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Differential effects of out-of-home day care in improving child nutrition and augmenting maternal income among those with and without childcare support: A prospective before–after comparison study in Pokhara, Nepal

Shinji Nakahara
Krishna Poudel
Milan Lopchan
Om Raj Poudel
Kalpana Poudel-Tandukar, *University of Massachusetts - Amherst*, et al.

Differential effects of out-of-home day care in improving child nutrition and augmenting maternal income among those with and without childcare support: A prospective before–after comparison study in Pokhara, Nepal

Shinji Nakahara, Krishna C. Poudel, Milan Lopchan, Om Raj Poudel, Kalpana Poudel-Tandukar, Masao Ichikawa

A B S T R A C T

Objectives: We examined (1) whether attending out-of-home day care centres (DCCs) has differential effects on improvement of child nutrition and facilitation of maternal employment depending on availability of non-institutionalised childcare support and (2) whether attendance increases infectious diseases.
Methods: In a prospective before–after comparison study at public DCCs in Pokhara, Nepal, we compared weight-for-age *Z*-score (WAZ) and height-for-age *Z*-score (HAZ) among children attending DCCs between at admission, after 6 months, and after 1 year and determined differential changes in these measures between those with and without appropriate childcare support. We used repeated measures analysis of variance with interaction terms between support availability and DCC attendance. We compared maternal income and incidence of diarrhoea and fever in children between the periods of waiting and attending.
Results: After 6 months, neither WAZ nor HAZ significantly changed. After 1 year, WAZ significantly improved, but HAZ did not change among all participants. Those without appropriate childcare support showed greater improvement in both WAZ and HAZ than those with support. While children were attending, income increased only among those mothers who were already working without any childcare support at baseline. Neither diarrhoea nor fever increased.
Conclusions: DCCs can be more beneficial for child nutrition and working mothers in households lacking childcare support than in those with support.

Keywords:
Child nutrition, Maternal employment, Childcare, Support

1. Introduction

Child malnutrition in the world, despite its declining trend, is still a major health problem, especially in low-income countries. The global prevalence of underweight and stunting among children under 5 years of age has been declining. However, the declining trends are uneven, and Sub-Saharan African and South Asian countries have not shown notable declines in child malnutrition [1–3]. These areas suffer from a higher prevalence of child malnutrition than the other areas [4]. In Nepal, one of the least developed countries in these areas, the prevalence of underweight and stunting among children under age 5 in 2006 were 39% and 49%, respectively [5].

Appropriate child growth requires quality care as well as sufficient food and health services [6,7]. A child's mother, on whom the childcare role often exclusively falls, cannot provide quality care without additional childcare support from family or community members because she also has many household chores, resulting in time conflicts between childcare and other tasks [8,9]. The conflict would worsen when mothers have to work away from home. In developing countries, mothers sometimes work away from home leaving their young children with preteen siblings, or at times, leave them unattended when childcare support is unavailable, contributing to the malnutrition of their children [10–15]. Appropriate childcare support from adults can prevent child malnutrition by compensating for reduced maternal input to childcare [11,14,16,17]. Research in South American urban cities [18,19] and in the Philippines [20] shows such support also has a positive impact on maternal employment.

Given the reality that poor mothers have no alternative but to work away from home, to achieve maximum child development it is important to examine the kind of support necessary for children and working mothers instead of investigating the impact of maternal factors, including working status [21]. Out-of-home day care centres (DCCs) for children are one form of support, with the potential to improve child development and to facilitate maternal employment, particularly when non-institutionalised childcare support is unavailable.

A few previous studies that have investigated the impact of DCCs on child physical development in developed and developing countries report inconsistent results. Studies in North America have not shown any favourable effects of DCC attendance or supplementary feeding in DCCs on child anthropometric measurements, though supplementary feeding has been shown to improve dietary intake [22,23]. Longitudinal studies in Thailand and Colombia showed no difference in nutritional status between DCC attendees and non-attendees [24,25]. A cross-sectional study in Brazil reported better nutritional status among children attending municipal DCCs than non-attendees [26]. A cross-sectional study in Nepal found favourable effects among attendees of a private DCC, but no effects among those of a municipal DCC [27]. Studies examining maternal outcomes in developed countries have indicated that DCCs tend to increase maternal employment and income [10,28–32].

These previous studies did not differentiate participants who received childcare support from those who did not. We hypothesise that those without such support have higher needs for institutionalised childcare support and would receive more substantial benefit from DCCs than that those with support. If this is the case, analyses without consideration of childcare support availability may not identify the benefit, depending on the magnitude of the differential effects and proportion of those with and without childcare support. Another possible explanation for inconsistent study results is increased risk of infectious diseases among children attending a DCC [23,33–35], deteriorating child nutrition [36,37]. Furthermore, evidence from developed countries is not applicable to developing countries because of largely different circumstances in developed countries (e.g. rarity of underweight, stunting, and childcare by preteen siblings).

We conducted a prospective before–after comparison study to evaluate the impact of DCC attendance on child physical development and maternal employment, focusing on differential effects between those with and without appropriate childcare support. Specifically, this study addressed the following research questions: (1) Do children without appropriate childcare support benefit more from attending a DCC than those with support? (2) Does child attendance at a DCC increase maternal employment or income when no childcare support is available? (3) Does DCC attendance increase incidence of infectious diseases such as diarrhoea and fever?

2. Methods

2.1. Study settings and participants

Pokhara, with a population of 160,000, is located 200 km west of Kathmandu. Pokhara runs 17 DCCs with the aid of the United Nations Children's Fund. In each DCC during the study period, two female staff members (a senior staff member and an assistant) cared for 25 pre-school age children from 10 AM to 4 PM and provided the children with a light meal at noon. The senior staff had basic training in childcare and education. Their median (interquartile range) age was 27 (26–30) at baseline, and most of them had 10 years of formal education. Because the DCCs target both childcare and education, admission was not restricted to children of working mothers, and children's age at admission ranged from about 2 years (infants were not admitted) to 5 years (before primary school enrolment). Each centre had a management committee consisting of people from the community and staff members. These committees maintained a waiting list of children selected from needy households and determined the admission order based on the level of need. Details are described elsewhere [14].

We conducted a prospective before–after comparison study in the DCCs run by the city from November 2003 to February 2006. Of the 17 centres, two were excluded. One centre moved to another community, and the other centre's catchment population migrated immediately after we started the study. In each centre, 15 children were recruited from the waiting list in order of increasing age. If the list contained <15 children, all were invited. Centre staff explained the objectives and procedures of the study to mothers and requested their voluntary participation. Written informed consent was obtained. Illiterate mothers were requested to seal the consent sheet with their thumbprint, a commonly used signature substitute in Nepal. In total, 218 children were invited. Three were not present for baseline measurements, and 18 dropped out of the study within the first 2 months. The staff recruited nine new children to replace the immediate drop-outs by February 2004. Thus, 206 children were enrolled in the study at baseline. In one centre, we defined August 2005 as the end of follow up because conflict in the community stopped the measurements. Both the Pokhara municipal government and the Institutional Ethical Review Board of the University of Tokyo approved this study.

2.2. Data collection

We measured child weight and height every month at each DCC during the periods when the children were waiting to enter a DCC and when they were in attendance at a DCC. Before the study started, DCC staff members were given 2-day training in the standard procedures of anthropometric measurement [38]. The children were weighed unclothed to the nearest 100 g using a Salter spring scale (Model 235 6s, Salter, England) and their heights were measured to the nearest 1 mm using locally constructed measuring boards. We measured children under the age of 24 months in a supine position and children aged 24 months or older in an upright position.

The mothers were invited to the monthly anthropometric measurements. DCC staff asked them about their child's experience of diarrhoea (watery stool three times or more per day) and fever (mother felt child's body was hotter than usual) in the preceding 1 week. Staff also asked about mothers' paid working hours per day, number of working days per week, and cash income in the preceding 1 week. To minimize recall biases, we used a 1-week recall period.

At baseline, the DCC staff visited households of the participants and interviewed the mothers using a pretested structured questionnaire. When mothers were not at home, the staff revisited them later. The collected information included socio-demographic characteristics, total household weekly income, father's occupation, mother's occupation, availability of a substitute caregiver when the mother was working, and if available, age of the caregiver.

2.3. Measures

We assessed child nutrition using weight-for-age *Z*-score (WAZ) and height-for-age *Z*-score (HAZ) converted from the raw anthropometric measurements and child age based on the National Centre of Health Statistics (NCHS) reference data (1978 NCHS/CDC/WHO Growth Reference) using Epi Info 2002 software. We did not use WHO standards released after the study was completed because the DCC staff used the NCHS reference to evaluate child nutrition throughout the study. Further, differences in WAZ and HAZ between the WHO standards and NCHS reference vary by age during infancy, but thereafter the differences are consistent and slight [39]. Therefore, differences in the standards did not affect our analyses examining changes of *Z*-scores rather than identifying malnutrition among children older than 12 months.

We categorized caregivers into adult, peer, or none available. Peer caregivers were defined as those younger than age 15. We defined having appropriate childcare support as availability of an adult substitute caregiver at home at baseline. Having no appropriate support was defined as availability of peer caregivers or none, based on our previous analyses indicating that peer caregivers were associated with poor child nutrition [14]. When we analysed the impact on maternal income and working hours, we defined having childcare support as the availability of any substitute caregiver whether adult or child, because in developing countries, women commonly work away from home leaving small children in the care of preteen siblings. We assumed, in the study area, DCCs do not have additional effects on maternal employment when peer caregivers are available.

2.4. Sample size

The primary outcome was changes in WAZ and HAZ between before and after admission to a DCC. Our pilot study suggested an improvement of 0.13 in WAZ and a 0.4 standard deviation of the changes could be expected in 6 months. With a statistical power of 80% at $\alpha = 0.05$, we estimated a necessary sample size of 150. Given the mobility of the population in the study area, possibly resulting in high drop-outs, we aimed to recruit 225 children, increasing the estimated sample size by 50%.

2.5. Statistical analyses

2.5.1. Socio-demographic characteristics

Descriptive statistics at baseline were calculated and presented as frequency (%) and median with interquartile ranges (IQRs), indicating 25th and 75th percentile values. Socio-demographic characteristics were compared between participants with and without appropriate childcare support. The χ^2 test and Mann–Whitney test were used for categorical and continuous data, respectively.

2.5.2. Child nutrition

To assess nutritional change during DCC attendance, we compared children's WAZ and HAZ using repeated measures analysis of variance with three time-points during DCC attendance (at admission, after 6 months, and after 1 year) as a within-subject factor and availability of appropriate childcare support as a between-subject factor. To focus on differential changes between those with and without appropriate childcare support, an interaction term between DCC attendance and support availability was included. Characteristics significantly different between those with and without appropriate childcare support (child's age at admission, maternal age, and maternal education level, which were potential confounding factors) were also included in the analyses as between-subject factors, with interaction terms between attendance and these factors. These factors were not treated as covariates in the form of continuous variables but were dichotomized because linear relations with the dependent variables could not be assumed. Number of siblings, birth order, and family composition, which also significantly differed between those with and without childcare support, were not included because they are obviously direct determinants of availability of a substitute caregiver (childcare support). To determine if child age influenced the interaction effects between DCC attendance and support availability, we included a three-way interaction term between DCC attendance, support availability, and child age. We also conducted subgroup analyses among those without childcare support to see if child age influenced the benefit of DCC attendance.

First, among 151 children who attended DCCs for 6 months or longer, we compared their nutritional status at admission into a DCC with their nutritional status after 6 months of attendance. Second, we made a comparison between the nutritional status at admission, the nutritional status after 6 months, and the nutritional status after 1 year among 120 children who attended DCCs for 1 year or longer.

For significant main effects among three time-points, post hoc pair-wise comparisons with Bonferroni adjustment were made. Mean values of WAZ and HAZ with 95% confidence intervals were indicated by each between-subject factor at each time point.

2.5.3. Income and working hours

For each mother, we calculated the average weekly income and working hours for the periods of waiting and attending, respectively, after excluding weeks with missing data or weeks in which there was a clear indication that a mother took maternity leave. Among those who had attended for 6 months or longer, excluding one child whose mother was a student ($n = 150$), a within-subject comparison was made between the periods of waiting and attending using the Wilcoxon signed rank test after stratifying the participants by availability of childcare support. We used stratification to see the differential effects of DCC attendance on income and working hours instead of analysis of variance with interaction terms because of skewed distributions of income and working hours. Participants were stratified into two groups: those with access to any childcare support whether by adult or child, and those with no support. Results were presented as median (IRQ) for each group.

2.5.4. Diarrhoea and fever

We compared incidence rates of diarrhoea and fever among the attendees between the period of waiting to be admitted to a DCC and while attending a DCC. The denominators of incidence rates were person-weeks examined at the monthly interviews. When symptoms were reported in a week preceding the interview, it was defined as a case. We calculated incidence rate ratios (RR) with 95% confidence intervals (CI) [40].

3. Results

3.1. Participants

Of the 206 children enrolled, 45 dropped out (of them, 37 migrated, five went to school, one died, one left the study, and the reason for the loss of one child at follow up was unknown) (Fig. 1). Of the 45 drop-outs, 13 attended for 6 months or longer. Of the 161 followed up until the end, 138 attended for 6 months or longer. In total, 151 children attended the 15 DCCs for a period of 6 months or longer, and 120 attended for 1 year or longer.

Children of those without childcare support were older at baseline and older at admission, though the difference

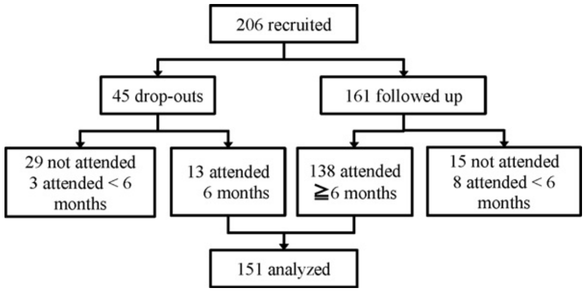

Fig. 1. Participants of the study.

was not large (Table 1). Children of participants without childcare support were more likely to be the third or later child and have more siblings. Mothers without childcare support were older, less educated, and more likely to live in a nuclear family. The other socio-demographic characteristics were not different between the two groups. Children of those without childcare support were more likely to be underweight and stunted. Vaccination status and incidence of diarrhoea and fever in the previous week did not differ between the groups.

3.2. Child nutrition

Among those in attendance for 6 months or longer, WAZ or HAZ did not significantly change after 6 months. The mean differences (CI) of WAZ and HAZ were −0.03 (−0.10, 0.04) and 0.10 (−0.01, 0.20), respectively (Table 2). Interaction effects between attendance and availability of appropriate childcare support in either WAZ or HAZ did not reach statistical significance. However, interaction effects between attendance and child age at admission in both WAZ and HAZ were significant. Three-way interaction effects between attendance, child's age at admission, and availability of childcare support did not reach statistical significance in either WAZ or HAZ.

Among those in attendance for 1 year or longer, WAZ at admission, after 6 months, and after 1 year differed significantly (Table 3). A post hoc test showed that WAZ after 1 year was significantly higher than WAZ at admission and after 6 months. Mean differences (CI) were 0.12 (0.01, 0.24) and 0.18 (0.08, 0.29), respectively (Table 3). HAZ at admission, after 6 months, and after 1 year did not differ significantly. Mean difference (CI) between HAZ after 1 year and at admission was 0.08 (−0.10, 0.27).

Interaction effects between attendance and availability of childcare support, and those between attendance and child age at admission reached statistical significance in both WAZ and HAZ. Only when childcare support was unavailable, both WAZ and HAZ improved during DCC attendance (Fig. 2). Older children (25 months or older) improved WAZ during DCC attendance while younger children did not. In contrast, older children did not improve HAZ while younger children did. The interaction effects between attendance and child age at admission after 6 months attendance among the 151 children showed the same pattern (not shown).

Table 1
Participants' characteristics and children's health status.[a]

	Availability of appropriate childcare support				χ^2 or U[b]	P
	Available		Unavailable			
	n	%	n	%		
Socio-demographic characteristics						
Child sex						
Male	23	40.4	41	43.6		
Female	34	59.6	53	56.4	0.16	0.69
Child age at baseline (months), median (IQR)	22	(19–26)	25	(20–29)	2004	0.01
Child age at admission (months), median (IQR)	28	(24–31)	29.5	(26–35)	2013	0.01
Birth order						
1	27	47.4	29	30.9	12.54	0.002
2	22	38.6	26	27.7		
3+	8	14.0	39	41.5		
Number of children						
1	25	43.9	24	25.5	13.78	0.001
2	24	42.1	30	31.9		
3+	8	14.0	40	42.6		
Total household income (NRs)[c], median (IQR)	900	(620–1375)	925	(600–1300)	2551	0.75
Ethnicity						
Indo-aryan	38	66.7	69	73.4	2.36	0.31
Tibeto-Burmese	16	28.1	17	18.1		
Others	3	5.3	8	8.5		
Mother's age at baseline (years), median (IQR)	23	(21–26)	26	(23–39)	1882	0.002
Mother's working status						
Working	26	45.6	42	44.7	0.01	0.91
Non-working[d]	31	54.4	52	55.3		
Mother's education						
No education	12	21.1	32	34.0	8.67	0.03
1–3 years	11	19.3	29	30.9		
4–6 years	15	26.3	15	16.0		
7+ years	19	33.3	18	19.1		
Husband's occupation						
Formal	13	23.6	12	13.6	2.35	0.13
Informal[e]	42	76.4	76	86.4		
Husband's education						
No education	5	9.1	20	22.7	5.64	0.13
1–3 years	6	10.9	9	10.2		
4–6 years	14	25.5	25	28.4		
7+ years	30	54.5	34	38.6		
Family composition						
Extended family	26	45.6	14	14.9	17.2	<0.001
Nuclear family	31	54.4	80	85.1		
Children's health status						
Weight-for-age *Z*-score						
>−2 (normal)	45	78.9	56	59.6	6.01	0.01
≤−2 (underweight)	12	21.1	38	40.4		
Height-for-age *Z*-score						
>−2 (normal)	36	63.2	42	44.7	4.85	0.03
≤−2 (stunting)	21	36.8	52	55.3		
Vaccination						
All completed	53	93.0	86	91.5	0.11	0.74
Not completed	4	7.0	8	8.5		
Diarrhoea in the previous week						
Yes	6	10.5	14	14.9	0.59	0.44
No	51	89.5	80	85.1		
Fever in the previous week						
Yes	18	31.6	23	24.5	0.91	0.34
No	39	68.4	71	75.5		

[a] Data at baseline are indicated unless otherwise stated.
[b] χ^2 test was used for categorical variables and Mann–Whitney test was used for continuous variables.
[c] Nepali Rupees: USD 1 was equivalent to NRs 75 at baseline. One child was excluded because his father was abroad and his weekly income was unknown.
[d] A student is categorized as non-working.
[e] Working outside Pokhara and non-working are included.

Table 2
Effects of DCC attendance after 6 months.

	WAZ Mean (95% CI) Admission	WAZ Mean (95% CI) 6 months	F	P	HAZ Mean (95% CI) Admission	HAZ Mean (95% CI) 6 months	F	P
Main effects								
Attendance	−1.41 (−1.58, −1.24)	−1.44 (−1.61, −1.28)	0.84	0.360	−1.58 (−1.79, −1.37)	−1.48 (−1.69, −1.27)	3.30	0.072
Interaction effects								
Attendance × childcare support								
Available	−1.27 (−1.53, −1.01)	−1.36 (−1.61, −1.11)	2.09	0.151	−1.40 (−1.73, −1.08)	−1.42 (−1.74, −1.10)	3.82	0.053
Not available	−1.55 (−1.79, −1.31)	−1.53 (−1.76, −1.30)			−1.75 (−2.05, −1.45)	−1.55 (−1.84, −1.25)		
Attendance × child age at admission								
Up to 24 months	−1.19 (−1.48, −0.90)	−1.29 (−1.57, −1.02)	4.06	0.046	−1.45 (−1.81, −1.09)	−1.24 (−1.59, −0.88)	4.59	0.034
25+ months	−1.63 (−1.81, −1.45)	−1.59 (−1.76, −1.42)			−1.71 (−1.94, −1.48)	−1.73 (−1.95, −1.51)		
Attendance × mother's age								
Up to 25 years	−1.47 (−1.69, −1.25)	−1.53 (−1.75, −1.32)	0.94	0.333	−1.70 (−1.98, −1.43)	−1.59 (−1.86, −1.32)	0.18	0.675
26+ years	−1.35 (−1.59, −1.11)	−1.35 (−1.58, −1.12)			−1.46 (−1.76, −1.16)	−1.38 (−1.67, −1.08)		
Attendance × mother's education								
0–3 years	−1.27 (−1.49, −1.05)	−1.32 (−1.53, −1.11)	0.33	0.569	−1.46 (−1.74, −1.19)	−1.33 (−1.60, −1.06)	0.55	0.459
4+ years	−1.55 (−1.80, −1.30)	−1.56 (−1.80, −1.33)			−1.69 (−2.00, −1.39)	−1.63 (−1.93, −1.33)		
Attendance × child age × support availability								
Up to 24 months								
Available	−0.99 (−1.41, −0.57)	−1.18 (−1.58, −0.78)	0.71	0.402	−1.28 (−1.80, −0.76)	−1.23 (−1.74, −0.72)	0.72	0.398
Not available	−1.39 (−1.82, −0.96)	−1.41 (−1.82, −1.00)			−1.61 (−2.14, −1.08)	−1.25 (−1.77, −0.73)		
25+ months								
Available	−1.55 (−1.85, −1.25)	−1.54 (−1.82, −1.25)			−1.53 (−1.90, −1.16)	−1.61 (−1.97, −1.24)		
Not available	−1.71 (−1.92, −1.50)	−1.64 (−1.84, −1.44)			−1.89 (−2.15, −1.63)	−1.85 (−2.10, −1.59)		

WAZ, weight-for-age *Z*-score; HAZ, height-for-age *Z*-score; *F*, *F* statistic.

The three-way interaction effects between attendance, child age at admission, and availability of childcare support did not show statistical significance in either WAZ or HAZ (Table 3). In both age groups, those without childcare support showed improving tendencies after 1 year in both WAZ and HAZ. A subgroup analyses of those without childcare support indicated HAZ improvement was significantly smaller in the older group than in the younger group (interaction term between attendance and age: $F = 3.29$, $p = 0.043$), whereas WAZ changes did not differ by age ($F = 0.77$, $p = 0.49$).

3.3. Diarrhoea and fever

The diarrhoea incidence rate was 0.117 per person-week while children attended a DCC (263 cases in 2241 person-weeks) and 0.165 while children were waiting to attend a DCC (140 in 847 person-weeks). The attending period showed a lower risk of diarrhoea than the waiting period; RR was 0.71 (CI: 0.58, 0.87). The fever incidence rate during the attending period was 0.235 (526 cases); during the waiting period it was 0.247 (209 cases). There was no significant difference. RR was 0.95 (CI: 0.81, 1.12).

3.4. Income and working hours

Among mothers without any childcare support, weekly income significantly increased from the waiting period to the attendance period (Table 4). Although their median weekly income decreased, 75th percentile (upper limit of IQR) income increased. Total amount earned per week increased (mean of weekly income increased from 145 to 183, not shown), whereas income distribution became more skewed. Of these mothers, those who had no income during the waiting period ($n = 20$) also had no income during the attendance period. Those with paid work during the waiting period ($n = 35$) increased their median (IQR) income from 210 (73–352) to 252 (95–500) (not shown). Their working hours showed a similar pattern but did not reach statistical significance. Among those with access to any childcare support, whether adult or child, neither income nor working hours changed.

4. Discussion

Those children without appropriate childcare support showed an improvement in their nutritional status dur-

Table 3
Effects of DCC attendance after one year.

	WAZ					HAZ				
	Mean (95% CI)					Mean (95% CI)				
	Admission	6 months	1 year	*F*	*P*	Admission	6 months	1 year	*F*	*P*
Main effects										
Attendance	−1.45	−1.51	−1.32	8.77	<0.001	−1.67	−1.59	−1.59	1.13	0.325
	(−1.63, −1.26)	(−1.68, −1.34)	(−1.50, −1.14)			(−1.90, −1.45)	(−1.81, −1.37)	(−1.82, −1.36)		
Interaction effects										
Attendance × childcare support										
Available	−1.21	−1.35	−1.24	4.38	0.015	−1.42	−1.47	−1.56	3.80	0.025
	(−1.50, −0.93)	(−1.61, −1.09)	(−1.52, −0.97)			(−1.77, −1.08)	(−1.81, −1.13)	(−1.92, −1.21)		
Not available	−1.68	−1.66	−1.40			−1.92	−1.71	−1.61		
	(−1.94, −1.42)	(−1.91, −1.42)	(−1.66, −1.15)			(−2.24, −1.61)	(−2.02, −1.40)	(−1.94, −1.28)		
Attendance × childage at admission										
Up to 24 months	−1.22	−1.38	−1.23	4.75	0.010	−1.54	−1.31	−1.39		
	(−1.53, −0.92)	(−1.66, −1.10)	(−1.53, −0.94)			(−1.91, −1.17)	(−1.68, −0.95)	(−1.77, −1.00)	4.62	0.012
25+ months	−1.67	−1.64	−1.41			−1.80	−1.86	−1.79		
	(−1.88, −1.46)	(−1.83, −1.44)	(−1.61, −1.21)			(−2.05, −1.55)	(−2.11, −1.62)	(-2.05, −1.53)		
Attendance × mother's age										
Upto25 years	−1.57	−1.64	−1.51	1.21	0.302	−1.81	−1.74	−1.82	1.62	0.202
	(−1.82, −1.33)	(−1.86, −1.41)	(−1.75, −1.28)			(−2.10, −1.51)	(−2.03, −1.45)	(−2.13, −1.51)		
26+ years	−1.32	−1.38	−1.13			−1.54	−1.44	−1.35		
	(−1.58, −1.05)	(−1.63, −1.13)	(−1.39, −0.87)			(−1.86, −1.21)	(−1.75, −1.12)	(−1.69, −1.02)		
Attendance × mother's education										
0–3 years	−1.21	−1.27	−1.18	2.50	0.086	−1.45	−1.35	−1.33	0.12	0.885
	(−1.45, −0.97)	(−1.50, −1.05)	(−1.41, −0.94)			(−1.75, −1.16)	(−1.64, −1.07)	(−1.64, −1.03)		
4+ years	−1.68	−1.74	−1.47			−1.89	−1.82	−1.84		
	(−1.96, −1.41)	(−2.00, −1.49)	(−1.73, −1.20)			(−2.22, −1.56)	(−2.15, −1.50)	(−2.19, −1.50)		
Attendance × child age × support availability										
Upto24 months										
Available	−0.88	−1.14	−1.12	1.13	0.327	−1.27	−1.23	−1.43	0.67	0.514
	(−1.33, −0.44)	(−1.55, −0.73)	(−1.55, −0.69)			(−1.81, −0.74)	(−1.75, −0.70)	(−1.99, −0.87)		
Not available	−1.56	−1.62	−1.35			−1.81	−1.40	−1.34		
	(−2.02, −1.10)	(−2.04, −1.20)	(−1.79, −0.91)			(−2.36, −1.26)	(−1.94, −0.86)	(−1.91, −0.77)		
25+ months										
Available	−1.54	−1.56	−1.36			−1.57	−1.71	−1.70		
	(−1.88, −1.20)	(−1.88, −1.25)	(−1.69, −1.03)			(−1.98, −1.16)	(−2.11, −1.31)	(−2.13, −1.27)		
Not available	−1.80	−1.71	−1.46			−2.03	−2.01	−1.89		
	(−2.04, −1.56)	(−1.93, −1.49)	(−1.69, −1.23)			(−2.32, −1.75)	(−2.30, −1.73)	(−2.18, −1.59)		

WAZ, weight-for-age *Z*-score; HAZ, height-for-age *Z*-score; *F*, *F* statistic.

ing the period spent in attendance at a DCC while those with such support did not. This finding suggests that DCCs can improve child development among children who are most in need of support by compensating for the lack of appropriate care. As a whole, the effect of DCCs on child nutrition among all participants was not clear, because of non-improving trends of nutritional status among those with childcare support.

Table 4
Income and working hours during waiting and attending periods ($n = 150$).[a].

	Income (NRs[b])				Working hours (h)			
	Median	IQR	Z[c]	*P*-Value	Median	IQR	Z[c]	*P*-Value
No childcare support ($n = 55$)								
Waiting	67	0–240			6	0–27		
In attendance	57	0–350	−2.42	0.02	4	0–36	−1.62	0.11
Childcare support available ($n = 95$)[d]								
Waiting	150	0–400			11.7	0–35		
In attendance	141	0–400	−0.58	0.56	12	0–36	−0.19	0.85

IQR, interquartile range.
[a] One mother who was a student was excluded.
[b] Nepali Rupees: USD 1 was equivalent to NRs 75 at baseline.
[c] Wilcoxon signed rank test was used.
[d] Peer childcare was categorized as support available.

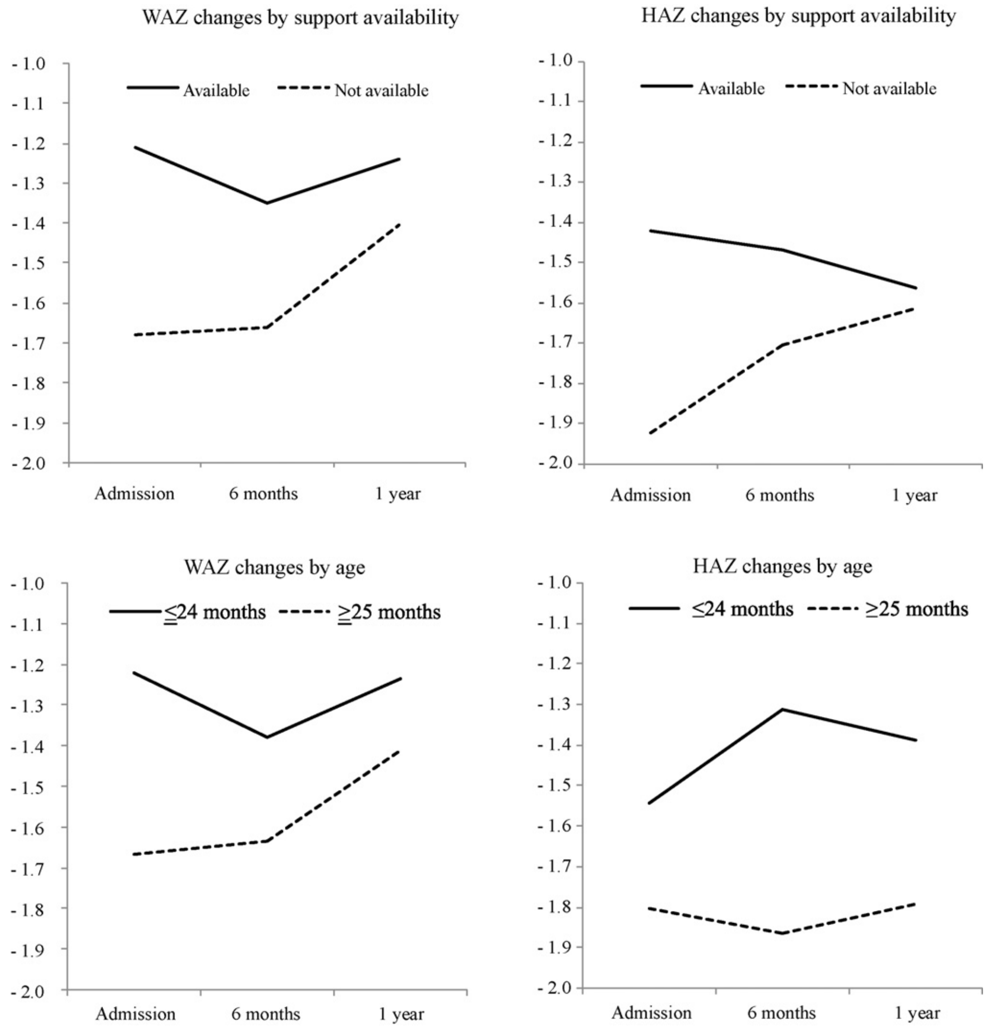

Fig. 2. Weight-for-age *Z*-scores and height-for-age *Z*-scores before and during attendance according to the availability of appropriate substitute caregivers and child age at admission among children who attended a DCC for 1 year or longer.

Among those who have appropriate childcare support, day care quality may not be better than substitute care at home. Quality of supplementary food in some DCCs, though the government office prepared a standardized menu, might have been lower than expected because of changes made due to insufficient budgets (e.g. giving noodles instead of cereals with vegetables and beans). This is just our speculation because we do not have information on their actual menus. However, we frequently observed noodles in the kitchen in some centres. Carbohydrate-rich but protein- and micronutrient-poor food might have contributed to marginal weight gain but not to height gain. Height gain needs bone lengthening in which micronutrients in addition to protein and energy play an important part [41]. Among children without appropriate childcare at home, even such food may be better than what they would have received from inappropriate caregivers.

Alternatively, non-mother substitute caregivers at home might have led to a deterioration in the quality of care in the period of DCC attendance. That is, if children received good care at a DCC, substitute caregivers might have perceived they could work less on childcare at home, possibly cancelling out the favourable effects of day care. Although further investigations are necessary to conclude decisively, it is possible that poor care practices, such as lessening the amount or frequency of feeding during the attendance period, happens more frequently among non-maternal caregivers. Non-maternal care has been associated with poor child nutrition [15,42].

DCC attendance effects also differed by age group. During DCC attendance, WAZ of older children improved while that of younger children did not. In contrast, HAZ of older children did not improve while that of younger children improved. In addition, among those without childcare support, HAZ improvement during DCC attendance was smaller in the older age group. The benefit in WAZ showed similar improvements between age groups. This may reflect the fact that weight can show short-term change without height change, whereas linear growth indicates longer-term cumulative nutrition [43]. Older age children might have experienced longer periods with poor nutrition before admission. In Nepal, prevalence of stunting and underweight sharply increase during the first two years of life [5,44,45]. Therefore, DCC attendance may bring about more benefit to children without access to appropriate childcare support when admitted at an earlier age.

Diarrhoea occurrence was lower during the attendance period than waiting period, a possible benefit of attendance for those who had no appropriate support. Infectious diseases, including diarrhoea, can be deleterious to child nutrition [36,37]. Most previous studies, however, have shown a higher risk of infections in day care settings [23,33–35], though a randomised-controlled-trial in the UK found no such evidence [30]. The hygienic conditions of the DCCs in Pokhara may be better than those seen in the participants' houses.

Having a child in attendance at a DCC only had a favourable effect on income for working mothers who had to care for children by themselves. No effect was seen among those with support, whether by adult or child. This may be because leaving young children with older siblings, even of preteen-age, while working is a commonly seen and probably acceptable practice. In contrast, children's attendance at DCCs did not increase the number of employed mothers from the waiting period, contrary to previous studies in developed countries [28,30,32]. This may be because of inflexible, short day care hours which do not allow sufficient support for a mother employed full-time [46]. It may also have been because the follow up period in the present study was too short to detect mothers' engagement in new employment.

Therefore, out-of-home day care has the potential to improve a child's life course by improving child health and increasing maternal income for those most disadvantaged whose mothers work away from home without childcare support. Because disadvantaged children tend to have a less opportunities in their later lives [47], it is important to improve children's life circumstances at an early stage. Generating women's income is one such intervention. We should consider providing childcare support for women if they do not have substitute caregivers at home rather than discussing whether maternal work is good or bad for children.

Limitations of this study should be noted. We compared growth indices between the periods of waiting and attending for individual children. However, because this was not an experimental study, we cannot exclude the possibility of confounding in the measurements. Changes in nutritional status might have resulted from educational effects of growth monitoring or changes in economics due to political instabilities during the study period. Such possibilities, however, should not distort the finding of a favourable effect on needy children because we were able to compare needy children with non-needy children during similar periods.

In addition, we did not obtain parents' anthropometric measurements despite the genetic influence on children's weight and height. However, this does not minimize the conclusions. We examined changes in nutritional status within each individual rather than examining absolute weight and height or their *Z*-scores which may require consideration of genetic influences. Genetic differences in growth pattern among younger children are smaller than differences due to health-related, nutritional, and socio-economic variations [43]. Affluent children aged 5 years or younger from different ethnic and cultural backgrounds show similar linear growth pattern [48].

In conclusion, our findings suggest that DCCs in a developing country have a favourable effect on needy children without access to appropriate childcare support and mothers who have no childcare support. In planning DCCs, we should give priority to households where there is a lack of any type of childcare support. In addition, children without access to appropriate childcare support should be admitted to a DCC at earlier age to fully benefit from the intervention.

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