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# Measurement of Polyethylene Glycol 3350 With Standard Household Measuring Devices

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**OBJECTIVE** Though standard household measuring devices (e.g., teaspoons, tablespoons) are often used in clinical practice to measure pediatric doses of polyethylene glycol 3350 (PEG-3350), no published literature documents the accuracy of these measurements. Standard dosing for adults is 17 grams, which is 1 capful according to the manufacturer. The objective of this study was to determine the weight of household teaspoons and tablespoons of PEG-3350.

**METHODS** PEG-3350 measurements were performed using 5 different household measuring teaspoons and tablespoons and the cap that accompanies the bottle for 3 different brands of PEG-3350. Using an electronic balance to determine weights, 3 investigators completed 5 measurements for each of the 5 measurement devices and PEG-3350 bottle caps as follows: leveled teaspoons and tablespoons, unleveled teaspoons and tablespoons, "heaping" tablespoons, half-capfuls, and capfuls.

**RESULTS** A leveled teaspoonful of PEG-3350 weighed ~3.3 grams and an unleveled teaspoonful weighed ~3.7 grams. A leveled, unleveled, and heaping tablespoon of PEG-3350 weighed about 10, 11, and 15 grams, respectively. Heaping tablespoons, half-capfuls, and capfuls resulted in the most measurement variability.

**CONCLUSIONS** Use of a kitchen scale may be the most precise method of measurement, however not all patients have kitchen scales. Standard household measuring devices (teaspoons and tablespoons) may be used to conveniently measure PEG-3350 doses. Using 1 dedicated measurement device and leveling the dose may improve consistency, which could be beneficial for patients who are sensitive to dose variability.

**ABBREVIATIONS** PEG-3350, polyethylene glycol 3350

**KEYWORDS** child; constipation; pharmaceutical preparation; polyethylene glycols

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## Introduction

Constipation, or passing delayed or infrequent hard stools with pain and excessive straining, is a common childhood complaint resulting in primary care and pediatric gastroenterologist visits.[1] The prevalence of functional constipation (constipation that is not explained by another medical condition) in infants, children, and adolescents is estimated to be 9.5% globally and 12% to 18% in the United States, making it the most prevalent gastrointestinal disorder among children ≥1 year of age and adolescents.[2–4] Management of pediatric constipation may include dietary and behavioral changes and/or medication therapy. For medication therapy, oral polyethylene glycol 3350 (PEG-3350) is recommended first line for both acute treatment of fecal disimpaction and maintenance treatment of constipation.[1,5] It is commonly used in the pediatric population due to its efficacy, tolerability, safety, convenient dosage form, and over-the-counter availability.[1,5]

Despite guideline recommendations for use and evidence demonstrating the efficacy of PEG-3350 for constipation in pediatric patients, a dosage form/product that allows measurement of weight-based dosages (i.e., 0.2 to 1 g/kg/day) in increments less than 17 grams is not available. In order to measure doses less than 17 grams, caregivers must either estimate a dose that is easily divisible into 17 grams (for example, "eyeballing" a half-capful for an 8.5 gram dose), use a scale to weigh the correct dose, or use other household measuring devices such as teaspoons and tablespoons. Unfortunately, the weight of one teaspoon or tablespoon of PEG-3350 has not been published, despite having been suggested by various sources.[10–16] Determining the amount of PEG-3350 measured in measuring teaspoons or tablespoons would help patients and caregivers measure appropriate evidence-based weight-directed doses. The objective of this study was to determine the weight of 5 leveled and unleveled standard household measuring teaspoons and tablespoons of PEG-3350, using 3 different brands of PEG-3350.

## Materials and Methods

This was a prospective descriptive analysis of PEG-3550 weights using standard household measuring devices that are typically used for baking.

**Procedures.** Five different standard household measuring teaspoons and tablespoons were utilized (see photos). Measurements were completed using 3 Mettler-Toledo PL83-S Portable Balances (Mettler-Toledo International, Inc, Columbus, OH). Three different investigators (KN, CK, and NG) participated in the analysis. Three different PEG-3350 products were measured: MiraLAX (Bayer Healthcare Pharmaceuticals [Berlin, Germany]; Lot 2034PU), Purelax (CVS Health [Woonsocket, RI]; Lot 2FR0592), and SmoothLAX (Walgreens Boots Alliance [Deerfield, IL]; Lot 2FR0598). The weight determination process for each measurement of PEG-3350 and the number of measurements was as follows.

**Level Household Utensils.** The investigator scooped powder into the teaspoon, then removed excess powder using the flat edge of a knife to ensure measurement of 1 level teaspoon. The powder was then transferred into the weigh tray of the electronic balance, which had been tared before use. The measurement value was documented in an Excel sheet and the powder removed from the scale. The process was then repeated 4 additional times, for a total of 5 "leveled" measurements per investigator per teaspoon. The process was repeated for tablespoons. Each investigator performed the measurements described for each of the 3 different PEG-3350 products.

***Unleveled Household Utensils.*** The above process was replicated except that the product was scooped into the utensil as close to the appropriate measurement as possible and not leveled. This process was performed for 5 measurements per investigator per each of the 5 teaspoons and 5 tablespoons.

**Heaping Tablespoons.** Measurement by each investigator for each tablespoon was repeated as above, except that the utensil was used to obtain as much of the PEG-3350 as possible, in order to determine the weight of a "heaping" tablespoon. This process was performed for 5 measurements per investigator per each of the 5 tablespoons.

**Manufacturer-Provided Container Cap.** Each empty manufacturer-provided bottle cap was used to measure a capful and an approximate half-capful of PEG-3350, which was then transferred onto the weigh tray of the electronic balance for measurement. For the "capful" measurements, the investigator measured powder into the corresponding manufacturer-provided bottle cap to the fill line. To measure half-capfuls, the investigator approximated what looked like enough powder to fill the cap halfway from the bottom of the cap to the fill line; no marking was used for the half-way line. This was repeated 4 additional times for a total of 5 measurements of cap weight and 5 measurements of half-cap weight per investigator, for each of the 3 products.

Each of the above processes were completed using each of the 3 PEG-3350 products. For each product, 3 investigators completed 10 trials for each teaspoon (leveled and not leveled) and 15 for each tablespoon (leveled, not leveled, and heaping). Each investigator performed 135 measurements per product (including both cap and spoon measurements) and 405 measurements overall (accounting for all 3 PEG-3350 products), bringing the total number of PEG-3350 measurements in this study to 1215.

Microsoft Excel was used to document weights for each measuring device and to compute the mean weight and standard deviation with each device individually and when all 5 measurements for the particular device were combined (e.g., all 5 level teaspoons combined, all 5 heaping tablespoons combined). The mean weight of capfuls and half-capfuls for each product were calculated similarly.

## Results

The mean weight (±SD) of PEG-3350 in a leveled teaspoon was 3.31 ± 0.05 grams and in an unleveled teaspoon was 3.74 ± 0.13 grams. The mean weight of PEG-3350 in a leveled tablespoon was 9.99 ± 0.12 grams, in an unleveled tablespoon was 11.17 ± 0.29 grams, and in a heaping tablespoon was 15.07 ± 1 grams (Table 1). For the same teaspoon or tablespoon, weights were similar amongst the 3 products (MiraLAX, SmoothLAX, and Purelax), but weights varied between different teaspoons and tablespoons. For a capful of PEG-3350, the mean weight was 17.04 ± 2.21 grams; for a half-capful, the mean weight was 8.35 ± 1.61 grams; no pattern was observed with respect to different products (Table 2). Among the teaspoons and tablespoons, measuring in the "heaping" style resulted in the greatest coefficient of variation, followed by "unleveled" and then "leveled" (Table 3). Measuring half-capfuls was associated with the greatest variability, with a coefficient of variation of 19.3%.

A 17 gram "usual adult dose" would be comprised of approximately 5 (5.14) level teaspoonsful or 4.5 (4.55) unlevel teaspoonsful, and 1.7 level, 1.5 unleveled, or 1.1 heaping tablespoonsful.

## Discussion

PEG-3350 powder is supplied in a bottle, with the standard adult dose of 17 grams being measured via the bottle's cap, with a line inside the cap line demarcating 17 grams. There are no additional graduations for smaller doses because the manufacturer does not recommend doses lower than 17 grams. While the weight of powder could be weighed using a kitchen scale, families may not own one. Therefore, clinicians often use measuring teaspoons and/or tablespoons to design and communicate PEG-3350 dosages for

**Table 1.** Household Utensil Measurements*

| | | Teaspoons† | | | | | | Tablespoons† | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total | 1 | 2 | 3 | 4 | 5 | Total |
| **MiraLAX** | **Leveled** | 3.38 (0.13) | 3.17 (0.11) | 3.32 (0.09) | 3.43 (0.08) | 3.24 (0.05) | 3.31 (0.13) | 9.75 (0.25) | 9.33 (0.15) | 10 (0.11) | 10.74 (0.12) | 9.75 (0.14) | 9.91 (0.5) |
| | **Unleveled** | 3.94 (0.25) | 3.63 (0.22) | 3.77 (0.18) | 3.86 (0.29) | 3.48 (0.19) | 3.74 (0.28) | 11.32 (0.49) | 10.18 (0.56) | 11.58 (0.46) | 12.35 (0.76) | 10.58 (0.48) | 11.2 (0.94) |
| | **"Heaping"** | | | | | | | 15.33 (1.68) | 14.56 (1.08) | 16.05 (1.9) | 16.52 (1.48) | 14.12 (1.24) | 15.32 (1.72) |
| **Purelax (CVS)** | **Leveled** | 3.35 (0.06) | 3.21 (0.09) | 3.31 (0.04) | 3.42 (0.09) | 3.3 (0.06) | 3.32 (0.1) | 10 (0.3) | 9.44 (0.14) | 10.07 (0.12) | 10.9 (0.18) | 9.95 (0.07) | 10.07 (0.51) |
| | **Unleveled** | 3.9 (0.25) | 3.73 (0.28) | 3.57 (0.27) | 3.83 (0.19) | 3.44 (0.2) | 3.69 (0.29) | 11.1 (0.59) | 10.21 (0.59) | 11.42 (0.41) | 12 (0.57) | 10.45 (0.33) | 11.03 (0.82) |
| | **"Heaping"** | | | | | | | 15.11 (0.91) | 14.15 (0.79) | 15.91 (0.9) | 16.05 (0.84) | 13.02 (2.27) | 14.85 (1.69) |
| **SmoothLAX (Walgreens)** | **Leveled** | 3.31 (0.08) | 3.21 (0.08) | 3.31 (0.11) | 3.43 (0.08) | 3.26 (0.04) | 3.3 (0.11) | 9.82 (0.16) | 9.36 (0.17) | 9.99 (0.14) | 10.79 (0.18) | 9.92 (0.18) | 9.98 (0.49) |
| | **Unleveled** | 3.9 (0.23) | 3.7 (0.26) | 3.8 (0.21) | 4.05 (0.18) | 3.44 (0.09) | 3.78 (0.29) | 11.45 (0.82) | 10.24 (0.39) | 11.54 (0.65) | 12.69 (0.7) | 10.4 (0.28) | 11.26 (1.07) |
| | **"Heaping"** | | | | | | | 15.29 (1.24) | 13.9 (0.91) | 16.2 (1.32) | 16.34 (1.02) | 13.48 (0.73) | 15.04 (1.57) |
| **All products combined** | **Leveled** | 3.35 (0.1) | 3.20 (0.1) | 3.31 (0.08) | 3.43 (0.08) | 3.27 (0.06) | 3.31 (0.05) | 9.86 (0.26) | 9.37 (0.16) | 10.02 (0.13) | 10.81 (0.17) | 9.87 (0.16) | 9.99 (0.12) |
| | **Unleveled** | 3.91 (0.24) | 3.69 (0.25) | 3.71 (0.24) | 3.91 (0.24) | 3.45 (0.16) | 3.74 (0.13) | 11.28 (0.65) | 10.21 (0.51) | 11.51 (0.51) | 12.34 (0.72) | 10.47 (0.37) | 11.17 (0.29) |
| | **"Heaping"** | | | | | | | 15.24 (1.29) | 14.21 (0.95) | 16.05 (1.41) | 16.31 (1.13) | 13.54 (1.59) | 15.07 (1) |

* Weights provided in grams as mean (SD).
† Teaspoons and tablespoons were numbered from 1 to 5 to identify each measuring device; see images 1 and 2.

pediatric patients and their caregivers as part of routine clinical practice. The 1999 MiraLAX prescription manufacturer's labeling indicated that a 17-gram dose is equivalent to "one heaping tablespoon," but this information was later removed from the labeling and is not included in the OTC drug facts.[10,11] Various internet sources provide unreferenced recommendations suggesting that a 17-gram dose equates to somewhere between 3.5 to 4.5 teaspoons.[12–16] However, a search of the medical literature revealed no published evaluation of weight per teaspoon or tablespoon. It is likely that these values (e.g., 3.5 or 4.5 teaspoonsful = 17 grams) have been previously unofficially measured by clinicians and passed down through local clinical practice and word of mouth. Our study demonstrates that a leveled teaspoonful of PEG-3350 weighs approximately 3.3 grams and an unleveled teaspoonful weighs approximately 3.7 grams, meaning it would take ~4.5 unleveled or ~5 leveled teaspoons to make up a ~17-gram dose. A leveled, unleveled, and heaping tablespoon of PEG-3350 weigh about 10, 11, and 15 grams, respectively.

Standard household measuring tablespoons and teaspoons varied in volume in this study, as demonstrated by the variability in amount of PEG-3350 weighed in the 5 different measuring devices obtained from investigators' own homes. This has previously been demonstrated by Hyam et al[18] in 1989, who showed that teaspoons ranged in volume from 1.5 to 5 mL, with most containing between 2 and 3 mL. This study used teaspoons and tablespoons specifically designed for cooking and baking, whereas spoons used in the 1989 study were described as household spoons, and may have been those designed primarily for eating. Clearly, none of the 5 teaspoons or tablespoons in our study were calibrated to any standard, with differences in materials and manufacturing potentially responsible. The use of household utensils (teaspoons and tablespoons) as measuring devices is generally discouraged due to potential size variations leading to inaccurate measurements and

**Image 1.** Teaspoons.


**Image 2.** Tablespoons.


under- or overdosing.[17] This is certainly true of household cutlery, and also applies to measuring teaspoons and tablespoons specifically used for baking. One teaspoon is equivalent to 5 mL in apothecary terms, but household measuring teaspoon volumes can vary from 2 mL to over 7 mL.[18,19] Similarly, tablespoons are variable in size and may contain 6.7 to 13.4 mL, despite being considered to be equivalent to 15 mL.[19]

As evidenced by each measurement unit and style's coefficient of variation (Table 3), unleveled measuring

**Table 2.** Capfuls and Half Capfuls*

| | ½ Capful | Full Capful |
|---|---|---|
| **MiraLAX** | 8 (1.3) | 16.5 (2.35) |
| **Purelax (CVS)** | 9.26 (1.74) | 18.04 (2.37) |
| **SmoothLAX (Walgreen's)** | 7.81 (1.44) | 16.55 (1.61) |
| **Total** | 8.35 (1.61) | 17.04 (2.21) |

* Weights provided in grams as mean (SD).

devices resulted in greater measurement variability as compared to leveled devices, which is unsurprising given a lack of standard for "unlevel." Anecdotally, heaping tablespoonfuls were the most difficult to measure in terms of psychologically feeling like the powder amount varied, and also in terms of transporting the spoonful of powder to another vessel without spilling. Though the average capful did weigh around 17 grams, variability was greater with this measurement as compared to those using standard household measuring teaspoons and tablespoons. This variability likely occurs because the measurer must estimate where the top of the powder falls within the bottle cap, and the top may be slightly above or below the marked line within the cap. It also may be due to differences in the caps provided on each product by different manufacturers, although we did not specifically evaluate that. The greatest variability was observed when measuring half-capfuls, which is not surprising given the lack of marking for half-capfuls on any of the products.

Because PEG-3350 has a fairly wide therapeutic window, the slight variability in measurement of "one capful" has not been reported to be associated with a lack of efficacy or an increase in side effects.[4,5,8] However, measurements may vary, particularly when using doses lower than the standard, and some patients may be sensitive to dosages higher or lower than what is required to obtain the desired effect. For example, in the study by Pashankar and Bishop,[8] 1 patient required 9 dosage adjustments to attain the goal of 2 soft stools per day. Though that patient was an outlier, it took an average of 2.8 dosage adjustments to get to the right dose, and 3 or more watery stools per day were reported in 12 out of the 20 patients evaluated. The final dosage ranged from 0.27 to 1.42 g/kg/day.[8] When patients are particularly dose-sensitive (i.e., if they experience loose stools at relatively low doses), using a kitchen scale may be the best strategy to reduce variability in PEG-3350 measurement from day to day. For smaller doses, measuring doses using standard household measuring devices offers a convenient and safe way to deliver PEG-3350 doses for those families who do not have a kitchen scale or do not want to weigh each dose. Knowing the approximate weights of a teaspoon and a tablespoon of the drug is helpful and provides a convenient, easy way for caregivers to measure doses.

Our study was limited by the number of measurements performed. We performed 1215 measurements using 5 different teaspoons and 5 different tablespoons, with 3 different PEG-3350 products. It is possible that additional measurements, with >3 measurers, could have resulted in more precise values. We did not account for potential hygroscopy that may occur over time as opened bottles of PEG-3350 are exposed to humidity in the environment.[20] We did not control for room temperature or humidity, and we performed our measurements the same day that we opened new bottles of each product. It is possible that measurements would differ after the bottle has been opened many times over the course of months due to sorption of atmospheric moisture over time.[20] In this case, a lower amount of actual PEG-3350 per mass could be seen, since more of mass would be composed of water molecules. The amount of these potential differences is unknown, but would not be expected to result in clinically significant measurement differences.

## Conclusion

The weight of a measuring teaspoon or tablespoon of PEG-3350 depended on whether the measure was

**Table 3.** Coefficients of Variation

| Measure | Measurement Style | Mean Weight (grams) | SD (grams) | Coefficient of Variation (%) |
|---|---|---|---|---|
| Teaspoon | Leveled | 3.31 | 0.05 | 1.5 |
| | Not leveled | 3.74 | 0.13 | 3.5 |
| Tablespoon | Leveled | 9.99 | 0.12 | 1.2 |
| | Not leveled | 11.17 | 0.29 | 2.6 |
| | Heaping | 15.07 | 1 | 6.6 |
| ½ capful | Estimate (not marked on cap) | 8.35 | 1.61 | 19.3 |
| Capful | Estimate (marked on cap) | 17.04 | 2.21 | 13 |

leveled, unleveled, or heaping, and on the specific measuring device. A leveled teaspoonful of PEG-3350 weighed ~3.3 grams and an unleveled teaspoonful weighed ~3.7 grams. A leveled tablespoon of PEG-3350 weighed ~10 grams, an unleveled tablespoon weighed ~11 grams, and a "heaping" tablespoon weighed ~15 grams. Heaping tablespoons, half-capfuls, and capfuls resulted in considerable variability in measurement. Now that weights are documented for PEG-3350 measured via these devices, clinicians may use the information to inform their dosing approaches and patient counseling. For the most consistent dosing regimen, caregivers should be advised to use a leveled teaspoon or tablespoon using a dedicated standard household measuring device. However, an unleveled measurement is also acceptable and likely adequate for the majority of patients.

## Article Information

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