- **Group 4 (37 weeks gestational age)**

The results are summarized in Table 5.14. The mean scores for the different oral structures, the p-value for the difference between bottle and cup-feeding and the level of significance are presented in Table 5.15.

This group performed slightly poorer with bottle-feeding than Group 3, which was a week younger. With cup-feeding they performed slightly worse in the numerical 2 scores (moderate/disorganised), but better in the numerical 3 scores (severe/ dysfunctional), resulting in an improvement of the total score.

Table 5.14 Problems experienced by Group 4 during the oral/oral preparatory phase

	Group 4 (37 weeks) N=10			
Score	**2**		**3**	
Feeding Method	Bottle	*Cup*	Bottle	*Cup*
LIPS/Pursing	1	*1*	0	*1*
Closure	0	*3*	0	*0*
Maintain	1	*4*	0	*4*
Loss of Liquid	1	*5*	0	*1*
Movement/Arrhythmic	3	*4*	0	*1*
" / Uncoordinated	3	*3*	0	*1*
JAW/Depression	1	*6*	0	*0*
" / Movement / Arrhythmic	3	*4*	0	*1*
" / " / Minimal / absent	3	*7*	0	*0*
" / " / Lack rate change	0	*5*	1	*1*
TONGUE / movement / protrusion	2	*2*	0	*1*
" / " / Elevated / retracted	3	*2*	0	*0*
" / " / Arrhythmic / weak	2	*4*	1	*2*
Sucking bursts	9	*7*	1	*2*
Flow rate	5	*7*	0	*0*
Bolus formation	1	*2*	0	*0*
SWALLOWING/uncoordinated/absent	1	*1*	0	*0*
" / Delayed /absent	0	*1*	0	*0*
" / Multiple / no	3	*2*	0	*0*
TOTAL	42	*70*	3	*15*
2+3	45	*85*		

The results are discussed according to the information and structure of Table 5.14.

LIPS

Bottle: Arrhythmic and uncoordinated movements of the lips were demonstrated in 30% of the subjects, which is slightly worse than Group 3 (see Table 5.14).

Cup: The main problem during cup-feeding was moderate liquid loss in 50% of the cases and an additional 10% exhibited extensive liquid loss. They also had trouble in maintaining the closure for more than 2 minutes (40% of subjects) and for less than 2 minutes (40% of the subjects), which accounts for the extent of liquid loss. Between 30 and 40% of them demonstrated arrhythmic and uncoordinated lip movements (see Table 5.14)

Lip functioning in this age group is **significantly** better during bottle-feeding than during cup-feeding (Table 5.15 – p-value 0.0156; 5% level of significance)

Table 5.15 The comparison between bottle- and cup-feeding in Group 4

	Group 4 (37 weeks) N=9					
	Bottle		*Cup*		Bottle – cup	
	Mean	SD	*Mean*	*SD*	p-Value	Level of significance
Lips	6.9	0.99	*1*	*3.162*	0.0156	5%
Jaw	4.9	1.595	*6.89*	*20.88*	0.025	5%
Tongue	9.5	1.434	*10.67*	*2.345*	0.125	None
Swallowing	4.5	0.972	*4.67*	*0.866*	0.312	None

JAW

Bottle: Minimal excursion and arrhythmic movements of the jaw each occurred in 30% of the cases (see Table 5.14).

Cup: 60% of the subjects had difficulty to initiate depression of the jaw. Minimal excursion was demonstrated in 70% of the cases and arrhythmic movements in 40% of the subjects. Half of them did not change sucking rate between NNS and NS (see Table 5.14).

The difference in jaw functioning between bottle- and cup-feeding was statistically **significant** (5%) in favour of bottle-feeding (see Table 5.15).

TONGUE

Bottle: Few problems were experienced with anterior-posterior rhythmic movements (20%), but sucking bursts were problematic in 90% of the subjects, two-thirds displayed short and one-third prolonged sucking bursts. Group 3 demonstrated bursts that were more prolonged. It seems that regression to short bursts had taken place. If the fact is taken into account that this is the group with the highest number of small for gestational age infants (90% of the subjects), it correlates with the findings of Mullen et al. (1988) that SGA infants display more feeding problems than their AGA peers. The flow rate was expectedly poor as a result of the short sucking bursts (see Table 5.14).

Cup: Arrhythmic movements occurred in 40% of the subjects. Sucking bursts during cup-feeding were short (70% of cases) or absent (20% of cases), resulting in a poor flow rate (see Table 5.14).

Although arrhythmic movement of the tongue occurred in more subjects during cup-feeding, the sucking bursts during both feeding methods were too short. The difference in the mean score between cup- and bottle-feeding was not statistically significant (see Table 5.15). This implies that the manner in which the tongue shapes around the nipple is facilitative of strong, rhythmic movement, but that the length of the sucking burst is not affected by the feeding method in this subject group.

SWALLOWING

Bottle: Multiple swallows occurred in 30% of the cases (see Table 5.14).

Cup: Relatively few problems were experienced with swallowing - only 20% of the subjects demonstrated multiple swallows (see Table 5.14).

No statistically significant difference between the two feeding methods was found for swallowing (see Table 5.15).

In summary, the oral feeding skills of Group 4 can be described as follows:

The **lips** could purse to initiate bottle- and cup-feeding, close around the nipple and maintain this closure to provide a seal to prevent liquid loss. During cup-feeding, however, the closure and maintenance thereof were more problematic and moderate liquid loss still occurred in half of the subjects. Lip movements still tended to be arrhythmic and uncoordinated in approximately a third of the subjects for both feeding methods. The lip functioning during cup-feeding for this group is better than for Group 3 in the sense that fewer numerical scores of 3 (severely dysfunctional) were awarded to this group for lip functioning.

Jaw depression for bottle-feeding was consistent, but was difficult to initiate in cup-feeding. Arrhythmic movements occurred in approximately a third of subjects for both feeding methods, but twice as many of the subjects demonstrated minimal excursions of the jaw with cup-feeding than with bottle-feeding. The rate of movement was similar to the rate in NNS in half of the cases during cup-feeding, but during bottle-feeding the rate of movement was 1 per second.

All subjects displayed central grooving of the **tongue**. In all of the subjects, the movement of the tongue was symmetrical, but 20% of them demonstrated mild protrusion of the tongue during the anterior-posterior movements. This protrusion did not, however, interfere with function. Another 20-30% demonstrated elevation of the tongue tip, but no retraction of the tongue tip was observed. Arrhythmic movements in the tongue were a problem in 20% of the cases during bottle-feeding and 40% of the cases during cup-feeding. Rhythm seems to be affected

in all of the oral structures involved in this phase. This fact correlates with the literature, which states that arrhythmic movements are problematic in premature infants (Morris & Klein, 1987; Bosma, 1993), although only a few infants in this group displayed it. A more serious problem throughout all groups, is the occurrence of short sucking bursts with associated poor flow rates. This applies to cup- as well as bottle-feeding. Only 10% of the subjects demonstrated appropriate sucking bursts with appropriate pauses during both feeding methods. During bottle-feeding, two-thirds of the subjects demonstrated short bursts and one-third, prolonged bursts. One subject showed no sucking bursts at all. During cup-feeding, 70% displayed short bursts and 2 subjects displayed no bursts at all. It is interesting to note that there seemed to be a shift towards prolonged bursts in Group 3, as it appeared that their oral motor skills improved with maturation but coordination with breathing still needed refinement. Group 4 regressed to short bursts and generally scored poorer than Group 3 in all of the items in this section. A possible explanation may be that this group is the group with the greatest number of SGA infants (90%) and has the highest incidence of abnormal body tone (40%). Mullen et al. (1988) found that SGA full-term infants had more oral feeding problems than AGA full-term infants. The findings in this study correlate with that. This has the implication that weight does play a roll in oral feeding skills (especially sucking bursts) and not only neuro-maturational factors, as stated in the literature (Brake et al., 1988; Creger, 1995; Vergara, 1993). It was speculated earlier that this group may not be representative of 37-weeks gestational age infants in general and oral feeding skills of this group should not be generalized to other AGA 37-week-old infants in the light of the above-mentioned facts.

There was, however, an improvement in swallowing, namely, that the swallows that were performed were more timely and more coordinated than in the previous age group. Multiple swallows also decreased during cup-feeding (Tables 5.12 & 5.14). Swallowing as such may therefore be more associated with neuro-maturity than weight.

. 2 Pharyngeal Phase

The information for this phase was obtained by observation and performing cervical auscultation. The data was recorded under the subheadings: Pharyngeal Phase on page 7 and Cervical Auscultation on page 8 of the FEFARI for bottle-feeding. Data for cup-feeding were recorded under the same headings but on pages 10 and 11, respectively.

The results are summarized in Table 5.16 and visually presented in Figure 5.10.

Table 5.16 Subjects with deviant behaviour during the pharyngeal phase

	Group 1		Group 2		Group 3		Group 4		TOTAL			
	Bottle	Cup	Bottle	Cup	Bottle	Cup	Bottle	Cup	Bottle		*Cup*	
	N=10	*N=10*	N=10	*N=11*	N=11	*N=9*	N=10	*N=9*	N=41		*N=39*	
Voice Quality	2	*4*	3	*2*	2	*3*	5	*4*	12	29.30%	*13*	*33.30%*
Suck-Swallow-Breathing	7	*9*	6	*10*	1	*5*	8	*8*	22	53.70%	*32*	*82.10%*
Naso-pharyngeal reflux	0	*0*	0	*1*	0	*0*	0	*0*	0	0	*1*	*2.60%*

The most problematic aspect of the pharyngeal phase was the coordination of sucking, swallowing and breathing. Discussion of the results according to Table 5.16 follows.

- **Group 1 (34 weeks gestational age)**

Bottle: The suck-swallow-breathing (SSB) sequence was associated with stress in 70% of the subjects and gurgly sounds (voice quality) in the pharynx could be detected by cervical auscultation in 20% of the subjects, which correlates with the 20% who displayed delayed swallows (see Table 5.8). This implies that swallowing is not very efficient in a small percentage of the subjects and may explain why half of them used multiple swallows to clear the pharynx (see Table 5.8).

Cup: 90% of the subjects experienced stress with the SSB sequence and gurgly sounds could be detected in 40% of them (see Table 5.16). This correlates with the slow bolus formation which occurred in 40% and/or delayed swallowing which occurred in 30% of the subjects. Swallowing was also ineffective during cup-feeding, as 50% also used multiple swallowing to clear the pharynx. This may explain why so many subjects experienced stress during swallowing. They constantly might have feared that their respiratory system was in danger. The reason why the swallowing at this age is ineffective, uncoordinated and disorganised may be due to their neuro-behavioural immaturity (Brake et al., 1988; Morris & Klein, 1987; Wolf & Glass, 1991).

According to Figure 5.10, more subjects experienced problems with voice quality and the SSB sequence during cup-feeding than during bottle-feeding, although the difference according to the p-value (0.375) of the overall score for the pharyngeal phase is statistically not significant. Aspects will have to be considered in isolation to determine which method of feeding is favoured for that particular group in order to plan appropriate intervention, as the total scores do not provide such information.

- Group 2 (35 weeks gestational age)

Bottle: The SSB sequence was associated with stress in 60% of the subjects and gurgly sounds were recorded in 30% of the subjects (see Table 5.16), which also correlates with the occurrence of delayed swallows in this group. The stress associated was slightly reduced in comparison to the previous age group and accordingly also the number of multiple swallows (see Tables 5.8 and 5.9).

Cup: From Table 5.16 it is clear that the stress caused by the SSB sequence was observed in 90% of the subjects and the voice quality was marked by gurgly sounds in only 18% of the subjects. The low percentage of gurgly sounds correlates with the low number of subjects (2) who displayed delayed swallows.

The high percentage of related stress (90%) correlates with the high percentage of multiple swallows (70%) that occurred during cup-feeding in this age group. Multiple swallows may be an attempt to clear the pharynx from an incomplete swallow due to neuro-behavioural immaturity. On the other hand, they may feel threatened by a bolus that may possibly be too large and may use multiple swallows to clear away the "danger" and become stressed by the situation. Only one subject demonstrated naso-pharyngeal reflux. Although Plaxico & Loughlin (1981) indicated this as a cause for apnea which needs consideration during feeding management, this study did not find a high incidence of naso-pharyngeal reflux and this was therefore not regarded as a major risk for these infants.

The number of subjects displaying problems with voice quality, the suck-swallow-breathing sequence and naso-pharyngeal reflux during the pharyngeal phase is visually presented in Figure 5.10.

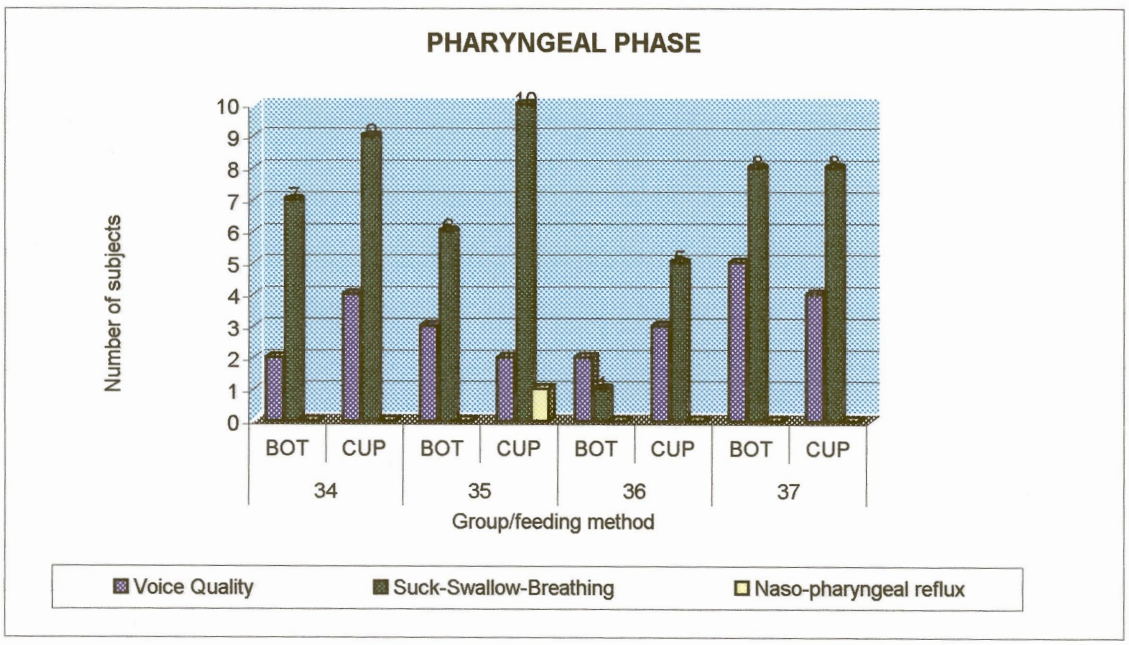

Figure 5.10 Subjects who displayed deviant behaviour during bottle- and cup-feeding in the pharyngeal phase.

According to Figure 5.10, a relative big difference between SSB for bottle- and cup-feeding can be seen in favour of bottle-feeding for age groups 34, 35 and 36 weeks gestational age. Although there was a visible difference for SSB during both feeding methods for Group 2 (35 weeks gestational age), the difference in the total score for performances in the pharyngeal phase was statistically not significant (p-value 0.37), so each aspect will have to be looked at in isolation to determine which feeding method caused the least problems, in order to plan appropriate intervention.

- **Group 3 (36 weeks gestational age)**

Bottle: Stress was associated with the SSB sequence in only 1 out of the 11 subjects and the voice quality marked with gurgly sounds, in 20% of the subjects, which correlates with the 20% who displayed delayed swallowing. This group generally displayed good performances during the pharyngeal phase, which correlates with the fact that this was the group with the lowest incidence of nasogastric feeding (54%).In the light of the fact that so few problems were experienced in the oral as well as the pharyngeal phases, it could be expected that more subjects in this group should receive oral feedings. The number of subjects who received tube feedings could manage less than half of their feeds according to the feeding history. During the evaluation for this study, 5 of the 11 subjects experienced fatigue after approximately 5 minutes of bottle-feeding and bottle-feeding had to be terminated. It is interesting to note that those infants who tired more easily, were the subjects with the lower weights at the time of the evaluation (1.34; 1.35; 1.55; 1.6 and 1.79 kg, respectively). The weights of the others in the group, who could manage more than half of their feed, varied from 1.6 to 1.81 kg. This implies that although they may be mature enough and have adequate oral feeding skills to feed orally, infants with lower weights do not have the endurance to complete an oral feed.

Cup: Approximately half of the subjects experienced stress with the SSB sequence during cup-feeding and gurgly sounds could be detected in 30% of the subjects. The incidence of stress associated with the SSB sequence correlated with the findings that about 60% of the subjects demonstrated uncoordinated swallowing and 40% used multiple swallowing to clear the pharynx. The presence of gurgly sounds correlated with the 30% of delayed swallows that were recorded. This group still experienced a considerable extent of problems during cup-feeding, contrary to the relative success they experienced with bottle-feeding.

The total score of cup-feeding for the whole subsection does not, however, differ statistically significantly from bottle-feeding, although the differences in two items presented in Figure 5.10 show a marked difference between bottle- and cup-feeding. The same implication as for Groups 1 and 2 applies for this group.

It can be concluded that readiness to feed orally is dependent on the neuro-maturity of an infant, but endurance to complete an oral feeding is related to his/her weight. This has implications for the management of oral feeding in premature infants, namely, that oral feeding may be introduced at the appropriate gestational age (34 weeks) in order to expose the infant to valuable experience in acquiring oral feeding skills. The length of time the infant is exposed to oral feeding will, however, be determined by his/her weight and medical history. This concept ties in with the statement of Wolf & Glass (1991) that experience interplays with maturation to improve the efficacy of oral feeding.

- **Group 4 (37 weeks gestational age)**

Bottle: 80% of the subjects experienced stress associated with SSB and the voice quality was affected with gurgly sounds in 50% of the cases. This does not correlate with the relative problem-free swallowing found in the oral preparatory/oral phase of this group (see Table 5.14). Multiple swallows were

recorded in 30% of the cases, which may tie in with the occurrence of gurgly sounds. The high incidence of stress may be related to the regression to short sucking bursts in this group. It may be argued that they were uncomfortable with oral feeding due to lack of experience and/or strength, became stressed with the confrontation of a bolus and in an attempt to manage the flow rate and coordinate SSB, reverted to short sucking bursts, as they were more mature to make such adaptations. Brake et al. (1988) stated that oral feeding may improve with experience, as cognitive skills mature. Comrie & Helm (1997) stated that short sucking bursts may be indicative of swallowing dysfunction. This study does not confirm that view in this age group, as their swallowing skills were relatively good (good coordination and timely), although they were executed with associated stress and short sucking bursts were used.

Cup: The same extent of problems were experienced during cup-feeding as in bottle-feeding, although the subjects also performed relatively well with the swallowing items in the oral preparatory/oral phase.

No statistically significant difference between cup- and bottle-feeding was found in this group during this phase, which is also reflected in Figure 5.10. This group, thus experienced the same extent of problems with both feeding methods.

In summary, the oral feeding skill during the pharyngeal phase of all four groups can be described as follows:

All of the subjects demonstrated a laryngeal and hyoid bone elevation when swallowing.

Naso-pharyngeal reflux did not occur in the majority of subjects.

Voice quality was affected due to delayed or inefficient swallowing in approximately a third of the subjects in Groups 1, 2 and 3, and in half of the subjects of Group 4, during both feeding methods.

The SSB sequence was generally stressful (82% of the total group), with the lowest incidence in Group 3, which correlates with the good performance that they displayed in the oral preparatory/oral phase. This may be an indication that oral feeding skills improve with maturity as expected according to the literature (Brake et al., Creger, 1995; 1988; Wolf & Glass, 1991). Group 4, however, was the oldest group but displayed more problems during both the oral preparatory/oral phase and the pharyngeal phase than Group 3. A possible explanation may be that Group 4 had the highest incidence of SGA infants (90%). Mullen et al. (1988) found significant differences in the oral feeding skills of SGA and AGA infants, implying that the oral feeding skills of this group may not be representative of the feeding skills of all 37-week infants and that weight does play a roll in the efficiency of oral feeding skills.

Breathing rate could not be recorded due to practical problems in the unit. The heart rates changed during the course of the feed, but never resulted in bradycardia or tachycardia. The stress symptoms that they experienced will be discussed under Impact on Physiological Status (par. 5.2.2.3).

. 3 *Oesophageal Phase*

The information was obtained by observation and was recorded under the subsection Oesophageal Phase on page 7 for bottle-feeding and page 10 for cup-feeding in the FEFARI (Appendix A).

A summary of the problems displayed is presented in Table 5.17.

Table 5.17 Subjects who displayed problems during the oesophageal phase.

	Group 1		Group 2		Group 3		Group 4		TOTAL			
Feeding method	Bottle	*Cup*	Bottle	*Cup*	Bottle	*Cup*	Bottle	*Cup*	Bottle		*Cup*	
N	10	*10*	10	*11*	11	*9*	10	*9*	41		*39*	
Emesis after feed	0	*0*	1	*0*	0	*0*	1	*0*	2	4.90%	*0*	*0*
GER	0	*0*	0	*1*	0	*0*	0	*0*	0	0	*1*	*2.60%*

Very few problems were observed in the subjects during this phase for both feeding methods.

Groups 1-4

Emesis less than 30 minutes after bottle-feeding occurred in only one of the subjects in each of Groups 2 and 4. Gastro-oesophageal reflux (GER) occurred in only one subject, receiving cup-feeding in Group 2 (Table 5.17). Emesis during a feed was not a problem and emesis more than 30 minutes after a feed did not cause any problems either. Projectile vomiting and trunchal arching also did not occur in any of the subjects. Although GER occurred, the incidence was very low (Table 5.17). This implies that the oesophageal peristalsis has matured to the extent that boluses could be managed effectively by the esophagus. It therefore does not support the view of Gryboski (1969) that oesophageal peristalsis is only well developed at 37-40 weeks gestational age, but rather supports the statement by the WHO (WHO, 1989) that peristalsis can be activated and organised from 34 weeks.

In conclusion, nutritive sucking in the premature subjects can be summarized as follows; During the oral preparatory/oral phase, uncoordinated and arrhythmic lip, jaw and tongue movements improved with maturity. The lips functioned well in terms of the ability to purse in order to initiate sucking with bottle-feeding, as well as maintaining the closure to prevent liquid loss. Jaw depression was only a problem in Group 1, thereafter the subjects could depress the jaw to effectively initiate bottle-feeding. Minimal excursion of the jaw was mainly a problem in cup-feeding. The tongue formed a central groove but short sucking bursts were displayed in 3 of the 4 groups. Swallowing was generally uncoordinated and delayed. Multiple swallows also occurred. Delayed and multiple swallows improved with maturity.

During the pharyngeal phase, the sucking-swallowing and breathing sequence was associated with stress, but this also seemed to decrease with maturity.

Few problems were experienced during the oesophageal phase.

5.2.2.3 Impact on the Physiological Status

The information was obtained by observation of the stress symptoms and the recording of data from the oximeter (saturation level and heart rate). This was entered in the FEFARI (Appendix A) under the headings **Pharyngeal phase – Stress symptoms**, page 7, and **Pulse Oximetry**, page 8, for bottle-feeding and pages 10 & 11 for cup-feeding.

. 1 Stress Symptoms

The **stress symptoms** were divided into nine moderate and nine severe symptoms. The results of the stress symptoms are summarized in Table 5.18 and visually presented in Figure 5.11. Other symptoms included in the FEFARI which was not displayed by any subject was excluded from Table 5.18.

Table 5.18 Subjects displaying stress symptoms.

	Group 1		Group 2		Group 3		Group 4		TOTAL			
Feeding method:	Bottle	*Cup*	Bottle	*Cup*	Bottle	*Cup*	Bottle	*Cup*	Bottle		*Cup*	
Moderate stress:												
Fatigue	2	*1*	1	*2*	3	*2*	0	*1*	6	14.6%	*6*	*15.4%*
Yawning	1	*0*	0	*0*	0	*0*	1	*0*	2	4.9%	*0*	*0.0%*
Hiccups	0	*0*	1	*0*	0	*0*	0	*1*	1	2.4%	*1*	*2.4%*
Flared nostrils	1	*0*	0	*1*	0	*0*	1	*0*	2	4.9%	*1*	*2.6%*
Crying	0	*2*	0	*0*	0	*4*	1	*2*	1	2.4%	*8*	*20.5%*
Averting gaze	1	*0*	1	*0*	0	*0*	0	*0*	2	4.9%	*0*	*0.0%*
Fisting	0	*0*	0	*0*	0	*0*	2	*1*	2	4.9%	*1*	*2.6%*
Severe stress:												
Falling Asleep	2	*7*	4	*4*	3	*4*	5	*6*	14	34.1%	*21*	*53.8%*
Coughing	0	*1*	1	*3*	0	*0*	1	*0*	2	4.9%	*4*	*10.3%*
Choking	2	*0*	0	*1*	0	*0*	0	*0*	2	4.9%	*1*	*2.6%*
Noisy Breathing	2	*2*	2	*2*	1	*0*	4	*3*	9	22.0%	*7*	*17.9%*
Colour change	1	*0*	0	*0*	0	*0*	1	*0*	2	4.9%	*0*	*0.0%*
Chest Retraction	1	*2*	1	*0*	0	*0*	0	*0*	2	4.9%	*2*	*5.1%*
Stridor	1	*2*	2	*0*	1	*1*	2	*0*	6	14.6%	*3*	*7.7%*
Actively refusing feed	4	*5*	1	*2*	1	*4*	1	*3*	7	17.1%	*14*	*35.9%*
TOTAL number	18	*22*	14	*15*	9	*15*	19	*17*	60		*69*	

The two symptoms displayed most often in the group as a whole, for bottle- and cup-feeding, fell into the severe category, namely falling asleep and actively refusing the feed.

Figure 5.11 provides a visual presentation of the number of subjects displaying each of the stress symptoms in the gestational age groups of 34, 35, 36 and 37 weeks (Groups 1 – 4). Bottle- and cup-feeding data for each age group is presented separately to provide a visual image of the difference between the two feeding methods.

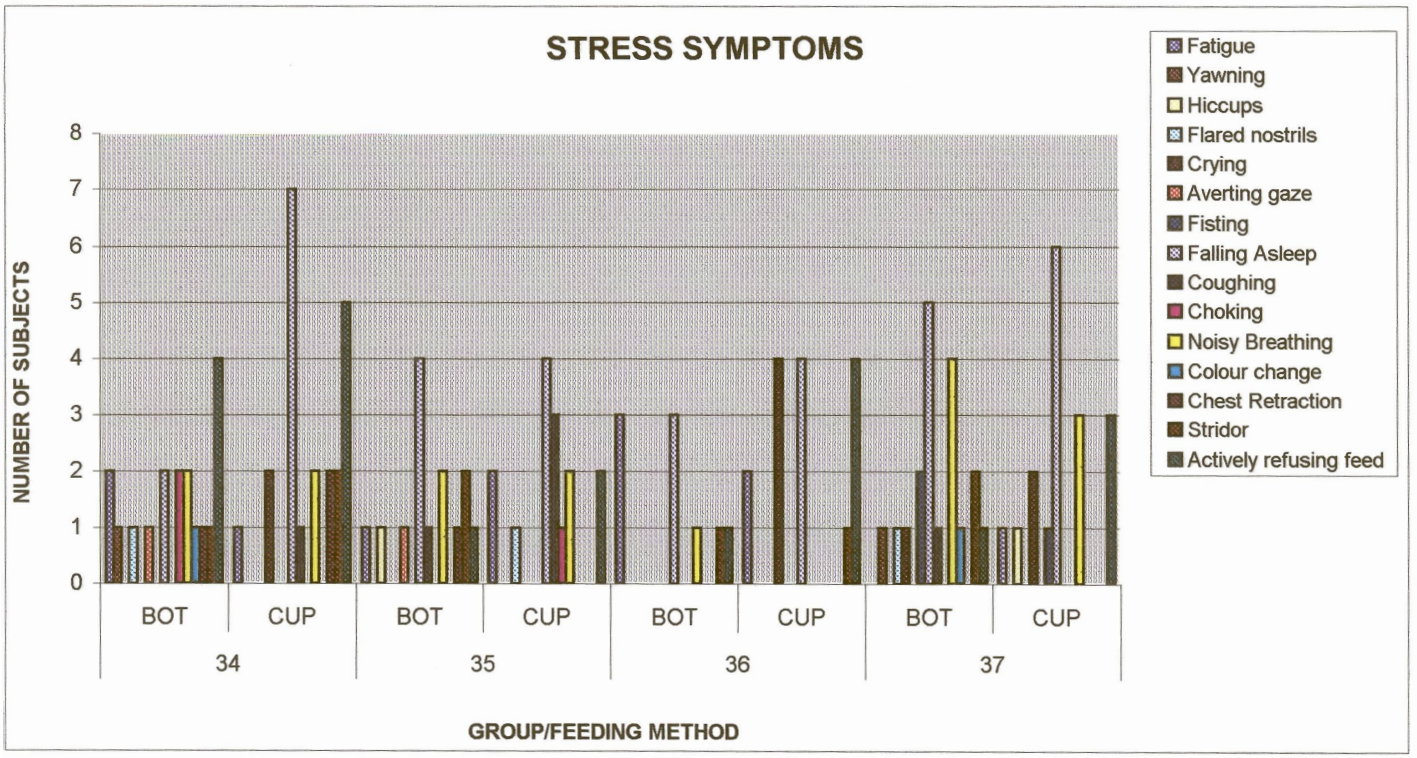

Figure 5.11 The stress symptoms displayed by the different subject groups during bottle and cup-feeding

Information in Table 5.18 and Figure 5.11 will be discussed for each group.

- **Group 1** (34 weeks gestational age)

Bottle: 40% of the subjects displayed severe stress by actively refusing the nipple after a few minutes of bottle-feeding. 20% of the subjects displayed each of the following symptoms: fatigue, falling asleep, choking and noisy breathing (see Table 5.18). The rest of the symptoms were displayed by either only one, or none of the subjects in this group, as depicted in Figure 5.11.

Cup: 70% of the subjects fell asleep and 50% actively refused the feed after a few minutes of cup-feeding and the feeding had to be terminated (both severe stress symptoms). The only moderate stress symptom that was displayed in more than one subject was crying, which was displayed in 2 of the 10 subjects. Severe stress symptoms were displayed in 20% of the cases in each of the following symptoms: noisy breathing, stridor and chest retraction (see Table 5.18). These symptoms were all related to the respiratory system. This is the group with the highest incidence of BPD (50%) and history of pneumonia (20%) (see Table 5.2). The incidence in these symptoms, however, was not high. A higher number of subjects experienced severe stress with cup-feeding (see Figure 5.11).

- **Group 2** (35 weeks gestational age)

Bottle: 40% of the subjects fell asleep during the feed and 20% of them displayed each of the following severe symptoms: noisy breathing and stridor (see Table 5.18).

Cup: 40% of the subjects receiving cup-feeding fell asleep, 30% coughed, and 20% displayed each of the following: fatigue, noisy breathing and actively refusing the feed (see Table 5.18).

Similar stress was experienced during both feeding methods, as depicted in Figure 5.11, with the highest incidence in falling asleep for both. This is the group

with the highest incidence of congenital infections (30% - Table 5.2). The implication is that those subjects may still be weak and have poor endurance for oral feeding, reacting to it by falling asleep, which may be considered as severe fatigue.

- **Group 3** (36 weeks gestational age)

Bottle: 30% of the subjects displayed the moderate symptom of fatigue and 30% the severe symptom of falling asleep.
Cup: Of the moderate symptoms, 40% of the subjects displayed crying and of the severe symptoms, 40% of the subjects displayed each of the following: falling asleep and actively refusing the feed.

A little more stress was experienced during cup-feeding than during bottle-feeding (see Figure 5.11). This group experienced the least stress during bottle-feeding of all groups, and the same during cup-feeding as Group 2 (Total number, Table 5.18). Group 3 also had the least problems with oral feeding skills of all groups and may therefore have experienced the least stress.

- **Group 4** (37 weeks gestational age)

Bottle: More severe than moderate stress symptoms were displayed, namely, 50% of the subjects fell asleep and 40% had noisy breathing. The moderate symptoms that were displayed were fisting and stridor (20% of the subjects for each of the symptoms). This group displayed the most stress during bottle-feeding of all groups (see Table 5.18). This ties in with the fact that they also experienced more problems generally with oral feeding skills.

Cup: Severe symptoms: 60% of the subjects fell asleep, 30% displayed noisy breathing and another 30% actively refused the feed. Moderate symptoms: 20% started to cry during the feed. This group was a little more stressed than the previous two groups, but not as much as Group 1 (see Table 5.18).

The number of subjects displaying different stress symptoms did not differ significantly for the two feeding methods.

In **summary** it may be stated that the stress symptoms which occurred most in the whole group during *bottle-feeding* were: Falling asleep (34.1%), noisy breathing (22%) and actively refusing the feed (17.1%). Groups 1 and 4 displayed the most stress.

The stress symptoms which occurred most during *cup-feeding* for the group as a whole were: Falling asleep (53.8%), actively refusing the feed (35.9%) and crying (20.5%). Group 1 displayed the most stress. These facts imply that approximately a third of premature infants do not have the strength and endurance to complete an oral feed without experiencing stress, particularly cup-feeding.

. 2 Pulse Oximetry

The **heart rate** changed during the whole feeding process, but never below or above the normal limits for premature infants.

The results of the saturation levels before (pre), during (mid), and after (post), feeding for each group, during bottle and cup-feeding are summarized in Table 5.19.

Table 5.19 The range and average percentages of the saturation levels pre-, mid- and post-feeding during both feeding methods.

	Group 1				Group 2				Group 3				Group 4			
Method	Bottle		*Cup*		Bottle		*Cup*		Bottle		*Cup*		Bottle		*Cup*	
%	Range	Avrg	*Range*	*Avrg*	Range	Avrg	*Range*	*Avrg*	Range	Avrg	*Range*	*Avrg*	Range	Avrg	*Range*	*Avrg*
Pre-	92-99	96.4	*92-99*	*96.3*	92-99	97	*93-99*	*96*	93-99	97.2	*96-99*	*96.1*	92-98	96.5	*92-98*	*95.3*
Mid-	82-99	93.7	*85-98*	*94.2*	83-99	93.9	*85-97*	*92.8*	92-99	95.2	*86-98*	*92.5*	80-97	89.8	*83-97*	*89.6*
Post-	90-99	96.6	*92-99*	*97.4*	93-99	96.5	*90-98*	*94.6*	94-99	96.9	*90-98*	*94.4*	92-98	95.6	*91-98*	*94.1*
Number of subjects below 90%	2		*1*		2		*3*		0		*2*		5		*5*	

The **saturation levels** generally lowered during feedings. During cup-feeding, 40.5% of the subjects' saturation levels fell to beneath 90% compared to the 28.2% during bottle-feeding. The range of the saturation levels and the average percentage did not differ much across the different groups before the feeding started.

The mid-feeding readings differed for different groups and for different feeding methods.

- **Group 1**

The difference between bottle- and cup-feeding is marginal in terms of their saturation levels. Only one subject had unfavourable saturation levels (under 90%) during cup-feeding and two subjects during bottle-feeding. Although more obvious differences in the stress symptoms were displayed during the two feeding methods in favour of bottle-feeding for this group, this did not seem to influence the saturation levels. It may be argued that they reacted with stress, e.g. falling asleep or refusing the feed to prevent a drop in saturation levels, thus protecting their oxygen status effectively.

- **Group 2**

The pre-, mid- and post-feeding readings for bottle- and cup-feeding differed slightly (see Table 5.19). During bottle-feeding the saturation levels of 2 subjects dropped below 90% and during cup-feeding it dropped below 90% in 3 subjects. This group displayed slightly fewer stress symptoms (see Table 5.18) than the previous group, but had slightly more infants with unfavourable saturation levels. This is the group with the lowest birth and current weights and second-most SGA infants (see Table 5.1). A possible explanation may be that they try to maintain feeding a little longer because they are a little more mature, by not reacting to the stress by falling asleep or refusing the feed as soon. However, since they are still weak and the energy demands during feeding are high, the saturation levels in a few infants fall below 90%.

- **Group 3**

A slightly larger drop in the average saturation levels occurred during cup-feeding (pre-mid = 3.6%) than during bottle-feeding (pre-mid = 2%). Two of the subjects' saturation levels fell beneath 90% during cup-feeding, compared to no subjects during bottle-feeding. This implies that infants in this group could maintain their physiological status slightly better during bottle-feeding. This correlates with the recordings for the oral preparatory/oral phase, which favoured bottle-feeding, as well as and the lower incidence of stress symptoms during bottle-feeding.

- **Group 4**

This group displayed the biggest fall in saturation levels from the pre-feeding to the mid-feeding situation, namely, 6.7% during bottle-feeding and 5.7% during cup-feeding. Approximately half of the subjects' saturation levels fell beneath 90%, which implies considerable stress and problems with coordination of sucking, swallowing and breathing. This correlates with the fact that this group

experienced more problems with the whole feeding process than the previous group. These problems may be the reason why they were still in the NICU despite their maturity.

In **summary** it can be stated that the range of saturation levels did not vary much between the different gestational ages. No statistically significant differences were found between pre- and mid-, pre- and post-, or post- and mid-feeding values for bottle and cup-feeding. The number of subjects whose saturation levels fell below 90%, were slightly higher for cup-feeding (11) than for bottle-feeding (9). This implies that although the oral feeding skills of relatively healthy premature subjects may not be adequate yet, they are able to protect their oxygen levels during oral feeding.

5.2.2.4 Developmental Trends

The information obtained in the oral-preparatory/oral phase on page 6 under the heading: Nutritive Sucking, Subheading: Oral-preparatory/oral phase of the FEFARI (Appendix A), will be used.

The functioning of the lips, jaw and tongue, as well as swallowing during bottle-feeding will be scrutinized in an attempt to identify any pattern of behaviour and/or to identify any developmental trends. Only the information for bottle-feeding will be used, as it is the natural and the most widely used alternative to breast-feeding.

The problems that were experienced by each group for every oral structure are visually presented in the following Figures: Lip - Figure 5.12, Jaw – Figure 5.13, Tongue – Figure 5.14 and Swallowing – Figure 5.15. Discussion of the results will follow in accordance with to the oral structures.

.1 Lips

The number of subjects in each age group who scored a number 2 or 3 for the different items for lip movements, during bottle- feeding is visually presented in Figure 5.12.

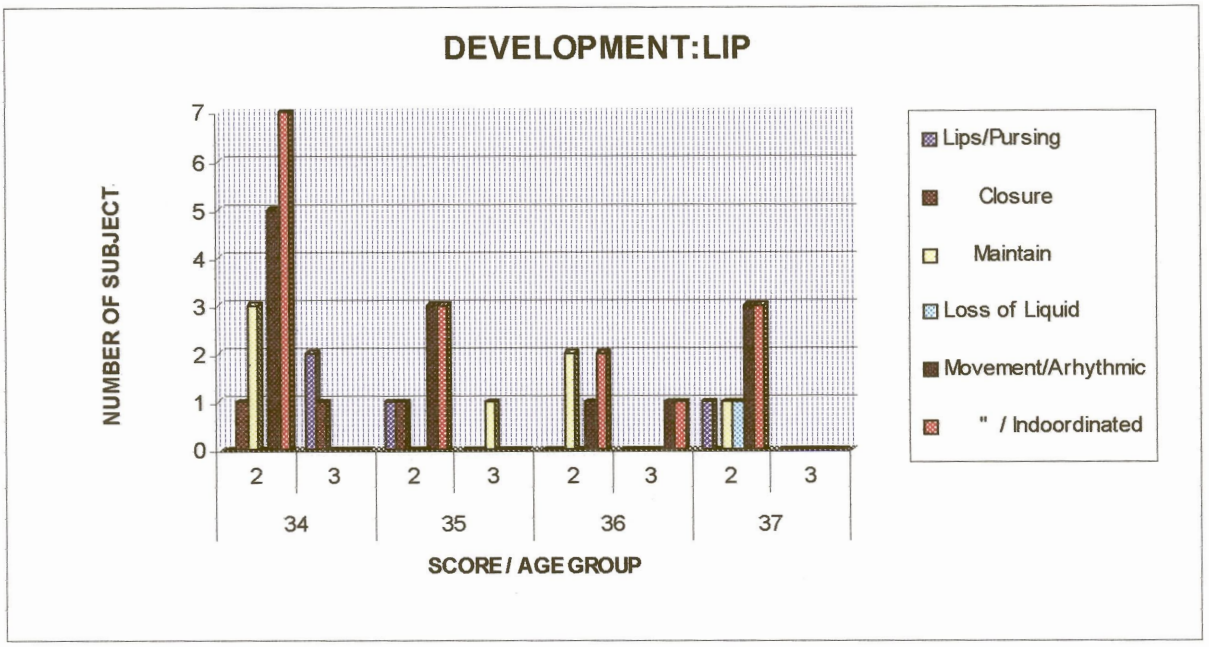

Figure 5.12 The distribution of problem areas in lip functioning for the different groups during bottle-feeding

Uncoordinated lip movements occurred in the highest number of subjects (7) in Group 1 (34 weeks gestational age) (Figure 5.12). The occurrence of uncoordinated lip movements decreased with an increase in gestational age, except for Group 4, but it has already been argued that this particular group may not be representative of other 37-week-old infants. This decrease in occurrence may suggest that coordination improves with maturity, with the biggest improvement between 34 and 35 weeks. This supports the statement of Brake et al. (1988) that premature infants are "unlikely" to feed successfully before 35 weeks gestational age. Arrhythmic movements (Figure 5.12) had the second highest incidence, which also decreased with maturity, except once again, in Group 4. A slight improvement with maturity can also be seen in maintaining the

lip closure (Figure 5.12) and lip pursing to initiate oral feeding. Thus, it may be stated that lip performance improves with maturity.

.2 Jaw

Figure 5.13 visually presents the number of subjects in each age group who scored a 2 or a 3 for different jaw movements.

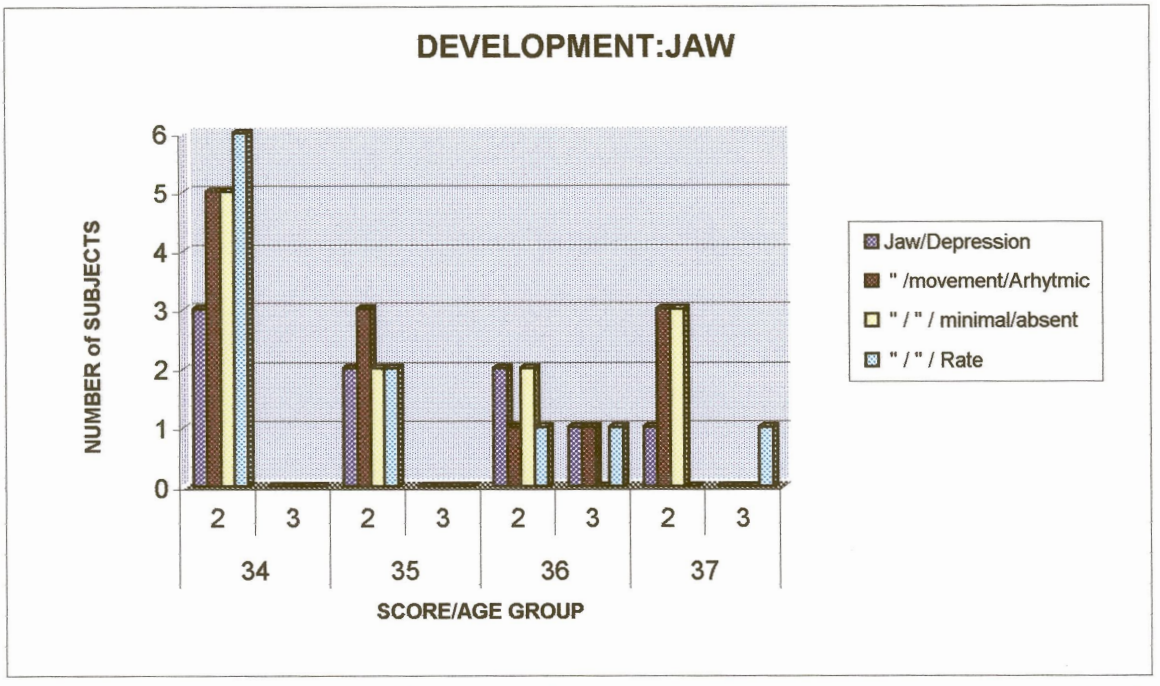

Figure 5.13 The distribution of problems in jaw functioning of the different age groups during bottle-feeding.

The 34 weeks gestational age group (Group 1) displayed the most problems with the change in rate of movement between NNS and NS (Figure 5.13). A marked improvement occurred in the 35 weeks group (6 to 2), after which age only a slight improvement can be observed, according to Figure 5.13. The second highest number of problems displayed by the 34 weeks group was arrhythmic movements of the jaw. According to Figure 5.13, improvement can also be observed, as the number of subjects who had problems decreased from 5 to 3 to 1, except for the 37 weeks group who may not be representative. Minimal movement of the jaw displayed a marked improvement from 34 to 35 weeks (number decreased from 5 to 2). Jaw depression to initiate oral feeding was not a

major problem as only about 20 - 30% of the subjects experienced problems with this item. The marked improvement observed from 34 to 35 weeks gestational age also supports the view of Brake et al. (1988), as mentioned above.

.3 Tongue

The visual presentation of the skills if tongue movements of the subjects, follows:

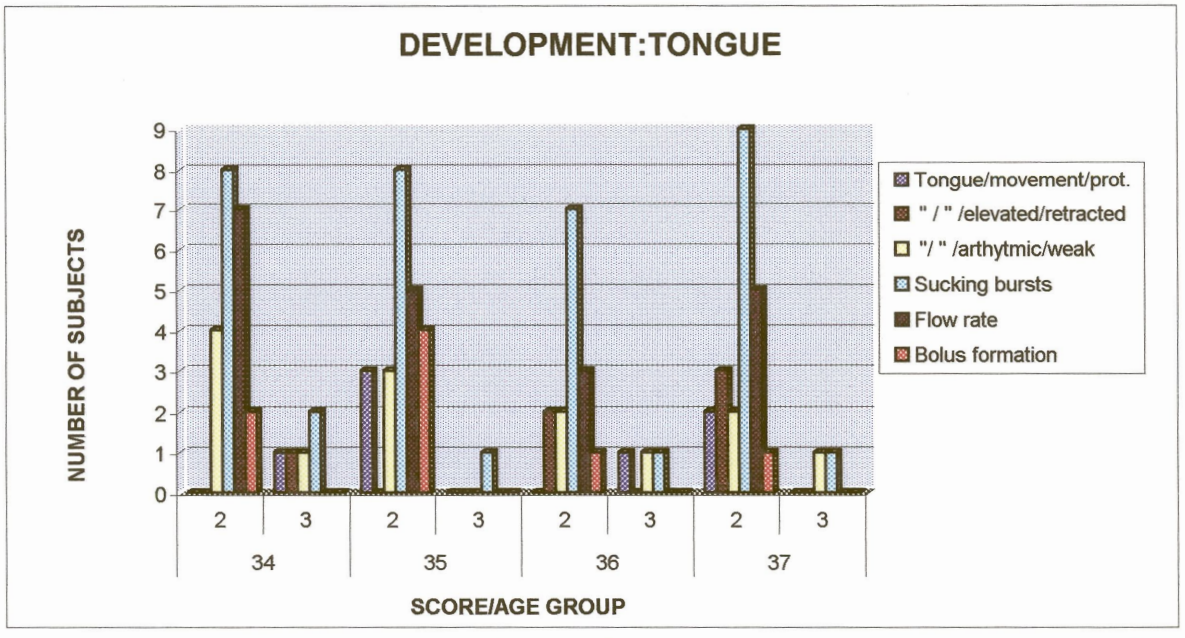

Figure 5.14 The distribution of problems with tongue functioning in different age groups during bottle-feeding.

According to Figure 5.14, inappropriate sucking bursts (prolonged or too short) (numerical score of 2) and/or no sucking bursts (numerical score of 3), were displayed by most subjects and did not change noticeably over the different gestational ages. This implies that development towards appropriate sucking bursts did not occur up to 36/7 weeks gestational age. Morris et al. (1999) found a positive relationship between length of sucking bursts and motor development at 6 months of age. The motor development of premature infants should therefore also be closely monitored and problem areas managed if required. Flow rate indicates that a slight improvement with maturity occurred (except-as expected by now, the 37 week group). Arrhythmic and/or absent movements of the tongue also showed a slight improvement from 34 to 36 weeks gestational age

Apart from sucking bursts, slight improvement in tongue functioning seemed to have occurred with an increase in maturity.

.4 Swallowing

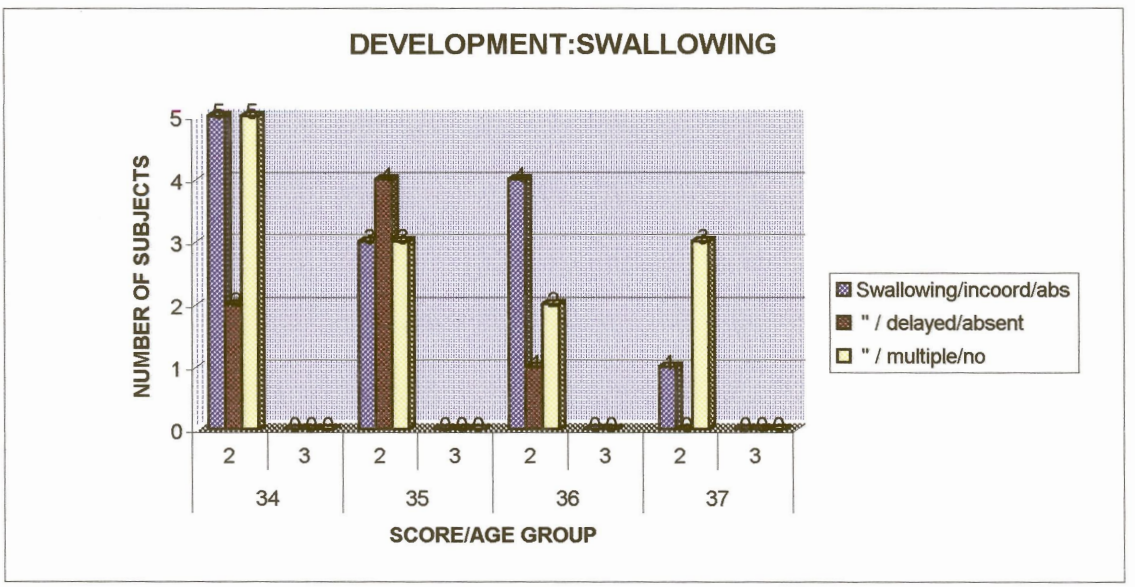

Figure 5.15 The distribution of problems with swallowing in the different age groups during bottle-feeding.

According to Figure 5.15, the coordination of swallowing seemed to be a problem in 30-50% of the subjects until they were 37 weeks gestational age. Group 4 had many problems related to lip, jaw and tongue movements, as well as with stress associated with swallowing. Yet, the ability to coordinate the swallowing seemed to have matured. Multiple swallows indicated a slight improvement from 34 to 36 weeks gestational age. The increase in multiple swallows in the 37-week group was associated with stress as discussed previously. Delayed swallowing varied and did not follow a particular pattern. Thus, according to Figure 5.15, it can be stated that the only aspect which seemed to have improved with maturity, was multiple swallowing.

In **conclusion**, it may be stated that oral motor skills of the subjects improved with maturity. The biggest improvement was observed between 34 and 35 weeks gestational age in terms of the coordination of lip movements, the rate change in jaw movements between NNS and NS, rhythmic movements and normal excursion of the jaw during bottle-feeding. Slight improvements were also observed in the pursing of lips to initiate the feed, the maintenance of the closure, the rhythmic movement of the tongue and the use of multiple swallows by the subjects.

5.3. CONCLUSION

The FEFARI proved to be invaluable for the description of the oral feeding skills of premature infants who served as subjects.

A very high percentage of the subjects used in this study were SGA (76%), and lethargic (83%) at the time of the evaluation. This with the presence of respiratory problems appeared to significantly influence their oral feeding skills. Little problems were experienced with NNS. Subjects in all the gestational age groups investigated generally managed bottle-feeding better than cup-feeding, especially in the oral preparatory/oral phase. The problems which occurred most in this phase, were arrhythmic and uncoordinated movements of the lips, jaw and tongue. Sucking bursts were problematic and multiple swallows were used by the younger groups, until swallowing became more coordinated and effective. During the pharyngeal phase the coordination of sucking, swallowing and breathing caused most of the problems upon which the subjects reacted to with considerable stress. The oral feeding skills of the subjects can be described as disorganised rather than dysfunctional. Oral feeding skills improved with gestational age, but weight played a role as well, as SGA subjects experienced more problems. The information obtained from the FEFARI provided a variety of guidelines for oral feeding intervention strategies.

5.4. SUMMARY

In this chapter, the results were described and discussed according to the sub-aims set out for this study. The results were firstly presented with regard to the description of the characteristics of the subjects and secondly with regard to their oral feeding skills which included both NNS and NS. Nutritive sucking was discussed according to the different phases of swallowing and the impact thereof on the physiological status of the subjects. Developmental trends were identified based upon the results obtained in this study.