Advanced Research in Gastroenterology & Hepatology
ISSN: 2472-6400

Juniper Publishers
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Research Article
Volume 5 Issue 2 – May 2017
DOI: 10.19080/ARGH.2017.05.555659

Adv Res Gastroentero Hepatol

Clinicoepidemiological Profile, Risk Factors and Outcome of Severe Acute Malnutrition Children at the Nutritional Rehabilitation Centre of a Tertiary Care Centre in Eastern India- A 4 Years Experience

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Submission: March 02, 2017; **Published:** May 03, 2017

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Abstract

Background-India is home to the greatest population of severely malnourished children in the world. This present study evaluates the clinical and epidemiological profile of children admitted with severe acute malnutrition (SAM) and assessment of the precipitating factors of SAM and evaluates the effectiveness of nutritional rehabilitation centre (NRC) in providing therapeutic care for children.

Methods: An observational prospective hospital based study in which all children under-5 years admitted in NRC over a period from January 2013-December 2016 were enrolled. Variables recorded were demographics, anthropometry, clinical presentation, laboratory tests, medical complications, outcome indicators and hospital course.

Results: Mean age of admitted children was 17.21±13.94 months and mostly belonged to lower socio-economic scale, rural areas and large families. 9.2% were less than 6 months at time of admission. Male: female ratio was 1:1.24. Most common associated infections were acute respiratory tract infections (35.87%), and diarrhoea (31.75%). Anaemia was an important co-morbidity (74.12%). Mean duration of exclusive breastfeeding was 3.1± 1.8 months and mean age of starting semi-solid complementary food was 8.5±2.5 months. Most commonly used supplementary food was over diluted cow milk (92%). Cure rate was 75.24%. Defaulter rate was 13.65% and death rate was 0.63%.

Conclusion: The problem of SAM is multidimensional and NRCs provide life-saving care for children as demonstrated by the high survival rates.

Keywords: Severe acute malnutrition; Nutritional rehabilitation centre; Cure; Follow-up

Introduction

Out of 19 million SAM child in all developing countries, 8 million (42%) are in India. National family health survey-3 (2005-2006) show that 42.5% of Indian children <5 years were underweight, 48% were stunted, 17% were wasted and 6.4% suffer from SAM and these SAM children have high mortality ranging from 20%-30% [1]. The prevalence of malnutrition varies across states like Madhya Pradesh recording the highest rate (55%) and Kerala among the lowest (27%) [2]. This is believed to be due to a combination of socio-economic and societal factors including poverty, food insecurity, gender inequality, disease and poor access to health and developmental services [2,3]. Recovery rates in inpatient facilities to treat SAM children (NRCs) varied from state to state ranging from 37.1% to 65% [4,5].

There is no published community/hospital based studies of SAM children in eastern India; hence the present study was conducted (Table 1).

Objectives

1) To evaluate the clinico-epidemiological profile, complications, and comorbidities of SAM children.

2) To identify the socio-demographic risk factors of SAM and

3) To evaluate the outcome of hospitalized SAM children.

Methods and Materials

i. Study type: Observational

ii. Study design: Observation model – cohort, Time perspective-prospective.

iii. Study centre: NRC at Dr B.C. Roy Post Graduate Institute of Pediatric Sciences, Kolkata (a tertiary care and referral centre).

iv. Study duration: January 2013-December 2016

Informed consent was obtained from the parents of all the children. Institutional ethical committee approval was taken (BCH/ME/PR/147).

Inclusion criteria

For 6 months -5 years age group: presence of any of the following

a) Weight for length/height<-3 standard deviation (SD) [World Health Organisation (WHO) median height].

b) Bilateral pedal edema.

c) Grossly visible severe wasting.

d) Mid upper arm circumference<11.5cm.

For 1-6 months age group- presence of any of the following

a) For infants >45cm length, weight for height <-3SD with or without bipedal edema.

b) For infants <45cm length, visible severe wasting was used to define SAM.

c) Presence of edema both feet.

At enrolment into the study, anthropometric parameters, socio-demographic variables, feeding practices [duration of breast feeding, age of initiation of complementary feeding, adequacy of complementary feeding as per Integrated Management of Neonatal and Childhood Illnesses (IMNCI) guidelines], clinical profile, and laboratory investigations of the study subjects were recorded in a structured proforma by a paediatrician. Body weight was recorded using electronic weighing machine with accuracy of±10 grams. Height/length was measured by a stadiometer/infantometer with accuracy of ±1cm. Mid upper arm circumference (MUAC) was measured midway between olecranon process and acromian process with measuring tape with an accuracy of±1 mm. Weight for height/length Z score was assessed using WHO charts. The measuring equipments were periodically calibrated. Investigations like complete hemogram, urine and stool examination, urine and blood cultures, renal and liver function tests, chest skiagram, abdominal ultrasound, enzyme linked immunosorbant assay for human immunodeficiency virus (HIV) screen, gastric aspirate for tubercular mycobacteria detection by cartridge based nucleic acid amplification test (CBNAAT), and tuberculin skin test were done as and when required. Socio-economic status was classified according to modified Kuppuswamy scale.

Mothers were specifically kept at the centres so that they could be integrated into the effective care of the children, were taught the preparation of the therapeutic diets from locally available material and counselling sessions focusing on the general health education measures were undertaken to prevent malnutrition. Rs 100/day reimbursement was paid to the mothers during their stay at the centers.

Exclusion criteria- children with non-nutritional causes of SAM

Statistical analysis: Data was entered in Microsoft excel sheet and SPSS software version 16 for windows was used for analysis. Chi square test and Fischer's exact test were used for nominal data.

Results and Analysis (Table 2)

Table 2: Characteristics of SAM children over the 4 years period.

Year	Total patient	Male	Female	<6month	6-12 months	12-24 months	24-36 months	36-48 months	48-60 months
2013	170	78	92	16	52	62	22	13	5
2014	156	75	81	15	49	56	21	11	4
2015	134	52	82	12	42	48	18	10	3
2016	170	76	94	15	52	62	24	12	6
Total	630	281	349	58	195	228	85	46	18

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The male and female ratio was 281:349 (1:1.24). The mean ages of SAM patients were 17.21±13.94 months (sample standard variance- 194.56 and population standard variance-193.78.) (Table 3).

Table 3: Social and dietary factors attributing to SAM.

Literacy status of parents	Number	%
Maternal illiteracy	145	23.01
Mother studied up to primary and middle school	262	41.58
Mother studied up to high school and intermediate	218	34.6
Mother graduated, postgraduate professionals	5	0.79
Paternal illiteracy	119	19
Father studied up to primary and middle school	315	50
Father studied up to high school and intermediate	189	30
Father graduated, postgraduate professionals	7	1.11
Socioeconomic status as per modified Kuppuswamy scale		
Upper (I)	0	0
Upper middle (II)	12	1.90
Lower middle (III)	20	3.18
Upper lower (IV)	230	36.50
Lower (V)	368	58.41
Awareness of malnutrition		
Yes	158	25
No	472	75
Sanitation facilities		
Present	504	80
Absent	126	20
Immunisation status		
Unimmunised	40	4.35
Partly immunised	540	85.71
Fully immunised	50	7.94
Familial status		
More than 3 children	322	51.11
Joint families	63	10
Residence		
Urban	158	25
Rural	472	75
Feeding practices		
Prelacteal feeds	201	32
Colostrum given	400	39
Exclusive breast feeding upto 6 months	63	10
Mixed feeds	567	90
Bottle feeds	289	45.82
Children initiated on semisolid/solid complementary feeds at admission	512	81.27
Adequacy of complementary feeds	189	30

Mean per capita income was Rs 980±600. Exclusive breastfeeding was carried out up to 1month in 554(87.94%), up to 2 months in 469(74.50%) children, up to 3 months in 302(47.93%), up to 4 months in 167(26.48%) children, and up to 5 months in 75(12.05%) children. Mean duration of exclusive breast-feeding was 3.1±1.8 months. Thereafter, they were started on mixed feeds. Most commonly used supplementary food among mixed feed infants <6 months was over-diluted cow's milk in 445(70.63%) and rest 122(19.36%) used over diluted commercially available formulas. The most common semi-solid complementary feed used was khichdi (rice-pulses gruel) in 144(22.86%) children, barley gruel in 134(21.27%) children, semolina porridge in 108(17.14%) children and mashed biscuits in 126(20%) children. 60(9.52%) children >6 months had not been introduced semi-solid complementary feeds at time of admission and were being given only diluted cow's milk at time of admission. Out of these 60 children, 36 were between 6-7 months, 14 were between 7-8 months and rest 10 was between 8-9 months of age. The mean age of starting semi-solid complementary food was 8.5±2.5 months. According to IMNCI guidelines, adequate complementary feeds mean semi-solid/solid/soft food-one 'katori' serving 3 times/day if breastfed and 5 times/day if not breastfed among 6-12 months children, and one and half 'katori' serving 5 times/day among >12 months children, which was present in only 30% children in our study (Table 4).

Table 4: Clinical characteristics and complications in SAM children.

Characteristics	Number	%
Oedema	34	5.4
Anemia (MCHC<33)	467	74.12
Skin changes	190	30.16
Hair changes	220	34.92
Signs of vitamin B deficiency	262	41.59
Signs of vitamin C deficiency	4	0.63
Signs of vitamin A deficiency	205	32.54
Hypothermia	128	20.31
Hypoglycaemia (capillary blood glucose<54 mg%)	19	3.02
Mental changes	65	10.31
Hyponatremia	80	12.70
Hypokalemia	75	11.90
AGE(acute gastroenteritis)	200	31.75
Shock	5	0.79
ARI(acute respiratiry infections)	226	35.87
UTI (urinary tract infection)	15	2.38
Tuberculosis (TB)	4	0.63
Developmental delay	150	23.81
Septicaemia	8	1.26
Skin infections and infestations(scabies)	50	7.94
Otitis media	5	0.79

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HIV infection	2	0.31
Malaria	2	0.31
Measles	4	0.63

MCHC- mean corpuscular haemoglobin concentration

Among 34 patients with oedema, 7 were children <6 months of age. Among anaemic patients, 30(4.76%) had haemoglobin<4gm% and hence were given packed erythrocyte transfusion. Mean haemoglobin level was 8.45±5.34 gm%. Skin changes included flaky-paint dermatoses, desquamation, ulceration, which were mainly seen in the buttocks, perineum and upper thighs. Signs of vitamin B deficiency involved smooth tongue, cheilosis, and angular stomatitis. Hair changes included depigmentation, lustreless sparse hair. Mental changes included apathy, irritability, and unhappiness. Among 5 children with shock, 3 presented with septic shock and 2 had hypovolemic shock due to profuse watery diarrhea. Developmental milestones were assessed by Denver Developmental Screening Test. Among 4 patients with TB, 1 had tubercular peritonitis and 1 had progressive primary TB and 2 had primary complexes on chest skiagram. All had negative Mantoux test (due to depressed cell mediated immunity), but had positive CBNAAT in gastric aspirate. Skin infections included bacterial infections (folliculitis, boils, pyoderma) fungal infections (tinea, candidiasis) (Table 5).

Table 5: Enumerating the diagnostic criteria used to diagnose SAM children.

Age	MUAC<11.5cm	Wt/ht<-3SD	Both	Edema	Visible severe wasting
>6 month	54 (9.44%)	185 (32.34%)	304 (53.15%)	29 (5.07%)	15 (25.86%)
<6 month		36 (62.07%)		7 (12.07%)	

Significant increase in mean MUAC occurred during NRC stay, 10.98±2.45 cm at admission versus 11.87±1.01 cm at discharge (one sided t value=8.3294, p<0.001). Significant increase in mean weight also occurred, 6.36±4.25kg at admission versus 7.25±4.87kg at discharge (one sided t value=3.3033, p<0.001). Mean weight gain was 0.89±0.62 kg. Mean duration of hospital stay was 20±0.35 days. Average weight gain was 6.99gms/kg/day.

Table 6: Showing the outcome of SAM children.

Year	Total	Cured (%)	Non-responder (%)	Death (%)	Defaulter (%)
2013	170	115 (68.52)	27 (15.88)	2 (0.31)	26 (15.29)
2014	156	124 (79.50)	12 (7.69)	1 (0.64)	19 (12.17)
2015	134	104 (77.62)	11 (8.21)	1 (0.74)	18 (13.43)
2016	170	131 (77.07)	16 (9.41)	0	23 (13.52)
Total	630	474 (75.24)	66 (10.47)	4 (0.63)	86 (13.65)

Recovery or cure indicates the number of beneficiaries that have reached discharge criteria. Defaulters indicate a SAM child admitted to the ward but absent from the ward for 3 consecutive days, without being discharged. Non-responders indicate those be neficiaries who fail to respond to the treatment (patient remains for a long period of time below the target weight) (Table 7) [6].

Table 7: Showing the follow-up details of SAM children.

Year	Patients called for follow-up	1st follow-up	Drop out (%)	2nd follow-up	Drop out (%)	3rd follow-up	Drop out (%)	4th follow-up	Drop out (%)
2013	142	93	34.51	91	35.91	81	42.96	72	49.29
2014	136	95	30.15	82	39.71	76	44.12	63	53.67
2015	115	76	33.91	75	34.78	72	37.39	71	38.26
2016	149	112	46.31	80	46.31	75	49.66	58	61.07
Average drop out (%)			35.47		39.18		43.53		50.56

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Hence it is seen that the drop-out rate increases progressively from first to fourth visit. This dropout rate at each follow-up visit was found to be statistically significant ($\chi 2=61.106$, $p<0.001$).

Discussion

SAM is a preventable and treatable cause of childhood mortality and morbidity. In our study, the mean age of admitted patients was 17.21±13.94 months. Maximum number of children (228 (36.19%)) were within 12-24 months of age. 481(76.35%) patients were <24 months of age. Similarly, in the studies by Choudhary [7] & Mamidi [8], majority of patients (96% and 71% respectively) were below 24 months. In the first 2 years of life, rapid growth occurs and requirement of substrates for energy and building of tissues also increases, thus deficiency of energy, protein and micronutrients often result in malnutrition. In our study, females were more than males (55.4% vs 44.6%) with a ratio of 1.24:1. Higher number of female patients was also found by Joshi [9] (78% vs 22%). Singh [10] and Rao [11] also reported that extent of malnutrition was significantly higher in girls $p<0.05$ and $p<0.01$ respectively. All these 3 studies were community based studies. Choudhary [7], Ashraf [12], Tariq [13], Goyal [2], Devi [14] & Aneja [15] described higher incidence of malnutrition in males (74.6%, 53.7%, 54.8, 84.3%, 57.7%, 55.5% respectively) in their hospital based studies. They postulated that due to ritual and social norms, parents give more importance and seek medical advice more often for male child. However, our study, despite being a hospital based one, showed higher number of female patients.

In our study, maternal and paternal illiteracy rates were 23.01% and 19%.41. 58% of mothers studied upto primary school and middle school, 34.6% studied upto high school and intermediate and only 0.79% studied upto graduation and beyond. The percentages for fathers being 50%, 30%, 1.11% respectively. Higher illiteracy rates were described by Chowdhury [7] (89.3%mothers and 66.2% fathers) and Goyal [2] (60.6% mothers and 39.4% fathers). This was due to regional variation of literacy rates. Joshi [9] and Mittal [16] described education beyond high school level among 31% and 21.2% of mothers of SAM children, which was similar to our study.

We observed that in the enrolled patients, 98.1% patients belonged to lower socio-economic strata (Kuppuswamy scale III, IV, V). Chowdhury [7], Tariq [13], Goyal [2] and Devi [14] reported 96%, 83.6%, 76%, 89.8% patients belonging to lower socio-economic strata. This indicates that poor purchasing power, unavailability of food, improper distributions make the children vulnerable to malnutrition in a deprived community. Sanitation facility was not available in 20% cases. Devi [14] reported that only 7.9% of SAM children in his study had sanitation facility.

In 10% cases, the families were joint and in 51.11% cases the birth order of the affected child was more than 3. Prevalence of SAM was 52% in the family have 3 or more children in the study by Chowdhury [7]. Sharma [17] also reported the prevalence of malnutrition to be significantly higher in families having more than 3 children due to lower per capita income and poor childcare practices. 6.35% of children were unimmunized and 85.71% were partially immunized in our study. The percentages were 42.7% versus 44% and 24% versus 62.3% in studies by Chowdhury [7] and Tariq [13]. Thus, failure of complete immunization is associated with SAM. However, Aprameya [18] & Kumar [19] reported 84.6% and 42.3% SAM children were completely immunised in their studies. In our study, 75% children belonged to rural areas. The NFHS 3 and 4 surveys also shows higher incidence of malnutrition in rural areas (Table 1). According to a UNICEF (United Nations Children's Fund) data, globally, over one-third of children in rural households are malnourished [20].

Table 1: Shows the recently published NFHS-4 (2014-2015) data [5] on childhood malnutrition in our state of West Bengal and compares it with NFHS-3 data.

Characteristics	Urban (NFHS-4)	Rural (NFHS-4)	Total (NFHS-4)	Total (NFHS-3)
Children under 5 years who are stunted (height-for-age) (%)	28.5	34.0	32.5	44.6
Children under 5 years who are wasted (weight-for-height) (%)	16.7	21.6	20.3	16.9
Children under 5 years who are severely wasted (weight-for-height) (%)	6.0	6.7	6.5	4.5
Children under 5 years who are underweight (weight-for-age) (%)	26.2	33.6	31.5	38.7

Exclusive breastfeeding upto 6 months was done in 10% cases and 90% were mixed fed. 45.82% mother practised bottle-feeding and 32% children received pre-lacteal feeds. The percentages were 32%, 35%, 39.7%, 25% in the study by Devi [14]. In the study by Tariq [13], 41% were exclusively breast-fed, 32% were predominantly breastfed and 26.2% were mixed fed. Aprameya [18] reported exclusive breastfeeding in 20.9% and bottle feeding in 58.2% cases. In our study, 81.27% children had been initiated on complementary feeds when admitted, compared to 63.5% in the study by Chowdhury [7]. In our study, 9.52% patients beyond 6 months had not been initiated on complementary feeds, compared to 8% patients in the study

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by Devi [14]. Over diluted cow's milk was the most common top milk supplementation in our study whereas Chowdhury [7] reported it to be goat's milk. The most common complementary food was khichdi in our study, chapati (hand-made whole wheat flour bread) and rabadi (condensed milk with dried fruits) with rice being reported by Chowdhury [7] & Rasamia [21]. Aneja [15] also reported khichdi to be the most common complementary food. Adequacy of complementary feeds was found in 30% children in our study, compared to 53.97% in the study by Devi [14]. The mean age of starting semi-solid complementary food was 8.5±2.5 months in our study and 11.6±3.53 months in the study by Chowdhury [7] and 7.04±2.31 in the study by Devi [14]. Bottle fed babies are more prone to infections due to poor hygienic condition of both bottle and nipple, and high incidence of bottle feeding have been reported by Aneja (28.3%) [15], Chowdhury (17.3%) [7] and Rasamia (65.8%) [21] (Table 8).

Table 8: Comparing the complications and comorbidities among various studies.

Characteristics	Index study (%)	Chowdhury [7] (%)	Kumar [19] (%)	Tariq [13] (%)	Devi [14] (%)
Anemia	74.12	85.3	88.3		69.2
Vit B deficiency	41.59	40	14.4		
Vit A deficiency	32.54	28	5.8		
Vit C deficiency	0.63	1.3	1.9		
Hypoglycaemia	3.02	21.3		6.8	
AGE	31.75	50	33.6	30.1	14
LRTI	35.87	52	27.9	26.3	63
TB	0.63	9.3	22.1	4	
HIV	0.31	4	2.9		2.6
Otitis media	0.79	2.7			
Measles	0.63	4	3.8	3.8	
Malaria	0.31		3.8		0
UTI	2.38	4	1	2.7	1.3
Edema	5.4	14.7	27		
Skin infection	7.94		18.2	16.38	
Hypothermia	20.31			11	11.5
Hypokalemia	11.9			9.58	6.4

LRTI (lower respiratory tract infection) was the most common associated infection followed by AGE (acute gastroenteritis) in our study. Chowdhury [7], Tariq [13], Kumar [19] also described similar findings. Most common vitamin deficiency was vitamin B – as also described by Chowdhury [7].

In our study, only 9.44% SAM children>6 months age had MUAC<11.5cm. Devi [14] reported sensitivity, specificity, positive predictive value (PPV) and negative predictive value of 44.9%, 94.74%, 84.62% and 72.73% of 11.5 cm MUAC as a diagnostic criteria for SAM. Dasgupta [22] also reported low sensitivity (17.5%) and PPV (30.5%) of MUAC cut-off value of 11.5cm. However, Finnish [23] and Bangladeshi [24] studies found MUAC<11.5cm to be a single useful criterion for identifying malnutrition. The mean MUAC in our study was 10.35±2.45cm and 11.32±1.18cm in the study by Taneja [25]. The mean weight gain was 6.99gms/kg/day compared to 9.25±5.89 gram/kg/day in the study by Taneja [25] and 5.5gms/kg/day in the study by Tariq [13] and 2.7±1.9gms/kg/day in the study by Aguayo [26] (Table 9).

Table 9: Comparing the outcome at NRC with other studies.

Characteristics	Index study (%)	Tariq [13] (%)	Taneja [25] (%)	Aguayo [26] (%)	Kapil [27]	Acceptable rates as per Indian ministry of health recommendation (%) [6]
Cure	75.24	76	53.76	65	46.8	>75
Defaulter	13.65	1.36	7	32	47.2	<15
Death	0.63			0.40	1.2	<5
Length of stay (days)	20±3.5		13.81±2.73	75.8±9.4	13.2±5.6	1-4 weeks

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The average drop-out rates for 1st, 2nd, 3rd, 4th follow-up visits at 15days, 1month, 3 months and 6 months in our study were 35.47%, 39.18%, 43.53%, 50.56%. The drop-out rates described by Taneja [25] were 9.89%, 23.07%, 42.65% and 61.76% for the 4 follow-up visits. The low compliance during follow-up visits limits the overall success rate of the programme. Creating a network of outreach workers from the NRCs or selecting volunteers from different localities who can monitor the follow-up dates of the discharged children would help in decreasing the number of drop-outs.

In our NRC, the cure, defaulter and death rates, acceptable weight gain were all within the acceptable rates as per Indian Health Ministry recommendations. Thus, NRCs provide life-saving care for children with SAM as demonstrated by the high survival rate. However other studies show variable recovery rates at the NRCs and was as low as 37% and high defaulter rates [4,10,25,27]. Hence, NRCs cannot be the only tool to combat malnutrition; linking of NRCs with the community based core model of management of SAM children (as revised by WHO) needs to be done. In this model, most SAM children are treated at home with inpatient care being reserved for those with acute complications, thereby minimizing the cost to families and maximizing access to treatment. The first study on conventional community based management of acute malnutrition programme in India was published by Burza [28] from the state of Bihar. There 57.4% children were discharged as cure, 36.2% defaulted, 1.1% died and mean weight gain was 5.1±3.7gms/kg/day.

The Government of India is currently strengthening the Integrated child development (ICDS) scheme, working on national guidelines on community-based management of severe acute malnutrition in India (CMAM), and allowing controlled use of ready-to-use therapeutic food (RUTF) in a number of states, so that in the years to come, more SAM children can be managed at home. However, in a vast country like India where there is deficiency of community health workers, it would be difficult to monitor the domiciliary care, especially in remote areas- hence it is vital to continue with the functioning of NRCs. India's biggest challenges now are to resource and manage this transition at scale within its health system. India has long way to go and as more studies like this present one is published, it would be more interesting and informative to know about the further developments.

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How to cite this article: Das S, Paul DK, Bhattacharya M, Basu S, Chatterjee A, Sen S and Bhakta S. Clinicoepidemiological Profile, Risk Factors and Outcome of Severe Acute Malnutrition Children at the Nutritional Rehabilitation Centre of a Tertiary Care Centre in Eastern India- A 4 Years Experience. Adv Res Gastroentero Hepatol 2017; 5(2): 555659. DOI: 10.19080/ARGH.2017.05.555659

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