Contents lists available at ScienceDirect

Children and Youth Services Review

journal homepage: www.elsevier.com/locate/childyouth

Multi-criteria techniques based proposals for the End of Childhood Index: Reference levels and compensation issues

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ARTICLE INFO

Keywords:
Performance bands
Composite indicators
Compensation
Multi-criteria techniques
Childhood

ABSTRACT

Child well-being is a subject of paramount importance, since a careful analysis of all the aspects related to childhood may have a major impact on the society as a whole. In this paper, based on the End of Childhood Index, which is a fully compensatory composite indicator published annually by the international organisation Save the children, we analyse the added information that can be provided through the use of multi-criteria analysis techniques. On the one hand, rather than analysing the overall performance of the countries by the use of the fully compensatory scenario, we make use of the international reference levels and performance bands provided by Save the Children itself, allowing to measure the distance of each country with respect to these levels. Besides, the use of a non-compensatory scenario offers interesting insights about the possible imbalances of each country, which is helpful in decision making processes. First, based on the data of the last available year, 2021, an overview of the worldwide analysis and a further detailed single region analysis is carried out. Second, a dynamic analysis over a period of five years (2017–2021) is undertaken. In this line, in order to guide childhood decision makers towards the identification of possible opportunities for improvement and the implementation of the corresponding action plans, the multiple reference point technique makes it possible to analyse the compliance in each one of the indicators, based on the use of distance reference levels and the joint consideration of a fully and non-compensatory composite indicators.

1. Introduction

Growing up in a stable and pleasant environment can have a significant positive impact, not only for the future citizens themselves, but also for their entire environment. According to Grantham-McGregor et al. (2007), an adult's annual income is reduced by about a fifth if he suffered a stunting in his childhood, which may lead to irreversible and damaging consequences for the medium and long term socioeconomic development of a country. Hence, children are essential to effectively boosting a country growth, especially when it comes to moving towards prosperity and a more sustainable world (Biggeri and Ferrone, 2022). As a consequence, several authors emphasize that analysing childhood is vital for the development and progress of humankind (Save the Children, 2008; Bárcena-Martín et al., 2017).

In this sense, since the publication of the *Convention of the Rights of the Child* by United Nations (1989), many initiatives concerning to analyse children's well-being from different angles have been undertaken. In this context, an exhaustive review on the indexes and techniques related to the child welfare has been carried out by Fernandes et al. (2011) and Cho and Yu (2020). Among them, let us mention, for example, Heshmati et al. (2008) and Dijkstra (2008), who, on the basis of UNICEF (2007) report, discuss alternative techniques for weighting and handling dimensions and indicators in order to provide reasonable overall rankings. Cho (2014) complemented the ranking method with the cluster analysis in order to group countries according to their similarities and differences in terms of the dimensions that measure children's well-being. Cho (2015), through a multidimensional approach, conducted an exploratory comparison of children's well-being in East and Southeast Asian countries. Bárcena-Martín et al. (2017) analysed household and country-level determinants of child deprivation by constructing a composite indicator. Prada and Sanchez-Fernandez (2021), with the aim of improving the limitations of the Child Well-being index of UNICEF, created an ad hoc index. Biggeri and Ferrone (2022) constructed the Child Sustainable Human Development Index in 60 countries from 2010 to 2017.

As for non-academic approaches in the field of childhood, the most prominent initiatives to be highlighted are: OECD (2009) constructed the well-being indicators aggregated in an index by six dimensions. Later

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https://doi.org/10.1016/j.childyouth.2024.107731
Received 13 July 2023; Received in revised form 3 June 2024; Accepted 3 June 2024

on, OECD (2021) developed the child Well-Being, which considers the average scores of countries on 20 key outcome indicators, placing them in three performance groups (yellow, green, red). UNICEF (2007) provides a league table of countries considering their average rank for six dimensions of child well-being. UNICEF (2021) provides a dashboard to monitor and compare a selection of indicators on child health and well-being by region, age group and income. Save the Children calculated the Child Development Index considering three indicators of children's health, nutrition and education (Save the Children, 2008; Save the Children, 2012). Later, from 2017 on, this organization expanded the analysis to eight indicators, resulting in the End of Childhood Index (Save the Children, 2017; Save the Children, 2021). To this end, they use the arithmetic average, which implies full compensation between indicators. It should be noted that they assess the performance of each country based on thresholds and five performance bands of each indicator given in an absolute way considering international standards.

Overall, these initiatives vary in terms of dimensions, indicators, countries included in the analysis or even techniques more o less sophisticated, although it can be stated that most of them develop and use indexes to provide league tables (Ben-Arieh, 2008; Cho, 2015). It is not arguable that in the last years, there has been an increased interest in composite indicators, including composite indicators related to children (El Gibari et al., 2019; Biggeri and Ferrone, 2022). This is hardly surprising in light of the multidimensional and complex nature of childhood issues, given that the use of composite measures facilitates the interpretation of the results and the drawing of cross-national comparisons. However, as stated by Cho (2014), providing the children's well-being results in an overall composite index may mask a large amount of country-specific information.

The multidimensional child well-being will continue to deserve attention, for at least two reasons, the relevance of the problem in itself and the dimension of the problem (Fernandes et al., 2011), being an explicitly recognised target by the 2030 Agenda (Biggeri and Ferrone, 2022). In this line, according to Ben-Arieh (2008), for its proper assessment it would be desirable to have composite measures that can adequately represent the overall well-being of children.

A myriad of methodologies to construct composite measures are found in the literature (Nardo et al., 2008; Gan et al., 2017). El Gibari et al. (2019) classified Multi-criteria techniques used to construct composite indicators in terms of the aggregation step, focusing on the compensation issue. According to Attardi et al. (2018), the quality of the construction of composite indicators is related to a good quality of underlying data. This occurs when the information provided by the composite measure is useful for policy-makers. In general, the joint consideration of both compensatory and non-compensatory composite indicators provides a richer information about the performance of the units (El Gibari et al., 2021). Therefore, the compensatory composite indicators are designed in order to provide an overall measure of the performance of each unit, while the non-compensatory ones are useful tools to point out bad behaviors.

However, few procedures to build composite indicators for different compensation degrees have been proposed. Tarabusi and Guarini (2013) build a function that somehow incorporates the two extreme cases of compensation: the full compensation represented by the weighted arithmetic mean and the zero compensation by the minimum function. Blancas et al. (2010) use the goal programming approach to develop two composite indicators, depending on the degree of compensation allowed between the strengths and weaknesses of the units. Ruiz et al. (2020) generalize the original reference point scheme proposed by Wierzbicki (1980) and Wierzbicki et al. (2000), which was adapted later on to build composite indicators based on two reference levels (Ruiz et al., 2011). In this direction, Ruiz and Cabello (2021) developed a new member of this Multiple reference point weak and strong composite indicators (MRP-WSCI), where a decision maker can establish a different compensation index for each indicator (or families, if this is the case), through the partially compensatory indicator (MRP-PCI). Therefore, the Multiple reference point methodology allows constructing different composite indicators depending on the compensation degree among the indicators.

Besides, the construction of composite indicators is sometimes based on the minimization of distance functions with respect to certain established reference levels. According to Miettinen (1999), a natural and comfortable way to provide preferential information for decision makers consists of giving reference levels. These reference levels can naturally define performance levels for the individual indicators and the corresponding distance function measures the position of each unit with respect to these levels. In this direction, although the TOPSIS technique (Hwang and Yoon, 1981) considers two reference levels, the ideal and anti-ideal ones, it allows for a full compensation among the criteria. Of the three methods mentioned above allowing the construction of composite indicators for different compensation degrees, only the Goal programming approach and the MRP-WSCI method are based on distance functions. The former analyses the position of each unit with respect to one reference level (aspiration level) while the latter allows the use of multiple reference levels.

Under this assumption, the paper aims to contribute to improve the measurement of the current End of Childhood Index (from now on, EoCI) by introducing MCDM techniques based on reference levels and different composite indicators regarding the compensation issue. In this line, with the potential usefulness of the MRP-WSCI method in mind, the purpose of this study is to demonstrate how it can provide a greater information to policymakers when analysing children's well-being across countries through the use of the thresholds and performance bands provided by the EoCI. Specifically, the EoCI establishes reference levels, based on international standards, for each indicator, making use of them only for the calculation of the global thresholds through the arithmetic average of the cut-off points of each band. This implies a loss of information about the countries' performance in each indicator and may lead to a misinterpretation of the results, since the indicators have a different measurement scale. Both limitations can be overcome by using the MRP-WSCI technique, given that its normalization allows the translation of all the indicators to a common measurement scale, which is maintained unalterable until the construction of the composite indicator. Besides, this normalization facilitates the interpretation of the results in terms of measuring, in the given performance band, how far is the performance of each country with respect to the reference levels established. Furthermore, The MRP-WSCI approach provides the possibility of complementing this information with the use of the non-compensatory scenario, which may be of special interest to policymakers, since the detection of existing warning signals is made in a practical and straightforward manner, making possible the reorientation and formulation of new priorities if this is the case. Therefore, the paper takes advantage of the MRP-WSCI method, in terms of, on the one hand, the use of the non-compensatory scenario and, on the other hand, the interpretation of each country's performance with respect to the individual absolute reference levels established by Save the Children. Specifically, the joint use of the non-compensatory scenario and the same scale for all the indicators throughout the entire process of construction of the composite indicator make results easier to understand and interpret, allowing to detect specific cases that go unnoticed in the process of constructing the EoCI. This analysis, both from a static and dynamic perspective, facilitates decision making in the appropriate direction and contrasting the effectiveness of the implemented strategies.

The manuscript is organized in the following way. Section 2 gives an overview of the EoCI, being the methodology adapted to its construction presented in Section 3. Section 4 provides an overall comparison of the results provided by the MRP-WSCI method with the End of Chilhood Index and suggests a dynamic analysis over five years. Finally, conclusions are given in Section 5.

2. Data: The EoCI

From 2017, an annual report on the main factors affecting childhood

Table 1
Indicators of the EoCI with the corresponding best and worst values and the performance bands. Own elaboration based on Save the Children (2021).

Indicators	Best value	Performance bands					Worst value	Description
		Very low	Low	Moderate	High	Very high		
Under-5 mortality rate	0	< 10	10 to < 25	25 to < 50	50 to < 100	≥ 100	156.9	The probability of dying between birth and exactly 5 years of age, expressed per 1,000 live births.
Child stunting	0	< 5	5 to < 20	20 to < 30	30 to < 40	≥ 40	57.5	Percentage of children aged 0-59 months who are below minus two standard deviations from median height-for-age of the WHO Child Growth Standards.
Out-of-school children and youth	0	< 5	5 to < 20	20 to < 30	30 to < 40	≥ 40	67.5	The number of children, adolescents and youth of official primary and secondary school age who are not enrolled in primary, secondary or higher levels of education, expressed as a percentage of the population of official school age. Children and young people (about ages 6 and over) who are enrolled in pre-primary education are considered to be out of school.
Child labor	0	< 5	5 to < 20	20 to < 30	30 to < 40	≥ 40	55.8	Percentage of children 5-17 years old involved in child labor.
Child marriage	0	< 5	5 to < 20	20 to < 30	30 to < 40	≥ 40	59.8	Percentage of girls 15-19 years of age who have been married and are not either divorced, widowed or separated.
Adolescent birth rate	0	< 15	15 to < 50	50 to < 100	100 to < 150	≥ 150	201.2	Births to women aged 15-19 per 1,000 women in that age group. Estimates are for 2018 for all but the three countries with supplemental data.
Population displaced by conflict	0	< 1	1 to < 2	2 to < 5	5 to < 20	≥ 20	65.4	Total population of concern to UNHCR, by country or territory of origin, expressed as a percentage of the country's or territory's population.
Child homicide rate	0	< 1	1 to < 5	5 to < 10	10 to < 20	≥ 20	32.8	Estimated number of deaths caused by interpersonal violence among children and adolescents aged 0-19 years (from WHO), expressed per 100,000 population in that age group (from UNDESA, Population Division).
The End of Childhood Index score		≥ 940	760 to 939	600 to 759	380 to 599	≤ 379		
		Relatively few children	Some children	Many children	Most children	Nearly all children		

around the world is carried out by Save the Children, an international organization for children. For this purpose, the EoCI is calculated taking into consideration eight indicators of type "the less, the better" and five performance bands (see Table 1). The country-level performance is assessed according to the thresholds established for each indicator on the basis of international standards (Save the Children, 2021).

The indicators are translated to a range from 0 to 1 by the Min–Max normalization as follows:

$$n_{ij} = \frac{(x_{ij} - worst_i)}{(best_i - worst_i)}, \tag{1}$$

where n_{ij} is the normalized value of indicator i ($i = 1,\ldots,8$) for country j ($j = 1,\ldots,J$), x_{ij} is the corresponding value before normalization, $worst_i$ and $best_i$ are, respectively, the highest and lowest values for indicator i ($i = 1, \ldots, 8$). This normalized value reflects the relative position of country j in relation to the best and worst global values of indicator i. In this way, the values of each indicator are translated to the same scale, which is [0, 1]. It should be noted that under this normalization scheme, it is assumed that the changes that occur in the value of the indicator have the same effect regardless of the performance band to which they belong.

Finally, the EoCI index is calculated through an aggregation over one step using the arithmetic average multiplied by 1,000 and therefore countries are ranked accordingly. This implies that the eight indicators have the same importance and full compensation between them is allowed. It should be noted that, in order to establish the five global performance bands and the corresponding cut-off points for each band, the boundary points between the thresholds (displayed in Table 1) are normalised for each indicator and then indexed through the arithmetic average, being multiplied by 1,000. This has two major implications: (a) the information provided by the individual thresholds is lost, since the individual reference levels are not considered in the construction of the EoCI index, but only to establish the global reference levels; and (b) the combination of the effect that the different cut-off points of the indicators can have (each one with a different scale), which may limit the interpretation of the results.

Summing up, according to the building process of the EoCI index, the results can be interpreted as an average distance to the worst value (relative to the range). Then, this average distance is classified into five performance bands according to the cut-off points obtained as relative averages of the thresholds of each indicator. Therefore, the values of each indicator are not compared with their corresponding thresholds, but only their corresponding average values with the average thresholds, assuming a loss of valuable information. Besides, the index score provides a compensatory global measure of the countries performances, without additional information about what happens in each indicator considered. In this line, we propose an analysis carried out based on the data provided by the EoCI for a period of five years (from 2017 to 2021). Besides, as done by them the results will be provided for the world as a whole and for a specific region based on the UNICEF's regional classification.

3. Methodology

The paper suggests the use of the Multiple reference point weak-strong composite indicator (MRP-WSCI) procedure. The method is an extension of undertaking objective rankings using two reference levels (Wierzbicki et al., 2000) and the construction of composite indicators with a focus on the compensation degrees among the criteria (Ruiz et al., 2011). The full generalized description of the MRP-WSCI method is detailed by Ruiz et al. (2020) for indicators of type "the more, the better" and by El Gibari et al. (2021) for indicators of type "the less, the better".

However, let us adapt the technique for the specific reference levels and scale used in this paper, that is from −20 to 30, with four intermediate reference levels ($q_i^1, q_i^2, q_i^3, q_i^4$). The authors consider this scale proposal, [-20, 30], to be consistent with the five performance bands set by the EoCI. In this line, it is deemed convenient to establish the zero level in the "moderate" performance one, in such a way that where children's rights are worst respected ("high" and "very high" bands), negative values will be considered. Note that any other scale could have been set without altering the interpretation of the MRP-WSCI results,

Table 2
Performance bands and reference levels of each indicator.

Reference levels	Indicators								Common scale	Performance bands
	Under-5 mortality rate	Child stunting	Out-of-school children and youth	Child labor	Child marriage	Adolescent birth rate	Population displaced by conflict	Child homicide rate		
[best , q^1)	[0 , 10)	[0 , 5)	[0 , 5)	[0 , 5)	[0 , 5)	[0 , 15)	[0 , 1)	[0 , 1)	(20 , 30]	Very low
[q^1 , q^2)	[10 , 25)	[5 , 20)	[5 , 20)	[5 , 20)	[5 , 20)	[15 , 50)	[1 , 2)	[1 , 5)	(10 , 20]	Low
[q^2 , q^3)	[25 , 50)	[20 , 30)	[20 , 30)	[20 , 30)	[20 , 30)	[50 , 100)	[2 , 5)	[5 , 10)	(0 , 10]	Moderate
[q^3 , q^4)	[50 , 100)	[30 , 40)	[30 , 40)	[30 , 40)	[30 , 40)	[100 , 150)	[5 , 20)	[10 , 20)	(-10 , 0]	High
[q^4 , worst]	[100 , 156.9]	[40 , 57.5]	[40 , 67.5]	[40 , 55.8]	[40 , 59.8]	[150 , 201.2]	[20 , 65.4]	[20 , 32.8]	[-20 , -10]	Very high

since the WCI and SCI are invariant to scale and origin changes (Ruiz et al., 2020).

First, since the eight indicators are of type "the less, the better" the achievement function takes the following form:

$$s_{ij} = \begin{cases} 20 + \dfrac{30-20}{q_i^1 - best_i}(q_i^1 - x_{ij}), & \text{if } best_i \leqslant x_{ij} < q_i^1 \\ 10 + \dfrac{20-10}{q_i^2 - q_i^1}(q_i^2 - x_{ij}), & \text{if } q_i^1 \leqslant x_{ij} < q_i^2 \\ 0 + \dfrac{10-0}{q_i^3 - q_i^2}(q_i^3 - x_{ij}), & \text{if } q_i^2 \leqslant x_{ij} < q_i^3 \\ -10 + \dfrac{0-(-10)}{q_i^4 - q_i^3}(q_i^4 - x_{ij}), & \text{if } q_i^3 \leqslant x_{ij} < q_i^4 \\ -20 + \dfrac{-10-(-20)}{worst_i - q_i^4}(worst_i - x_{ij}), & \text{if } q_i^4 \leqslant x_{ij} \leqslant worst_i \end{cases} \quad (2)$$

where x_{ij} is the value of indicator i ($i = 1,\ldots,8$) for country j ($j = 1,\ldots,J$) and ($best_i, q_i^1, q_i^2, q_i^3, q_i^4, worst_i$) are the six reference levels of indicator i. According to Ruiz et al. (2020), these reference levels can be established statistically depending on the dataset or they can be given in an absolute way by stakeholders or experts. Anyway, they must be set taking into account the objective of the analysis, since the results depend to a great extent on these levels (Gibari et al., 2022). The reference levels considered in this analysis are absolute ones and they have been exogenously set up by the EoCI itself. It is important to take into account that these levels remain unchanged for the whole period analysed later (from 2017 to 2021). This indicates that a country improvement or worsening is due to its own performance and not to the variations produced in the reference levels.

Then, we are going to evaluate the performance of each country with respect to these (absolute) levels. Therefore, there are four reference levels, $q_i^1, q_i^2, q_i^3, q_i^4$, for each indicator i ($i = 1,2,\ldots,8$), which correspond to the upper value of each interval defined in Table 2, for each case, respectively. The minimum and maximum values for indicator i, are taken as the *best* and *worst* values considered by the EoCI. From these levels, as noted in Table 2, the raw values of the indicators are transformed to a common scale ($\alpha^0 = -20; \alpha^1 = -10; \alpha^2 = 0; \alpha^3 = 10; \alpha^4 = 20; \alpha^5 = 30$), by using Eq. 2. Such scale naturally induces a classification of the performance for each indicator: very low ($20 < \alpha \leq 30$, colored blue in Table 2), low ($10 < \alpha \leq 20$, grey color), moderate ($0 < \alpha \leq 10$, yellow color), high ($-10 < \alpha \leq 0$, orange color), very high ($-20 \leqslant \alpha \leqslant -10$, red color), so that higher values mean a better performance. It should be noted that this common scale is maintained at the aggregation step, in such a way that the composite indicators calculated also oscillate between -20 and 30, with the corresponding five performance levels. Furthermore, the achievement function, s_{ij}, measures the relative position of country j with respect to the set levels.

It must be noted that all the reference levels used in this study (including the minimum and maximum values considered for each indicator) are exogenous. More concretely, we have used the limits defined by the EoCI for each performance band, as described in Table 1. Therefore, for example, for the first indicator (*Under-5 mortality rate*), $best = 0, q_1^1 = 10, q_1^2 = 25, q_1^3 = 50, q_1^4 = 100$ and $worst = 156.9$. Once these values are set, the achievement function of this indicator (s_{1j}) transforms these reference points, respectively, into the values 20, 10, 0, -10, -20 of the common scale, and calculates the corresponding values of each country for this indicator in this scale accordingly. Table 2 shows the absolute reference levels for the eight indicators and consequently the common measurement scale and the performance bands considered in the analysis. The first column (Reference levels) reflects the intervals defined for every indicator by the reference levels. The corresponding values q are specified for each indicator, as the endpoints of each performance interval, from columns 2 to 9. The column called "Common scale" shows the intervals of values for the achievement functions corresponding to each performance interval, and the last column indicates the label for classifying the performance of countries. Furthermore, the rows in Table 2 are color-coded according to the performance bands established, which is the same color code used in Table 1.

Besides, the EoCI considers that the eight indicators are equally weighted (Save the Children, 2021). Therefore, this analysis follows the same pattern being the next step aggregating the indicators. In this sense, the following aggregation scenarios are proposed:

- The weak (fully compensatory) composite indicator (WCI) measures the overall performance of each country and then is calculated as an arithmetic average:

$$WCI_j = \frac{1}{8}\sum_{i=1}^{8} s_{ij} \quad (3)$$

- The strong (non-compensatory) composite indicator (SCI) considers the worst performance of each country, taking the minimum value of the achievement functions:

$$SCI_j = \min_{i=1,\ldots,8}\{s_{ij}\}. \quad (4)$$

As noted, contrary to the EoCI, two composite indicators are obtained. This is due to the fact that, in our opinion, the measurement of the end of childhood demands the use of tools capable of transmitting a larger quantity of information in a simplified and easy-to-interpret manner to policymakers, thus enabling to make comparisons between nations and above all to develop more appropriate and effective policies with the information provided. This way, overall country's performance appraisal is evaluated through the WCI, while the possible failing indicators (and therefore to be better monitored by decision makers) are identified through the SCI.

According to El Gibari et al. (2021), minimal changes in the normalization and aggregation steps can have a major impact not only on the numerical results, but also on their meaning. In this line, before making comparisons of the results provided by the EoCI and MRP-WSCI

Table 3
Example - Original values, normalization procedures and final composite indicators.

Original values								
Indicator	Under-5 mortality rate	Child stunting	Out-of-school children and youth	Child labor	Child marriage	Adolescent birth rate	Population displaced by conflict	Child homicide rate
Hypothetical case	65.90	24.15	28.35	23.44	25.12	84.50	27.47	13.78

Min-Max normalization									EoCI
Indicator	Under-5 mortality rate	Child stunting	Out-of-school children and youth	Child labor	Child marriage	Adolescent birth rate	Population displaced by conflict	Child homicide rate	
Hypothetical case	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	580

MRP-WSCI normalization (Achievement functions)									WCI	SCI
Indicator	Under-5 mortality rate	Child stunting	Out-of-school children and youth	Child labor	Child marriage	Adolescent birth rate	Population displaced by conflict	Child homicide rate		
Hypothetical case	-3.18	5.85	1.65	6.56	4.88	3.10	-11.64	-3.78	0.43	-11.64

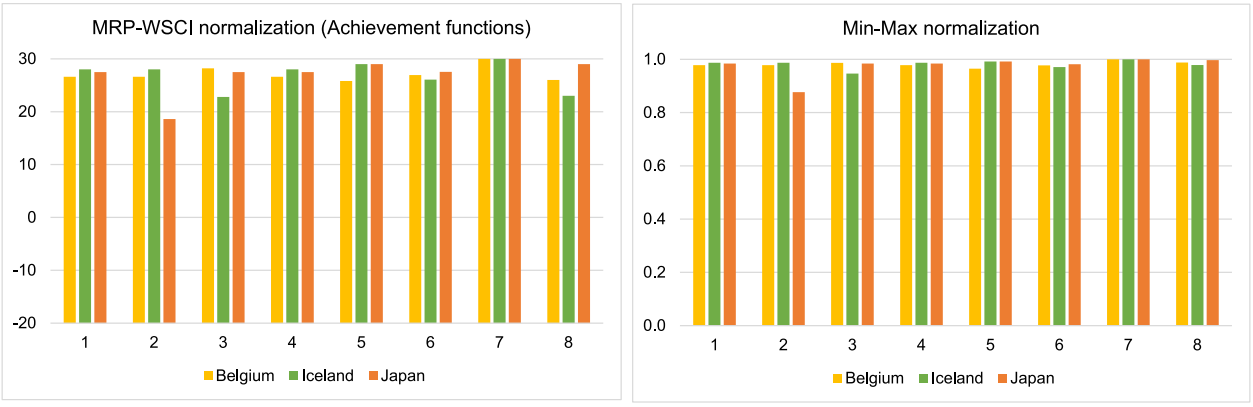

Fig. 1. MRP-WSCI and Min–Max normalization values of Belgium, Iceland and Japan.

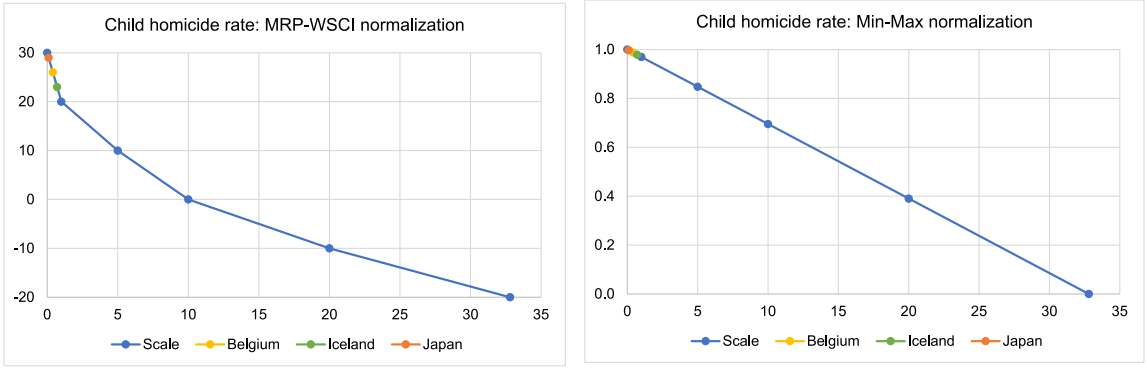

Fig. 2. MRP-WSCI and Min–Max normalization values of the *child homicide rate* indicator.

procedures, in order to illustrate the main differences between them and the effect of the compensation issue in the final composite indicators, let us consider a hypothetical case. It should be noted that, to this end, the indicators, individual thresholds and performance bands given by the EoCI will be used considering a hypothetical unit. Table 3 shows information about a hypothetical example where, according to the individual thresholds established by the EoCI, a unit is performing poorly in two indicators (*Under-5 mortality rate* and *Child homicide rate*), very bad in one (*Population displaced by conflict*) and moderately in the rest of the indicators. Following the EoCI procedure, it can be observed that

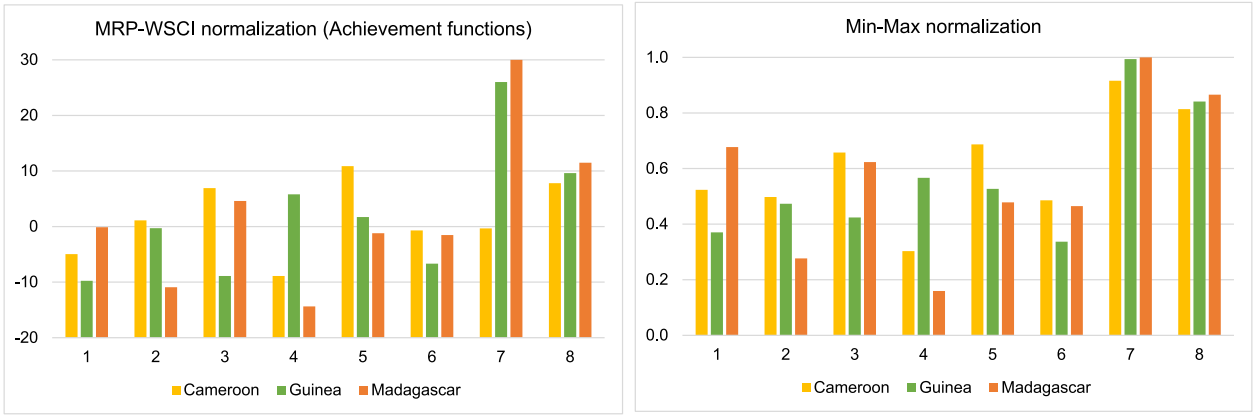

Fig. 3. MRP-WSCI and Min–Max normalization values of Cameroon, Guinea and Madagascar.

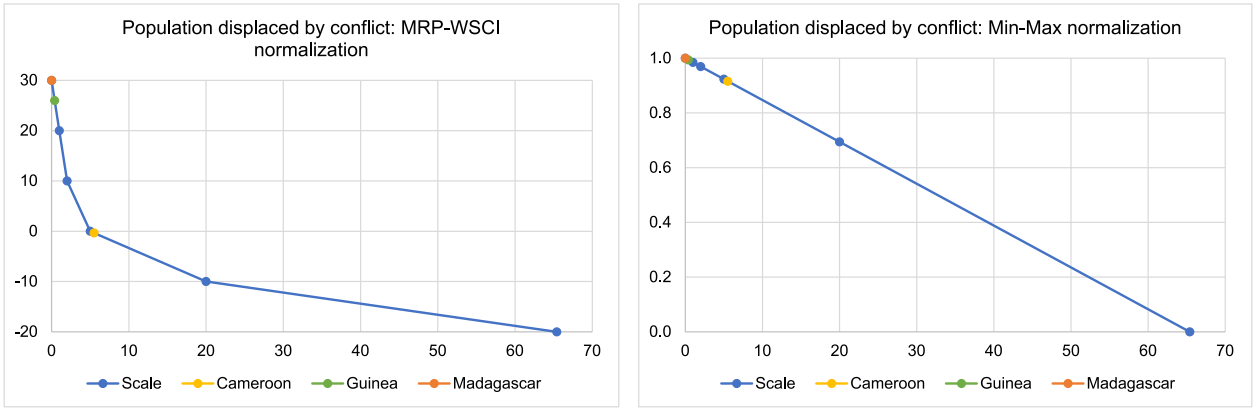

Fig. 4. MRP-WSCI and Min–Max normalization values of the *population forcibly displaced by conflict* indicator.

once the normalization is carried out using the Min–Max Method, all the indicators have the same normalized value (0.58). Note that this normalization procedure measures the deviation (or distance) from the worst individual values, while the intermediate performance levels are not taken into account. Finally, the EoCI index is 580, by calculating the average of the 8 indicators with the same value, 0.58, multiplied by 1,000, which is classified in the "high" performance band. Regarding the MRP-WSCI technique, it can be observed that the normalized values through the construction of the achievement functions provides information about the performance of this hypothetical unit in each indicator in relation to the individual predefined thresholds. On one hand, the use of the same scale for all the indicators and the corresponding colors associated to each performance band make results easier to understand and interpret (for example, the worst performance of this hypothetical unit is due to *Population displaced by conflict* indicator, −11.64, corresponding to its SCI value, indicates that within the "very high" performance band, this unit is 8.36 points away from the worst value, −20, and 1.64 from the upper end of the "very high" band, −10). On the other hand, the WCI value is 0.43, being classified in the "moderate" performance band, which makes more sense according to the individual performances of this unit, given that it has 5 of the 8 indicators classified in the "moderate" performance band, while the other indicators are closer to the upper end values, within the corresponding band. This highlights that, in the case of the EoCI procedure, in addition to the full compensation allowed among the normalized values, there is also compensation in the established scale itself, which is avoided by using the MRP-WSCI approach.

4. Results

In this section, a comparison of the scores of the EoCI with those obtained using the MRP-WSCI approach is carried out. To this end, focusing on the last available year, 2021, subSection 4.1 provides an overview of worldwide results; in subSection 4.2, we will compare the results obtained within the Latin America and Caribbean context ($j = 31$ countries); finally, subSection 4.3 carries out a dynamic analysis from 2017 to 2021.

4.1. A worldwide analysis

The indexes provided by EoCI and WCI make use of the arithmetic average, which implicates full compensation among the eight indicators. In fact, the EoCI and WCI rankings are very similar, being the Spearman's rank coefficient correlation between them of 99.17%. However, it should be noted that the main difference between the two fully compensatory scenarios is due to the normalization step. As indicated in Section 2, EoCI establishes absolute thresholds for each individual indicator, classifying them according to five performance bands (associated to the previously indicated colors in Table 1). This information is lost when the normalization is carried out through the Min–Max method, when the EoCI is constructed, and in fact, different global thresholds (obtained by compensatory aggregation of the individual ones) are used for each performance band. Meanwhile, the MRP-WSCI method makes use of the individual thresholds established for each indicator, translating them to a common measurement scale, which is maintained from the beginning of the process until the construction of the final indexes (WCI and SCI). In this line, as stated in Section 3, throughout the entire process, the performance of each country in each

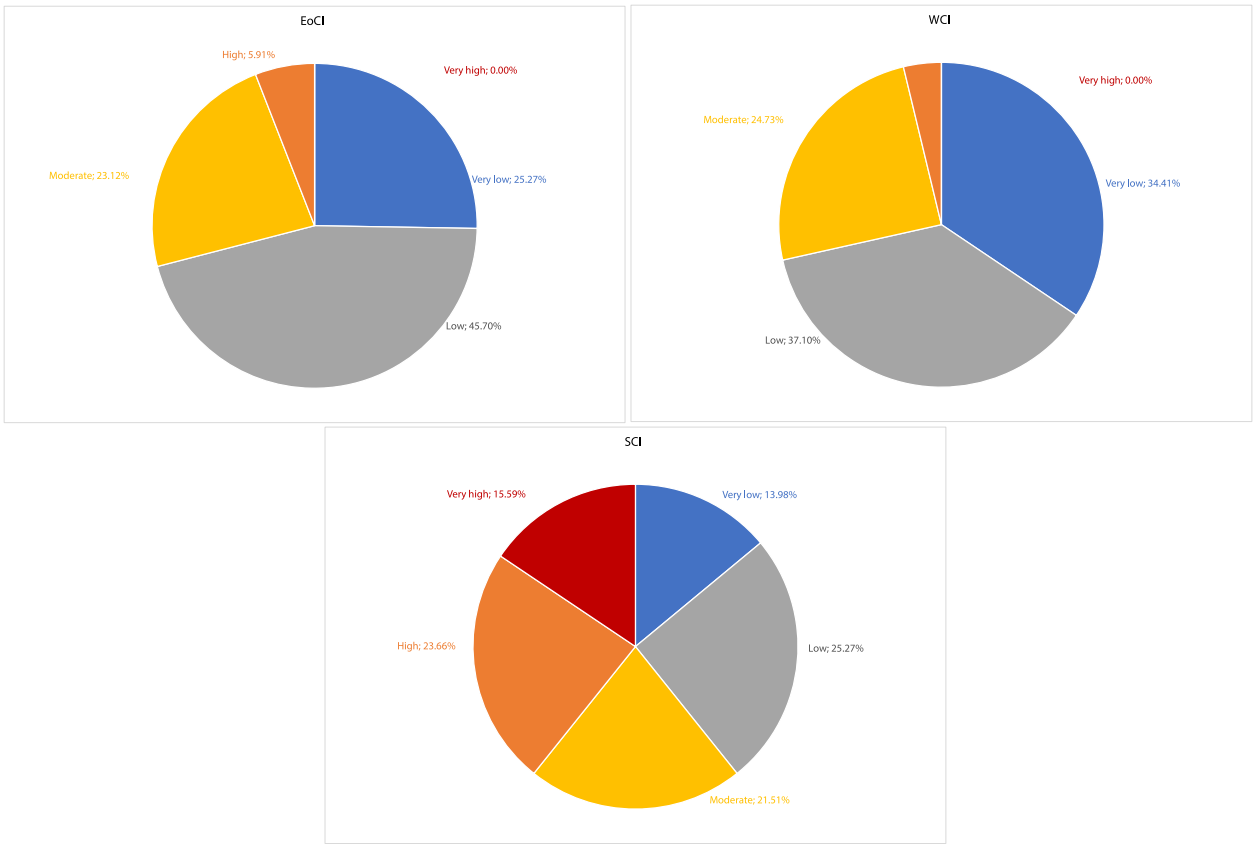

Fig. 5. Percentage of countries in each performance band for the EoCI, WCI and SCI.

Table 4
Percentage of countries in each performance band for each individual indicator.

	Percentage of countries							
Performance band	Under-5 mortality rate (deaths per 1,000 live births)	Child stunting (% children aged 0-59 months)	Out-of-school children of primary and secondary school age (%)	Children engaged in child labor (% ages 5-17)	Adolescents currently married or in union (% girls aged 15-19)	Adolescent birth rate (births per 1,000 girls aged 15-19)	Population forcibly displaced by conflict (% of total)	Child homicide rate (deaths per 100,000 population aged 0-19)
Very low	34.95%	26.34%	28.49%	43.55%	32.80%	28.49%	79.03%	32.80%
Low	26.88%	36.56%	44.09%	33.87%	52.15%	26.34%	4.30%	43.01%
Moderate	18.28%	16.13%	13.44%	16.13%	10.75%	33.33%	6.45%	17.20%
High	17.20%	15.59%	7.53%	3.76%	2.69%	9.68%	8.06%	5.38%
Very high	2.69%	5.38%	6.45%	2.69%	1.61%	2.15%	2.15%	1.61%

indicator (and in the final composite indicators) can be visually and easily analysed with respect to the absolute thresholds set by EoCI. Besides, the second advantage provided by the MRP-WSCI technique is the construction of the non-compensatory scenario, which, in addition to sharing the advantage of the interpretation of the performance of each country with respect to the predefined thresholds, identifies the worst performance(s) of each country, allowing decision makers to redress possible imbalance(s).

Table 6 in Appendix A records the world rankings 2021, where the countries placed at the Top 10 and Bottom 10 for the three composite indicators compared are displayed in blue and red, respectively. It can be observed that 8 countries are in the Top 10 positions in the three rankings, while 5 are not. Among these 5, Belgium and Iceland are in the 9^{th} position, according to the EoCI, while under the MRP-WSCI ranking, Iceland it is dropped to the 13^{th} position in the WCI and 17^{th} position in the SCI. Japan is ranked 10^{th} by the WCI, but 21^{st} by the EoCI and 37^{th} by the SCI. Let us compare the normalized values of these three countries, which are displayed in Fig. 1, where the eight indicators are denoted by 1 to 8 in the horizontal axis and the vertical axis records the corresponding normalized scale. Comparing both normalization procedures, it can be observed that the differences among the three countries can be better seen in the MRP-WSCI normalization (Fig. 1, left). Specifically, let analyse in further detail the *child homicide rate*, I8, indicator. To this end, Fig. 2 shows the normalized values of Belgium, Iceland and Japan in this indicator according to the original individual thresholds (horizontal axis) and the scale used by the EoCI and by the MRP-WSCI approach (vertical axes). The original values of these countries are Belgium, 0.4, Iceland, 0.7, and Japan, 0.1, being all of them classified in the "very low" performance band for this indicator, [0, 1). These performance differences are hardly appreciated through the Min–Max normalization procedure (Belgium, 0.988, Iceland, 0.979 and Japan, 0.997), while even these small differences, they are better seen by using the MRP-WSCI technique (Belgium, 26, Iceland, 23 and Japan, 29). Specifically, considering the Min–Max normalization for Belgium and Iceland, the

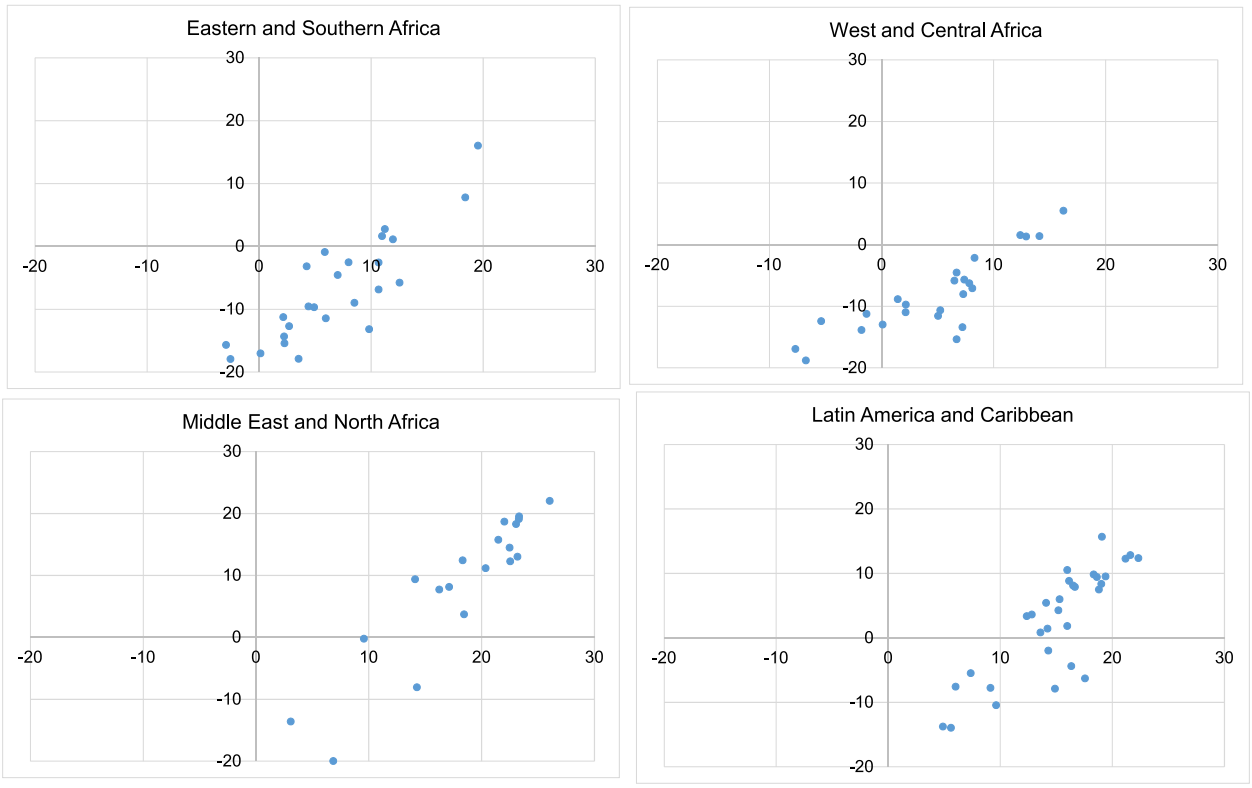

Fig. 6. Two-dimensional representations of WCI and SCI for Africa and Latin America and Caribbean.

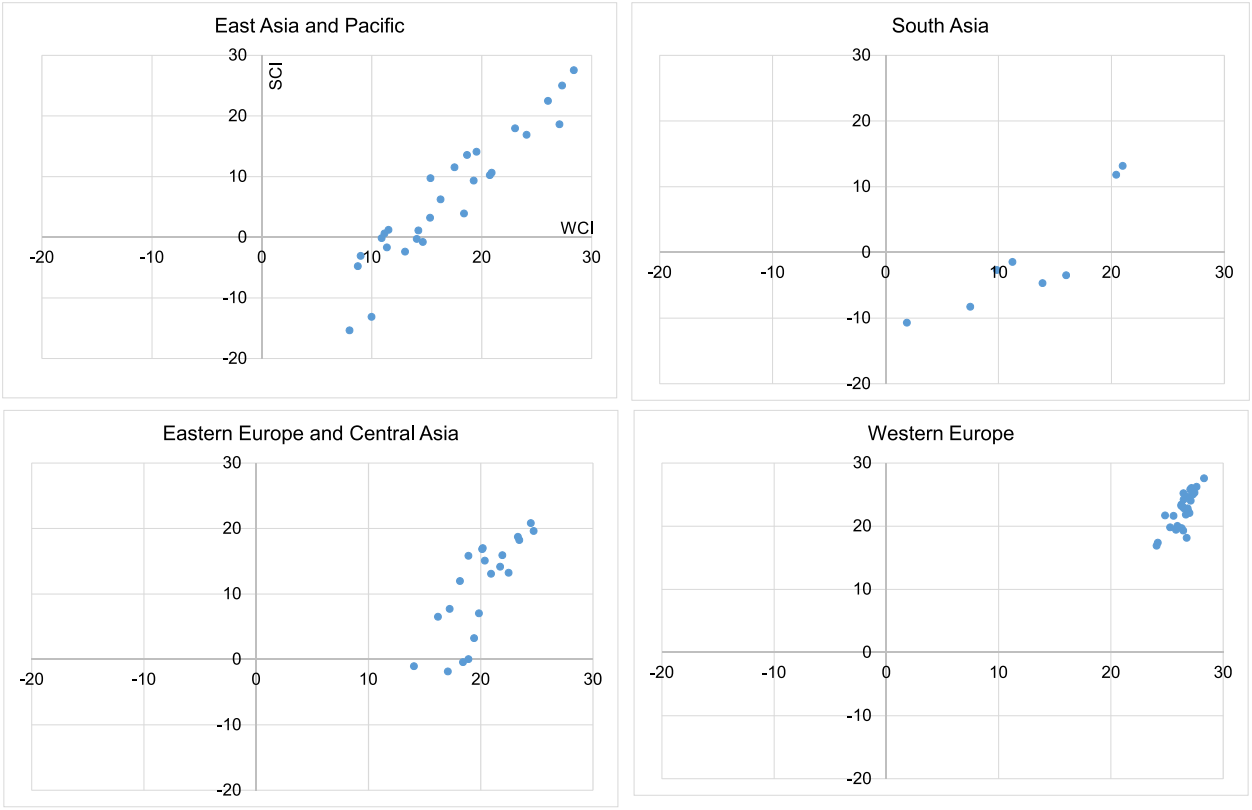

Fig. 7. Two-dimensional representations of WCI and SCI for Asia and Europe.

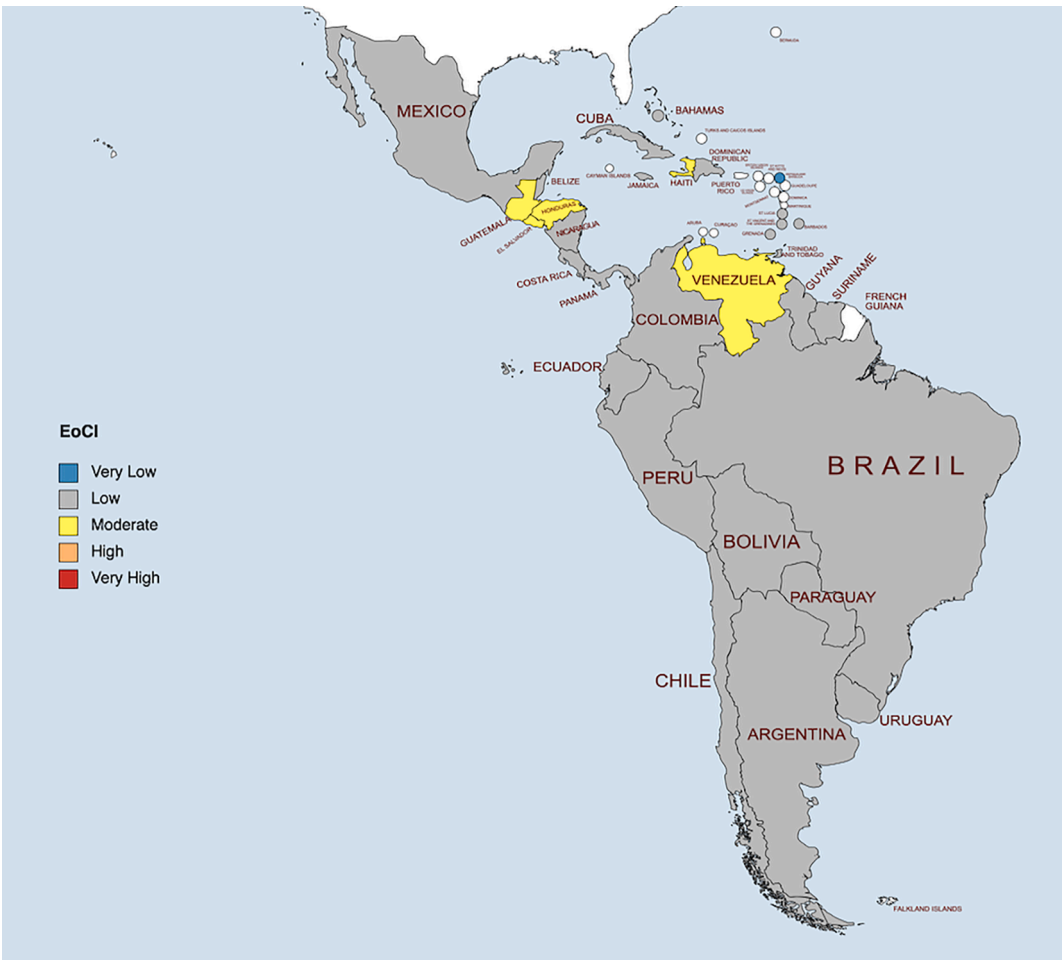

Fig. 8. EoCI scores.

improvements' sum in some indicators is fully compensated by the worsening' sum in the others, resulting, for both countries, in a final rounded value of 981. However, if the achievement functions of the MRP-WSCI approach are compared, the total improvements of Belgium is 1.16, while the total improvements for Iceland compared to Belgium is 0.93. As a consequence, Belgium has a better WCI value than Iceland by 0.23, being the latter worse positioned in the WCI ranking. Besides, the worst performance of Belgium (SCI $= 25.8$) is better than this of Iceland (SCI $= 22.8$), being the difference among them in the non-compensatory scenario greater than this of the WCI, and consequently there are a more difference among them in their SCI ranking positions. In the case of Japan, the greater difference with respect to Iceland can be observed in Fig. 2 (left) for the *Child Homicide rate* indicator (I8, in Fig. 1) and for other two other indicators (I3 and I6), resulting in a slightly higher WCI value of Japan (27.08) than this of Iceland (26.86). On the contrary, under the Min–Max normalization, the total improvements of Japan with respect to Iceland do not compensate its total worsening in three indicators (I1, I2 and I4, Fig. 1, right), resulting in an EoCI value of Japan lower than this of Iceland (975 and 981, respectively).

Regarding the Bottom 10 ranking, let us analyse the performance of Cameroon, Guinea and Madagascar. As can be observed in Table 6 in Appendix A, Madagascar and Guinea are classified in the Bottom 10 EoCI ranking, while they are outside this classification in the MRP-WSCI indexes. On the contrary, Cameroon is in the Bottom 10 MRP-WSCI rankings, being outside this classification in the EoCI one. Once again, let compare the normalized values of these countries (Fig. 3). Guinea and Madagascar are performing very well in the *Population forcibly displaced by conflict*, I7, indicator ("very low" band), performing Madagascar slightly better than Guinea. Specifically, both countries are classified in the "very low" performance band for this indicator, [0, 1), being the original values of these countries, Madagascar, 0, and Guinea, 0.4. These performance differences are hardly appreciated through the Min–Max normalization procedure, being these values, 1.000 and 0.994, respectively (Fig. 3, right). However, the broader bandwidth used by the achievement function of the MRP-WSCI approach allows the appreciation of these differences, being the normalized values, 30 and 26, respectively (Fig. 3, left). The case of Cameroon is even more remarkable. Its original value in this indicator is 5.5 ("high" performance band), being its normalized value through the Min–Max method 0.916 (Fig. 3, right), which is close to the normalized best value (1), and consequently, its poor performance in this indicator goes unnoticed. On the contrary, its normalized value by using the MRP-WSCI approach is -0.33, being classified in the "high" performance band and it indicates that within this performance band, Cameroon is 9.67 points away from the lower end value, -10, and 0.33 from the upper end value, 0. In this case, the linear piecewise formulation of the achievement function makes the normalized value of the MRP-WSCI approach remain in the "high" performance band and, therefore, the difference with the rest of the countries can be more clearly observed, as seen in Fig. 4.

Considering both approaches, Cameroon is located in the "moderate" performance band. However, the notable difference observed in the *Population displaced by conflict* indicator (I7, in Fig. 3, left), together with its behavior in the rest of the indicators, results in a WCI value of 1.47, being significantly worse than this of the other two countries. Under the Min–Max procedure (Fig. 3, right), this difference is not that important and the compensation with the rest of the indicators results in an EoCI

Fig. 9. WCI scores.

value of 611 for Cameroon, being better than this of Guinea and Madagascar. On the other hand, Guinea and Madagascar have similar values, for both compensatory scenarios, EoCI (566 and 568, respectively) and WCI (2.18 and 2.24, respectively). However, while under the EoCI these values imply locating these countries in the overall "high" performance band, under the WRP-WSCI approach, they are located in the "moderate" band. Regarding the non-compensatory scenario, in Fig. 3 (left), it can be observed that Madagascar has the worst performance in the *Child labor* indicator (I4, −14.37), being worse than this of Guinea in the *Under-5 mortality rate* indicator (I1, −9.76) and Cameroon in the *Child labor* indicator (I4, −8.9). This implies that under the SCI, the latter country is ranked 153^{th}, while Guinea is 157^{th} and Madagascar 176^{th}.

It can be observed in Fig. 5-Top that neither of the EoCI and WCI classify countries in the "very high" performance band, being more than 70% of countries classified in the "very low" and "low" performance bands and around 29% of countries have many children ("moderate" performance band) and most children ("high" performance band) missing out on childhood. It is remarkable that the percentage of countries classified in each performance band for each individual indicator is very similar for the MRP-WSCI and EoCI (see Table 4).

Analysing each individual indicator (Table 4), more than half of the countries in the world have a very good and good performances in all the indicators (relatively few children and some children do not have the childhood they deserve), yielding the best results for the *Adolescents currently married or in union* and *Population forcibly displaced by conflict* indicators with more than 80% of countries classified in the "very low" and "low" performance bands. These percentages rise substantially to around 80% of countries when a "moderate" performance band is also considered. That is, at least around 80% of countries perform better than the corresponding lower threshold of the "moderate" performance band for all the individual indicators. In fact, more than 90% of countries around the world perform better than the aforementioned threshold in the *Adolescents currently married or in union*, *Children engaged in child labor* and *Child homicide rate* indicators (96%, 94% and 93%, respectively). Note that the percentages displayed in Table 4 are the same for the EoCI and MRP-WSCI composite indicators. For further details about the performances of each country in the individual indicators, see Tables 7–10 in Appendix B.

Furthermore, as noted in Table 4, some countries have a very bad behavior in at least one indicator, being the *Out-of-school children of primary and secondary school age* and *Child stunting* the two most common indicators around the world (6% and 5%, respectively). This kind of information is lost when the EoCI and WCI are constructed. As a consequence, the percentages presented in Fig. 5-Top vary greatly when the non-compensatory scenario is analysed. According to Fig. 5-Bottom, 16% of countries around the world have at least one indicator below the corresponding "very high" threshold, indicating that nearly all children are deprived of childhood. As a consequence, in contrast with the more than 94% of countries classified in the "very low", "low" and "moderate" performance bands according to the EoCI and WCI (Fig. 5-Top), only 61% of countries achieve a moderate or better performance in all the indicators (positive values based on the common measurement scale established in Table 2, Section 3).

Let us make use of the joint consideration of the compensatory and non-compensatory scenarios provided by the MRP-WSCI approach in the spirit of giving an overview of worldwide results. To this end, two-dimensional representations of the WCI (horizontal axis) and SCI

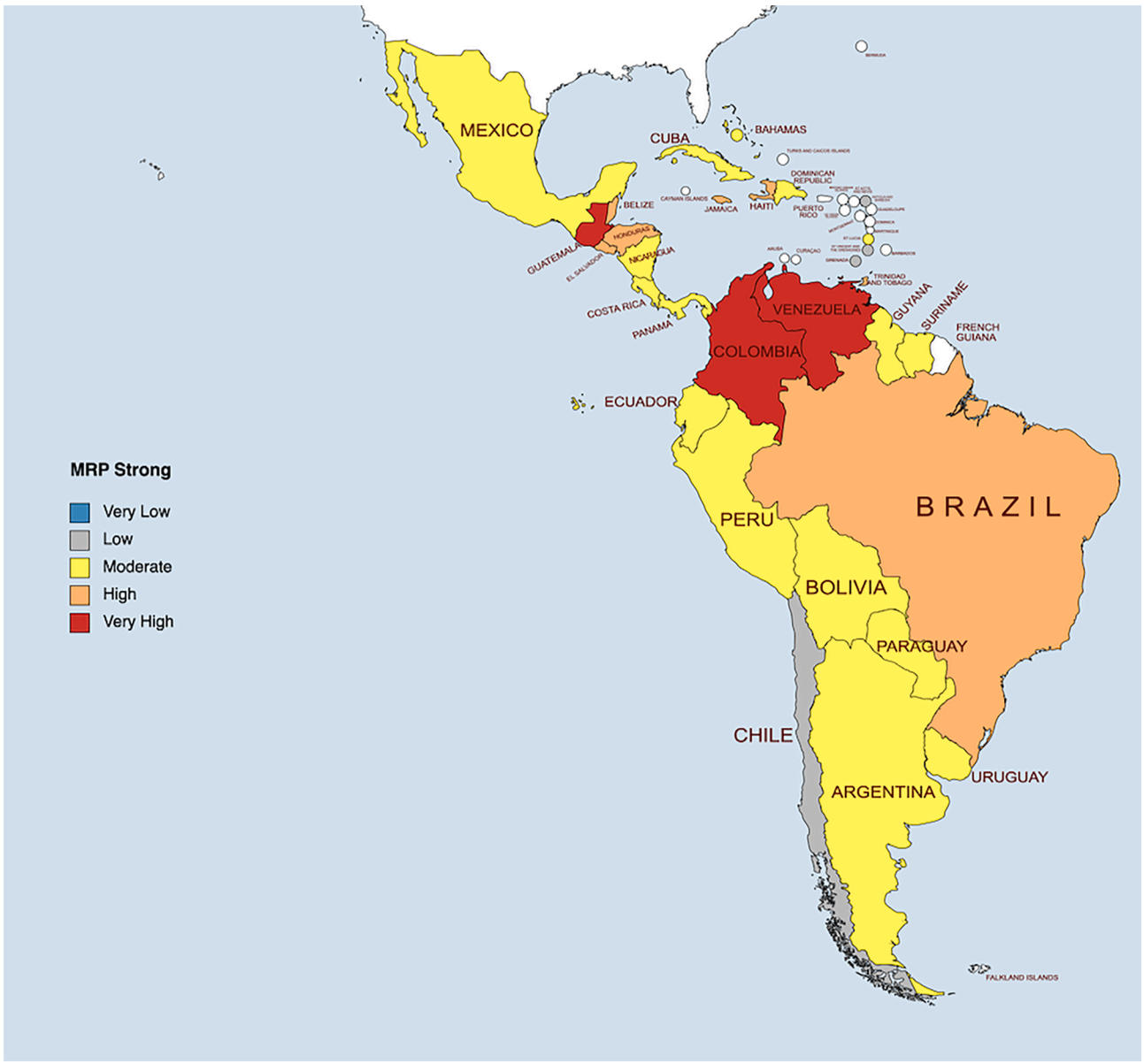

Fig. 10. SCI scores.

(vertical axis) are used, where each blue point represents a country. Specifically, Fig. 6 covers Africa, Latin America and Caribbean and Fig. 7 includes Asia and Europe. Although we do not provide a graphical representation of North America, the results of the only two countries included in this region, Canada and United States, will also be mentioned. Note that, as done by the EoCI, the paper uses the Regional classification given by UNICEF.

As a starting point, it could be stated that the countries' performance in Middle East and North Africa and Latin America and Caribbean is quite similar, with positive WCI values in both regions (that is, when the fully compensatory scenario is analysed, these countries perform better than the lower moderate threshold). However, analysing both regions in further detail, it can be observed in Fig. 6 that there is a greater dispersion in Middle East and North Africa region, with three countries located in the "moderate" performance band, while the rest are located in the "low" and "very low" ones with a greater number of countries in this latter performance band. On the other hand, in Latin America and Caribbean region, most countries are located in the "low" performance band, with quite similar WCI values. Regarding the non-compensatory scenario, Middle East and North Africa regions have countries in the five performance levels established, being the only country classified in the "very low" performance band Israel (SCI value = 22, which indicates that, considering the absolute thresholds set, Israel is the only country from this region with a very good performance in all the indicators). Similarly to this region, Latin America and Caribbean countries, despite having indicators classified in the "high" and "very high" performance bands (negative SCI values), manage to compensate them resulting in a positive WCI, with the only difference that this region does not present any country classified in the best performance band.

Eastern and Southern Africa and West and Central Africa are the only two regions around the world with no country located in the "very low" performance band in the compensatory scenario, and moreover, with countries not managing to compensate their poor performance(s) (negative SCI values, which indicates that most or nearly all children are missing out on childhood). These countries are Somalia, South Sudan from Eastern and Southern Africa; Burkina Faso, Central African Republic, Chad, Mali and Niger from West and Central Africa. These 7 countries present negative values in at least half of the eight indicators, being the most common one *Out-of-school children of primary and secondary school age*, which shows us that decision-makers from both

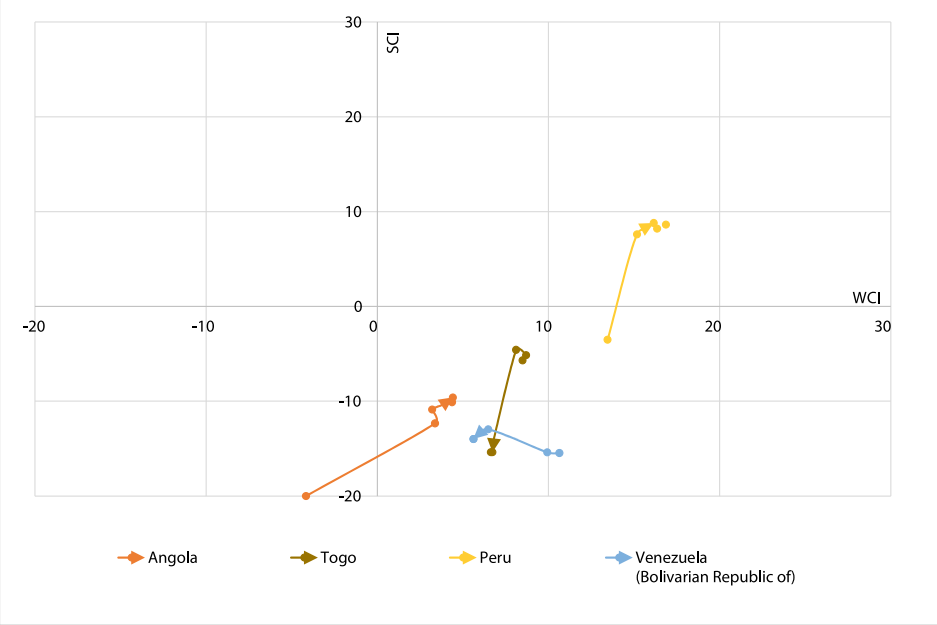

Fig. 11. Dynamic evolution of the MRP-WSCI composite indicators in selected countries.

Table 5
Evolution of the achievement functions and MRP-WSCI composite indicators for selected countries.

Country	Year	Under-5 mortality rate (deaths per 1,000 live births)	Child stunting (% children aged 0-59 months)	Out-of-school children of primary and secondary school age (%)	Children engaged in child labor (% ages 5-17)	Adolescents currently married or in union (% girls aged 15-19)	Adolescent birth rate (births per 1,000 girls aged 15-19)	Population forcibly displaced by conflict (% of total)†	Child homicide rate (deaths per 100,000 population aged 0-19)	WCI	SCI
Angola	2017	-20,0	-7,6	-1,1	-20,0	-12,3	-12,3	28,0	12,0	-4,2	-20,0
	2018	-6,5	-7,6	-6,4	6,6	11,2	-12,3	29,0	13,0	3,4	-12,3
	2019	-6,2	-7,6	-6,4	6,6	11,2	-10,9	29,0	10,0	3,2	-10,9
	2020	-5,4	-7,6	-3,0	10,9	11,2	-10,1	29,0	10,0	4,4	-10,1
	2021	-4,9	-7,6	-3,0	10,9	11,6	-9,6	28,0	10,0	4,4	-9,6
Togo	2017	-5,7	2,5	11,8	2,1	14,9	1,6	28,0	12,8	8,5	-5,7
	2018	-5,1	2,5	11,9	2,1	14,9	1,6	29,0	12,8	8,7	-5,1
	2019	-4,6	2,5	8,4	2,1	14,9	2,1	29,0	10,5	8,1	-4,6
	2020	-4,0	6,2	8,9	-15,4	15,9	2,2	29,0	10,3	6,6	-15,4
	2021	-3,4	6,2	8,9	-15,4	15,9	2,3	29,0	10,3	6,7	-15,4
Peru	2017	15,4	13,6	18,3	-3,5	15,8	10,5	30,0	7,6	13,5	-3,5
	2018	16,5	13,7	19,1	8,2	15,8	10,5	30,0	7,6	15,2	7,6
	2019	16,7	14,6	21,8	8,2	15,8	10,5	30,0	13,3	16,3	8,2
	2020	17,1	15,2	21,2	13,7	16,1	8,6	30,0	13,0	16,9	8,6
	2021	17,9	15,2	23,8	13,7	15,9	8,8	21,0	13,0	16,2	8,8
Venezuela (Bolivarian Republic of)	2017	16,7	14,4	15,3	16,7	4,2	4,2	29,0	-15,5	10,6	-15,5
	2018	15,8	14,4	13,5	15,8	4,2	4,2	27,0	-15,4	9,9	-15,4
	2019	7,6	14,4	11,8	7,6	12,8	2,8	7,7	-13,0	6,5	-13,0
	2020	10,3	14,4	14,5	10,3	12,8	2,9	-6,4	-14,0	5,6	-14,0
	2021	10,5	14,4	14,5	10,5	14,0	3,0	-8,1	-14,0	5,6	-14,0

regions have to pay special attention to childhood education. This information is not transmitted through the fully compensatory scenario of the EoCI (and WCI). See Table 7 in Appendix B for further details about the achievement functions, and the corresponding MRP-WSCI composite indicators and EoCI for each country.

With respect to Asia and Europe (Fig. 7), it can be observed that at a first glance the overall situation of this region is much better than Africa, Latin America and Caribbean countries. The situation in East Asia and Pacific is quite similar to Middle East and North Africa, with the difference that in East Asia and Pacific there are more countries located in the "very low" performance band in the non-compensatory scenario. This shows that there is a greater number of countries with a better performance than the absolute threshold of the "relatively few children deprived of childhood" established for all indicators. Specifically, Singapore belongs to this region, which is the best country worldwide ranking in the fully compensatory scenarios of the WCI and EoCI (see Table 6 in Appendix A) and and the second best ranked in the non-compensatory scenario (being surpassed by Slovenia, although they

Table 6
2021 Rankings for the EoCI and MRP-WSCI technique.

Country	EoCI	WCI	SCI
Afghanistan	166	176	160
Albania	67	73	49
Algeria	63	62	70
Angola	175	166	155
Antigua and Barbuda	46	49	64
Argentina	81	75	88
Armenia	61	64	46
Australia	28	26	19
Austria	21	21	15
Azerbaijan	93	115	121
Bahamas	89	100	103
Bahrain	42	41	34
Bangladesh	140	135	130
Barbados	57	55	65
Belarus	35	34	26
Belgium	9	9	5
Belize	114	107	125
Benin	158	151	150
Bhutan	100	98	133
Bolivia (Plurinational State of)	122	120	98
Bosnia and Herzegovina	55	74	114
Botswana	119	124	110
Brazil	108	105	149
Brunei Darussalam	68	59	73
Bulgaria	70	57	60
Burkina Faso	179	180	162
Burundi	159	168	183
Cabo Verde	93	95	93
Cambodia	127	118	127
Cameroon	173	177	153
Canada	25	29	15
Central African Republic	185	186	181
Chad	184	184	166
Chile	55	53	62
China	45	44	41
Colombia	132	137	158
Comoros	149	146	128
Congo	139	143	126
Costa Rica	75	69	76
Côte d'Ivoire	161	157	142
Croatia	32	33	30
Cuba	80	77	77
Cyprus	5	6	8
Czechia	11	11	21
Democratic People's Republic of Korea	69	58	71
Democratic Republic of the Congo	169	175	161

Country	EoCI	WCI	SCI
Denmark	21	23	13
Djibouti	138	136	170
Dominican Republic	112	110	106
Ecuador	109	104	95
Egypt	104	94	86
El Salvador	134	139	148
Equatorial Guinea	174	162	159
Eritrea	170	178	182
Estonia	14	16	23
Eswatini	135	133	129
Ethiopia	170	171	179
Fiji	84	101	75
Finland	21	22	29
France	14	19	7
Gabon	123	119	108
Gambia	142	147	143
Georgia	74	89	124
Germany	31	28	32
Ghana	125	122	105
Greece	16	18	11
Grenada	59	71	51
Guatemala	163	165	173
Guinea	178	173	157
Guinea-Bissau	153	149	140
Guyana	111	114	94
Haiti	146	150	139
Honduras	147	158	147
Hungary	36	35	42
Iceland	9	13	17
India	118	116	137
Indonesia	107	106	119
Iran (Islamic Republic of)	90	88	82
Iraq	120	138	116
Ireland	3	4	6
Israel	16	25	22
Italy	13	12	20
Jamaica	102	92	134
Japan	21	10	37
Jordan	81	78	97
Kazakhstan	49	51	48
Kenya	129	128	102
Kiribati	131	131	115
Kuwait	47	50	36
Kyrgyzstan	92	87	86
Lao People's Democratic Republic	143	140	131
Latvia	30	31	28

Country	EoCI	WCI	SCI
Lebanon	34	40	31
Lesotho	168	159	164
Liberia	152	144	146
Libya	91	108	151
Lithuania	16	27	27
Luxembourg	25	15	40
Madagascar	177	172	176
Malawi	154	142	154
Malaysia	76	70	79
Maldives	65	56	59
Mali	181	181	174
Malta	33	32	24
Marshall Islands	141	141	138
Mauritania	151	156	135
Mauritius	65	66	47
Mexico	97	91	83
Mongolia	77	76	57
Montenegro	44	38	39
Morocco	85	82	63
Mozambique	176	174	163
Myanmar	117	129	113
Namibia	123	130	104
Nauru	129	125	109
Nepal	137	127	122
Netherlands	7	7	4
New Zealand	41	36	45
Nicaragua	116	123	99
Niger	186	185	185
Nigeria	180	179	168
North Macedonia	49	47	58
Norway	3	3	3
Oman	51	54	50
Pakistan	147	148	152
Panama	120	117	112
Papua New Guinea	144	145	177
Paraguay	106	103	92
Peru	99	97	80
Philippines	110	113	117
Poland	25	24	14
Portugal	11	14	10
Qatar	40	42	61
Republic of Korea	7	5	8
Republic of Moldova	86	84	67
Romania	58	52	54
Russian Federation	37	39	35
Rwanda	125	132	145
Saint Lucia	72	83	74

Country	EoCI	WCI	SCI
Saint Vincent and the Grenadines	83	99	72
Samoa	72	67	55
Sao Tome and Principe	113	112	107
Saudi Arabia	48	46	65
Senegal	155	152	171
Serbia	52	65	89
Seychelles	87	80	85
Sierra Leone	172	163	165
Singapore	1	1	2
Slovakia	37	37	44
Slovenia	1	2	1
Solomon Islands	136	126	123
Somalia	183	183	180
South Africa	128	121	141
South Sudan	182	182	184
Spain	16	17	17
Sri Lanka	63	60	68
State of Palestine	96	111	78
Sudan	163	170	167
Suriname	97	90	84
Sweden	5	8	12
Switzerland	16	20	33
Syrian Arab Republic	165	154	186
Tajikistan	105	96	90
Thailand	93	86	69
Timor-Leste	133	134	169
Togo	160	155	178
Tonga	79	81	96
Trinidad and Tobago	88	85	144
Tunisia	54	48	53
Turkey	59	63	43
Turkmenistan	71	68	100
Tuvalu	100	102	101
Uganda	156	167	132
Ukraine	52	79	118
United Arab Emirates	37	43	38
United Kingdom	28	30	25
United Republic of Tanzania	167	164	156
United States of America	43	45	56
Uruguay	78	72	81
Uzbekistan	62	61	52
Vanuatu	115	109	110
Venezuela (Bolivarian Republic of)	145	161	175
Vietnam	103	93	91
Yemen	162	169	172
Zambia	157	153	136
Zimbabwe	150	160	120

have a very similar SCI value, 27.5 Singapore and 27.53 Slovenia).

A great dispersion can be observed in the South Asia region. Although the eight countries belonging to this region manage to compensate their unfavorable indicators, only two of them, Maldives and Sri Lanka, manage to be located in the "very low" performance band when the overall performance is analysed (WCI value $= 21$ and 20.4, respectively). Within this region, the only country with a very bad SCI value is Afghanistan, which belongs to the *Out-of-school children of primary and secondary school age* indicator, stressing the need to improve its performance in the child out of school indicator in order to be comparable to the countries of this region in terms of childhood.

Eastern Europe and Central Asia is the first region analyzed so far, where all the countries have a good and very good performances in the fully compensatory scenario. However, when the SCI is considered, it can be observed that there are countries with a SCI values in the "high" performance band. These countries, *Georgia*, *Azerbaijan*, *Ukraine* and *Bosnia Herzegovia*, perform poorly or moderately on the same indicator, which is the *Population forcibly displaced by conflict* (SCI values $= -1.9$, -1.1, -0.5 and 0, respectively). Finally, Western Europe and North America are the regions with the best performance worldwide. Specifically, all the countries belonging to these regions are classified in the "very low" performance band when the overall performance is considered. Regarding the non-compensatory scenario, only 8 countries in Western Europe have a worse value than the lower threshold of the "very low" performance band (although with values very close to this threshold), being the most common indicators the *Out-of-school children of primary and secondary school age* and *Population forcibly displaced by conflict*. Similarly, in North America, United States has a SCI value worse than the corresponding lower threshold of the very good performance band with the main difference that its SCI is worse than the countries belonging to Western Europe. Specifically, in Western Europe, the worst SCI value is due to the performance of Slovakia in the *Adolescent birth rate* indicator (SCI $= 16.9$, being the distance in the corresponding performance band of 3.1 to the upper threshold and 6.9 to the lower threshold), meanwhile the SCI value of United States is due to its performance in the *child homicide rate* indicator (SCI $= 14$, which is closer to the lower threshold).

Summing up, the analysis proposed by considering the MRP-WSCI composite indicators facilitates the interpretation of the results in terms of childhood enders indicators. There are two main reasons for this: (a) the consideration of a common scale for all the indicators taking into account the international absolute levels assigned by the EoCI makes possible to analyse at a glance not only the countries classified in each performance band, but also the distance that each country has in relation to these thresholds; and (b) as previously commented, the inclusion of the non-compensatory scenario in the analysis offers more information about the possible imbalance(s) of each country.

4.2. *Joint use of WCI and SCI for policy making: the case of Latin America and Caribbean countries*

In order to analyze in further detail the complementary information provided by the MRP-WSCI indicators and their advantages over the EoCI, we have selected the Latin American and Caribbean countries. In

Table 7
EoCI scores, MRP-WSCI indicators and the correponding achievement functions values (Eastern and Southern Africa, West and Central Africa).

		Achievement functions values								MRP-WSCI		
Regional Classification (UNICEF)	Country	Under-5 mortality rate (deaths per 1,000 live births)	Child stunting (% children aged 0-59 months)	Out-of-school children of primary and secondary school age (%)	Children engaged in child labor (% ages 5-17)	Adolescents currently married or in union (% girls aged 15-19)	Adolescent birth rate (births per 1,000 girls aged 15-19)	Population forcibly displaced by conflict (% of total)	Child homicide rate (deaths per 100,000 population aged 0-19)	SCI	WCI	EoCI
Eastern and Southern Africa	Angola	-4.9	-7.6	-3.0	10.9	11.6	-9.6	28.0	10.0	-9.6	4.4	608
	Botswana	3.4	1.1	3.4	17.3	17.9	11.3	30.0	11.3	1.1	12.0	788
	Burundi	-1.3	-17.9	4.6	-0.9	19.6	9.0	3.0	12.3	-17.9	3.5	652
	Comoros	-2.6	-1.1	5.1	1.5	13.6	7.2	27.0	13.3	-2.6	8.0	687
	Djibouti	-1.5	-3.5	-13.2	18.2	19.2	19.0	27.0	13.5	-13.2	9.8	735
	Eritrea	3.8	-17.1	-11.8	3.8	9.8	9.9	-8.0	10.8	-17.1	0.1	614
	Eswatini	0.2	4.5	14.9	18.1	15.3	4.9	30.0	-2.6	-2.6	10.7	744
	Ethiopia	-0.1	-6.8	-3.8	-15.4	12.2	7.0	13.0	12.3	-15.4	2.3	614
	Kenya	2.7	3.8	13.1	2.7	15.9	5.2	30.0	16.5	2.7	11.2	767
	Lesotho	-7.3	-4.6	14.6	14.1	11.0	1.5	30.0	-11.5	-11.5	6.0	621
	Madagascar	-0.1	-10.9	4.6	-14.4	-1.2	-1.5	30.0	11.5	-14.4	2.2	568
	Malawi	3.4	-9.0	12.3	10.4	6.6	-6.4	30.0	21.0	-9.0	8.5	673
	Mauritius	16.0	16.0	17.2	16.0	19.1	17.1	30.0	25.0	16.0	19.5	914
	Mozambique	-4.8	-11.3	5.1	7.8	-8.3	-9.3	20.0	18.3	-11.3	2.2	574
	Namibia	3.0	7.3	15.2	3.0	20.0	7.7	30.0	1.6	1.6	11.0	777
	Rwanda	6.3	-6.9	13.1	10.7	24.8	13.2	9.3	15.0	-6.9	10.7	776
	Seychelles	17.2	18.1	19.1	17.2	18.9	7.8	30.0	19.0	7.8	18.4	867
	Somalia	-13.0	4.7	-13.0	-15.7	8.9	0.5	-10.6	14.8	-15.7	-2.9	489
	South Africa	6.2	2.6	14.1	22.8	24.0	6.4	30.0	-5.8	-5.8	12.5	771
	South Sudan	-9.2	-1.3	-18.0	-9.2	7.1	8.1	-13.6	15.8	-18.0	-2.5	499
	Sudan	-1.7	-8.2	-12.7	11.3	11.1	7.8	-0.8	14.8	-12.7	2.7	642
	Uganda	1.7	1.1	6.7	11.3	10.1	-3.2	-0.1	6.6	-3.2	4.3	668
	United Republic of Tanzania	-0.1	-1.8	-9.7	5.2	7.4	-3.4	30.0	11.8	-9.7	4.9	625
	Zambia*	-2.3	-4.6	7.9	7.0	13.0	-3.7	30.0	9.0	-4.6	7.0	656
	Zimbabwe	-0.9	6.5	13.9	2.1	10.6	3.4	10.0	1.4	-0.9	5.9	686
West and Central Africa	Benin	-8.1	-2.2	6.2	5.2	11.1	3.2	30.0	13.0	-8.1	7.3	653
	Burkina Faso	-7.5	5.1	-7.6	-11.3	-0.6	-0.4	1.7	10.0	-11.3	-1.3	557
	Cabo Verde	16.7	16.7	14.6	19.1	16.9	5.5	30.0	10.5	5.5	16.2	854
	Cameroon	-5.0	1.1	6.9	-8.9	10.9	-0.7	-0.3	7.8	-8.9	1.5	611
	Central African Republic	-11.8	-9.8	-13.6	3.1	-17.0	-5.4	-11.8	5.0	-17.0	-7.7	399
	Chad	-12.4	-7.8	-12.4	-9.0	-7.8	-11.5	9.3	8.8	-12.4	-5.4	450
	Congo	0.9	8.8	15.9	13.9	11.1	-2.2	7.0	11.0	-2.2	8.3	734
	Côte d'Ivoire	-5.9	8.4	2.2	7.9	8.2	-3.2	28.0	6.6	-5.9	6.5	645
	Democratic Republic of the Congo*	-7.0	-11.0	12.3	13.5	10.3	-4.5	-1.6	5.4	-11.0	2.2	619
	Equatorial Guinea	-6.4	3.8	-6.4	2.2	9.5	-10.7	30.0	20.0	-10.7	5.3	609
	Gabon	3.0	12.0	18.1	10.3	16.5	1.3	29.0	13.3	1.3	12.9	777
	Gambia	-0.3	14.3	-6.3	12.1	9.9	4.9	19.0	9.4	-6.3	7.9	713
	Ghana	1.5	11.7	17.1	2.1	19.7	6.8	29.0	11.3	1.5	12.4	776
	Guinea	-9.8	-0.3	-8.9	5.8	1.7	-6.7	26.0	9.6	-9.8	2.2	566
	Guinea-Bissau	-5.7	2.3	-0.6	11.9	17.8	-0.6	28.0	6.2	-5.7	7.4	674
	Liberia	-6.9	-0.1	13.9	14.0	15.2	-7.1	28.0	8.0	-7.1	8.1	676
	Mali	-8.8	3.1	-13.9	14.5	-11.1	-13.3	9.3	6.0	-13.9	-1.8	520
	Mauritania	-4.6	7.2	-2.2	14.0	7.6	6.1	20.0	5.6	-4.6	6.7	682
	Niger	-6.1	-14.8	-14.4	-4.4	-18.8	-16.5	16.0	5.2	-18.8	-6.7	392
	Nigeria	-13.0	-6.8	-8.0	-1.5	7.2	-1.1	15.0	9.2	-13.0	0.1	549
	Sao Tome and Principe	8.1	15.5	15.3	16.3	13.8	1.3	30.0	12.5	1.3	14.1	801
	Senegal	1.9	11.4	-13.4	7.2	5.7	5.9	28.0	11.3	-13.4	7.2	670
	Sierra Leone	-11.6	0.5	0.3	4.8	13.6	-2.0	28.0	7.0	-11.6	5.1	613
	Togo	-3.4	6.2	8.9	-15.4	15.9	2.3	29.0	10.3	-15.4	6.7	650

this region, as we have previously commented, most countries have similar values for WCI, located in the "low" band, but this information can mask deficient behaviors that can be detected using SCI values. Consequently, policy makers can jointly use the information provided by WCI and SCI, to detect key aspects on which to act to improve the conditions of children in the country.

Figs. 8–10 show, respectively, the EoCI, WCI and SCI scores of the Latin America and Caribbean countries, using the color code previously commented. Besides, the values of the achievement function of each indicator reached by these countries, as well their corresponding SCI, WCI and EoCI values, are displayed in Table 8 of Appendix B. Comparing Figs. 8 and 9, no Latin America and Caribbean country is in any of the two worst performance bands, "high" and "very high". This implies that, according to the EoCI and the WCI, no Latin America and Caribbean country has a very bad behavior (nearly all children are deprived of childhood) or a bad behavior (most children are missing out on childhood). Note that, as commented in Section 2, the information provided by the individual thresholds is lost in the EoCI approach and they are only taken into account at the end to calculate the global performance bands. This leads to the color difference observed for Chile, Barbados and Colombia, between Figs. 8 and 9. The first two countries are in the "low" performance band in Fig. 8, but in the "very low" performance band in Fig. 9. Therefore, the WCI better reflects the situation of the countries in each of the indicators with respect to the performance bands initially established.

However, the information provided by WCI can be complemented by the results for SCI, shown in Fig. 10. The joint use of both composite indicators allows policy makers to obtain relevant information for decision making.

In this line, the case of Colombia is noteworthy (with purple border in Table 8 of Appendix B). This country is classified in three different performance bands, depending on which composite indicator is analysed ("low" for the EoCI, "moderate" for the WCI and "very high" for the SCI). The scores of the overall performance of Colombia are fairly close to the lower end of the EoCI range (its score is 762, being the range between 760 and 939) and from the upper end of the WCI range (its score is 9.6 while the interval ranges from 0 to 10). Consequently, it appears in grey and yellow color, respectively, in Figs. 8 and 9. Colombia has four indicators in the "low" performance band and one indicator in each of the other performance bands. Nevertheless, while the EoCI classifies these indicators before the normalization procedure based on the thresholds established (see Table 1), the MRP-WSCI method

Table 8
EoCI scores, MRP-WSCI indicators and the correponding achievement functions values (Middle East and North Africa, Latin America and Caribbean).

		Achievement functions values								MRP-WSCI		
Regional Classification (UNICEF)	Country	Under-5 mortality rate (deaths per 1,000 live births)	Child stunting (% children aged 0-59 months)	Out-of-school children of primary and secondary school age (%)	Children engaged in child labor (% ages 5-17)	Adolescents currently married or in union (% girls aged 15-19)	Adolescent birth rate (births per 1,000 girls aged 15-19)	Population forcibly displaced by conflict (% of total)	Child homicide rate (deaths per 100,000 population aged 0-19)	SCI	WCI	EoCI
Middle East and North Africa	Algeria	11.1	16.8	16.9	25.0	21.2	23.5	30.0	18.5	11.1	20.4	915
	Bahrain	23.1	23.1	19.9	23.1	19.1	21.2	30.0	27.0	19.1	23.3	951
	Egypt	13.1	7.7	19.2	20.4	13.3	9.4	30.0	17.0	7.7	16.3	840
	Iran (Islamic Republic of)	17.4	18.8	18.4	15.7	8.1	12.7	27.0	19.0	8.1	17.1	858
	Iraq	9.6	14.9	8.6	21.0	11.1	5.7	-0.3	6.0	-0.3	9.6	782
	Israel	26.3	26.3	28.8	26.3	24.8	23.9	30.0	22.0	22.0	26.0	976
	Jordan	16.3	18.1	3.7	26.6	18.3	16.9	29.0	18.8	3.7	18.5	880
	Kuwait	22.1	19.1	18.7	22.1	19.5	24.7	29.0	21.0	18.7	22.0	940
	Lebanon	22.8	22.8	22.8	26.2	25.0	20.5	27.0	19.5	19.5	23.3	960
	Libya	19.0	-8.1	19.0	19.0	19.0	26.2	-0.9	21.0	-8.1	14.3	857
	Morocco	12.4	13.3	17.3	17.8	17.5	15.5	30.0	23.0	12.4	18.3	874
	Oman	19.1	15.7	23.4	19.1	25.6	21.5	30.0	17.5	15.7	21.5	931
	Qatar	23.5	23.5	21.8	23.5	26.6	23.6	30.0	13.0	13.0	23.2	953
	Saudi Arabia	23.4	17.1	24.8	23.4	24.2	25.3	30.0	12.3	12.3	22.6	938
	State of Palestine	13.7	17.5	18.0	18.5	13.5	9.6	9.3	12.8	9.3	14.1	853
	Syrian Arab Republic	12.3	2.1	-10.4	22.0	15.9	13.4	-20.0	19.5	-20.0	6.9	639
	Tunisia	15.4	17.7	14.5	25.4	28.2	24.7	30.0	24.0	14.5	22.5	929
	United Arab Emirates	22.5	22.5	23.2	22.5	19.5	26.1	30.0	18.3	18.3	23.1	954
	Yemen	-1.7	-13.6	1.9	7.3	12.4	8.2	-5.1	15.5	-13.6	3.1	644
Latin America and Caribbean	Antigua and Barbuda	23.4	23.4	24.0	23.4	22.2	12.3	28.0	22.0	12.3	22.3	941
	Argentina	20.7	18.1	24.4	21.2	13.9	7.5	30.0	14.8	7.5	18.8	880
	Bahamas	18.3	18.3	2.6	18.3	25.8	15.9	27.0	1.8	1.8	16.0	861
	Barbados	18.2	18.2	24.0	27.2	25.2	15.4	29.0	12.3	12.3	21.2	924
	Belize	18.5	13.3	16.7	23.4	9.0	6.4	29.0	-2.0	-2.0	14.3	800
	Bolivia (Plurinational State of)	9.6	12.6	14.9	3.6	16.6	7.2	30.0	8.0	3.6	12.8	778
	Brazil	17.4	18.7	18.7	19.7	14.1	8.4	30.0	-7.9	-7.9	14.9	815
	Chile	23.0	26.4	23.8	19.4	19.8	12.8	30.0	17.8	12.8	21.6	928
	Colombia	17.5	14.9	18.5	22.8	14.6	6.9	-7.5	-10.5	-10.5	9.6	762
	Costa Rica	21.4	17.3	26.6	18.5	17.6	9.5	30.0	14.3	9.5	19.4	891
	Cuba	24.9	18.6	18.3	24.9	9.4	9.7	24.0	19.3	9.4	18.6	881
	Dominican Republic	8.8	18.6	17.4	18.7	10.1	1.4	30.0	8.8	1.4	14.2	809
	Ecuador	17.3	6.1	18.8	20.2	10.5	4.2	29.0	15.5	4.2	15.2	813
	El Salvador	17.8	14.3	10.1	16.7	12.8	6.3	3.0	-7.8	-7.8	9.1	749
	Grenada	15.7	15.7	19.9	15.7	23.0	16.2	29.0	17.5	15.7	19.1	918
	Guatemala	10.3	-13.8	1.7	4.2	10.0	6.0	21.0	-0.4	-13.8	4.9	642
	Guyana	8.3	15.8	17.5	16.1	12.9	5.4	29.0	7.8	5.4	14.1	810
	Haiti	-2.6	8.1	13.8	-5.5	19.1	9.8	21.0	-4.7	-5.5	7.4	693
	Honduras	15.5	7.4	2.4	13.9	8.6	5.6	2.3	-7.6	-7.6	6.0	690
	Jamaica	17.4	19.3	10.9	24.2	24.6	9.7	29.0	-4.4	-4.4	16.4	842
	Mexico	17.2	16.7	17.5	20.6	13.3	8.1	29.0	9.8	8.1	16.5	852
	Nicaragua	15.6	11.8	15.5	15.6	8.2	3.3	19.0	10.0	3.3	12.4	796
	Panama	16.7	10.7	9.7	24.8	12.2	3.8	30.0	0.8	0.8	13.6	782
	Paraguay	13.7	19.6	12.9	11.4	13.9	6.0	30.0	15.0	6.0	15.3	819
	Peru	17.9	15.2	23.8	13.7	15.9	8.8	21.0	13.0	8.8	16.2	850
	Saint Lucia	11.8	25.0	18.4	23.4	20.4	12.9	25.0	9.8	9.8	18.3	901
	Saint Vincent and the Grenadines	16.9	16.9	20.6	16.9	13.8	10.5	21.0	11.3	10.5	16.0	877
	Suriname	14.7	17.8	11.3	21.4	16.3	7.9	30.0	14.0	7.9	16.7	852
	Trinidad and Tobago	15.0	17.2	21.6	28.4	19.7	15.9	29.0	-6.3	-6.3	17.6	865
	Uruguay	22.9	16.2	23.4	21.6	16.2	8.4	30.0	13.5	8.4	19.0	883
	Venezuela (Bolivarian Republic of)	10.5	14.4	14.5	10.5	14.0	3.0	-8.1	-14.0	-14.0	5.6	697

classifies them by constructing the achievement functions and using the common measurement scale (see Table 2), which remains unalterable throughout the whole construction of the MRP-WSCI composite indicators. Thus, the part of the indicators classified in the "moderate" performance band or better, has a value of 11.89 ("low" overall performance band), while the part corresponding to the indicators classified in the "high" and "very high" band is −2.25, and therefore the full compensation allowed among them results in a WCI value equal to 9.6 ("moderate" overall performance band). On the other hand, this country appears in red color in Fig. 10. This means that there is at least one indicator whose value is classified in the "very high" performance band, but this valuable information remains unnoticed for the EoCI, while it is reflected by the SCI value. In Table 8 of Appendix B, it can be observed that this is due to the *Child homicide rate* indicator. Consequently, the SCI indicates policy makers what aspect needs to be focused most to improve the childhood conditions in this country.

Similar valuable information can be obtained for countries like Guatemala and Venezuela reaching the same performance band ("moderate") for the EoCI and WCI (in yellow color in Figs. 8 and 9). However, under the SCI, they are categorized into the "very high" performance band. This implies that such countries have a very bad behavior in some indicator, but they also have good behaviors in enough indicators to compensate for these poor performances. The case of Venezuela, with red border in Table 8 in Appendix B, is noteworthy. This country achieves a value of 5.6 for WCI and 697 for EoCI, while it only achieves a value of −14 for SCI, the worst Latin America and Caribbean score (red color in Fig. 10), due to its bad performance in the *Child homicide rate* indicator. Similarly, countries such as Belize, Brazil, Jamaica and Trinidad and Tobago also reach an acceptable overall compensatory performance ("low", grey color in Figs. 8 and 9) under EoCI and WCI.

Table 9
EoCI scores, MRP-WSCI indicators and the correponding achievement functions values (East Asia and Pacific, South Asia).

		Achievement functions values								MRP-WSCI		
Regional Classification (UNICEF)	Country	Under-5 mortality rate (deaths per 1,000 live births)	Child stunting (% children aged 0-59 months)	Out-of-school children of primary and secondary school age (%)	Children engaged in child labor (% ages 5-17)	Adolescents currently married or in union (% girls aged 15-19)	Adolescent birth rate (births per 1,000 girls aged 15-19)	Population forcibly displaced by conflict (% of total)	Child homicide rate (deaths per 100,000 population aged 0-19)	SCI	WCI	EoCI
East Asia and Pacific	Australia	26.4	26.0	25.8	26.4	25.2	22.5	30.0	26.0	22.5	26.0	972
	Brunei Darussalam	19.1	10.2	18.2	19.1	26.0	23.5	30.0	20.0	10.2	20.8	911
	Cambodia	9.4	-2.4	7.6	14.9	13.0	9.9	29.0	23.0	-2.4	13.0	772
	China	22.1	17.9	18.3	22.1	24.0	24.9	30.0	25.0	17.9	23.0	942
	Democratic People's Republic of Korea	15.1	10.6	15.1	21.4	29.6	29.8	30.0	15.8	10.6	20.9	910
	Fiji	9.7	9.7	18.3	9.7	19.1	10.3	27.0	19.0	9.7	15.4	875
	Indonesia	10.7	-0.8	14.9	18.7	17.3	10.9	30.0	15.5	-0.8	14.7	816
	Japan	27.5	18.6	27.5	27.5	29.0	27.5	30.0	29.0	18.6	27.1	975
	Kiribati	-0.2	13.2	-0.2	4.6	14.0	19.9	30.0	6.0	-0.2	10.9	763
	Lao People's Democratic Republic	1.8	-3.1	6.8	1.8	16.0	7.0	29.0	12.8	-3.1	9.0	708
	Malaysia	21.4	9.3	14.4	21.4	20.0	21.0	29.0	17.8	9.3	19.3	890
	Marshall Islands	7.3	-4.8	-0.3	7.3	8.9	3.1	30.0	18.5	-4.8	8.7	715
	Mongolia	16.3	17.1	17.7	13.5	22.6	15.3	28.0	19.0	13.5	18.7	886
	Myanmar	2.1	0.6	12.1	16.7	15.5	16.2	8.3	17.8	0.6	11.2	793
	Nauru	7.6	6.0	14.4	7.6	11.1	1.2	28.0	16.3	1.2	11.5	767
	New Zealand	25.3	25.3	28.0	25.3	16.9	19.0	30.0	23.0	16.9	24.1	952
	Papua New Guinea	2.1	-15.4	9.5	2.1	14.3	9.6	30.0	11.8	-15.4	8.0	706
	Philippines	9.1	-0.3	19.5	15.9	17.8	9.0	28.0	13.8	-0.3	14.1	812
	Republic of Korea	26.8	25.0	25.6	26.8	29.2	29.1	30.0	26.0	25.0	27.3	982
	Samoa	16.7	18.5	22.0	14.1	18.9	17.6	29.0	19.5	14.1	19.5	901
	Singapore	27.5	27.5	29.6	27.5	29.4	27.7	30.0	28.0	27.5	28.4	990
	Solomon Islands	13.5	-1.7	-1.3	11.4	16.9	4.3	30.0	18.0	-1.7	11.4	742
	Thailand	21.0	14.5	15.2	17.8	12.9	11.5	30.0	17.5	11.5	17.5	854
	Timor-Leste	2.3	-13.2	15.9	2.3	18.1	15.0	30.0	9.4	-13.2	10.0	753
	Tonga	15.6	25.6	18.3	3.9	21.6	20.5	25.0	16.8	3.9	18.4	882
	Tuvalu	10.7	16.7	3.2	10.7	18.0	16.3	30.0	17.0	3.2	15.3	848
	Vanuatu	9.6	1.1	14.3	12.9	16.3	10.3	30.0	19.5	1.1	14.3	799
	Vietnam	13.4	6.2	16.5	14.6	17.0	15.9	27.0	19.5	6.2	16.3	841
South Asia	Afghanistan	-2.1	-8.2	-10.7	8.6	11.9	7.0	-6.5	15.3	-10.7	1.9	628
	Bangladesh	7.7	2.0	1.9	18.8	-2.7	3.5	29.0	18.8	-2.7	9.9	722
	Bhutan	8.6	-3.5	14.9	23.0	21.2	18.9	21.0	24.0	-3.5	16.0	848
	India	6.3	-4.7	9.7	15.5	13.4	21.9	30.0	19.3	-4.7	13.9	789
	Maldives	22.4	13.1	15.8	22.4	20.0	25.1	30.0	19.3	13.1	21.0	914
	Nepal	7.7	-1.5	17.3	8.3	3.6	7.1	29.0	18.5	-1.5	11.3	740
	Pakistan	-3.4	-7.6	-8.3	14.8	14.3	13.4	29.0	8.0	-8.3	7.5	690
	Sri Lanka	22.9	11.8	20.0	28.0	19.4	18.4	21.0	22.0	11.8	20.4	915

However, their values for SCI ("high", orange color in Fig. 10) show that there are aspects related to childhood that need to be improved (in this case, it is the *Child homicide rate*, once again, for all of them).

This highlights the importance of jointly considering WCI and SCI, which allows policy makers to detect critical aspects that are unnoticed with traditional compensatory measures, including the EoCI. Therefore, they are complementary operational tools for policy action in order to elaborate improvement measures in the correct direction promoting an adequate childhood.

4.3. Dynamic analysis

The previous analyses correspond to a single year (2021) and therefore, they provide a picture of the situation of the countries at that moment. The scheme proposed can also be used in a dynamic fashion, in order to show the evolution of the countries over a certain period. Such a dynamic analysis aids policy makers in finding out the aspects that have been improved and worsened, and to make decisions accordingly. In this section, we show some results where a five year period (2017–2021) has been considered.

As an example, we have chosen four countries whose performance has varied significantly over the period considered. Fig. 11 displays their evolution graph. Specifically, the behavior of each country is represented by a line and each point of the line represents the WCI (horizontal axis) and SCI (vertical axis) performance for each year. In particular, the point with the arrow represents the WCI and SCI values for the given country in 2021, while the other extreme point of the line corresponds to the initial year, 2017.

Let us study the evolution of these countries in further detail. The evolution of Angola shows a significant improvement in both composite indicators (from −4.2 to 4.4 for the WCI and from −20 to −9.6 for the SCI). The improvement of the SCI means that, while Angola had some indicator with the worst performance among all the countries in 2017 (*Under-5 mortality rate*, lying thus in the "very high" band), it's greatest weakness in 2021 is now in the "high" band (*Adolescent birth rate*). On the other hand, the evolution of the WCI (evolving from the "high" to the "moderate" band) means that there has been a general improvement in most of the indicators during the period considered (in fact, 4 indicators have improved and two remain at the same levels). These results should encourage decision makers to keep on with the policies they have been carrying out, given that, although the situation is better, there is still much room for further improvement. The specific values of the composite indicators and the achievement functions of the single indicators over the period considered can be seen in Table 5.

Venezuela has improved slightly in the non-compensatory scenario (from −15.5 to −14), while it has worsened in the compensatory one (from 10.6, in the "low' ' performance band, to 5.6, in the "moderate" band, 5.6). This means that the greatest weakness of this country has been improved by a very small amount, and still lies in the "very high" performance band (*Child homicide rate*), but the evolution of many

Table 10
EoCI scores, MRP-WSCI indicators and the corresponding achievement functions values (Eastern Europe and Central Asia, Western Europe, North America).

		Achievement functions values								MRP-WSCI		
Regional Classification (UNICEF)	Country	Under-5 mortality rate (deaths per 1,000 live births)	Child stunting (% children aged 0-59 months)	Out-of-school children of primary and secondary school age (%)	Children engaged in child labor (% ages 5-17)	Adolescents currently married or in union (% girls aged 15-19)	Adolescent birth rate (births per 1,000 girls aged 15-19)	Population forcibly displaced by conflict (% of total)	Child homicide rate (deaths per 100,000 population aged 0-19)	SCI	WCI	EoCI
Eastern Europe and Central Asia	Albania	20.3	15.8	18.5	23.4	19.3	18.7	18.0	17.5	15.8	18.9	912
	Armenia	18.8	17.1	16.8	21.8	21.4	18.3	23.0	24.0	16.8	20.1	917
	Azerbaijan	13.1	11.5	23.0	19.0	17.4	8.7	-1.1	21.0	-1.1	14.1	854
	Belarus	26.8	21.0	27.6	22.0	23.6	20.8	29.0	25.0	20.8	24.5	959
	Bosnia and Herzegovina	24.1	17.4	24.1	19.8	19.1	23.9	0.0	23.0	0.0	18.9	928
	Bulgaria	23.3	18.7	14.8	23.3	18.3	13.1	30.0	26.0	13.1	20.9	909
	Croatia	25.2	25.2	19.6	25.2	27.2	24.5	23.0	28.0	19.6	24.7	968
	Georgia	20.4	19.5	26.8	26.8	14.0	11.4	-1.9	19.8	-1.9	17.1	897
	Kazakhstan	19.7	18.0	28.6	25.6	19.5	15.9	29.0	19.3	15.9	21.9	933
	Kyrgyzstan	14.5	15.5	19.7	7.7	17.1	15.0	29.0	19.5	7.7	17.2	856
	Montenegro	27.7	18.5	19.5	18.2	26.6	24.1	28.0	25.0	18.2	23.5	943
	North Macedonia	23.9	21.4	13.2	24.2	23.4	19.9	28.0	26.0	13.2	22.5	933
	Republic of Moldova	17.1	19.1	11.9	12.5	16.9	17.9	28.0	22.0	11.9	18.2	869
	Romania	23.0	23.0	14.3	23.0	19.5	14.1	30.0	27.0	14.1	21.7	923
	Russian Federation	24.2	24.2	28.6	24.2	19.0	18.7	29.0	18.8	18.7	23.3	954
	Serbia	24.7	19.7	19.7	17.0	23.2	20.6	7.0	27.0	7.0	19.9	930
	Tajikistan	6.5	11.7	16.5	16.7	14.9	8.5	30.0	25.0	6.5	16.2	830
	Turkey	20.0	19.3	17.1	19.4	19.9	17.0	28.0	21.0	17.0	20.2	918
	Turkmenistan	3.2	18.6	18.8	29.4	19.3	17.4	30.0	18.8	3.2	19.4	905
	Ukraine	21.6	21.6	19.5	23.6	19.9	17.7	-0.5	24.0	-0.5	18.4	930
	Uzbekistan	15.1	16.1	22.0	15.1	22.4	17.4	30.0	25.0	15.1	20.4	916
Western Europe	Austria	26.5	26.5	23.0	26.5	25.6	25.3	30.0	28.0	23.0	26.4	975
	Belgium	26.6	26.6	28.2	26.6	25.8	26.9	30.0	26.0	25.8	27.1	981
	Cyprus	27.7	27.7	26.0	27.7	27.4	27.0	30.0	25.0	25.0	27.3	983
	Czechia	26.8	26.8	27.2	26.8	28.4	22.1	30.0	28.0	22.1	27.0	980
	Denmark	26.2	26.2	24.2	26.2	23.4	27.2	30.0	27.0	23.4	26.3	975
	Estonia	27.6	27.6	26.6	27.6	21.8	25.3	30.0	27.0	21.8	26.7	977
	Finland	27.6	27.6	26.8	27.6	19.7	26.2	30.0	25.0	19.7	26.3	975
	France	25.5	25.5	27.2	25.5	25.2	26.9	30.0	26.0	25.2	26.5	977
	Germany	26.2	26.6	19.4	26.2	26.4	24.7	30.0	27.0	19.4	25.8	970
	Greece	26.2	26.2	24.2	26.2	25.8	25.4	30.0	28.0	24.2	26.5	976
	Hungary	26.3	26.3	18.9	26.3	22.4	17.3	29.0	27.0	17.3	24.2	955
	Iceland	28.0	28.0	22.8	28.0	29.0	26.1	30.0	23.0	22.8	26.9	981
	Ireland	26.7	26.7	29.4	26.7	28.0	25.3	30.0	27.0	25.3	27.5	984
	Italy	26.9	26.9	22.4	26.9	27.4	26.6	30.0	28.0	22.4	26.9	979
	Latvia	26.4	26.4	26.4	26.4	26.0	19.8	30.0	21.0	19.8	25.3	971
	Lithuania	26.3	26.3	28.6	26.3	26.8	23.2	30.0	20.0	20.0	25.9	976
	Luxembourg	27.2	27.2	18.1	27.2	28.4	26.9	30.0	29.0	18.1	26.8	974
	Malta	23.0	23.0	23.0	23.0	29.0	21.7	30.0	26.0	21.7	24.8	967
	Netherlands	26.0	26.0	28.2	26.0	26.8	27.5	30.0	27.0	26.0	27.2	982
	Norway	27.6	27.6	26.2	27.6	27.6	26.6	30.0	28.0	26.2	27.7	984
	Poland	25.6	24.8	25.0	25.6	28.0	23.2	30.0	28.0	23.2	26.3	974
	Portugal	26.3	26.3	29.2	26.3	25.8	24.7	30.0	26.0	24.7	26.8	980
	Slovakia	24.2	24.2	19.0	24.2	27.2	16.9	30.0	27.0	16.9	24.1	954
	Slovenia	27.9	27.9	28.0	27.9	29.2	27.5	30.0	28.0	27.5	28.3	990
	Spain	26.9	26.9	25.8	26.9	22.8	25.0	30.0	28.0	22.8	26.5	976
	Sweden	27.4	27.4	28.8	27.4	25.4	26.6	30.0	24.0	24.0	27.1	983
	Switzerland	26.0	26.0	19.3	26.0	29.2	28.3	30.0	27.0	19.3	26.5	976
	United Kingdom	25.7	25.7	26.8	25.7	25.2	21.6	30.0	24.0	21.6	25.6	972
North America	Canada	25.1	25.1	26.4	25.1	27.0	24.7	30.0	23.0	23.0	25.8	974
	United States	23.5	23.0	27.4	23.5	23.0	19.0	30.0	14.0	14.0	22.9	948

indicators has been negative during the period considered (in practice, in 5 of them, as can be seen in Table 5). This shows that the policies carried out have not been appropriate and therefore, different decision must be made in order to improve the situation.

The case of Togo shows a much more vertical evolution. In fact, while the WCI has experimented a small decrease (from 8.5 to 6.7, staying in the "moderate" performance band), the SCI has significantly decreased (from −5.7, in the "high" band, to −15.4, in the "very high" band). This means that some indicator is now performing much worse (*Children engaged in child labor*). This impairment has been partially compensated by slight improvements in other indicators, as seen in Table 5.

Finally, Peru shows the opposite behavior, with a slight improvement in the WCI (from 13.5 to 16.2, both in the "low" performance band) and a significant improvement in the SCI (from −3.5, in the "high" band to 8.8, in the "moderate" band). This means that the greatest weakness of Peru (*Children engaged in child labor*) has been improved, and the general tendency has been a slight improvement of the rest of the indicators (in fact, as seen in Table 5, 6 indicators have been improved over the period considered).

Therefore, this dynamic analysis can be used by the policy makers to evaluate the effectiveness of the decisions carried out so far, in order to detect which of them are working and which others need to be reconsidered.

5. Conclusions

Throughout the ages, childhood measurement has gained special importance, given its potential impact on a country's growth. To enable comparability across countries, several initiatives have been carried out, although the literature states that the international comparisons of children's well-being have still room for improvement.

Of these initiatives, the End of Childhood Index developed annually by Save the Children should be noted. Once this index is aggregated through the arithmetic average of the eight indicators considered, countries are classified into five performance bands according to their

performance with respect to global thresholds calculated. There is no doubt that when assessing the performance of each country, the consideration of these performance bands can be very useful for decision-makers and policymakers in facilitating the interpretation of the results in a simple and visual way through the use of colors associated with these bands.

However, this valuable information is lost in the aggregation process of the End of Childhood Index. First, for each indicator, absolute reference levels are established, based on international standards, which are later only used to calculate the global thresholds by means of an arithmetic average of the cut-off points of each band. Second, since each indicator has a different measurement scale, the calculation of the global thresholds in this way may give rise to a misinterpretation of the results.

Under this assumption, this paper based on the functionality of the multiple reference point technique, set out to demonstrate that this End of Childhood Index can be complemented by a richer information. On one hand, the translation of the reference levels of each indicator to a common measurement scale, which remains unalterable throughout the whole construction of the MRP-WSCI composite indicators, allows measuring the degree of compliance with the international standards set by Save the Children for each indicator, by analysing the distance of the performance of each country with respect to the established absolute thresholds. On the other hand, the joint use of the compensatory and non-compensatory composite indicators makes possible the identification of possible limitation(s) on certain indicators and consequently more effective actions on child-related policy measures can be implemented. This is evident in the general analysis of the results, which shows that over a 94% of countries are classified in the ”moderate” or better performance bands, according to the EoCI and WCI, while this percentage drops to 61% when the SCI is considered. This means that 39% of countries have at least one indicator below the corresponding ”very high” or ”high” thresholds, revealing that there are key aspects on which it is necessary to take actions. In this line, the deeper analysis done in Latin America and Caribbean region explores such differences, revealing where children are being threatened and why this is the case. For example, Venezuela has good behaviours in enough indicators to reach a “moderate” band when a fully compensatory scheme (like EoCI or WCI) is used. But this masks deficient behaviours that are revealed by the SCI, which lies in the “very high” band. In fact, Venezuela gets the worst Latin American and Caribbean SCI score. Therefore, Venezuelan policy makers get a serious warning signal about a single indicator that is behaving very poorly (in this case, the *Child homicide rate*, and therefore, information about policy actions to be taken.

Consequently, the SCI provides useful information for policy makers to detect the points on which they should focus their strategies and elaborate plans to protect childhood. Also, using jointly the WCI and SCI, in a dynamic fashion, aids to monitor such plans by contrasting if the countries evolve in the correct direction, or if some decisions need to be reconsidered and changes should be introduced.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgments

This research is part of the project PID2022-139543OB-C42 funded by MICIU/AEI/10.13039/501100011033 and by ERDF/UE. Funding for open access charge: Universidad de Málaga / CBUA. The authors extend their appreciation to the Theme Net RED2022-134540-T.

Appendix A. 2021 worldwide rankings

Table 6

Appendix B. EoCI scores, MRP-WSCI indicators and the correponding achievement functions values

Tables 7–10

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