JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1977, 10, 573-578 NUMBER 4 (WINTER) 1977

THE EFFECT OF A TOKEN ECONOMY ON DIETARY COMPLIANCE FOR CHILDREN ON HEMODIALYSIS

PHYLLIS R. MAGRAB[1] AND ZOE L. PAPADOPOULOU

GEORGETOWN UNIVERSITY

Adherence to dietary restrictions is a recurring problem for children on hemodialysis. The effect of behavior modification in maintaining dietary control is reported for four patients aged 11 to 18 years. Weight gain, potassium level, and blood urea nitrogen were utilized as criteria measures. A token reinforcement program implemented by the hemodialysis team resulted in significant changes in the dietary pattern of the children. The average weight gain between dialysis sessions for the four subjects during treatment was reduced by 45% and the degree of weight fluctuation was lessened. Potassium levels and BUN were controlled to their appropriate level for subjects who initially exceeded the criterion level. With the withdrawal of weight gain from the contingency system, increase of weight gain between dialysis sessions was noted for all subjects.

DESCRIPTORS: weight control, dietary management, renal dialysis, compliance, token economy, adolescents

Dietary management of children on hemodialysis is a critical aspect of the overall treatment for renal failure. One of the major problems in these children is the provision of adequate nutrients and calories to maintain normal growth (Holliday, 1972; Simmons, Wilson, Potter, and Holliday, 1971). The necessary limitations of sodium, potassium, protein, and fluid and electrolyte allowances are calculated on the basis of body weight, and hence, the dietary allowances in those children who are small in size are even more limited than in adults (Broyer, 1974).

Problems with dietary control can occur as a result of a variety of factors. Most children, and especially teenagers, have many psychosocial adjustments to make as they start hemodialysis, and severe restrictions or major changes in their eating style may become further barriers to normal social activity (Wilson, Potter, and Holliday, 1973). Family problems, lack of family support, low level of education, and rebellion against strong parental supervision, may also result in dietary abuse. For those children who fail to adhere to their prescribed diets, there is an increased risk for fluid overload and congestive heart failure, hypertension, hyperkalemia, azotemia, and bone disease. In the pediatric hemodialysis unit at Georgetown Medical Center, in spite of careful and repeated instructions for adherence to the dietary restrictions and the consequences of dietary indiscretion, a number of children have suffered episodes of congestive heart failure secondary to fluid overload and dangerous hyperkalemia on several occasions, requiring acute hemodialysis.

The purpose of the present study was to determine whether a token program for dietary management is effective in maintaining dietary control in children with a continued inability to adhere to dietary restrictions. Behavioral approaches have been reported to be effective with other types of dietary problems such as obesity (Penick, Filion, Fox, and Stunkard, 1971; Stuart and Davis, 1972; Stunkard, 1972) and anorexia nervosa (Bachrach, Erwin, and Mohr, 1965; Stunkard, 1972), but have not been

[1]Reprints may be obtained from Phyllis R. Magrab, University Affiliated Program for Child Development, Marcus J. Bles Building, Georgetown University Medical Center, 3700 Reservoir Road, Washington, D.C. 20007.

studied in relation to children requiring special diets as result of hemodialysis.

Patient compliance is recognized as a major problem in clinical medicine, and few useful techniques, beyond enhancing the quality of doctor-patient relationships, have been developed (Zifferblatt, 1975). Zifferblatt supports an applied analysis of behavior, evaluating antecedent and consequent events in compliance situations. He asserts for example, that when the behavior of taking medication is succeeded by pleasant events it is more likely to occur. This token program, though not focusing on a functional analysis of cue behaviors, does deal with pleasurable consequent events.

Kazdin and Bootzin (1972) reviewed the use of token economies in a wide range of settings and cited their general effectiveness in altering a variety of behaviors. Although they alluded to a need for further study of maintenance of target behaviors, for the purpose of this investigation, which was precipitated by crisis care needs, generalization was not a first priority, but rather a secondary consideration. The token program was considered to be a preventative, life-saving effort and considerably less costly than hospitalization. Since the ultimate goal for each patient is renal transplantation, dietary restrictions are time limited.

METHOD

Subjects

All patients on the pediatric hemodialysis unit, four boys and three girls, were identified at the outset of the study; three were excluded from the final reporting of data because they were unable to complete the total program for the following reason: one child left the unit to receive a kidney transplant, one child was hospitalized in another hospital during the program because of unrelated medical complications, and one child died. The four study patients included two males: Subject 1, who was 13 yr old, weight 92 lb and Subject 2, who was 11 yr old, weight 90 lb; and two females: Subject 3, who was 13 yr old, weight 62 lb and Subject 4, who was 18 yr old, weight 93 lb. The 18-yr-old subject was maintained on a pediatric unit because she was observed to be socially immature and intellectually slightly below average.

Children were dialyzed two or three times a week. Dialysis was considered to be adequate for all patients as calculated by the pre- and postdialysis levels of blood, urine, and nitrogen (BUN); creatinine; potassium; and serial determinations of serums Ca, P, alkaline phosphatase; bone x-rays and nerve conduction studies. The average length of stay on the unit for the four patients was 12 months, with a range of seven to 21 months. Adherence to dietary restrictions had been reported as a continuous and serious problem for three of the four patients. Previously utilized methods of dietary intervention, such as dietary instructions, increased staff attention, parent counselling, and medical consultation had been unsuccessful.

Procedure

A program for the maintenance of special diets based on a token system of reinforcement was designed for the children's hemodialysis unit. Three measures related to dietary behaviors were designated for observation: weight, BUN, and potassium.

Weight was routinely measured each dialysis session pre- and postdialysis on the same scale, at the same time of day, and with the same amount of clothing worn. Weight gain between dialysis sessions was considered to be a primary measure of fluid intake. Increases in dry weight were observed by changes in blood pressure and the inability to reduce weight by dialysis. During this study, there were no observable increases in dry weight for these subjects. An acceptable weight gain between dialysis sessions was defined as two pounds, representing the amount of fluid that could safely be dialyzed for subjects. This determination was appropriate for all subjects.

BUN, a measurement of protein breakdown,

and potassium, a measurement of cellular breakdown, were also routinely measured during dialysis sessions. Blood samples for these measures were obtained through the dialysis lines and did not require puncturing the child. A BUN level of 100 and a potassium level of six were defined as acceptable. Quality control for these measures in the laboratory required running high-low controls of known serum levels and repeat measures of out-of-range values.

All children were informed of the new dietary program by the head nurse and by a special memo through which a reinforcer list was developed for each child:

> Specially for You
>
> We will be starting a new program to help you stay on your diet. You will have a chance to earn special privileges and prizes in this program. We would like to know from you what kinds of prizes and privileges (not food) you like best. Below are spaces for you to write these down. (Things like toys, games, trips, craft projects, television time at the hospital.)

The prize list was constructed from the children's responses to the initial *Specially for You* memo and included puzzles, comic books, yarn, crochet and knitting books, earrings, model car and airplane kits, fishing rods, pocketbooks, baseball and hockey games, and leather crafts. Eighteen points were designated equivalent to approximately $2.00 of conversion value for purchasing prizes. Children could also obtain money instead of prizes at the same conversion value. Because of the low socio-economic status of the group, this was perceived as adequate by the participants. A budget of $500.00 was allocated for the program. For the initial six-week phase, the maximum cost for the program was estimated to be $84.00 for all seven potential participants. The dialysis team members shared the responsibility of purchasing prizes.

Before beginning the new program, children were instructed on the requirements of their special diet by the dietician. The token system was carefully explained to each child by the pediatric psychologist. Each day the child was dialized, the unit staff routinely measured the three criteria. The child then received a designated number of points depending on the number of days per week he or she was dialized for maintaining acceptable levels of weight (2 to 3 points), potassium (2 to 3 points), and BUN (2 to 3 points). The maximum number of points possible to be earned each week was 18. Subjects on dialysis twice a week received three points for each measure for each dialysis session; subjects on dialysis three times a week received two points for each measure for each dialysis session. A chart recording points was visibly posted in the unit to provide further motivation and recognition of the program by staff and participants. At the end of each week, each child could exchange earned points for prizes and privileges with assigned values or could accumulate points from week to week.

Before initiating the special program, two training sessions with the unit staff around behavioral principles and recording procedures were conducted. Staff were responsible for daily measurement and point recording. This required limited additional time because measurements were routine. Two followup staff training sessions occurred during the treatment period.

The token system was assessed in an ABA design. Baseline measures were recorded for eight dialysis sessions. The treatment period was conducted for four weeks (12 to 18 dialysis sessions depending on the number of times a week the child received dialysis). When the program was initiated, weight gain was the main recurring problem. Only one child evidenced difficulty with BUN and one with potassium; thus, a withdrawal of weight gain from the contingency system was selected for the reversal phase. After the treatment period, reinforcement for weight was discontinued for four dialysis sessions. This was followed by a return to the token system, but consistent data were not available for subjects because of unpre-

dicted interceding events, such as prolonged hospitalization and departure for dialysis camp.

Important to the overall design was the inclusion of all children on the dialysis unit in the program. Thus, compliance, rather than noncompliance, with dietary restrictions was reinforced and children who did not have dietary management problems were not excluded from obtaining prizes.

RESULTS

During the token program for dietary control, weight reduction between dialysis sessions occurred for all subjects. Baseline data indicated that the average weight gain between dialysis sessions for subjects was 2.18 lb, with a range of 1.13 to 3.91 lb. During the treatment phase, average weight gain was 0.97 lb with a range of 0.55 to 1.26 lb. A significant relationship was found between the token economy system

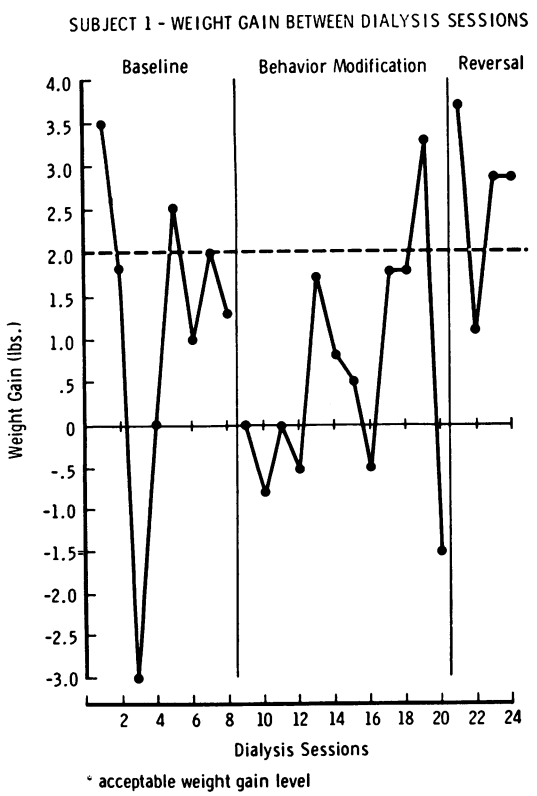

Figure 1

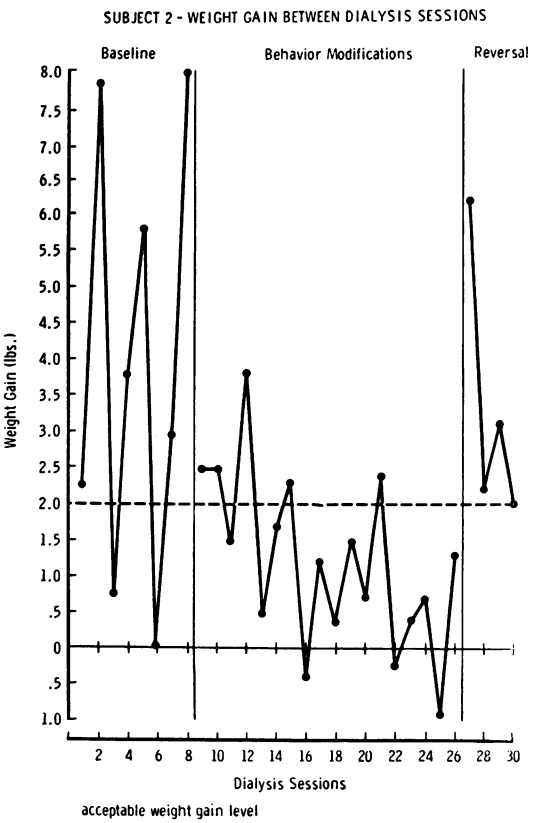

Figure 2

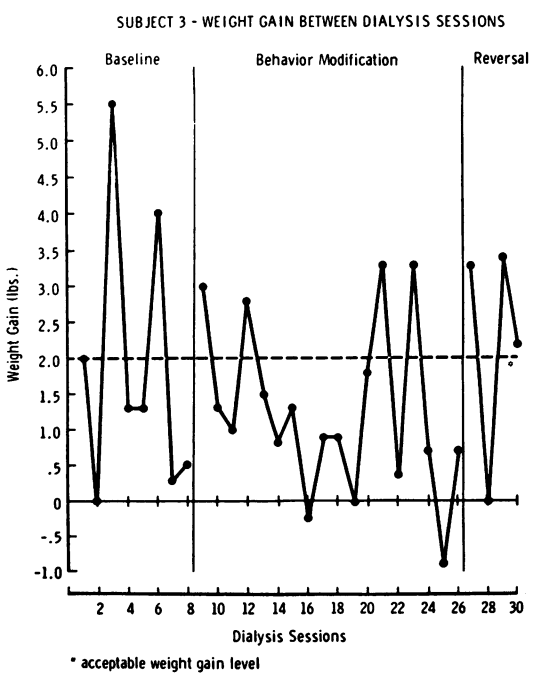

Figure 3

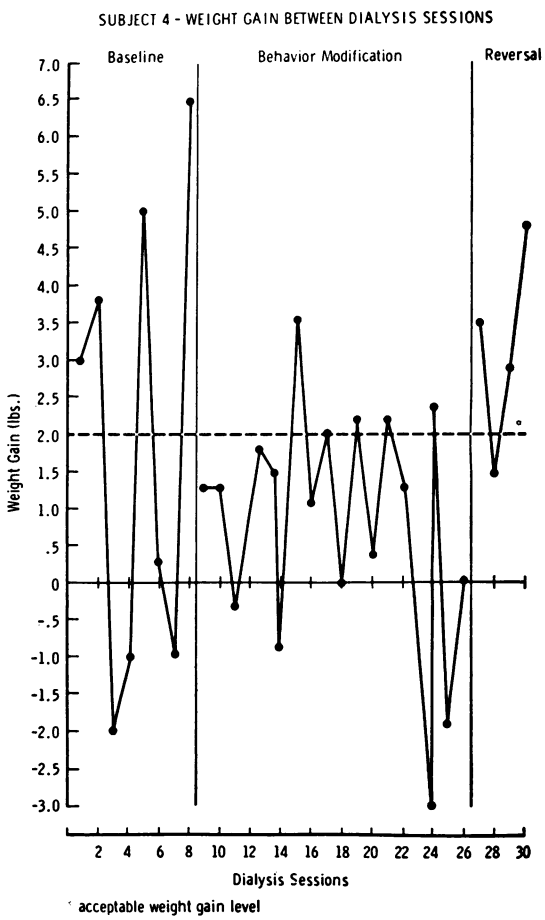

Figure 4

and decrease in weight gain between hemodialysis sessions when comparing baseline data with the treatment phase ($t = 2.39$; $p < 0.05$). The average weight gain between dialysis sessions for the four subjects during treatment was reduced by 45% (Table 1). Figures 1 to 4 depict the pattern of weight change for each subject. There was a substantial change in the per cent of sessions each subject exceeded the acceptable weight gain limits: baseline (47%), treatment (20%), and reversal (75%). During the baseline period, extreme weight fluctuation was reduced in all cases during the treatment phase. During the withdrawal period, an increase of weight between hemodialysis sessions was noted for all subjects (Table 1).

Although the results of weight reduction were reported in an ABA design, the token program was re-instated for weight reduction after the withdrawal phase. Unfortunately, consistent data were not available for the subjects because of intervening events, but comparing the average of the next available eight measures for weight gain for each subject to the withdrawal phase demonstrated a return to a more acceptable level. The average weight gain between dialysis sessions for subjects on returning to the treatment phase was as follows: Subject 1, 0.46 lb; Subject 2, 1.48 lb; Subject 3, 2.10 lb; and Subject 4, 1.50 lb.

Potassium and BUN levels remained at acceptable levels for those patients whose baseline levels initially were acceptable (Table 1). Subject 4, whose initial potassium level (6.4) exceeded the criteria, reduced that level to 4.4 during the withdrawal phase where reinforcement was still enforced for potassium (Table 1). Subject 2, whose BUN level (106.2) was slightly

Table 1

Weight gain between dialyses sessions, BUN, Potassium during baseline, treatment, and reversal

	LBS			*BUN*			*Potassium*		
	Baseline	*Treatment*	*Reversal*	*Baseline*	*Treatment*	*Reversal*	*Baseline*	*Treatment*	*Reversal*
Subject	(*mean*)	(*mean*)	(*mean*)	(*mean*)	(*mean*)	(*mean*)	(*mean*)	(*mean*)	(*mean*)
1	1.13	.55	2.40	86.4	86.7	82.1	5.4	5.4	4.7
2	3.91	1.22	3.38	106.2	100.7	85.3	5.0	5.4	5.6
3	1.84	1.26	2.26	86.4	70.4	89.0	5.7	5.4	5.6
4	1.82	.83	3.2	93.3	100.6	63.2	6.4	6.6	4.4
$\overline{X}$	2.18	.97	2.81	93.1	89.6	79.9	5.6	5.7	5.1

elevated during the baseline period, continued to decrease steadily that level through the treatment period (100.7) and withdrawal period (85.3) where reinforcement for BUN was continued (Table 1).

DISCUSSION

Adherence to dietary restriction is one of the many problems to which children in chronic renal failure have to adjust. In situations where rapid change in dietary behavior is necessary, a behavioral approach can be immediately effective. In this study, a token system for maintenance of dietary restrictions on a pediatric hemodialysis unit was effective in controlling the amount of weight gain, a measure of fluid intake, between dialysis sessions. Children were able to comply with dietary restrictions more consistently; thus, the degree of fluctuation in weight gain, as well as the frequency of noncompliance, was substantially reduced. The behavioral program also seemed effective in controlling BUN and potassium levels for those children who had prior difficulties. A special feature of this particular token program was the limited amount of parental participation required. Where family support is lacking, as was true for the majority of the subjects, a program that can be incorporated as a part of routine hospital care is extremely desirable.

Because children with chronic illnesses such as renal failure are confronted with many restrictions in normal childhood activities, it is important, if at all possible, that any behavioral program be based on enhancing the quality of life for the child, rather than making contingent the few special pleasures or privileges he or she may already have. For the children involved in this study, the behavioral program became an added source of "life" motivation, as well as a vehicle for intragroup communication. With the cooperation of the renal team and appropriate staff training, token reinforcement systems can be an effective means of managing dietary problems on a pediatric hemodialysis unit.

REFERENCES

Bachrach, A. J., Erwin, W. J., and Mohr, J. P. The control of eating behavior in an anorexic by operant conditioning techniques. In L. P. Ullman and L. Krasner (Eds), *Case studies in behavior modification.* New York: Holt, Rinehart & Winston, 1965.

Broyer, M. Chronic renal failure. In M. Broyer, P. Royer, R. Habib, and H. Mathieu (Eds), *Pediatric nephrology.* Philadelphia: W. B. Saunders, 1974.

Holliday, M. A. Calorie deficiency in children with uremia: effect upon growth. *Pediatrics,* 1972, **50,** 590.

Kazdin, A. E. and Bootzin, R. R. The token economy, an evaluative review. *Journal of Applied Behavior Analysis,* 1972, **5,** 343-372.

Penick, S. B., Filion, R., Fox, S., and Stunkard, A. J. Behavior modification in the treatment of obesity. *Psychosomatic Medicine,* 1971, **33,** 49-55.

Simmons, J. M., Wilson, C. J., Potter, D. E., and Holliday, M. A. Relation of calorie deficiency to growth failure in children on hemodialysis and the growth response to caloric supplementation. *New England Journal of Medicine,* 1971, **28,** 653.

Stuart, R. B. and David, B. *Slim chance in a fat world: behavioral control of obesity.* Champagne, Ill.: Research Press, 1972.

Stunkard, A. J. New therapy for the eating disorders: behavior modification of obesity an anorexia nervosa. *Archives of General Psychiatry,* 1972, **26,** 391-398.

Wilson, C. J., Potter, D. E., and Holliday, M. A. Treatment of the uremic child. In R. W. Winters, (Ed), *Body fluids in pediatrics.* Boston: Little Brown and Co., 1973.

Zifferblatt, S. Increased patient compliance through the applied analysis of behavior. *Preventive Medicine,* 1975, **4,** 1973-182.

Received 12 August 1976.
(Final acceptance 22 February 1977.)