Research Article

Increased Classroom Consumption of Home-Provided Fruits and Vegetables for Normal and Overweight Children: Results of the *Food Dudes* Program in Italy

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ABSTRACT

Objective: To increase classroom consumption of home-provided fruits (F) and vegetables (V) in obese, overweight, and normal weight children.

Design: Consumption evaluated within and across the baseline phase and the end of the intervention and maintenance phases.

Setting: Three Italian primary schools.

Participants: The study involved 672 children (321 male and 329 female) aged 5–11 years. Body mass index measures were available for 461 children.

Intervention: Intervention schools received the *Food Dudes* (FD) program: 16 days of repeated taste exposure (40 g of F and 40 g of V), video modeling, and rewards-based techniques. The comparison school was only repeatedly exposed to FV.

Main Outcome Measure: Grams of FV brought from home and eaten.

Analysis: Chi-square, independent *t* test, repeated-measures ANOVA, and generalized estimating equation model.

Results: Intervention schools show a significant increase in home-provided F ($P < .001$) and V ($P < .001$) consumption both in overweight and non-overweight children. Approximately half of children in the intervention schools ate at least 1 portion of FV at the end of the intervention and maintenance phases.

Conclusions and Implications: The increase in home-provided FV intake was similar in overweight and non-overweight children in the FD intervention schools compared with the comparison school. The effect of the FD program was higher at the end of the intervention phase than the end of the maintenance phase.

Key Words: child, fruit, vegetables, childhood obesity, food habits (*J Nutr Educ Behav*. 2015;47:338-344.)

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INTRODUCTION

Childhood overweight and obesity in Western countries are continuously rising.[1] In Italy, their prevalence has reached 22.9% and 11.1%, respectively.[2] Results from national surveys show that daily fruit (F) and vegetable (V) (FV) intake for Italian schoolchildren is far lower than recommended.[3,4] Consumption of a high-calorie diet, often associated with reduced daily activity, is a behavioral factor that affects body weight.[5] Fruits and vegetables have lower energy density than other foods.[6] Experts recommend a daily intake of 400 g or 5- to 80-g portions of FV for children.[7,8] However, there are conflicting reports regarding overweight children's consumption of FV: In some studies, overweight children eat less FV than do their normal weight counterparts[9] whereas in other studies they eat the same F and/or V quantities as normal weight children.[10] Moreover, little is known about whether obesity or overweight[11] might be a moderator of any program designed to increase FV consumption. It is postulated that interventions explicitly based on well-evidenced theories of behavior change are more likely to be effective in altering dietary habits,[12] specifically, in increasing FV consumption.[13]

School-based, multi-component programs seem to be effective in modifying variables related to FV consumption.[14] One such intervention is the *Food Dudes* (FD) *Healthy Eating Program*,[15] a behavior change program based on 3 core principles: (1) role-modeling,

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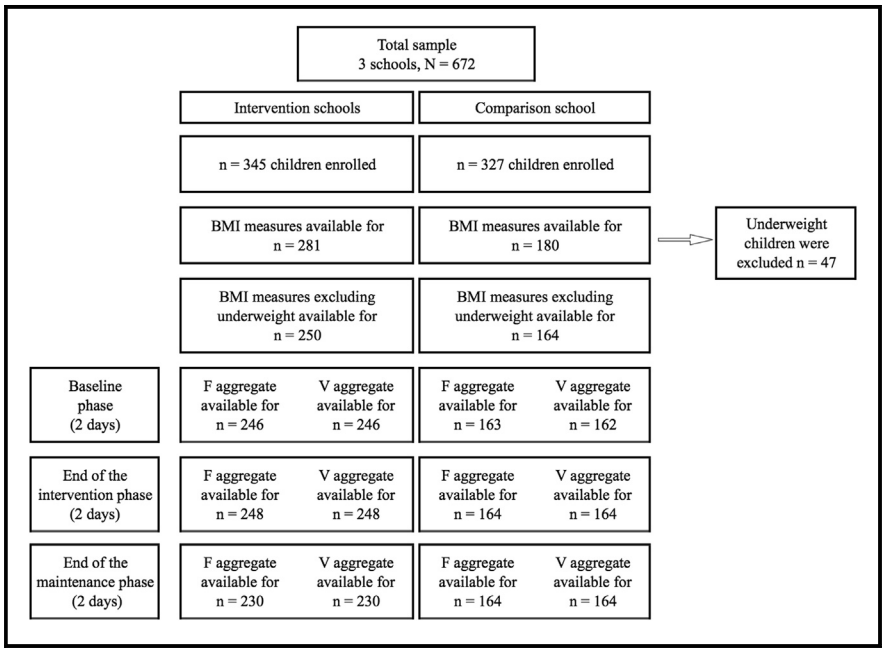

Figure 1. Flow of participants thought the study phases (days) for parent-referred data to calculate body mass index (BMI) and home-provided fruit (F) and vegetable (V) intake.

(2) rewards, and (3) repeated tasting. To date, studies have been conducted in English-speaking countries,[16-20] with children of differing socioeconomic status,[17,18] as well as in the home setting.[15,21] However, consensus on the effectiveness of this program is not unanimous[22,23] and further work is required to verify both its short- and long-term effectiveness in increasing FV consumption,[22] including its extension to other cultures and languages. Moreover, the question of whether body weight might moderate the effectiveness of the FD program has yet to be investigated.

The aim of the current study was to assess whether overweight and normal weight children who followed the FD program would differ in the amount of classroom consumption of home-provided FV compared with children who did not follow the program.

METHODS

Ethics

Although Italian laws and IULM University guidelines for this type of study mandated no institutional review board approval, the study was conducted according to the Declaration of Helsinki. The school board, school managers, and teachers approved all procedures involving the students. If parents did not provide informed consent, their children did not participate in the study. Moreover, if a child did not want to participate, teachers communicated this to the researchers and the child was not enrolled.

Settings and Participants

Children aged 5–11 years who attended 3 elementary schools located in different towns in Sicily, Italy participated in the study. In all participating schools, parents routinely provided their children with snacks to be eaten during the midmorning snack time in the classroom. Children in schools in Acireale (n = 221) and Camporotondo (n = 124) were assigned to the intervention condition, and children in the school San Pietro Clarenza (n = 327) to the comparison condition. These cities were chosen based on a convenience and logistic criterion. The cities are located in the same zone and are medium-sized suburban districts according to national data. No differences were found in terms of size and sociodemographic characteristics with respect to children and families. Children with a known allergy to any of the provided F or V did not receive that food. Overall, 672 children were enrolled (Figure 1), 327 and 345 of whom entered the comparison and intervention groups, respectively. Gender information was available for 650 children (321 male [49.4%] and 329 [50.6%] female). Parent-reported body mass index (BMI) data were available for 461 children (68.8%). Data from underweight children were not included because of the small group sizes (n = 31 for the intervention schools [17 male and 14 female]; n = 16 for the comparison school [8 male and 8 female]).

Study Design

Baseline phase. For 2 consecutive days, in both intervention and comparison schools, trained researchers assessed all food that was brought from home for the midmorning snack. No additional food was provided. On day 3, teachers were instructed to give study-provided FV to children immediately before they ate their usual home-provided snack. Children were free to taste study-provided FV or not. All teachers were instructed not to encourage or coerce children in any way to eat the FV or to comment on whether children tasted the study-provided foods.

Intervention phase. While children in the comparison school continued to receive the study-provided FV, the full FD program was implemented in the intervention schools (see details below). Children in both groups continued to receive home-provided FV.

Maintenance phase. Study-provided foods were discontinued in both groups. Intervention rewards were phased out.

Intervention Procedures

Classroom teachers were thoroughly trained by the researchers before the beginning of the study and received a written description of the procedures, phases, and use of rewards. They were instructed to refer to all foods with the general terms of *fruits* and *vegetables* rather than by their specific names, in line with the language

theory and mechanisms of the FD program proposed by the original authors.[16,21] At the onset of each phase, children were informed about the contingencies of reward delivery: On the first 4 days for biting both FV and on the following 12 days for eating all of the provided quantity. Rewards consisted of items useful for school activities, such as erasers, pencils, and pencil cases marked with an FD logo. Overall, during this phase, each child who reached the criterion for both FV could earn 16 rewards (1/d).

On any given day of the intervention phase, an FD episode was shown and/or an FD letter was read aloud to the children before midmorning snack time. Letters addressed from FD heroes to the children offered encouragement and reminded them about reward contingencies. The 6 original English-language videos, which modeled and encouraged eating FV, were dubbed in Italian. The researchers translated the original script and letters, which were checked by independent experts for consistency with the originals.

After the episode or letter, the teacher offered the study-provided FV to all children. Four different types of ready-to-eat FV were offered. For each of 16 days of intervention, 2 half portions[7] of both F (40 g) and V (40 g) were presented in the following rotating order: banana/fennel; cantaloupe/red cabbage; white melon/cherry tomato; pineapple/carrot. After assessing each child's consumption, the teacher provided rewards.

On day 1 of the intervention phase, children also received a home pack containing information and tips for parents on healthy eating, and a chart for children to record the number of FV portions eaten at home. Teachers provided an additional reward to any child who returned a completed chart.

In the maintenance period, the material rewards were phased out and children were socially reinforced for eating FV. Food boxes marked with the FD logo were provided to bring FV from home. Children who ate F and/or V from their lunchboxes received a mark on a wall chart. The number of marks required to achieve the tangible reward increased as this phase progressed, according to the following schedule as in previously published protocols: 2, 4, 6, and 8.[19,20] This phase lasted only 1 month for the purposes of this study.

Comparison School Procedures

Teachers were simply instructed to offer the study-provided FV on each day immediately before the midmorning snack time. No contingency was placed on children who ate FV.

Measures

For the specific purpose of this article, data presented relate only to the consumption of home-provided FV eaten at school during the midmorning snack time. These data were collected at baseline, and at the end of the intervention and maintenance phases.

Children's weight and height. Body mass index scores were calculated using children's weight and height, which parents voluntarily communicated at the beginning of the study. Children were ranked as underweight, normal, overweight, or obese according to International Obesity Taskforce criteria.[11,24]

Home-provided FV. Consumption was assessed by weighing home-provided food with digital scales (accurate to 1 g) before and after the midmorning snack interval. On both occasions, children were asked to place their snack food, including any remaining pieces of food and waste, in an anonymously coded transparent bag, which was collected by researchers. Fruit juice was not computed as F.

Outcome measures. The amount (in grams) of home-provided FV eaten by the children during midmorning snack time was calculated by subtracting the weight of leftovers from their initial weight. The 3 aggregate means for both F and V intake were used in the statistical analyses. To determine the amount consumed in relation to the suggested 5-A-Day target, consumption in grams of home-provided FV eaten were transformed into portions in accordance with the ratio of 80 g to 1 portion used by Pomerleau et al.[7]

Statistical Analyses

Categorical data are presented as n (%) and continuous data as means (±SD). A 95% confidence interval (CI) indicates uncertainty around the estimates. Chi-square (Fisher exact test was used when appropriate) was used to evaluate differences between categorical variables, whereas independent *t* tests and 1-way ANOVA were used when appropriate to investigate differences between continuous variables. Analysis of variance for repeated-measures models tested the effectiveness of the intervention. *Post hoc* tests were adjusted for multiple comparisons using Bonferroni correction.

To clarify the magnitude of the effect size, η^2 was rescaled in *f* index ($f = \sqrt{\eta^2/\eta^2-1}$).[25] Effect size is defined as small, medium, or large, based on (*f*) equal to 0.1, 0.25, and 0.40, respectively.[25]

To establish the relations between the intervention condition and eating at least 1 portion of home-provided FV at the end of the intervention phase and at the end of the maintenance phase, a generalized estimating equation model was performed. In these models the reference group is always the comparison group.

The researchers used SPSS (version 20.0, SPSS, Inc, Chicago, IL, 2011) and STATA (version 8.0, Stata Corp, College Station, TX, 2003) for statistical analysis. $P < .05$ was considered statistically significant for all analyses.

RESULTS

Study Population

Nearly one third of parents (n = 211) did not provide data on child weight and/or height. Reporting was higher (χ^2 (1) = 54.33; $P < .001$) in the intervention than the comparison schools. Body mass index was thus available for 461 children (68.8%). Overall, 184 children (39.9%) (95% CI, 37.6–42.2) exceeded normal weight (overweight plus obese). This characteristic was homogeneously distributed between intervention and comparison groups (χ^2 (1) = 1.44; $P = .230$) and across classes (χ^2 (4) = 6.04; $P = .196$). However, more males (44.7%) than females (35.1%) were above normal weight (χ^2 (1) = 5.23; $P = .022$; odds

ratio [OR], 1.49; CI, 1.02–2.17). At baseline, 3.0% of children ate at least 1 portion of FV, with no difference between overweight and non-overweight children ($P = 1.0$) in both the intervention and comparison schools ($P = .096$). To assess potential selection bias, the researchers compared baseline characteristics between children with known (n = 461) and with unknown BMI (n = 211). No significant differences emerged for FV intake between groups ($P = .765$).

Effectiveness of FD Program

The researchers performed analyses on home-provided FV consumption for subjects whose data were available for all phases (Figure 1). All analyses compared 2 groups: non-overweight, excluding underweight children, vs overweight children, including both overweight and obese individuals.

A 3 × 2 × 2 ANOVA model compared home-provided F consumption, amount of F consumption (grams) at baseline, end of intervention and maintenance phases (within-subjects factor) vs intervention (intervention vs comparison school), and weight (overweight vs non-overweight). The upper graph in Figure 2 shows an increase in F consumption only in the intervention schools. A significant effect for Intervention × Amount of F consumption was observed ($F[2, 458] = 54.34$; $P < .001$; $\eta^2 = 0.192$; $f = 0.49$). *Post hoc* analysis indicated that the amount of F consumption in the intervention schools was significantly higher at the end of intervention ($t[89] = 11.85$; $P < .001$) and maintenance ($t[100] = 12.07$; $P < .001$) phases than at baseline, and the amount of F consumption was similar in both assessment time points ($t[106] = 0.40$; $P = .691$). The effect Intervention × Weight status was not significant ($F[2, 458] = .579$; $P = .561$); thus, the effectiveness of the FD program on F consumption was equivalent in both overweight and non-overweight children.

A similar ANOVA model (3 × 2 × 2) was applied to home-provided V consumption. The lower graph in Figure 2 shows an increase in V consumption only in the intervention schools, with a significant effect Intervention × Amount of V consumption ($F[2, 458] = 49.64$; $P < .001$; $\eta^2 = 0.178$; $f = 0.47$). The amount of V consumption in the intervention schools was significantly higher at the end of the intervention ($t[60] = 8.02$; $P < .001$) and maintenance phases ($t[63] = 7.18$; $P < .001$) than at baseline, and the consumed amount was similar in both follow-up measures ($t[76] = 0.41$; $P = .683$). The effect of Intervention × Weight ($F[2, 458] = .431$; $P = .65$) showed that the FD program was equally effective at increasing the consumption of V in overweight and non-overweight children.

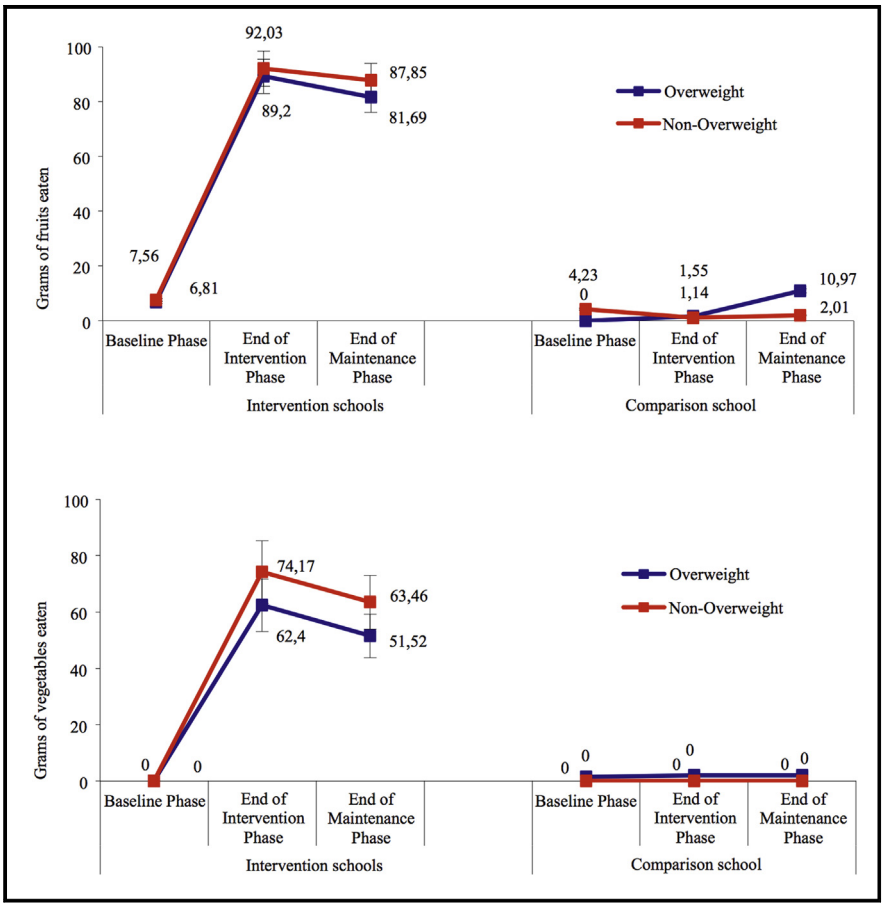

Figure 2. The upper graph shows home-provided fruit consumption in overweight (blue line) and non-overweight (red line) children in the intervention (upper left) and comparison schools (upper right) during the baseline phase and at the end of the intervention and maintenance phases. The lower graph shows home-provided vegetable consumption in overweight (blue line) and non-overweight (red line) children in the intervention (lower left) and comparison schools (lower right) during the same phases.

Finally, a further ANOVA model (3 × 2 × 2) model was applied to combined home-provided FV intake (Table) with similar factors as in the previous analyses. A significant effect Intervention × Amount of FV consumption was found ($F[2, 554] = 76.86$; $P < .001$; $\eta^2 = 0.217$; $f = 0.53$). The amount of FV consumption in the intervention schools was significantly higher at the end of the intervention ($t[183] = 18.42$; $P < .001$) and maintenance phases ($t[202] = 15.05$; $P < .001$) than at baseline. The amount consumed was significantly higher at the end of the intervention phase than the end of the maintenance phase ($t[76] = 3.11$; $P = .002$). Nevertheless, the effect of Intervention × Weight was not significant ($F[2, 554] = 0.455$; $P = .63$).

The combined weight of FV was transformed into portions and used as a dichotomized variable: at least 1 portion vs < 1 portion eaten. Regardless of BMI class, approximately half of the children in the intervention schools ate at least 1 portion of FV at the end of intervention and maintenance phases. A generalized estimating equation model tested the relationship between Intervention × Eating for at least 1 portion of home-provided FV. After adjusting for gender

Table. Mean (SD) Intake of Home-Provided Fruit (F) and Vegetables (V) Eaten by Overweight and Non-Overweight Children in Intervention and Comparison Schools in Each Phase of the Study

Outcome Measure	Baseline Phase, Mean (SD)	End of Intervention Phase, Mean (SD)	End of Maintenence Phase, Mean (SD)
F + V, g			
Intervention			
Overweight	6.26 (3.07)	163.54 (11.04)	121.66 (10.68)
Non-Overweight	6.31 (2.57)	168.34 (9.26)	136.28 (8.96)
Comparison			
Overweight	0 (3.74)	3.08 (13.48)	8.82 (13.03)
Non-Overweight	3.77 (3.94)	1.31 (14.19)	1.79 (13.72)
F + V portions			
Intervention			
Overweight	0.05 (0.03)	1.66 (0.13)	1.15 (0.12)
Non-Overweight	0.57 (0.03)	1.69 (0.11)	1.32 (0.10)
Comparison			
Overweight	0 (0.37)	0.20 (0.15)	0.78 (0.14)
Non-Overweight	0.43 (0.039)	0.22 (0.16)	0.22 (0.15)

Grams were transformed into portions according to the ratio of 80 g to 1 portion (n = 461).
ANOVA for repeated measure were used to test the effectiveness of the intervention. *Post hoc* tests were adjusted for multiple comparisons.
F + V, g: Intervention vs comparison, F(2,554) = 76.86; $P < .001$.
F + V, g: Overweight vs non-overweight, F(2,554) = 0.455; $P = 0.63$.
F + V, g: End of intervention phase vs end of maintenance phase in the intervention schools, t(76) = 3.11; $P = .002$.

and BMI, a significant association between intervention and portion eaten was found (adjusted OR, 32.5; 95% CI, 13.26–79.66; Wald $\chi^2 = 57.92$; $P < .001$). However the effect of weight status (Wald $\chi^2 = 0.12$; $P = .732$) and the effect of Intervention × Weight status (Wald $\chi^2 = 0.21$; $P = .649$) were not significant. Specifically, both in non-overweight children (adjusted OR, 46.16; 95% CI, 13.71–155.40; Wald $\chi^2 = 38.28$; $P < .001$) and in overweight children (adjusted OR, 32.50; 95% CI, 13.26–79.66; Wald $\chi^2 = 57.92$; $P < .001$), a similar significant increase in home-provided FV consumption was found. In other words, weight status was not a moderator of the effect.

DISCUSSION

Overall, these results show that Italian primary schoolchildren who take part in the FD program have a significantly greater likelihood of eating at least 1 portion of home-provided FV regardless of their BMI at the end of the intervention and maintenance phases. According to Cohen's definition,[25] the current results show a large effect size for the assessed outcomes at the end of intervention and maintenance phases. Furthermore, about 50% of both overweight and normal weight children ate at least 1 portion of home-provided food at the end of the maintenance phase.

These findings compare favorably with those shown in other research on the FD program[17-20] and contrast with the findings of Upton et al[22] on parent-supplied lunches. To the authors' knowledge, the current study also shows for the first time that the program works the same way for overweight and non-overweight children.

Furthermore, although children in the comparison school were repeatedly exposed to 4 pairs of FV for 20 days (4 baseline days plus 16 intervention days), neither overweight nor non-overweight children increased their home-provided FV consumption at either the end of the intervention or maintenance phases, which confirms that repeated exposure alone is not enough to increase home-provided FV intake. The current results are in line with other FD studies and show that repeated exposure alone, without the 3 components of the FD program, is not enough to increase home-provided FV intake. These results partially contrast with the work of Upton et al,[22] which showed that home-provided FV consumption in the comparison schools had a statistically significant but not clinically meaningful (7-g) increase at 3 months' follow-up after repeated exposure. Although in the study of Horne et al,[19] home-provided FV intake returned to baseline levels, and in the Upton et al[22] study, it returned to baseline levels at 12-month follow-up, it could be hypothesized that children in the comparison school may not have achieved a sufficient number of tasting opportunities necessary to change intake.

A particular strength of this study is the use of weighed measures of FV intake.[26] Some limitations should be taken into account in interpreting the current findings, as well. First, the follow-up period was too short to determine whether the results hold for overweight and non-overweight children in the longer term. Second, the current study has limited ecological validity because generalization of behavior change to the home was not directly tracked. Moreover, the amount of FV eaten by children at baseline could moderate the effect of the program,[18] but in the current research it was impossible to determine the effect of this moderator because most of the population did not eat home-provided FV at baseline at school.

Although the observed rates of overweight and obesity are comparable to the general population of Italian children,[2] it is possible that these reported weights and heights are underestimations. No substantial hypothesis can be made on the difference in missing data between the 2 groups. In addition, the small number of underweight children (10.2%) precluded any statistical analysis of these children.

IMPLICATIONS FOR RESEARCH AND PRACTICE

A number of questions arise from these results on both normal and

overweight populations. Are they unique to the FD program? Are other programs based on role-modeling and rewards and aimed at increasing consumption in schoolchildren during fruit scheme initiatives[18,19,27] also effective? Future research also should consider evaluating whether the increase in FV intake is maintained in the long term and whether this increase displaces other, more energy-dense foods[6] to provide additional and lasting benefits to the health of both normal and overweight or obese children.

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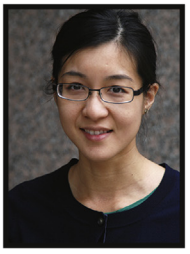

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.