 (36.7%) had no PNC.

Behavioral factors (Maternal knowledge and attitudes)

Among the study, 431 (73.286%) had medium knowledge of IYCF practice, only 53 (9%) of mothers found to have high knowledge. The rest 105(17.8%) mothers/caregivers had low knowledge. Among the study mothers, Only 119 (20.2%) of the mothers found to have a positive attitude towards IYCF practice.

Prevalence of IYCF based on WHO recommendations in Kalu district east Amhara, Ethiopia 2019

The result of this study showed that Breastfeeding was practiced by almost all mothers. About 576 (97.8%) of the mothers reported that they had ever breastfed their children at least once before the survey and 453 (76.9 %), had initiated breastfeeding within the first one hour of birth, but the rest one-third 136 (23.1%) mothers had started breastfeeding after one hour of birth. Around 88 (14.9 %) had practiced pre-lacteal feeding in the two to three days after they were born and out of this, 44 (50%), 23 (26.1%), and 20 (22.73%) were sugar water, butter, and milk, respectively. As regards to colostrum feeding, we found that 531 (90.2 %) of all mothers had fed colostrum to their new-born babies, whereas 58 (9.8%) discarded colostrums.

The proportion of 280 (59.8%) of the mothers initiated liquids, semi-solids, and soft foods at 6-8 months of life, 263 (56.2%) received the recommended minimum meal frequency and only 83 (17.74%) of children aged 6-23 months had received four or

more of food groups as per the recommendations. The proportion of children age 6-23 months who met a minimum acceptable diet, composite of minimum dietary diversity and minimum meal frequency, was 55 (11.8%) and 413 (88.2%) didn't meet the requirement. Nearly half 223(47.6%) of the child Consumed of iron-rich foods in the last 24 hrs before the survey. whereas very smallest number 51(10.9%) of children were Consumed Vit A-rich foods as shown in Figure 1.

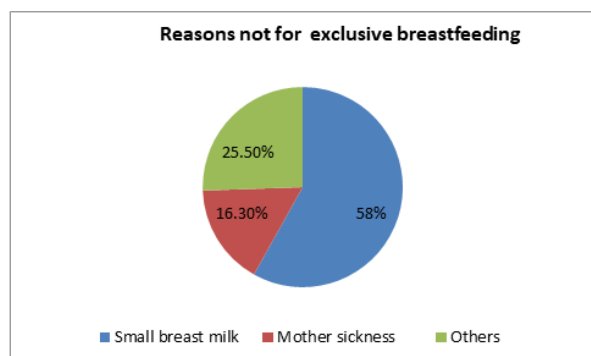


Figure 1: Reasons for not on exclusive breastfeeding in the first six months of age.

Breastfeeding practices

In the first bivariate regression model, age of the child, preceding birth, family size, maternal education, father occupation, place of delivery, and maternal knowledge was found to be the predictors of child breastfeeding practices with a P-value of 0.20. However, in a multivariable logistic regression analysis, child age, father occupation, and place of delivery were some of the predictor variables with breastfeeding practice.

Complementary feeding practices

The bivariate regression analysis showed that age of the child, place of residence, family size, Maternal age, PNC visit and practical support on IYCF practice were identified as factors associated with appropriate complementary feeding practices and exported to a multivariate logistic regression model to identify independent predictors of complementary feeding practice and control confounding factors. However, in the multivariate analysis, the mother who attended postnatal care, place of residence, family size, and age of the child were statistically associated with appropriate complementary feeding practices.

DISCUSSION

This study aimed to assess infant and young child feeding practice status and associated factors among children aged 0-23 months in Kalu district, Amhara region, Northeast Ethiopia. In this study, it was found that 32.1% of children received appropriate breastfeeding practice, and only 9.6% performed appropriate complementary feeding practice. This better rate of breastfeeding in the study is maybe because breastfeeding practice is a common, accessible, and norm in society [19-22].

Breastfeeding practices of children 0-23 months of age

A considerably high proportion of (97.8%) children were breastfed at least once in life, while, more than three-fourth (76.9%) of the mothers initiated breastfeeding within 1 h after birth, which was higher than another recent study done in Jimma Arjo district, west Ethiopia 62.6 % , Debre Berhan town, northeast Ethiopia 62.6 % and Ethiopia demographic and health survey national figure 73%. The difference might be attributed to the fact that majority 376 (91.7%) of the mothers had given birth at a health institution is dramatically increasing due to persistent promotion of the free delivery services provider in the country, which creates a good opportunity for health professionals to promote the initiation of breastfeeding within an hour after birth and better performance in the study area. Furthermore, maybe due to the time between studies in Ethiopia.

Although Global strategy on infant and young child feeding recommends that newborns should feed of colostrum and discourages pre-lacteal feeding. Our study finding revealed that 531 (90.2%) mothers gave colostrum to their infants, This finding was found to be high as compared to other findings from Raya Kobo district, North-eastern Ethiopia (86.5%), Debre Markos, Northwest Ethiopia 62.7% and much higher than Karachi, Pakistan, 48.8%. This result may be justified that in the study area mothers fed colostrum as they considered that it encourages disease protection 211 (39.7%), nutritive value 126 (23.7%), and culturally beneficial 194 (36.5%). Furthermore, might be due to increasing of community awareness, increasing potential and accessibility of health coverage

Complementary feeding practices of children 6-23 months of age

In the current study, the overall complementary feeding practices as indicated by timely introduction, dietary diversity, meal frequency, minimally acceptable diet, and consumption of iron-rich foods were 9.6% in Kalu district. which is comparable to other study conducted in northern Ethiopia 10.75%, Damot sore district, Southern Ethiopia 11.4% and Ghana 13.8%. But, this study higher than with other studies in Bahir Dar City, Tanzania, Sri Lanka and Zambia [35, 52, 58, 59]. On the other hand, it is much lower than study finding in Enemay district, Northwest Ethiopia (40.5%) and Lasta District, Amhara Region, Northeast Ethiopia 56.5%, The reasons for the variations might be due to differences of socio-economic, demographical, health-seeking behavior and utilization of maternal health care services. Another possible reason might be health extension workers were usually concerned only on timely initiation of complementary feeding than dietary diversity and frequency of meal. This indicates the generally low level of appropriate complementary feeding practices in many countries including Ethiopia [23].

Our study finding revealed that about 59.8% of children 6-8 months received solid, semisolid, and soft foods at 6-8 months of the child's age, as recommended. This result is in line with national EDHS report in 2016 (60%) and the previous study was done from Mekele 62.8%, it was also slightly higher than the study done in Harare 54%, but this finding is lower than the study conducted in Southern Ethiopia (74.2%) and Abiy Adi

town, Tigray, Northern Ethiopia (80%). The possible explanation of this discrepancy could be attributed to variation in the measurement of initiation of complementary feeding, in which the latter studies assessed initiation of complementary food at 6-8 months of age of the child while it was at a sixth month for the former study. Thus, the use of a reference period 6-8 months might overestimate the prevalence. Furthermore, the difference might be due to socio-cultural differences or lack of knowledge about the initiation of complementary feeding [24].

CONCLUSION

The findings of this study have indicated that there is a gap between appropriate infant and young child feeding practices and national recommendation. Both the breastfeeding and complementary feeding practices were inappropriate (sub-optimal) in general in Kalu district. The current appropriate breastfeeding practice was 32.1% and the performance of complementary feeding practice was 9.6%. Complementary feeding practices, in particular dietary diversity, and consumption of iron-rich and animal-source foods should receive greater focus in the study area. Mothers' postnatal checkup, place of delivery, father occupation, household family size, and urban residence were significantly associated with appropriate infant and young child feeding practice. As a result, increasing the coverage of postnatal care utilization, health institution delivery service is crucial to implement appropriate infant and young child feeding practices. Health facilities need to be strengthened and fully utilized to provide high-quality feeding counseling. Standardizing the basic health care elements and postnatal care package are also critical in addition to increasing service utilization. Furthermore, special attention needs to be given to rural mothers.

Based on the current finding the following recommendations are suggested to the zonal health department, district health office, and respective health institutions

RECOMMENDATIONS

Awareness should be raised among reproductive age group women on appropriate IYCF practice and maternal healthcare services utilization. Health information dissemination should be strengthened to all expectant mothers.

Efforts should be made to enhance maternal health care services utilization

Maternal health service outlets should be used to transmit child feeding information and hence, training should be given for all health workers to focus on IYCF practice as well.

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REFERENCES

- Shelton C, White S. Anaesthesia for hip fracture repair. *BJA Educ.* 2020;20(5):142-149.
- Enneking FK, Chan V, Greger J, Hadzic A, Lang SA, Horlocker TT. Lower-Extremity Peripheral Nerve Blockade: Essentials of Our Current Understanding. *Reg Anesth Pain Med.* 2005;30(1):4-35.
- Ahamed ZA, Sreejit MS. Lumbar plexus block as an effective alternative to subarachnoid block for intertrochanteric hip fracture surgeries in the elderly. *Anesth Essays Res.* 2019;13(2):264-268.
- Taha AM, Ghoneim MA. Hip hemiarthroplasty using major lower limb nerve blocks: A preliminary report of a case series. *Saudi J Anaesth.* 2014;8(3):355-358.
- Petchara S, Paphon S, Vanlapa A, Boontikar P, Disya K. Combined lumbar-sacral plexus block in high surgical risk geriatric patients undergoing early hip fracture surgery. *Malays Orthop J.* 2015;90:28-34.
- Demissie T, Ali A, Mekonen Y, Haider J, Umata M. Magnitude and distribution of vitamin A deficiency in Ethiopia. *Food Nutr Bull.* 2010; 31: 234-241.
- Woolfe JA. Sweet potato-past and present. In: Sweet potato: An untapped food resource. Cambridge University Press, Cambridge, UK. 1992.
- Tumuhimbise AG, Orishaba J, Atukwase A, Namutebi A. Effect of Salt on the Sensory and Keeping Quality of Orange Fleshed Sweet potato Crisps, *Food Nutr. Sci. J.* 2013; 4: 454-460.
- Jalal F, Nesheim MC, Agus Z, Sanjur D, Habich JP. Serum retinol concentrations in children are affected by food sources of betacarotene, fat intake, and anthelmintic drug treatment. *American J Clin Nutr.* 1998; 68:623-629.
- Hagenimana V, Low J. Potential of orange-fleshed sweet potatoes for raising vitamin A intake in Africa. *Food and Nutrition Bulletin* 2000; 21: 414-418.
- Van Jaarsveld PJ, Marais DW, Harmse E, Nestel P, Rodriguez-Amaya DB. Retention of β -carotene in boiled, mashed orange-fleshed sweet potato. *J Food Comp Analysis.* 2006; 4: 321-329.
- Low J, Walker T, Hijmans R. The potential impact of orange-fleshed sweet potatoes on vitamin A intake in Sub-Saharan Africa. The VITAA Project, vitamin A and orange-fleshed sweet potatoes in Sub-Saharan. Paper presented at a regional workshop on food-based approaches to human nutritional deficiencies. 9-11 May 2001, Nairobi, Kenya. 2001.
- Wu X, Chengjun S, Yang L, Zeng G, Liu Z, Li Y β -carotene content in sweet potato varieties from China and the effect of preparation on β -carotene retention in the Yanshu No. 5. *Innovative Food Science and Emerging Technologies.* 2008; 9: 581-586.
- Bengtsson A, Namutebib A, Almingera ML, Svanberga U. Effects of various traditional processing methods on the all-trans- β -carotene content of orange-fleshed sweet potato *Journal of Food Composition and Analysis.* 2008; 21: 134-143.
- Rodriguez-Amaya DB, Miekko K. Harvest Plus Handbook for Carotenoid Analysis. International Food Policy Research Institute (IFPRI). 2004.
- Takahata Y, Noda T, Nagata T. Varietal differences in chemical composition of the sweet potato storage root. *Acta Horticulture.* 1993; 343: 77-80.
- Hagenimana V, Carey EE, Gichuki ST, Oyunga MA, Imungi JK. Carotenoid contents in fresh, dried and processed sweet potato products. *Ecology of Food and Nutrition* 1999; 37: 455-473.

18. . Sunette ML. Agronomic Performance, Consumer acceptability and nutrient content of new sweet potato varieties in South Africa. PhD Thesis, University of Free state, South Africa. 2010.
19. Leighton CS. Nutrient and Sensory Quality of Orange Fleshed Sweet Potatoes. MSc. Thesis, University of Pretoria, South Africa. 2007.
20. Vimala B, Nambisan B, Hariprakash B. Retention of carotenoids in orange-fleshed sweet potato during processing. *J Food Sci Technol*. 2011; 48: 520-524.
21. K'osambo LM, Carey EE, Misra AK, Wilkes J, Hagenimana V. Influence of age, farming site, and boiling on pro-vitamin A content in sweet potato storage roots. *Journal of Food Composition and Analysis*. 1998; 11: 305-321.
22. Ukom AN, Ojimelukwe PC, Okpara DA. Nutrient composition of selected sweet varieties as influenced by different levels of nitrogen fertilizer application. *Pak J Nutr*. 2009; 8: 1791-1795.
23. Bengtsson A, Namutebi A, Alminger ML, Svanberg U. Effects of various traditional processing methods on the all-trans- β -carotene content of orange-fleshed sweet potato. *J. Food Comp. and Analysis*. 2008; 21(2): 134-143.
24. Huang AS, Tanudjaja L, Lum D. Content of alpha-, beta-carotene, and dietary fiber in 18 sweet potato varieties grown in Hawaii. *J Food Comp Anal*. 1999; 12: 147-151.