Report on
the Second Meeting of
the WHO Technical Advisory Group on
Gestational Weight Gain

6–7 December 2023
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Report on the Second Meeting of the WHO Technical Advisory Group on Gestational Weight Gain

ACRONYMS

BMI  Body mass index
GWG  Gestational weight gain
IOM  Institute of Medicine
Ki   Knowledge integration
MAH  Maternal Health Unit
MCA  Department Maternal, Newborn, Child and Adolescent Health and Ageing
MNF  Monitoring Nutrition and Food Safety Events Unit
MPH  Maternal and Perinatal Health Unit
NFS  Department of Nutrition and Food Safety
PPWR Postpartum weight retention
SRH  Sexual and Reproductive Health and Research
TAG-GWG Technical Advisory Group on Gestational Weight Gain
WHO  World Health Organization
1. INTRODUCTION

The World Health Organization (WHO) is undertaking a normative process to develop global standards for gestational weight gain (GWG) and optimal GWG ranges based on these standards to reduce the risk of adverse maternal and infant outcomes.1 The process aims to address the lack of evidence-based public health tools for monitoring GWG that apply to women of all body mass index (BMI) categories and geographic locations.

This initiative is being led by the WHO Departments of Nutrition and Food Safety (NFS) and Sexual and Reproductive Health and Research (SRH), with contributions from the Department of Maternal, Newborn, Child and Adolescent Health and Ageing, in partnership with a research group comprised of scientists from the Federal University of Rio de Janeiro (Brazil), Cornell University (United States), and the University of British Columbia (Canada). The Steering Committee includes some members of these external institutions and the WHO Secretariat (see Annex I for details).

In 2023, WHO established a multidisciplinary Technical Advisory Group on Gestational Weight Gain (TAG-GWG) to advise on the process of developing GWG standards and optimal ranges (see Annex I).2 TAG-GWG members provide advice on the development of the detailed research protocol, eligibility criteria for determining a sample that is as prescriptive as data and evidence allow, and methods and approaches for developing the global GWG standards and optimal ranges.

The Second Meeting of the WHO TAG-GWG was convened virtually from 6–7 December 2023. The objective of the meeting was for the three TAG-GWG working groups to provide updates on their work since the first TAG-GWG meeting in June 2023, explore the status of data acquisition and seek advisers’ feedback on a list of planned outputs. A revised timeline and workplan were also discussed. This report provides a summary of discussions and recommendations emanating from this meeting. A list of participants and meeting agenda are available in Annexes I and II.

2. SUMMARY OF DAY 1 PRESENTATIONS AND DISCUSSIONS

Elaine Borghi, WHO/NFS, opened the meeting and thanked the TAG-GWG working groups for their work since the previous meeting. She introduced the meeting co-chairs, Helena Teede (Day 1) and Suzanne Phelan (Day 2). TAG-GWG advisers were asked to declare any conflicts of interest before beginning the meeting; none were declared.

The TAG-GWG welcomed newly appointed adviser Hayfaa Wahabi, Professor of Obstetrics and Gynaecology and Maternal Epidemiology of King Saud University in Riyadh, Saudi Arabia. Professor Wahabi introduced herself and described her long-standing interest in the effect of maternal weight on pregnancy outcomes.

The meeting co-chairs described the objective of the global GWG standards project, which is to address the critical gap in global GWG standards and related tools and recommendations for promoting maternal and child health and well-being during pregnancy and the postnatal periods. With the support of the TAG-GWG, WHO initiated a normative process to: 1) develop global GWG standards that can be used as a tool for dynamic monitoring in antenatal care in diverse settings; and 2) define optimal GWG ranges based on these curves, to reduce the risk of adverse maternal and infant outcomes.

Session 1: Updates from working group 1 on individual-level eligibility criteria

Suzanne Phelan introduced the goal of working group 1: To propose individual-level eligibility criteria to be considered when creating the GWG standards. The standards should describe patterns of optimal pregnancy weight gain; however, at present, there is no clear consensus on what inclusion/exclusion criteria should be used to identify the population of women who should be included in the sample.

To contribute towards this objective, working group 1 is focusing on two key outputs: 1) an ideal initial list of recommended individual-level criteria to define the sample for developing the GWG standards; and 2) a revised list
of recommended individual-level criteria that considers the availability of the data in eligible studies. The working group reviewed background literature on individual eligibility criteria from studies that had been conducted to develop GWG curves published in the last 10 years. In addition, the working group reviewed the conceptual framework based on the 2009 Institute of Medicine (IOM) guidelines and other relevant references.

As part of its review, working group 1 considered three questions: 1) Are there other studies that have explored similar eligibility criteria? 2) Are there any established conceptual/causal frameworks for GWG determinants that need to be considered in addition to the IOM guidelines? 3) What is the list of relevant maternal and child outcomes that need to be considered? Based on these discussions, the working group elected to use the IOM 2009 guidelines as a starting point, adding further work to augment the framework with more recent literature.

As part of its work to establish eligibility criteria, the working group considered evidence about whether GWG charts should exclude individuals with excess postpartum weight retention (PPWR). Data from a Swedish cohort found that GWG curves did not change after excluding women with excess PPWR. In contrast, a study on the impact of potential exclusion criteria on percentiles of GWG charts in the United States found that excluding women with high PPWR was the only variable that shifted GWG percentiles. Given the contradictory evidence, the working group is discussing how to define a healthy cohort and determine which of the adverse outcomes linked with GWG should be included or excluded.

The working group has discussed various criteria for determining inclusion/exclusion of variables (e.g., the prevalence and/or the strength of association with GWG, sufficient evidence, clinical significance or severity of an outcome). In addition, the working group has considered how the current IOM conceptual framework should be extended, updated or adapted and how it should consider data availability (Annex III). New variables shown in the literature to be associated with GWG have been proposed (e.g., socioeconomic level, employment status, parity, maternal height, interpregnancy interval, sleep, sedentary behaviour, micronutrient status) and outcomes (e.g., special care nursery admission). Based on the literature, the working group suggested additional variables that are determinants and outcomes of GWG (Table 1).

Table 1. List of potential determinants and outcomes of GWG

<table>
<thead>
<tr>
<th>Potential determinants of GWG</th>
<th>Potential outcomes of GWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>• BMI – underweight, overweight, obesity</td>
<td>• Caesarean delivery</td>
</tr>
<tr>
<td>• Time initiating prenatal care</td>
<td>• Gestational diabetes mellitus</td>
</tr>
<tr>
<td>• Country</td>
<td>• Pregnancy-induced hypertension or pre-eclampsia</td>
</tr>
<tr>
<td>• Neighbourhood environment</td>
<td>• Postpartum weight retention &gt; 5 kg</td>
</tr>
<tr>
<td>• Co-morbidities (diabetes mellitus and hypertension)</td>
<td>• Small for gestational age</td>
</tr>
<tr>
<td>• Low socioeconomic status (education, income)</td>
<td>• Large for gestational age</td>
</tr>
<tr>
<td>• Rural residence lower</td>
<td>• Perinatal death (including stillbirth)</td>
</tr>
<tr>
<td>• Parity (more than five)</td>
<td>• Miscarriage</td>
</tr>
<tr>
<td>• Age</td>
<td>• Pre-term birth</td>
</tr>
<tr>
<td>• Perceived discrimination (race/ethnicity)</td>
<td>• Admission to neonatal intensive care unit</td>
</tr>
<tr>
<td>• Stress</td>
<td>• Congenital defects</td>
</tr>
<tr>
<td>• Irregular menstrual cycle</td>
<td>• Length of gestation (&lt;37 or &gt;42 weeks)</td>
</tr>
<tr>
<td>• Maternal/paternal/fetal genotype</td>
<td>• The newborn’s Apgar score after 5 minutes</td>
</tr>
<tr>
<td>• Rural (poor) versus urban (higher-income)</td>
<td>• Non-sustained breastfeeding</td>
</tr>
<tr>
<td>• Medical complications, and previous health care use</td>
<td>• Maternal post-partum haemorrhage</td>
</tr>
<tr>
<td>• Sex of neonate</td>
<td>•</td>
</tr>
</tbody>
</table>
After creating an extended, updated or adapted IOM conceptual framework on GWG, the working group will abstract a list of variables that both predict GWG and are a consequence of GWG. The working group will recommend the criteria to be applied to the long list of variables and provide a shorter list of factors that can be proposed as part of the individual-level eligibility criteria and identify potential stratifying factors, which may change based on data availability.

A systematic review, led by Helena Teede, is being performed in parallel to update a previous 2017 systematic review on association of GWG with maternal and infant outcomes, considering the additional study characteristics and outcomes generated by working group 1. Results will help to validate the decision on the list of criteria to be used to define the sample. Progress thus far on the systematic review includes generating the PICO (patient, population, intervention, comparison and outcome), registering the Prospero document, defining the outcomes and expanded study characteristics, creating the data extraction tables and refining definitions. The group found and screened around 16,000 relevant search results. Data extraction includes pregnancy, birth and long-term health outcomes for mother and child. Data extraction will be largely conducted during December 2023 and January 2024, with a brief report produced towards the end of February 2024, followed by a publication plan. Criteria should be extracted by March 2024. Much of the information that the TAG-GWG is seeking could be difficult to extract from the studies, especially in an aggregate context; however, it will provide important detail about the type of outcomes that have been reported across the literature.

Discussion and questions:

A question was raised about how PPWR could be a determinant of GWG.
- Working group 1 responded that PPWR was being considered as an outcome of GWG. The inclusion/exclusion of this criterion is therefore being considered to determine whether it affects the standard. In theory, if high GWG increases the chance of PPWR and obesity, these women should not be retained in the standard because it would normalize higher GWG that leads to adverse outcomes. However, in practice, inclusion/exclusion may not make a practical difference to the curves.

There was a comment that using PPWR to define the healthy population would require observation beyond the time of birth, which would limit the sample, as few data sets are available. If the timepoint goes beyond birth, other variables could also be relevant.
- The working group noted that the list is a compilation of all potential variables. After the global call for data (see Session 3, below), the group will assess data availability and decide which variables are feasible.

A comment was made about PPWR and its relationship to prematurity and multiparity.
- The working group responded that parity would be modelled. While parity is indeed a determinant of GWG, it is unlikely to affect healthy outcomes, and as such, it would not be necessary to adjust for it when generating a standard.
- BMI is the most important determinant of weight gain in the data already modelled from low- and middle-income countries (and some high-income countries). Curves will therefore need to be stratified by BMI. Other stratifying factors are being considered, such as ethnicity; however, it was noted that ethnicity is not well measured in most data sets.

There was some discussion about whether one standard for the global population was indeed possible and whether such a global standard would ignore differences in cut-off points. One adviser suggested the TAG-GWG find consensus on what constitutes a different or similar distribution.
- The working group responded that the appropriateness of developing a global standard would only be known once the data are modelled.
- The GWG Steering Committee stressed that the intended outcome is indeed to construct a global GWG standard that applies to any pre-pregnancy BMI. The literature suggests that ethnicity has only a minor influence on GWG. The data sets used to construct the standard will reflect different geographies and ethnicities. Any limitations to the standard will be acknowledged. Once the global standard has been developed, future work could be undertaken to define different cut-offs based on regions.
There was discussion about the consequences of excluding the many adverse outcomes, which may leave only a small sample from which to construct curves. This will have to be considered once the data sets become available. Longer-term outcomes are also not available in data sets from most low- and middle-income countries. Defining an ideal list of criteria is thus only a first step; the list will need to be modified based on data availability.

Session 2: Updates from working group 2 on the identification and harmonization of databases

Nandita Perumal described the objectives of working group 2 to: 1) propose additional search strategies for identifying eligible studies for the pooled data set; 2) propose approaches for adjustments that might be required in specific variables (e.g., hierarchy, conversions, plausible ranges); and provide feedback on harmonization strategies.

On the first objective, working group 2 has reached out to large organizations working in maternal and child health, academic societies, global NGOs, and individual investigators to raise awareness about the global call for data (see Session 3) and encourage investigators to contribute data. TAG-GWG members are encouraged to share the global call for data with relevant colleagues.

WHO is maintaining a database of all studies, including investigators that have been contacted to contribute data, or who have contributed data, or those whose data the TAG-GWG has access to via the Bill & Melinda Gates Foundation Knowledge Integration (Ki) database.

Regarding the working group’s second objective, the harmonization of pre-conception weight and other key variables identified by working group 1 is underway; these discussions will serve as a template for discussing other variables that will be harmonized.

As part of harmonization efforts, the working group has established a GitHub repository (managed by the GWG Steering Committee) where working group members can view updates and changes to the harmonization code. Once more data are available, the working group will discuss strategies for harmonization based on the form of the variables contributed in the data. A limiting factor is not having access to microdata to test potential strategies prior to recommending specific approaches. Once the working group has access to more microdata, the next step will be to explore targeted strategies and consultative work to support decision-making. Some aspects can be anticipated, such as the variation in timing of assessment of pre-conception weight, while other aspects may not be anticipated.

Session 3: Data acquisition and study eligibility status

Giovanna Gatica-Domínquez and Richard Kumapley described the global call for GWG data and studies identified in a literature review (see the Report of the First Meeting of the TAG-GWG).

Thus far, 82 studies have been received through the global call for data. Of these, 19 studies were eligible, 23 studies may be eligible, 34 studies were not eligible, and two studies are still being reviewed to determine eligibility. The remaining four studies did not have enough information to access eligibility. Ten more applications were received during the week of the Second TAG GWG meeting. In addition to the global call, 84 studies were identified as potential contributors to the GWG database and respective principal investigators were contacted. Nine principal investigators submitted the online form and, of these, four studies were eligible, one may be eligible and four are still under assessment by the GWG Steering Committee.

The call for data has been extended; the deadline to submit the online form is 29 February 2024 and data can be submitted thereafter. The GWG Steering Committee has created an online form for those invited to submit data in order to differentiate the source of the responses, but the questions are the same.

Overall, 46 eligible studies have been identified thus far. They cover 46 out of 198 countries and areas (23% world population coverage). Some countries, such as Brazil, India and Mexico have more than one study. The coverage of eligible countries by both income classification and geography (based on the data received thus far) was presented.
Data sharing agreements for these eligible studies are now underway to allow access to the microdata. These data agreements are narrow in scope and cover only the GWG project; therefore, the data cannot be used for any other WHO research without the prior written approval of the data provider. Data received thus far include original studies, administrative data and medical records information.

The first step in the data sharing process is for the data provider to share the data sharing agreement with WHO and together they work to reach consensus on agreement. Next, both the data provider and WHO sign the agreement and the data provider begins sharing the microdata. WHO has a repository ready for the data once the agreement is signed.

**Discussion and questions (sessions 2 and 3):**

There was a request for more information about the lack of microdata and its impact on decision-making.

- The working group responded that while assumptions could be made, a true assessment of impact would require microdata. For example, the group can anticipate variation across studies in the timing of pre-pregnancy weight assessment and that analytical decisions will need to be made on which time periods or methods (e.g., self-reported) will be included and how differences will be reconciled.
- An adviser suggested that the working group intentionally prescribe what it plans to do before looking at the data and then adapt the approach as necessary once data are available.

Regarding the global call for data, there was a request for the GWG Steering Committee to share a list of the organizations and individuals that had already been approached about submitting data, as well as those from whom a response is awaited. Keeping this information as an updated list would allow TAG-GWG members to better support the follow-up process without duplicating efforts.

- The GWG Steering Committee agreed to share such a list, including the status of contact with each study team.
- Steering Committee welcomed the support of TAG-GWG advisers in reaching out to principal investigators who had not responded, as well as identifying other possible study teams. Advisers were asked to review the list and let the Steering Committee know if they could support.
- It was noted that the eligible data received thus far show good geographical and income distribution.
- There was a suggestion to share the list of 82 potentially eligible studies/data sets with the team working on the systematic review (described in Session 1) to ensure as many as possible are captured; the GWG Steering Committee agreed to do so.

There was a question about whether data providers could be asked to begin harmonizing their data before sharing it.

- The GWG Steering Committee noted that a minimum list of variables is provided as part of the global call for data, along with a guide to harmonization on the format in which data should be shared. This information could be reiterated during the signing of the data sharing agreement.
- It was acknowledged that having the data already harmonized before receipt could also introduce complications, and as such, raw data may be preferable.

There was a suggestion to track the reasons for data ineligibility to determine whether more data are being excluded from a particular region.

- The GWG Steering Committee agreed that this could be done.
- The main reasons for data ineligibility thus far include sample size and lack of ultrasound data confirming gestation age (which is a WHO criterion).

Regarding geographical distribution maps, there was a question about whether data from research studies would be differentiated from administrative data sets, noting that the former data may cover only a segment of the population whereas the latter data tend to be national.

- The GWG Steering Committee responded that the types of data can be differentiated. At present, there are only two administrative data sets: one from Uruguay and one from the city of Geneva. Sample sizes vary. The cut-off sample size is 200.
- In the data analysis phase, the sample size, data source, representativeness and methodology will need to be accounted for in the modelling.
• A suggestion was made to update the geographic coverage maps for the next TAG-GWG meeting in March 2024.

There was a question about whether principal investigators could contribute data to the project by doing the analysis in the host country rather than sharing the data. In China and Finland, for example, legislation precludes data sharing.

• The GWG Steering Committee replied that this would not be feasible as the data are needed to construct curves; however, these data could be considered as part of the definition of optimal ranges.

3. SUMMARY OF DAY 2 PRESENTATIONS AND DISCUSSIONS

Day 2 sessions were chaired by Suzanne Phelan, Özge Tuncalp and Olufemi Taiwo Oladapo, WHO/SRH, were introduced to TAG-GWG advisers; they will take over the lead of the GWG-TAG during the second phase of the project. Summaries of the day 1 discussions were provided as follows:

Working group 1 will:
• Continue to build the list of consistent factors to be used for inclusion/exclusion criteria in the context of known trade-offs.
• Consider different factors, such as geographic location, ethnicity, parity and other variables to determine their compatibility before they can be processed together to produce global standards (term to be confirmed).

Working group 2 will:
• Share the current list of studies received to allow TAG-GWG advisers to offer additional suggestions and reach out to or follow up with the principal investigators they know personally
• Share the list of studies identified in the literature review to support the systematic review
• Present data coverage by data source type.

Session 4: Updates from working group 3 on methods for the development of GWG standards

Eric Ohuma provided an overview of the working group 3 key outputs, which contribute towards developing the statistical methodology that will be applied for the development of the global standard. These outputs include:
• Data analysis flow for data exclusions identified by working group 1 and heterogeneity analysis (i.e., compatibility of the different data sets obtained)
• Method selection to flag outliers, considering cross-sectional and/or longitudinal approaches
• Method selection to assess heterogeneity after pooling data from multiple sources, including the levels to be considered in this assessment (e.g., study, country, region)
• Method selection to calculate the minimum sample size to model the GWG centiles (e.g., sample sizes for the different BMI categories)
• Selection of the statistical approach to generate the GWG centiles, including diagnostic and validation procedures to be adopted for each model.

Regarding the first output on the data analysis flow, the working group recommended the following:
1. Variables to consider in the identification of outliers: weight, height, weight gain (two time points), pre-pregnancy BMI and gestational age
2. Adoption of a systemic process for excluding data points only. The first step in this process comprises the identification of gross data entry errors (e.g., 9999, 0) in the individual data sets before combining them
3. The second step comprises the application of a common process for identifying cross-sectional/longitudinal outliers in the individual data sets before any other step
4. After removal of outliers, the group recommended evaluating the heterogeneity of weight gain and other key variables/distribution parameters; then, identifying and removing outliers in the key variables in the complete data set.
These processes will be prescribed before looking at the data and will be applied consistently across data sets. The next working group 3 meeting will involve a deep dive into the methods for detecting outliers.

**Discussion and questions:**

There was some discussion about potential biases in registered data. For example, a question was raised about whether a woman in the sample with gestational diabetes could have received a diet-related intervention that influences GWG.

- The working group acknowledged that this is a limitation of using data that were not necessarily collected with the intention of measuring GWG. As such, data could come from studies where other interventions were implemented.
- Working group 1 was also asked to respond to this question, given its focus on exclusion criteria. Working group 1 explained that women with comorbidities in pregnancy, including gestational diabetes, would likely be removed from the sample. This is because when data sets were requested, the GWG Steering Committee had asked for intervention studies with control arms that used standard of care during pregnancy. It would, however, be difficult to know whether any of the women had received counselling on GWG during pregnancy.

There was some discussion about how GWG would be assessed over the course of the pregnancy and how this would be managed with data using only two time points for measurement.

- The working group clarified that it would be tracking patterns of cumulative weight gain rather than the velocity of weight gain or total weight gain.
- There is no pattern of “healthy” weight gain. Given the large variation in GWG patterns, it will be important to use metrics that can summarize average weight gains at different intervals of gestational age.
- Women with data for only a certain period would contribute data to only that time interval and could still contribute to constructing the curves.

There was a question about how differences identified in the heterogeneity analysis would be managed.

- The working group responded that it was focusing on the process and methodology to be used to assess heterogeneity. The working group could consider the relevance of the different approaches used to develop other WHO standards.

There was a comment about the different WHO cut-off points for defining overweight and obesity in Asian women and other populations.

- If the TAG-GWG agrees, the GWG Steering Committee would like to look into how different BMI classifications affect the GWG trajectory.
- One adviser noted that defining ethnicity is challenging. However, the aggregate data show that if the BMI classification is correct by ethnicity, the international standard is the same for all women.
- BMI classification pre-pregnancy is key. It will be important to test different BMI categories using data from the Harvard project.
- WHO clarified its position on BMI classification: For pre-pregnancy BMI cut-offs, the TAG-GWG will help define different ranges to be considered and select one. In terms of absolute BMI, cut-offs will not be made based on standard deviations. There is no way of using different cut-offs for different populations. However, different populations will be taken into account when defining the cut-off ranges to be applied for all women.
- WHO advised working group 1 to consider the alignment of the selection criteria with WHO global guidance. Specifically, in addition to focusing on criteria that make a difference to the weight gain of the mother, it would also be important to exclude unhealthy behaviours or outcomes (e.g., women with pre-term births).

There was a suggestion for the TAG-GWG to decide how it would respond in the case that the data show it would not be possible to develop a single global standard.

- It was suggested that working groups 1 and 3 could discuss this issue further and propose any recommendations.
Session 5: Workplan for 2024

Elaine Borghi presented a table of TAG-GWG deliverables for the 2024–2025 period. The deadline for the construction of the GWG standard is September 2025.

Several interim deadlines were also noted: the systematic review should be completed by March 2024; data acquisition will be ongoing until September 2024; data harmonization will be extended to December 2024; a technical report will be published describing the final underlying sample for the GWG standards in February 2025; and the curves will be constructed between January and June 2025, with a report published on the final GWG standard in September 2025, including methods and outcomes (see Annex IV).

The GWG Steering Committee noted that while some deliverables are contingent on the working groups, other deliverables, such as the signing of data sharing agreements, will depend on factors beyond the TAG-GWG’s control.

Discussions and questions:

There was a question about whether there would be opportunities to use the GWG data sets for additional analysis, after completion of the project.

- The GWG Steering Committee responded that the data sets can only be used to develop the GWG standards, as this is a principle upon which the data have been shared.

There was a question about the whether there was an estimate of the minimum number of data sets needed to effectively develop the GWG standard.

- A key task of working group 3 will be to answer this question.

One adviser noted the potential challenge of obtaining data from the extremes of the BMI range from different parts of the world. This is a natural consequence of selecting only healthy pregnancies, as there will be fewer women with BMIs at the extreme ends of the classification.

- There was a suggestion to consider modelling first on healthy pregnancy and then later on the IOM guidelines. The IOM model would have a much larger data set and could serve as a ‘back up’ if there are inadequate sample sizes for some BMI categories. This was previously done by Helena Teede’s research group and the results were the same.

- While some systemic review data have validated the use of IOM guidelines across the world, it was noted that the authors of the IOM report explicitly stated that they should not be used globally. Several advisers expressed discomfort with the idea and suggested that if TAG-GWG were to proceed with such an exercise, it would be important to be cautious about how the objectives were communicated.

- It is important to understand the impact of certain characteristics of the sample on GWG to determine whether it makes a difference to exclude these data sets. This will help to achieve balance between validity and retaining the largest sample size possible. It is important to note the reason for data exclusions as part of this process. There was a request for statisticians within the TAG-GWG to review the approach to the systematic review variables to make sure that it reflects the needs of working group 3.

There was further discussion about the importance of keeping track of the reasons for data exclusions.

- A review of study-level eligibility has already been carried out and the exclusions are non-negotiable in order to align with WHO guidance. However, when individual-level eligibility are considered, it will be important to track which data sets are being removed and analyse what, if anything, is being missed and whether these exclusions should be reconsidered, with the aim of recovering more women for the sample. Much work can be done in advance to identify the variables with the most impact.

There was some discussion about the challenge of defining ‘healthy’ women, and the relationship between pre-pregnancy BMI and healthy pregnancy.

- The GWG Steering Committee noted that healthy, uncomplicated pregnancy was being defined as healthy pregnancy outcomes for mother and newborn, and as such, higher BMIs would not necessarily be excluded. Factors that cannot be controlled for will be indicated as limitations. In terms of defining healthy outcomes, it would be those outcomes that are influenced by GWG, based on the systematic review.
• There was a recommendation to have a broader discussion on this point during the next TAG-GWG meeting in March 2024.
• A mandatory variable for all data is birth outcome (in order to exclude low birthweight babies, etc.). Primary investigators are also asked to provide any variables related to diabetes and hypertension, where available.

Next steps
The third TAG-GWG meeting will be held in March 2024. There was a proposal made for working group 1 to begin meeting twice a month given its workload. The GWG Steering Committee invited Hayfaa Wahabi to join any of the working groups.

On behalf of WHO, Elaine Borghi closed the meeting and thanked participants for their contributions.
ANNEX I. Meeting participants

TECHNICAL ADVISORY GROUP ON GESTATIONAL WEIGHT GAIN (TAG-GWG)

- Professor Annick Bogaerts (Belgium)
  Midwife, perinatal epidemiology, lifestyle interventions (RCT), mental health
- Professor Amel Fayed (Egypt)
  Public health and biostatistics
- Dr S. M. Tafsir Hasan, MD MSc
  (Bangladesh) Maternal Nutrition, public health
- Dr Kari Johansson (Sweden)
  Perinatal epidemiology
- Professor Lisa M. Bodnar (United States)
  Epidemiology, maternal nutrition, adverse pregnancy outcomes
- Dr Cinthya G. Muñoz-Manrique (Mexico)
  Maternal-neonatal mortality and morbidity in high-risk women
- Dr Eric Ohuma (Kenya)
  Medical statistician on maternal, newborn and child health
- Dr Jodie Dodd (Australia)
  Obstetrician and maternal fetal medicine specialist research – not available to participate
- Dr Hayfaa Wahabi (Sudan)*
  Obstetrics and Gynaecology and Maternal Epidemiology
- Professor Aris Papageorghiou (Germany)
  Maternal and perinatal health, maternal disease in pregnancy, fetal diagnosis and therapy and ultrasound
- Dr Nandita Perumal (India)
  Perinatal epidemiology and global maternal and child health
- Professor Suzanne Phelan (United States)
  Kinesiology, public health, maternal and child nutritional assessment
- Dr Dayana Rodrigues Farias (Brazil)
  Nutritional epidemiology
- Professor Harshpal Singh Sachdev
  (India) Paediatrician, paediatrics and clinical epidemiology, maternal and child nutrition
- Professor Helena Teede (Australia)
  Public health, epidemiology, healthy gestational weight gain and health in women of reproductive age
- Dr Molin Wang (China)*
  Epidemiology, biostatistics, gestational weight gain assessment

GWG STEERING COMMITTEE

From the WHO Secretariat:
- Francesco Branca (NFS Director) *
- Elaine Borghi (MNF/NFS)
- Giovanna Gatica-Domínguez (MNF/NFS)
- Monica Flores-Urrutia (MNF/NFS)
- Richard Kumapley (MNF/NFS)

From external institutions:
- Gilberto Kac (Universidade Federal do Rio de Janeiro)
- Jennifer Hutcheon (University of British Columbia)
- Kathleen M. Rasmussen (Cornell University)

- Olufemi Taiwo Oladapo (SRH/MPH) – not available to participate
- Özge Tuncalp (SRH/MPH)*
- Allisyn Carol Moran (MCA/MAH) – not available to participate
- Maurice Bucagu (MCA/MPH) – not available to participate

- Mariana Arruda Silva (Universidade Federal do Rio de Janeiro)
- Thais Rangel Bousquet Carrilho (University of British Columbia)

*Present for day 2 only
ANNEX II. Meeting agenda

Chairs: Helena Teede and Suzanne Phelan

<table>
<thead>
<tr>
<th>Day 1: Wednesday, 6 December</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>14:00 – 14:10 (10 min)</td>
<td>Welcoming and introducing TAG-GWG chairs</td>
</tr>
<tr>
<td>14:10 – 14:20 (10 min)</td>
<td>Meeting agenda</td>
</tr>
<tr>
<td>14:20 – 14:45 (25 min)</td>
<td><strong>Session 1:</strong> Updates from WG #1 on the Individual-level eligibility criteria</td>
</tr>
<tr>
<td>14:45 – 15:20 (35 min)</td>
<td>Discussion</td>
</tr>
<tr>
<td>15:20 -15:30 (10 min)</td>
<td>Break</td>
</tr>
<tr>
<td>15:30 – 15:50 (20 min)</td>
<td><strong>Session 2:</strong> Updates of the WG #2 on Identification and harmonization of databases</td>
</tr>
<tr>
<td>15:50 – 16:20 (30 min)</td>
<td><strong>Session 3:</strong> Data acquisition and study eligibility status</td>
</tr>
<tr>
<td>16:20 – 17:00 (40 min)</td>
<td>Discussion</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Day 2: Thursday, 7 December</th>
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</thead>
<tbody>
<tr>
<td>14:00 – 14:10 (10 min)</td>
<td>Summary of Day 1 discussions</td>
</tr>
<tr>
<td>14:10 – 14:30 (20 min)</td>
<td><strong>Session 4:</strong> Updates on WG#3 Methods on the development of the GWG Standards</td>
</tr>
<tr>
<td>14:30 – 15:00 (30 min)</td>
<td>Discussion</td>
</tr>
<tr>
<td>15:00 -15:10 (10 min)</td>
<td>Break</td>
</tr>
<tr>
<td>15:10 – 15:40 (30 min)</td>
<td><strong>Session 5:</strong> Workplan for 2024</td>
</tr>
<tr>
<td>15:40 – 15:55 (15 min)</td>
<td>Questions &amp; answers (overall)</td>
</tr>
<tr>
<td>15:55 – 16:10 (15 min)</td>
<td>Rapid survey “How are we doing?”</td>
</tr>
<tr>
<td>16:10 – 16:20 (10 min)</td>
<td>Next steps</td>
</tr>
<tr>
<td>16:20 – 16:25 (5 min)</td>
<td>Closing statement</td>
</tr>
</tbody>
</table>
ANNEX III. Proposed extended/modified IOM conceptual framework on GWG\textsuperscript{11}

Determinants

Total and overall pattern of gestational weight gain
Outcomes

Total and overall pattern of gestational weight gain

- Consequences during pregnancy (preeclampsia and gest. DM)
- Consequences at delivery (c-section)
- Maternal mortality
- Special care nursery admission
- Fetal growth
- Preterm birth
- Birth defects
- Stillbirth
- Infant mortality
- Lactation
- Postpartum depression
- Weight retention
- Long-term consequences (i.e., DM 2 and CVD)
- Neonatal body composition
- Breastfeeding
- Infant weight gain
- Obesity
- Neuro-development (cognitive, motor, and psychological)
- Allergy/asthma
- Cancer

Note: As fetal growth is considered birth weight and size at birth.
## ANNEX IV. 2024–2025 work plan

<table>
<thead>
<tr>
<th>Final outputs/intermediate outputs</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jan</td>
<td>Feb</td>
</tr>
<tr>
<td>Individual-level eligibility criteria</td>
<td>X</td>
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<tr>
<td>Methodology for the construction of the global GWG standards, including the entire data processes and analyses</td>
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<tr>
<td>Method selection to flag outliers, considering cross-sectional and/or longitudinal approaches</td>
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<tr>
<td>Method selection to assess the heterogeneity after pooling data from multiple sources, including the levels to be considered in this assessment (e.g., study, country, region)</td>
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<tr>
<td>Method selection to calculate the minimum sample size to model the GWG centiles</td>
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<tr>
<td>Selection of the statistical approach, including diagnostic and validation procedures to be adopted for each model</td>
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<tr>
<td>Identify methodology to treat data imbalances, particularly by geographic distribution and other factors flagged as relevant</td>
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<tr>
<td>Protocol for the construction of the GWG standards</td>
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<tr>
<td>Final outputs/intermediate outputs</td>
<td>2024</td>
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### Outputs

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
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<tbody>
<tr>
<td>Development and closure of the GWG database</td>
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<td>Data acquisition</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Data harmonization</td>
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<tr>
<td>Technical report on the description of the final underlying sample for the standards</td>
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<tr>
<td>Construction of the GWG standards (report)</td>
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<tr>
<td>Technical report on the Global GWG standards: methods and outcomes</td>
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*GWG* stands for Gestational Weight Gain.
ENDNOTES

1 For more information about the process, see: <https://www.who.int/teams/nutrition-and-food-safety/development-of-global-gestational-weight-gain-standards>.
4 Hutcheon et al., 2013; Xu et al., 2014; Hutcheon et al., 2015; Cheikh-Ismail et al., 2016; Johansson et al., 2016; Santos et al., 2018; Huang et al., 2020; Kac & Carrilho et al., 2021; Thiruvengadam et al., 2022.
5 The IOM guidelines, which have been adopted in multiple countries, were developed primarily from evidence from high-income countries.
9 Those contacted (beyond the those reached by a normal WHO call for data) include: American Society for Nutrition, Optimistic Newsletter, the Micronutrient Forum, Healthy Mothers, Healthy Babies; USAID Advancing Nutrition; Alive and Thrive; the Global Health Network; Societies for Epidemiological Research; Society for Pediatric and Perinatal Epidemiologic Research; National Council for Scientific and Technological Development, Brazil; International Federation of Gynecology and Obstetrics; Knowledge Integration; International Union of Nutritional Sciences; Dohad Society; and Global Alliance for Improved Nutrition.
10 Coverage of eligible countries by income classification is as follows: low-income countries (30.8%); lower-middle-income (27.8%); upper-middle-income (15.1%); and high-income (24.2%). Coverage of eligible countries by geography is: Western and Northern Africa (8.3%); sub-Saharan Africa (29.2%); Oceania excluding Australia and New Zealand (7.1%); Latin America and the Caribbean (17.6%); Eastern Asia and South-eastern Asia (33.3%); Central Asia and Southern Asia (42.9%); and Australia, Europe, New Zealand and Northern America (23.9%).
11 Variables in the grey boxes in the conceptual framework were added after a review of the literature and references shared by TAG-GWG members from working group 1. In the figure in Annex IV, variables marked with an “X” are those to exclude individuals and variables with a star are those relevant but with challenges to be measured in studies.